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*** The following statement shows the subjects to which the different members of the editorial staff have severally given their more particular attention, not only in themselves preparing articles relating to those subjects, but also in securing contributions from others, and in carefully scrutinizing all such contributions with a view both to ensure accuracy and to exclude anything which might seem objectionable.

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* The latest labors of Mr. Greeley's life were given to this work, to which he contributed largely. It is with justice, therefore, that his name is preserved in the list of its Editors.

F.

F, the sixth letter of our alphabet, is the equivalent of *ph*, and probably of the Greek φ. It is a labio dental mute, and is quite strongly aspirated, but is not truly vocalized. F, as we learn from old Latin writers, differed in power from the Greek φ, and in ancient times was doubtless a strong, rough aspirate, like the Greek digamma, Ϝ, from which it took its form, if not its power. In Spanish, *h* takes the place of the Latin *f* very frequently, while *f* often represents the Greek φ. F is to some extent interchangeable with the dentals *t*, *d*, and *th*, as well as with the labials *p*, *v*, and *wh*, but less so in English than in some other languages. F in chemistry is the symbol of fluorine.

F, in music, the fourth degree in the ascending scale of C, major or minor, being the subdominant in that scale. The bass or F clef is placed on the fourth line of the stave, at the distance of a seventh above gamut G; hence, as a note on that line is called F, the other notes, above and below, take their names accordingly. In German music, F Dur is F major; F Moll, F minor; Fis is F sharp; Fis Dur, F sharp major; and Fis Moll, F sharp minor. The letter F, or *f*, is also used for *forte*, loud; and FF, or *ff*, for *fortissimo*, very loud. WILLIAM STAUNTON.

Fa'am, an orchidaceous plant growing in the Mauritius, in Réunion, and in India—the *Angræcum fragrans*, highly prized for its fragrance, and long used there, in the same way as Chinese tea is used, as a beverage. Many residents in the East greatly prefer it to tea. It is aromatic, stimulant, and of very agreeable taste. It is used to some extent in France, and has reputation as an antispasmodic and an expectorant.

Fa'ba [Lat., a "bean"], a genus of leguminous plants to which belongs *Faba vulgaris*, or *Vicia Faba*, L., of unknown, probably Oriental, origin, the common bean of Europe, but not the beans ordinarily raised in the U. S., which are of the genus *Phaseolus*.

Fabaceæ. See LEGUMINOSÆ.

Fa'ber (BASIL), a German Protestant writer and scholar, b. at Sorau 1520, wrote *Thesaurus Eruditionis Scholasticæ* (1571), often reprinted, and d. rector of the academy at Erfurt in 1576.

Faber (FREDERICK WILLIAM), D. D., an English theologian and poet, a nephew of George Stanley Faber, noticed below, was b. at Durham June 28, 1814, graduated at Oxford in 1836, became vicar of Elton in 1843, went over to the Roman Catholic Church in 1845, founded the Oratory of the brotherhood of St. Philip Neri in London in 1849, and in 1851 removed with it to Brompton, where he d. Sept. 26, 1863. He wrote a considerable number of books, both controversial and devotional, in support of the Church of his adoption, but will be longest remembered as the author of some exquisitely beautiful hymns, equally admired by all communions. The first edition of his hymns, few in number, appeared in 1848, and the 5th ed., containing 150 hymns, in 1862. R. D. HITCHCOCK.

Faber (GEORGE STANLEY), D. D., English theologian, b. near Bradford, in Yorkshire, Oct. 25, 1773, graduated at University College, Oxford, in 1803, and was prebendary of the cathedral of Salisbury in 1831, and master of Sherburn Hospital at Durham, 1832; d. there Jan. 27, 1854. Wrote *Horæ Mosaicæ, or View of the Mosaical Records* (1801), *Difficulties of Infidelity* (1824), *Difficulties of Romanism* (1826), *Original Expiatory Sacrifice*, etc.

Faber (JACOBUS STAPULENSIS), the greatest of the "Reformers before the Reformation" in France, was b. at Étaples about the year 1450, and d. in 1536. His translation of the New Testament appeared in 1523, and of the Old Testament in 1528. He published also several commentaries. R. D. HITCHCOCK.

Faber (JOHN), a Dutch mezzotint engraver, who d. at Bristol, England, in May, 1721, was the father of another John Faber, an excellent mezzotint engraver, who produced portraits of the Kit Cat Club and the Hampton Court beauties, and probably d. in 1756 in London.

Faber (TANAQUIL). See LE FEVRE.

Fa'bian, SAINT, was pope 236 A. D., suffering martyrdom under Decius, 250 A. D.

Fa'bius, tp. of Davis co., Ia. Pop. 1494.

Fabius, tp. of St. Joseph co., Mich. Pop. 1277.

Fabius, tp. of Knox co., Mo. Pop. 1587.

Fabius, tp. of Marion co., Mo. Pop. 1908.

Fabius, tp. of Schuyler co., Mo. Pop. 1474.

Fabius, post-v. and tp. of Onondaga co., N. Y. Pop. of v. 378; of tp. 2047.

Fa'bius Max'imus Verruco'sus (QUINTUS), surnamed CUNCTATOR, was consul for the first time 233 B. C., and dictator in 217. Contending against Hannibal the Carthaginian, he adhered so closely to the policy of defensive warfare that his opponent could gain no advantage, and his successes of this sort, long continued, secured for him his surname. His is one of the most illustrious names in Roman history.

Fa'bius Pic'tor (QUINTUS), the earliest Roman historian, was a member of the patrician family of the Fabii, and lived at the time of the Second Punic war (which began B. C. 218), though the dates of his birth and death are unknown. The last distinct notice of him is his being sent as an ambassador to Delphi after the battle of Cannæ, B. C. 216. He wrote a history or annals of Rome (for the name is not given) from the early settlement of the city to his own times, and his work is often quoted by Livy, Dionysius, and Polybius. He has been charged with great carelessness and perversion of the truth, especially in the earlier portions of his work. But both Livy and Dionysius draw freely from him, and frequently commend his fidelity; and Polybius, who is his severest censor, uses his materials in his own account of the Second Punic war (in which Fabius was an actor), though charging him with carelessness and partiality for the Romans. His work was written in Greek, but it is supposed there existed also a Latin translation of it. Among modern writers Fabius has found a defender in the historian Niebuhr in his *Lectures on the History of Rome*. The fragments of Fabius Pictor are collected, and the events of his life given, by KRAUSE, *Hist. Rom. Fragmenta*, Berlin, 1833; by MÜLLER, *Hist. Græc. Fragm.*, vol. iii., pp. 80–92. (See also H. K. WHITTE, Copenhagen, 1832; BAUMGART, Breslau, 1842; NIEBUHR, quoted above; and GERLACH, *Geschichtschreiber der Römer*, Stuttgart, 18[illegible].) H. DRISLER.

Fabius River, of Missouri, rises by several forks, and flows into the Mississippi River nearly opposite Quincy, Ill. The course of the main stream is but short. The North Fabius, the longest fork, rises in Iowa.

Fa'ble [Lat. *fabula*, from *for*, *fari*, to "speak;" Fr. *fable*; Ger. *Fabel*], as a peculiar kind of literary composition, means a fictitious story in prose or verse, enacted by animals, without any regard to probability, or even possibility, and illustrative of some moral maxim, which is given in a positive and pointed form after the story, like the title under an engraving. Of all kinds of didactic poetry, the fable is the most pleasant and the most effective. By representing the several features of the human mind—as, for instance, pride, rashness, avarice, shrewdness, etc.—under the picture of individual animals, the fable gives to the imagination a most striking and entertaining portrait of these features, thereby rousing the attention for the story, and inculcating the moral truth which it illustrates in a most impressive manner. Good fables were always highly appreciated, but they are rare. When we look at the whole literature of fables—the Indian by Pilpay, the Arabic by Lokman, the Greek by Æsop (620–564 B. C.?), the Latin by Phædrus, a Greek slave whom Augustus gave his liberty, the French by La Fontaine (1621–95), the English by Gay (1688–1732), and the German by Gellert (1715–69)—we find that quite a number of the stories are common to all the writers, taken from the same source, or transferred from one literature to another: only the scenery, depending on the climate and the age, and the style, depending on the individuality of the writer, are different. The two most original fable-writers are Æsop and La Fontaine. Æsop's fables, however, we do not know in their original form. They were written in prose, and afterwards turned into verse. (See BABRIUS.) But, as far as we can judge, they were very vigorous and pointed, and whenever it is possible to trace the story back to an Oriental source, it is interesting to see how the wild and gorgeous fancies of the Hindoo are reduced by the Greek to clearness and plastic simplicity. La Fontaine is sometimes garrulous, and he does not always hit the nail on the head with the first stroke; but his style is elegant, his sarcasm well bred, his observation acute, and a tone of refined good humor per-

vades the whole, making his fables an exceedingly pleasant book. CLEMENS PETERSEN.

Fabliaux [Fr., plu. of *fabliau*] is the name given in early French literature to the metrical tales composed in the *langue d'oil*, or northern dialect, by the Trouvères, chiefly in the twelfth and thirteenth centuries. The fabliaux were often satirical, and not unfrequently licentious.

Fabre (ANTOINE FRANÇOIS HIPPOLYTE), French medical writer, b. at Marseilles 1797, edited the *Lancette Française*, and had a medal (1833) from the French Institute for a work on cholera, d. in Dec., 1853.

Fabre (FRANÇOIS XAVIER PASCAL), French painter, was b. at Montpellier Apr., 1766, and wrought at Rome and Florence. His best works are *The Judgment of Paris, The Preaching of John the Baptist*, and a portrait of Alfieri. D. at Montpellier Mar. 12, 1837.

Fabre (JEAN RAYMOND AUGUSTE), French poet, b. at Jaujac June 24, 1792, wrote *Calédonie* (1823), *Irene*, tragedy (1825), etc. D. Oct. 23, 1839.

Fabre (MARIE JOSEPH VICTORIN), French poet and orator, b. at Jaujac July 19, 1785, wrote an *Eulogy on Corneille*, prose (1808), which was crowned by the French Institute. The *Death of Henry IV.*, poem (1808), *Ode on Tasso, Eulogy on Montaigne* (1812), and *Literary History of France in the Eighteenth Century* (1810), are among his works. D. May 29, 1831.

Fabre de l'Aude (JEAN PIERRE), French statesman, b. at Carcassonne Dec. 8, 1755, was deputy to the Council of Five Hundred in 1795 and 1797, and commissioner of finance. In 1807 was senator and count of the empire, then chevalier of the grand council of administration of the senate, and d. at Paris July 6, 1832.

Fabret'ti (RAFAEL), Italian antiquary, b. at Urbino 1618, was secretary to Pope Alexander VIII., and keeper of archives in the castle of St. Angelo under Innocent XII. Wrote *De Columna Trajani* (1683) and *Inscriptionum Antiquarum Explicatio* (1699). D. at Rome Jan. 7, 1700.

Fabria'ni (SEVERINO), Italian author and philanthropist, b. at Spilimbergo Jan. 7, 1792, aided Baraldi in his *Memoirs on Religious Literature*, and wrote biographies, besides instructing the deaf and dumb. D. Apr. 27, 1849.

Fabria'no, town of Italy, in the province of Ancona, 38 miles S. W. of Ancona, especially known for its paper-mills, established in the sixteenth century. Pop. 5699.

Fabriano, da (GENTILE), an Italian painter of whom little is known: lived between 1360 and 1440, was a contemporary of Fra Angelico. Several of his works are at Urbino and Perugia, but his fame is associated with a picture in the great council-chamber in Venice, which, some say, was thought so remarkable that the republic conferred on him a life pension and the patrician's robe. Specimens of his work are in the churches Santa Maria Maggiore and St. John Lateran in Rome, and the San Felice, Venice.

O. B. FROTHINGHAM.

Fabri'ce, von (GEORG FRIEDRICH ALFRED), general of cavalry and secretary of war in the kingdom of Saxony, became widely known as commander of the German army of occupation in France from Mar. 7 to June 19, 1871. Was b. at Quesnoy-sur-Deule May 23, 1818; entered the Saxon service in 1834; became a member of the staff in 1850; was chief of the staff to the Saxon troops in Sleswick-Holstein in 1863 and 1864, and to the crown-prince of Saxony in 1866, during the Bohemian campaign, in which position he distinguished himself greatly, though the latter campaign could boast of no victory. Became secretary of war Oct. 1, 1866, thus assuming the great task of reorganizing the Saxon army after the Prussian pattern, in accordance with the present political position of the kingdom—a task which required both great military ability and great diplomatic talent, as, after the unfortunate war, there reigned in Saxony a great bitterness against Prussia. But he fulfilled the task with perfect success, and displayed the same talents as commander-in-chief of the army of occupation in France in 1871; even during the revolution of the Commune in Paris he understood how to maintain his position without incurring any conflict, and he commanded the respect of the Frenchmen at the same time he earned the hearty regard of the Germans. AUGUST NIEMANN.

Fabric'ius (JOHANN), b. at Altorf, in Saxony, Feb. 11, 1614; studied theology in his native town, at Nuremberg, and from 1663 to 1665 at Helmstedt, in Brunswick, where he became a disciple of Georg Calixtus; travelled in Germany and Italy from 1670 to 1677, during which period he was for some time a minister to the German Lutheran congregation in Venice; and was appointed professor in theology at Altorf in 1677, and at Helmstedt in 1697, which was especially famous as a school of theology, and Johann Fabricius vindicated its fame. His *Amœnitates Theologica* (1699) and *Consideratio Variarum Controversiarum* (1704) were received with great applause. King Charles of Spain, afterwards emperor of Germany under the name of Charles VI., proposed marriage to the princess Elizabeth Christine of the house of Brunswick, and wished her to embrace the Roman Catholic faith. Fabricius published a *Gutachten*, showing that it was proper, and even her duty, to renounce her Protestant faith to become queen of Spain and empress of Germany. The elector of Hanover, afterwards George I. of England, disliked this *Gutachten*, and in 1709 Fabricius was removed from his chair at the university. D. Jan. 29, 1729.

Fabricius (JOHANN ALBRECHT), German scholar and writer, b. at Leipsic Nov. 11, 1668, was professor of eloquence and philosophy at Hamburg about 1700. Published more than one hundred learned works, among the most important of which were *Bibliotheca Latina, sive Notitia Scriptorum Veterum Latinorum* (3 vols., Leipsic, 1697; revised and greatly improved by Ernesti, 3 vols., 1773); *Bibliotheca Græca* (14 vols., 1705–28; 4th ed., improved by Harles, 12 vols., 1790–1809); *Bibliographia Antiquaria* (1713; enlarged 1760); *Bibliotheca mediæ et infimæ ætatis* (5 vols., Hamburg, 1734; a 6th added by Schœttgen, 1746); *Codex Apocryphus Nov. Test.* (3 vols., Hamburg, 1719); and *Codex Pseudepigraphus Veteris Test.* (Hamburg, 1713). D. at Hamburg Apr. 30, 1736.

Fabricius (JOHANN CHRISTIAN), b. at Tondern, in the duchy of Sleswick, Jan. 7, 1743; studied natural history at Copenhagen, Leyden, Edinburgh, Freiberg in Saxony, at Upsal under Linnæus (of whom he became an enthusiastic disciple), and was appointed professor of natural science in 1775 at the University of Kiel, where he d. in 1807. Entomology was his favorite study, and his *Systema Entomologica* (Copenhagen, 1775, 4 vols.), *Philosophia Entomologica* (1778), and *Supplementum Entomologiæ* (1797) are his principal works. An utterance of Linnæus led him to establish the structure of the mouth as the principle of division in the entomological system, and he worked out this idea with great energy and enthusiasm. He undertook every year extensive pedestrian trips in different parts of Europe, studying the world of insects in nature and in the museums; and his writings are rich in observations.

Fabricius (THEODOSIUS), Lutheran theologian, b. at Nordhausen in 1560, was professor at Göttingen. His *Harmony of the Four Evangelists* was published in Latin, Greek, Hebrew, and German. D. in 1597.

Fabri'zio (GERONIMO), Italian anatomist and surgeon, b. at Acquapendente 1537; was professor at Padua, wrote treatises on anatomy and surgery, and had for a pupil Dr. Harvey, whose discovery of the circulation of the blood was suggested by some observations of his teacher upon the valves of the veins. D. in May, 1619.

Fabro'ni, or **Fabbroni** (ANGELO), Italian biographer and Latin scholar, b. at Marradi Sept., 1732; published in 1766 the first volume of *Lives of Italians Eminent for Learning who flourished in the Seventeenth and Eighteenth Centuries* (twenty volumes in all), was prior of the church of San Lorenzo, Florence, 1767, is sometimes called the "Plutarch of modern Italy," and d. at Pisa Sept., 1803.

Fabroni, or **Fabbroni** (GIOVANNI VALENTINO MATHIAS), b. at Florence Feb. 13, 1752; studied natural science in his native city and in France and England; was appointed director of the physical cabinet of the grand duke of Tuscany, and went in 1798 to Paris as a member of the committee assembled in that city for the establishment of unity between the French and Tuscan weights and measures. During the annexation of Tuscany with France, Fabroni occupied a very conspicuous position both socially and politically, and many very difficult tasks, both scientific and diplomatic, he performed with great success. He constructed the bridge across the Dora Baltea, and the road across Mont Genèvre leading from the Sardinian province of Susa into the French department of the Hautes-Alpes, at an elevation of 6500 feet. After the restoration of the house of Lorraine in Tuscany, in 1815, Fabroni retired to the chair of natural science at the University of Pisa, where he d. Dec. 17, 1822. His writings are on political economy, natural science, agriculture, education, etc.

Fabry (JEAN BAPTISTE GERMAIN), French writer, b. at Cornus in 1780; edited *Spectateur Français* (12 vols., 1805–12), wrote *Itinéraire de Bonaparte de l'Isle d'Elbe à Saint Hélène* (1817), and d. Jan. 4, 1821.

Fabvier (CHARLES NICOLAS), BARON, b. at Mousson, in the department of Meurthe, France, Dec. 10, 1782; educated at the École Polytechnique and the military school of Metz; entered the first regiment of artillery in 1804; was sent in 1807, as a member of a corps of French officers, to Constantinople and Ispahan for the purpose of reorganizing

the Turkish and Persian armies after the French model; returned in 1809 to Europe; fought in Spain in 1811 as aide-de-camp to Marshal Marmont, and distinguished himself greatly in 1812 at the storming of Moskva. In 1817 he accompanied Marshal Marmont as chief of his staff to Lyons, and when the insurrection was put down, he published a pamphlet, *Lyons in 1807*, charging the whole civil service of the city and department with gross abuses. He was arraigned and fined; left the military service, and devoted himself for several years to commercial business. In 1823 he went to Greece, and fought with great distinction in the war of liberation until 1827. In the revolution of July, 1830, he played quite a conspicuous part; was for some time the military commander of Paris; became lieutenant-general in the army in 1839 and peer of France in 1845; was a member of the legislative assembly in 1849; filled minor diplomatic offices, and d. at Paris Sept. 15, 1855.

Façade [Fr.], one of the sides of a building viewed from without, especially applied to the principal front of a large or architecturally fine building. But there may be also rear and lateral façades, as well as interior façades surrounding a court.

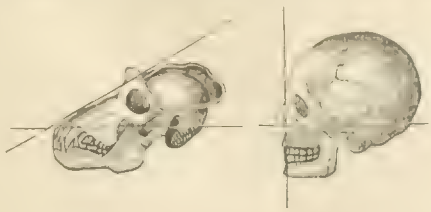
Facciola'ti, or **Facciola'to** (Giacomo), Italian philologist, b. at Torreglia, near Padua, Jan. 4, 1682; was professor of logic in the University of Padua 1722, published an edition of the *Lexicon Septem Linguarum* of Ambrogio Calepino (an Augustine friar of Calepio), (2 vols. folio, Padua, 1731), of the Greek lexicon of Schrevelius (Padua, 1715, etc.), and of the *Lexicon Ciceronianum* of Nizolius (Padua, folio, 1734). He began a Latin lexicon, finished by Forcellini, and d. at Padua Aug. 25, 1769. (See Forcellini.)

Fa'cet [Fr. *facette*, a "little face"], a term used by lapidaries to denote the plane surfaces cut upon precious stones to increase their lustre. The planes which bound a crystal, the flat surfaces of the cornea of an insect's eye, and in fact any minute plane surface may take this name.

Face'tiæ [Lat. pl. of *facetia*, "things facetious"], a collection of humorous sayings, witty stories, *bons mots*, repartees, in prose and verse. From the ancients nothing has come down to us except the *Jests of Hierocles*, the sayings and doings of one "Scholasticus," the typical blunderer of earlier times, the prototype of the modern perpetrator of "bulls;" *e. g.* hearing that a raven would live 200 years, he bought one to test the truthfulness of the statement. Of the earliest specimen in modern times, the *Liber Facetiarum* of Poggio Bracciolini (1st ed. Rome, 1470), Shepherd gives this account: "During the pontificate of Martin V. the officers of the Roman chancery were accustomed to assemble in a kind of common hall. In this apartment, which from the nature of the conversation of its frequenters, who were much more studious of wit than of truth, acquired the name of *Bugiale* [manufactory of lies], they discussed the news of the day, and amused themselves by the communication of entertaining anecdotes. They indulged themselves in the utmost latitude of satiric remark, dealing out their sarcasms with such impartiality that they did not spare even the pontiff himself." These "pointed jests and humorous stories . . . furnished the greater portion of the materials for the *Liber Facetiarum*."

Properly, *ana* and *table talk* are facetiæ; ana being mainly the personal observations of him whose name forms the title, sometimes, though not always, supplied by himself. The first printed *ana*, *Scaligerana Secunda* (Joseph Scaliger), was the work of Jean and Nicholas de Vassan, published by Isaac Vossius (1666). *Menagiana*, one of the best (Paris, 1715), was furnished and published by the friends of Giles Menage. On the other hand, *Chevræana* (Amsterdam, 1700), *Parrhasiana* (Amsterdam, 1701), and *Huetiana* (Paris, 1722) were the recorded observations of the men whose names the books bear. *Walpoliana* (London, 1804) is the best English ana. *Table-talk* is graver in its tone than ana, giving the views of some thinker on topics with which he is especially conversant, less formally than in essays. Martin Luther's *Colloquia Mensalia* (best ed. Leipsic, 1844; English translation by Capt. Henrie Bell, London, 1652) handles phenomena of nature, matters in Church and State, and social relations. John Selden's *Table-Talk* (London, 1860) abounds in learned, pithy remarks. From Melanchthon to Charles Sumner men have found amusement in these works. Richard Porson was fond of them; many of his own are in *Facetiæ Cantabrigienses* (London, 1825) and in E. H. Barker's *Literary Anecdotes* (London, 1852). America has furnished her share; *e. g.* the *Breitmann Ballads*, by C. G. Leland, the works of Bret Harte, of John Hay, of John G. Saxe; and in our newspaper press, as Mr. Frederic Hudson says, "there is a daily effervescence of *bons mots*, from Canada to Mexico. . . . The United States are a Vesuvius of wit and humor in a constant state of eruption, and the lava is in perpetual motion down the sides of its mountains." (See Journalism.) Jonathan S. Green.

Fa'cial An'gle (the angle formed by the face with a certain other plane), as generally accepted, is the angle subtended by (1) a line coincident with the face, or rather



Facial angle, according to Owen.

the most projecting parts of the face, and (2) a line drawn from the external opening of the ear to the floor of the nostrils. Such was the idea of Camper, who originally (about 1771) employed the facial angle as a diagnostic criterion for the distinction of the races of men and their contradistinction from the lower animals. Others have modified the criterion by taking different lines; thus, the angle subtended by (1) the face, and (2) the plane coincident with the axis of the floor of the skull, was considered by Von Baer to furnish a more trustworthy criterion for the purposes desired; by others, still, the angle intersected by (1) the face, or "the most prominent parts of the forehead and upper jaw," and (2) "a line drawn from the occipital condyle along the floor of the nostrils," is accepted as the facial angle. Such is the view promulgated by Prof. Owen (*On the Anatomy of Vertebrates*, ii. 572). These are all inconsiderable modifications of the same idea, and are the true expressions of the facial angle. With it must not be confounded, as has been done by some persons, measurements of the skull to express the relations of other parts of the skull and the comparative intellectual conditions of animals. The facial angle, as properly understood, is not only of little value in determining the relative intellectual rank of an animal, but is often very deceptive as an index. Its value has been greatly exaggerated, and it is now only used by scientific writers with great reserve and precautions as to its fallacious nature. To some extent, however, it is quite useful as a diagnostic character at least. If we compare the several races of mankind in their *adult* stages, it will be found that there are *average* indexes furnished by the facial angle for each one, and that between the European and negro the differences in this respect are notable; thus, in the former the facial angle (by Camper's method) is about 80°; in the latter, about 70°; if these are contrasted with the old individuals of some of the apes and monkeys, the differences will be found still greater; *e. g.* in the adult baboons the angle is only about 30°; in the common monkeys it ranges from about 45° to 60°; and in those nearest to man it varies considerably in the adult, and bears an indefinite relation to the size attained, the largest having a more acute angle. Thus, in the gibbons it is about 60°, in the larger apes about 30°–40°. The contrast in this respect between man and most other animals has led to a very exaggerated idea of the value of the character as an exponent of intelligence. A very few facts, however, serve to disabuse our minds. It will be readily granted, probably, that adults, on the whole, are more intelligent than the young of the same species, and that therefore there should be some coincidence between the development of the facial angle and that of the individual, if the angle were in fact an exponent of intellectuality. So far is this from being the case, however, that there is an *inverse* development of the angle and the individual, which is illustrated in the case of man, and to a much greater extent in [illegible]. In the young of the different races of mankind the differences of the facial angle are inconsiderable, and the angle in all is more obtuse (instead of being more acute) than in the adult; and especially is the contrast marked between the negro baby and the adult man. In the young of the apes and monkeys the head [illegible] resembles that of man rather closely in its contour—and the facial angle is proportionately developed, being generally not much if any less than [illegible]. As has been [illegible] indicated, the angle is more acute in the old; and this acuteness, on the whole (but by no means in all), increases in proportion to the size of the animal; thus, in the older and larger monkeys it becomes as acute as 45°; in the [illegible] baboon the angle is even more acute than 30°. If the facts in several cases are analyzed, it will be found that the same [illegible] for the chimpanzee and the orang-outang, the [illegible]

produced by different causes, the upper jaw in the former being produced forward, and in the latter downward to the suture; on the other hand, there is apparently much greater difference between the adult male chimpanzee and gorilla indicated by the facial angle, although the differences otherwise are slight, from the fact that in the chimpanzee the supraorbital ridges are moderate, while in the gorilla they are very strongly developed; the differences in the facial angle in these cases are therefore not the exponents of differences in intelligence or brains, but simply of the development of osseous matter over the orbits. The differences in all the cases between the young and old result from the fact that whereas in the young the teeth are undeveloped and the jaws correspondingly reduced, in the old the teeth become developed and the jaws correspondingly enlarged to accommodate them; and hence they became prognathous —*i. e.* the jaws protrude—in proportion to the size and number of the teeth. Inasmuch as the same being is certainly less intelligent when just born or very young than when old, it follows that any index which points to the reverse must be fallacious; and such is the facial angle in this case. The facial angle, in brief, is merely the exponent of either (1) the development of the jaws (and to a certain extent of the teeth) in some one or other direction, or (2) the development of the forehead at some one point; *e. g.* by frontal sinuses or supraorbital ridges. It is a very uncertain and unreliable exponent of the size of the cranial cavity or brain, and therefore of the intelligence of any given animal. This truth has been recognized by the best naturalists; among others, Prof. Huxley (*Man's Place in Nature*, p. 171) has proposed a substitute in other measurements, remarking that "the lines the intersection of which forms the facial angle are drawn through parts of the skull, the position of each of which is modified by a number of circumstances, and is not the expression of any one definite organic relation of the parts of the skull." The application of the facial angle is also sometimes impossible, or would result in absurdities; *e. g.* in the case of the elephants and whales; and inasmuch as in the birds and lower vertebrates the position of the nostrils varies greatly in related forms, the facial angle determined in accordance with any of the criteria cited would be deceptive in its indications. The practical or diagnostic applicability of the character is also limited.

In the fishes, and to a great extent in the amphibians, no external ear is developed, and there is no certain external index for it or for the other bases taken by Von Baer or Owen; therefore, the use of the facial angle is impracticable. The modifications and diverse relations of the facial and other bones in allied forms are also so great in the fishes as to vitiate any results if they could be obtained. In the reptiles and birds, on account of the extreme modifications of the bill or snout and position of the nostrils in related forms, the index, unless specifically checked or counter-indicated by other characters, would be illusive and lead to false conclusions. In the mammals, likewise, the character would be very often extremely illusive; *e. g.* the sloths, ant-eaters, and various species of armadillos are closely related (within ordinal limits), yet the index of the facial angle for the sloths would be the same as for some of the highest monkeys, while that for the ant-eaters would be the same as for the long-snouted reptiles or long-billed birds. These examples will suffice to show with what extreme caution conclusions should be drawn from the indication of the facial angle; and although there may be a rough general agreement in the highest mammals between the index for the facial angle and the intellectual status, it is even in them very often exceedingly fallacious.

Of course the index of the facial angle will vary with the bases accepted, and the indexes of Von Baer's and Owen's methods differ considerably from that of Camper's; thus, while, according to Camper's method, the facial angle in the European is about 80° and in the African about 70°, according to Owen's in the former it would be about 95° and in the latter about 85°. It is important, therefore, to ascertain the method used in every case. Unless otherwise indicated, it may be assumed generally that Camper's is the one adopted.

The substitutes that have been proposed in place of the facial angle will be more properly indicated in the article on the SKULL (MEASUREMENTS OF THE). A method analogous to the facial angle is, however, noteworthy in this connection. CRANIOFACIAL ANGLE is a name given by Prof. Huxley (see *The Anatomy of the Vertebrated Animals*, p. 420) to the angle subtended by the intersection of (1) the plane of the bony face in its prominent parts, and (2) "a line drawn from the anterior extremity of the *premaxilla* to the anterior extremity of the basicranial axis." In the several races of mankind "it varies with the extent to which the face lies in front of or below the anterior end of the cranium, from less than 90° to 120°. When it is great, the face is *prognathous;* when it is small, the face is *orthognathous.* This is the fundamental condition of *prognathism* or *orthognathism.* A secondary condition is the form of the alveolar portion of the upper jaw, which so far as it is vertical tends toward orthognathism, but so far as it is oblique and produced tends to prognathism."

THEODORE GILL.

Fa′cial Nerve. The facial nerve is the seventh cranial nerve, according to the numerical classification of Sömmering. It originates from a mass of nerve-cells lying deep in the medulla oblongata in its upper median part, passes out of the medulla at its upper lateral tract, just behind the pons Varolii, leaves the cranial cavity by entering the internal auditory foramen in company with the auditory (eighth) nerve, pursues an irregular course through the petrous portion of the temporal bone, and issues from the skull through the stylo-mastoid foramen. The majority of its branches are now given off, and the most important lie in the superficial parts of the face, and are distributed to the facial muscles—the muscles of expression. The deeper branches of the nerve go, after communicating with other nerves, to the muscles of the middle ear and to those of the palate. The facial nerve communicates with the following nerves: the auditory, the intra-cranial sympathetic, the pneumogastric, the glosso-pharyngeal, and with the various branches of the trigeminus. The seventh nerve is strictly a motor nerve, though, away from its origin, it communicates so freely with the trigeminus as to appear sensitive. It is often called *portio dura*, to distinguish it from *portio mollis*, the auditory nerve, considered by some anatomists a portion of the seventh nerve. E. C. SEGUIN.

Fa′cial Neural′gia, a disease characterized by more or less paroxysmal pain in parts of the head and face supplied with sensibility by branches of the trigeminus nerve. Any one branch of the trigeminus nerve may be the seat of pain (in brow-ague the supraorbital branch), or all its branches may be involved. The cause of the neuralgia is a morbid state of the nervous centre giving origin to the nerve (the medulla oblongata); and this morbid state may itself be the result of simple malnutrition (anæmia), of blood-poisoning (malaria), or of inherited predisposition. Various other pathological conditions may give rise to pain in the distribution of the trigeminus, irritation of other sensitive nerves (bad teeth), tumors pressing on the nerve, inflammation of the nerve itself. E. C. SEGUIN.

Fa′cial Paral′ysis, a paralysis of the superficial muscles of the face, due to a loss of the motor property of the nerve supplying them—the seventh or facial nerve. The symptoms are loss of expression on the affected side of the face, a drawing of the mouth and features generally to the opposite (healthy) side, inability to close the eyelids on the palsied side, slight impairment in articulation, owing to palsy of a part of the muscles of the tongue. When both sides of the face are palsied, the face appears like a smooth mask, the mouth (lips) is open, the eyes cannot be closed. The pathological conditions which produce this palsy may be disease of the cerebrum, pons Varolii, or of the medulla oblongata, pressure upon the nerve in the skull or in the canals in the petrous bone, injuries to the nerve in these locations or upon the face, or the sudden impact of cold air upon the face (draught). E. C. SEGUIN.

Fack′ler's Station, tp. of Jackson co., Ala. Pop. 760.

Fac Sim′ile [Lat., "make the like," imperative], an exact copy of a picture, handwriting, or any work of art.

Fac′tor [Lat., a "maker"], in mathematics, is one of the several measures or divisors of a number or quantity. The name is given to each of those quantities which, when all are multiplied together, will produce the *product.*

Factor, a general agent employed in the purchase or sale of merchandise, with power to retain possession of the property in regard to which his authority is exercised, and to control, to a large extent, its management and disposal by proceedings in his own name. By the possession of these peculiar powers a factor is distinguished from a broker, who only conducts negotiations and bargains concerning property of his principal, without having it in his charge, and who properly acts in a representative character by the use of his principal's name. The term "factor," though the one usually employed in law, is not so common in popular usage as "commission merchant" or "consignee." Compensation by the principal is generally a certain percentage on the amount of purchases or sales, called factorage or commission. A *domestic factor* is one who resides in the same country with his principal; a *foreign factor*, one who resides in a different country. A foreign factor, in his relations with third persons, is regarded, to a large extent, as if he were himself principal, and he is therefore under a greater responsibility than one merely domestic. In the application of this distinction

the States of the Union are not, according to the general course of decisions, regarded as foreign to one another. The fundamental duty of a factor is to exercise reasonable care in the performance of the duties with which he is entrusted, and to exhibit such skill and prudence as is required by the nature of the business and a proper consideration for the welfare of his employer. Otherwise, he has no valid claim for his commissions, and for injurious negligence and default may even be subjected to an action by his principal. In the management of the property committed to him he has commonly extensive discretionary power. He may buy and sell, sue and be sued, collect money, give receipts, etc., in the same manner as if he were himself owner of the goods, unless specially restricted by the principal. If any special instructions are given to guide his action, he is bound, as between him and his principal, to follow them strictly, except in some few cases where the necessary protection of his own interests requires that such directions be violated. An instance of the latter kind occurs where the factor has made advances for his principal, and finds it necessary to sell the goods upon the credit of which the advances were made, in order to reimburse himself, upon failure or refusal of the principal to make repayment after proper notice and demand. In such a case the generally established American rule is that the factor has a right to sell to the extent of his advances, even in opposition to the wishes of his principal. The English rule, however, is different. Even where the factor violates special instructions, he may, in certain cases, confer a title upon a purchaser acting in good faith. In the absence of instructions, factors should conform to the usages of the business in which they are engaged, and will be justified in the adoption of any practice which such usages warrant, provided there is no wanton disregard of their employers' interests. They have a lien upon the property entrusted to them for their commissions, advances, and other proper charges, so long as they retain possession. Sometimes, in consideration of an increased commission, a factor guarantees the payment of the price of goods by the purchaser to his principal. He is then said to act under a *del credere* or guaranty commission, and is subject to most of the obligations of a surety. A factor acquires no right to his commissions until all the services for which he was engaged have been rendered. (See AGENT; BROKER.) See STORY on *Agency;* DUNLAP'S *Paley on Agency;* PARSONS, CHITTY, and other authors on *Contracts.* Statutes have been passed in England and some of the American States regulating the rights and duties of factors in certain respects. GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fac'tory [from the Lat. *factor*, a "maker," from *facio, factum*, to "make"]. This word is, in the U. S., applied almost exclusively to a building or collection of buildings devoted to the manufacture of goods on an extensive scale. Until near the close of the last century such a thing as a factory was hardly known in America. Now factories have multiplied till we have them not only for making cloth, to which our first factories were devoted, but for making it up into clothing; for hats and hose and boots and shoes; for doors and blinds and sashes; for household furniture, for carriages, for mechanics' tools and agricultural implements, for clocks and watches, for pins and buttons, and other articles innumerable. A million of our people, probably, are engaged in these various manufactures.

We propose to treat, briefly, in this article of the *factory system* of industry as distinguished from the separate and independent labor of individuals, with reference to its bearing upon the pecuniary, mental, physical, and moral interests of the community.

The *advantages* of the factory system are, 1st, the bringing together of a large number of workers for one purpose, thus securing such a division of labor that each may be employed constantly upon some one part of a complex object. In a carriage-factory, *e. g.*, no individual makes an entire carriage. One set of men work on the bodies, another on the wheels, another on axles, etc. And these are again subdivided, no one making an entire wheel, but one working on the hubs, another the spokes, another the felloes; and even these several parts are still further distributed. The larger the number of hands employed in a particular establishment, the farther the division of labor may be carried; and the smaller the part that each one has to perform, the more skilful and expert he will be likely to become in doing it. In each of the breech-loading rifles now making (July, 1874) at the National Armory in Springfield, Mass., there are sixty different pieces, and more than six hundred distinct operations in making them, and some six hundred men are now employed there. Now, if each workman were required to go through all these operations, far more time would be lost in making the changes from one to another, and getting mind, muscles, and tools adjusted to each new operation, than is now spent in doing all the work. 2d. Machinery is made to perform a large share of most factory operations; and they are not only performed with vastly greater rapidity than they can be by hand, but most of them more accurately also. It is one of the marvellous triumphs of modern machinery that the corresponding parts in a thousand or a million complex mechanisms can be made so exactly alike that each of them will fit in the place of any other. So if a wheel or lever breaks in a factory-made watch, another that will be sure to fit can be ordered and sent by mail at a thousand miles' distance; or when a gun is disabled upon the battle-field, the damaged part may be replaced at once from another that is injured in a different part. Again: the simplification of processes by the use of machinery enables a cheaper class of hands to do a large share of the work, so diminishing further the price of the manufactured goods. The direct effect of the factory system, therefore, financially and as a matter of political economy, must be largely profitable to the community at large.

But there are aspects of the factory system that are not so pleasing—its *disadvantages.* Among these, real or alleged, are, 1st, *intellectual degeneracy* of the operatives. This, it is argued, is the natural consequence of being engaged in an everlasting routine of mechanical operations that require so little mental exercise; at the same time, opportunities for education and for acquiring general information are very limited.

Another danger from factory employment is *injury to health.* The work is often done in crowded and ill-ventilated rooms, frequently in an atmosphere loaded with particles from the materials wrought upon, or in air heated far above a healthful temperature, perhaps saturated with moisture, or sometimes even pervaded by poisonous gases. Then, the work is such as, more than in most other departments of labor, taxes some muscles at the expense of others. The result is, not seldom, positive distortion and deformity in a degree, and when it falls short of that, cannot but be unfavorable to good health. Some of these unwholesome influences touch comparatively few; others affect, in a measure, a large proportion of those employed in factories. And it is evident that the more complete the division of labor, the more will some of these injurious influences be aggravated.

Again: *family ties* and *domestic habits* are likely to suffer, especially through the extensive employment of females in the mills.

Furthermore, it is alleged that so large a capital is requisite to enable one to be a master-manufacturer that most of the workmen despair of attaining such a position, and become spendthrifts, and that they constitute a dangerous political element, their limited opportunities disqualifying them for intelligent citizenship, and their relation to their employers preventing them from casting their votes independently.

Finally, it is thought that factories are *demoralizing,* productive of irreligion and vice.

Such are the principal disadvantages known or suspected to attend on the factory system of industry. And there are those who believe that the densest masses of ignorance, thriftlessness, infidelity, and vice are found almost exclusively in manufacturing towns, and regard the rise of a factory village as the breaking out of a plague-spot in a community. Thus, a British poet, contemplating the manufactories that had sprung up upon a certain stream dear to his youth, exclaimed—

"And call they this improvement?—to have changed,
  My native Clyde, thy once romantic shore,
Where Nature's face is banished and estranged,
  And heaven reflected in thy wave no more.
  *   *   *   *   *   *   *   *
And for the daisied greensward, down thy stream
Unsightly brick-lanes smoke and clanking engines gleam.

"Speak not to me of swarms the scene sustains;
  One heart, free, tasting Nature's breath and bloom,
Is worth a thousand slaves to Mammon's gains.
  But whither goes the wealth, and gladdening whom?
  See, left but life enough and breathing-room
The hunger and the hope of life to feel,
  Yon pale mechanic bending o'er his loom,
And childhood's self, as at Ixion's wheel,
From morn till midnight tasked to earn its little meal."

A melancholy picture, indeed! And its gloom is not all the mere product of the poet's imagination. But we think its counterpart would be easier to find in Great Britain than in America. And, if we may credit some apparently trustworthy statements recently published, it would not be difficult to paint as dark and as truthful a picture of the condition of the agricultural laborers in some districts there. It is not to be denied that there have been factory villages which, if we took them as fair specimens of what manufacturing communities are, should make us earnestly deprecate their multiplication. But there is reason to think

that facts as they exist, in this country at least, do not justify the very disparaging view which some take.

As to the tendency of manufacturing employments to dwarf the intellect, it may be said, first, that there are some compensations for any lack of ordinary means of culture. The contact of mind with mind where so many are thrown together will do something to sharpen the intellect. Perhaps the fact that the simple operations performed demand so little mental effort may lead, in some cases, to a freer range of thought abroad. And it not unfrequently happens that the compact populations of manufacturing towns have larger opportunities for schools and lectures and such means of mental improvement than those in agricultural towns. Even in Great Britain high authorities doubt the mental inferiority of the manufacturing class.

That factory employments are injurious to *health* seems better established. Yet the quietness of the life, and the shelter from storms and from extremes of heat and cold, may counterbalance some unhealthful conditions; and in most factories of recent construction the necessity of ventilation is recognized, and of securing a proper temperature and purity of atmosphere. This, however, is limited in some cases by the necessities of the work.

As to the alleged unthrift and hopeless poverty of factory-workers, it is not sustained by observation in New England. Many of them do accumulate property enough to make them more than comfortable in advanced years. And if this is not generally true, it is not for want of opportunity. The wages they receive are believed to be equal to those of the corresponding class in most other departments of labor, and, as a general rule, they are as well fed and clothed and housed.

Of the moral and religious condition of factory populations it is not easy to speak with assurance; different persons come to different conclusions. But from the direct testimony of numbers of intelligent men who have excellent opportunities to observe in various places and divers branches of manufacture, we conclude that, when rightly estimated, the moral standing of our larger manufacturing towns, at least, is not below that of others of equal size. They seem to be as well supplied with churches; and, since it is for the interest of employers that their workmen be temperate and virtuous, they are pretty sure to use the great power of control which they have to exclude certainly the grosser forms of immorality from their establishments. It is true that the operatives in some of our largest and oldest manufacturing towns are inferior in intelligence and in general character to what they were forty years ago. But this does not prove a damaging influence of factory employment. They are not only not the same *persons*, but they are drawn from very different sources. A large majority of those employed in our cotton and woollen mills to-day are of foreign origin, and others are from families at a low grade in the social and moral scale; so that, remembering what the raw material of these operatives is, we can believe, as we are assured by men who know, that there is in general a decided lifting up, and not a degeneracy in character after they enter this employment.

Remedies.—While thus we guard against an exaggerated estimate of the evils attending the factory system, unquestionably they are enough, and great enough, to demand the earnest inquiry, What can be done to remove or diminish them? Legislation may lend important aid toward that good end. It *has* done something in Great Britain and in this country. Laws limiting the hours of work, limiting the age at which children shall be permitted to enter the mills, and compelling a certain amount of schooling, have accomplished not a little good. And while there are difficulties attending the regulating of such matters by law, yet probably legislation might be advantageously yet farther invoked. Again: An important means of exciting a healthful ambition, and which would work for good in various ways, is allowing the operatives themselves to become owners of stock in the companies for which they labor. This is practised now by some companies, and might be by many others if they were so disposed.

But the grand remedy for the ills of this branch of industry is the same as for all others—a *general purification of society*. There are wise and good men managing some of our manufacturing establishments who do a great deal for the physical, intellectual, and moral health of their employés by providing good work-rooms, healthful lodging-houses, well-selected and free libraries, and helping to secure suitable religious privileges. And when upright, magnanimous Christian men shall be at the head of all our factory companies, there will be a great diminution of whatever special infelicities now attend them. Such a consummation may be distant, yet we cannot but cherish strong hopes that our multiplying manufactories, instead of being the curse and ruin of the country, are to contribute to its prosperity socially, politically, and morally, as well as financially, and to have their full share of the glory which we fondly anticipate for the nation.

George T. Dole.

Fac'tory Point, post-v. of Manchester tp., Bennington co., Vt., on the Harlem Extension R. R. It has manufactures of leather, lumber, wagons, and knit goods, and quarries of marble.

Fac'tory Village, a v. of Milton tp., Saratoga co., N. Y., has two paper mills.

Factoryville, Staten Island, N. Y. See New Brighton.

Fac'toryville, post-v. of Barton tp., Tioga co., N. Y., has a planing-mill and other manufactures. Pop. 318.

Factoryville, post-v. of Clinton tp., Wyoming co., Pa., on the Delaware Lackawanna and Western R. R., 15 miles N. W. of Scranton. The seat of Keystone Academy.

Faculæ. See Sun, by Prof. Charles A. Young, Ph. D.

Fac'ulty [Lat. *facultas*], as applied to the body of instructors of an institution of learning, is a term of mediæval origin, and at first designated all the graduates, or those who had received power or authority (*facultas*) to impart instruction. There were said to be four faculties—those of philosophy, medicine, law, and divinity. Even now, the whole body of graduates are occasionally so called, especially in the phrases "medical faculty" and "legal faculty;" but more frequently the officers of instruction and discipline in a college or university are collectively designated as the faculty of that particular college.

Faculty of the Mind. See Mind, by Pres. James McCosh, S. T. D., LL.D.

Fæ'ces [the plu. of the Lat. *fæx*, the lees of wine or the dross of metals], the substance ejected by animals from the alimentary canal, consists in general of (1) the surplus of the food, over and above what is needed for nutrition for the time being; (2) those elements of the food which are not available for nutrition; and (3) certain excrementitious and effete matters which the liver, the intestine, etc. have removed from the blood (stercorine, cholesterine, etc.). To these, in the Monotremata and all the vertebrates inferior to mammals (as well as in many invertebrates), the renal excretions are added. Fæcal matters are highly important as fertilizers; and this is especially true of guano and the excrement of birds generally, since it contains the urinary excretions combined, as we have seen, with those of the intestine, the whole in a very condensed form.

Fæcula. See Starch.

Faed (John), artist, b. in 1820 at Burley Mill, Kirkcudbright, Scotland. His father was an engineer and millwright, but the lad showed a taste for painting that made the homely surroundings tributary to it, and at the age of twelve finished a picture so well that his future career was determined. In 1841 he went to Edinburgh for study, and there, in 1850, exhibited pictures which attracted attention from their naturalness and met a ready sale. He painted *Shakspeare and his Friends, The Cotter's Saturday Night, The Soldier's Return, Tam O'Shanter, Haddon Hall of Old, John Anderson my Jo, Parting of Gabriel and Evangeline*, and other pieces of kindred character, clothing historical fact with sentiment. Since 1864, he has lived in London.

O. B. Frothingham.

Faed (Thomas), R. A., younger brother of the above, b. at the same place in 1826. He too had a passion for art, and on the death of his father followed his brother to Edinburgh. At the Academy of Design there, under the instruction of Sir W. Allan, he soon distinguished himself. His first exhibited piece was in water-colors, *The Old English Baron*. After that he tried oil-painting, like his brother choosing humble themes—*The Players of Draughts, The Shepherd Boys*. In 1849, Faed became an associate of the Royal Scottish Academy. Two years later the well-known picture, *Walter Scott and his Friends at Abbotsford*, made him famous. In 1852 he removed to London, and sent his work to the Royal Academy. From year to year his reputation increased. *The Mitherless Bairn* (1855) was pronounced the picture of the season. His painting *Baith Father and Mither* (1864) was again exhibited at the World's Fair of 1867, along with two other canvases by the same hand. Was made member of the Royal Academy Dec., 1864.

O. B. Frothingham.

Faen'za, city of Central Italy, 19 miles S. W. of Ravenna. The manufactures of the peculiar earthenware which received its name from this city (*faïence*) have recently increased considerably. The city has many remarkable old buildings and fine pictures. Pop. 17,486.

Fag'gert's, tp. of Cabarrus co., N. C., Pop. 619.

Fag'ging, a technical term to denote a custom which has become part of the public-school system of England. This custom differs in detail in the several schools, but rests in all on the same principle. This principle is, that the discipline of the school should be left, as far as possible, to the boys themselves, the responsibility for order being thrown on the highest form, known as the sixth form, called also prefects (as at Winchester) or praeposters (as at Rugby). Those who are thus responsible for discipline have also the right of "fagging" the boys in the lower forms, those in the forms immediately under the sixth being exempted. Dr. Arnold defines fagging as "the power given by the supreme authorities of the school to the sixth form, to be exercised by them over the lower boys, for the sake of securing a regular government amongst the boys themselves, and avoiding the evils of anarchy; in other words, of the lawless tyranny of brute force." (*Quarterly Journal of Education*, vol. ix.) The origin of this custom of fagging cannot now be ascertained with any certainty, but, so far as there are any authentic records, it would seem to have always existed in the old schools. Thus, it is clear, from Christopher Johnson's poem *De Collegio* and the *Consuetudinarium Vetus Scholæ Etonensis*, that it was in active operation at Winchester and Eton in the sixteenth century. It is probable, however, that the custom arose as soon as the schools received any large number of boys as boarders. It is indeed obvious that where large numbers of boys of ages ranging from ten and eleven up to nineteen are thrown together away from their own homes, they must be placed either under the constant surveillance of masters or under some distinct and recognized form of self-government. The latter alternative has always prevailed in the English public schools, and is, in fact, the only one which is in accord with the national character. There is abundant proof, moreover, that the custom of fagging as a part of the system does not stand merely on tradition, but is accepted as beneficial at the present time, in the fact that it has been deliberately introduced in the schools which have been founded within the last thirty years. The number of the great public schools had remained stationary for three hundred years, since Queen Elizabeth's reign, during which Harrow, Rugby, and others not so well known were founded. In the present reign a remarkable revival has occurred, and a number of public schools have been founded, of which the best known are Marlborough, Haileybury, Wellington College, and Cheltenham. Fagging has been introduced in the three former of these. At Cheltenham, where the school is in a large town, and is chiefly composed of day-scholars, or boys living at their own homes, though there is no legal system of "fagging" recognized by the school authorities, the practice exists, but without the usual safeguards against abuse. In all the schools the power of fagging carries with it certain duties. Besides that of keeping order generally, the sixth-form boy is the recognized adviser and protector of those fags with whom he comes in immediate contact. In any case of bullying or bad conduct the appeal of the aggrieved boy is to the sixth form boy of his room or passage, or to the head of his house, and not to his tutor or house or form master. And the sixth-form boy is bound to accept the responsibility of acting himself, and would completely lose caste were he to refer any but flagrant cases of ill-conduct to the master.

Simultaneously with the public-school revival of the last thirty years, however, great modifications of the fagging system have been introduced. At the beginning of that period "fagging" included a number of menial functions, such as cleaning boots and candlesticks, and the power of the sixth form was practically unlimited as to hours. A boy might be fagged, for instance, during a whole afternoon at cricket, day after day. All this is now changed. At Eton and one or two other schools there is now no cricket fagging, and in those where it still exists it is very light. Thus, at Haileybury the whole of the fags are taken in regular order for one hour, so that each fag's turn comes only once in three weeks, and even then he is let off if he makes a good catch or otherwise distinguishes himself. A similar custom prevails at Marlborough, where, however, besides the sixth form, the Eleven have the power of fagging at cricket—a solitary example (it is believed) where this power is not dependent on proficiency in study as evidenced by position in the school. Football-fagging is also very light at all the schools except Rugby, only some half dozen fags being told off to keep the ball in bounds. At Rugby every fag is obliged to play "little side," lasting two hours at most, unless he holds a medical certificate of inability to play. He is also obliged to run (in the paper chases) unless holding such a certificate. Apart from games, general fagging is practically confined to running errands, a sixth-form boy having power to call any fag, at any time, for this purpose. House-fagging, in like manner, consists of little beyond small services of this kind—carrying up the trays on which their master's breakfast and tea things are set, and perhaps toasting a round of bread or a rasher of bacon. "Study-fagging" still exists at Rugby, where each sixth-form boy has two fags specially attached to him, who sweep out his study and put it in order in alternate weeks. At the school house also "night-fagging" is still in force. Every fag has his choice between study-fagging and night-fagging. The rota of night-fags is kept by the head fag, who tells off four for each week in the term. Their duties are to be ready in the passages between 8.30 and 9.30 to answer the call of any of the sixth form.

At Eton the fifth form have the power of fagging, but (as above stated) it is usually confined exclusively to the sixth form. The numbers of the sixth are not strictly limited, but seldom exceed thirty-five or forty. Harrow has the largest sixth form of any school, divided into the "upper," "lower," and "modern side," and numbering eighty, all of whom have the power of fagging, but only the fifteen highest, or "monitors," have the power of enforcing discipline with the cane, if necessary. Only the fifth form at Harrow, numbering 140, are exempt from fagging. As the school averages in all 550 boys, there are consequently some 330 fags to 80 masters.

The most distinguished masters of public schools, from Dr. Arnold downward, have been singularly unanimous in their approval of the modified system of fagging which now exists. The public opinion both of old public-school men and of the boys themselves is also strongly in favor of it as the best means of maintaining the due subordination of ranks, of keeping down "cheek," and preventing bullying. There is every likelihood, therefore, that it will not only continue in its present form in all the higher public schools, but will also be adopted in the numerous middle-class public schools which are springing up in England upon old and neglected foundations or in consequence of local effort. (See also Arnold's *Life*, by STANLEY, 1st ed., vol. i., p. 105, and *Report of Public-School Commissioners* (1864), and *Appendix of Evidence of Bishop of Exeter, Drs. Butler, Balston, and others;* and specially section of *Report on Monitorial System*, p. 42 *et seq.*)

THOMAS HUGHES.

Fa'gius (PAUL BÜCHEIN), German Protestant theologian, b. at Rheizabern in the Palatinate 1504, was pastor at Isny in 1537, and professor of Hebrew at Strasburg in 1544. Was in England in 1549, and was appointed to the chair of theology at Cambridge University, but d. Nov. 12, 1549. His body was exhumed and burned by order of Queen Mary in 1558.

Fagna'ni (JOSEPH), b. at Naples, Italy, Dec. 24, 1819; studied in the royal academy of his native city, and made crayon portraits in early youth; went to Vienna, Paris, and Madrid, and in 1849 came to the U. S. with Sir Henry Bulwer; in 1851 married an American lady and settled in New York; was afterwards distinguished, both in Europe and the U. S., as a painter of portraits, and for his skill received several decorations and other honors. D. in New York May 22, 1873.

Fagun'dus, post-v. of Warren co., Pa., in the Oil Region.

Fagus. See BEECH.

Fahlun. See FALUN.

Fahr'enheit (GABRIEL DANIEL), F. R. S., a physicist, b. in 1690 at Dantzic, Prussia; became a constructor of scientific instruments; resided in France, England, and afterwards in Holland, and was everywhere recognized as one of the leading physicists of his time. In 1720 he first introduced the use of mercury in thermometers. He invented the Fahrenheit scale (see THERMOMETER); also an improved areometer and other valued instruments. He was the author of several learned papers, chiefly regarding heat and specific gravities. D. at Amsterdam in 1740.

Faidherbe (LOUIS LÉON CÉSAR), French general of division and author of several geographical, ethnographical, and linguistical papers, was b. at Lille June 3, 1818, and began his career in the colonies, principally in Algeria, where he served with distinction. Made himself favorably known while governor of Senegal by several valuable scientific papers which were published in the *Annuaire du Sénégal* (1859, 1860, and 1861) and in the *Bulletin de la Société de Géographie*. He also wrote *Chapitre de Géographie sur le Nord Ouest de l'Afrique* (St. Louis, 1861), and *Collection complète des inscriptions Numidiques* (Paris, 1870). Published from 1860 the *Bulletin du Sénégal* (St. Louis), and rendered the French dominion in Africa great service by his exact knowledge of the country and its population, and by his talent of organiza-

tion. At the outbreak of the war with Germany he commanded the subdivision of Bona, and was called to active participation in the war by the government of National Defence in Dec., 1870. On Dec. 3 received the supreme command of the armée du Nord, organized in and around Lille. He commanded in the undecided or drawn battles of the Hallue, on Dec. 23, 1870 (also called the battle of Quérieux), and of Bapaume on Jan. 2 and 3, 1871. On Jan. 19, 1871, he was defeated by General von Goeben at St. Quentin, but his artillery was weak, and he had almost no cavalry, and thus it is certainly not to be wondered at that his newly-organized and little-practised forces could not hold their ground against the old German soldiers, led by an excellent commander. Acknowledged as a very able commander and organizer in war, Faidherbe entered into politics after the war during the reorganization of the government. Joined the party of Gambetta, and was elected to the National Assembly from three different places; accepted the election from his native place, Lille. But when the government of Thiers triumphed, and the influence of Gambetta decreased, Faidherbe retired from public life. He wrote a book on the war, *Campagne de l'armée du Nord*, dedicated to Gambetta (Paris, 1871). A. NIEMANN.

Faïence [Fr., from *Faenza*, the original place of its manufacture], a name for glazed pottery having an earthenware ground and enamelled with painted designs.

Fai-Fo, seaport of Anam, and a mart of considerable importance. It trades principally with China, and exports sugar and cinnamon. It has a large Booddhic temple, with 2 Chinese temples. Pop. 5000.

Faillon (MICHEL ÉTIENNE), b. at Tarascon, France, in 1799, became a Sulpician in Paris, and in 1854 came to Canada as a visitor to the Sulpician houses of that country. He published numerous valuable biographies of distinguished French Canadian religionists, and undertook an extended history of the French in Canada, of which 3 vols. 4to (1865–66) were completed. D. at Paris Oct. 25, 1870.

Failly, de (CHARLES ACHILLE), French general, was b. at Rozoy-sur-Serre, Aisne, Jan. 21, 1810. After 1828 served partly in France, partly in Algeria. In the Crimean war distinguished himself in the battle of the Alma and the storming of Sebastopol; and at the battle of the Tschernaya led his brigade with valor and success. In the war against Austria, in 1859, commanded, as general of division, the third division of the fourth army corps, and on the day of the battle of Solferino received the grand cross of the Legion of Honor. After this war, and to 1870, was president of the comité consultatif de l'infanterie, and under his authority all improvements in the equipment and exercise of the infantry were discussed and put in practice; he had the merit of introducing the Chassepot gun. In 1867 commanded the expedition whose task was to protect the pope against the attacks of Garibaldi, and his name attained a sad celebrity from the battle of Mentona, in which Garibaldi's irregular host were slaughtered, and from the report of this battle, in which the Chassepot gun was mentioned as having done "wonders." At the beginning of the war with Germany, Failly received the command of the fifth corps, but was very unsuccessful, and was violently attacked by his countrymen; after the war he published a pamphlet in vindication of himself—*Marches et opérations du cinquième corps* (Brussels, 1871)—in which a broken heart speaks from every line. The principal charges brought against Failly are—that at Wörth he did not come to the support of MacMahon, though he stood near enough to do so; and that he marched his corps from Chalons to Sedan so badly and improvidently that it was surprised and defeated at Baumont. On these accounts he lost his command on the very day before the battle of Sedan. In the above-mentioned pamphlet he tries to refute these charges, but on his return from German captivity he received no command. AUGUST NIEMANN.

Fainéants [Fr.], ("Do-Nothings"), a name applied to several Frankish sovereigns, chiefly of the Merovingian dynasty. The title is indicative of their idle and worthless reigns, which indeed were merely nominal. Thierry III. of Austrasia and Burgundy, Clovis III., Childebert III., Dagobert III., Chilperic II., Thierry IV., and Childeric III., all Merovingian kings of France, were *rois fainéants*, as was also Louis V., the last of the Carlovingians. The same appellation is often applied to worthless monarchs of later times and other countries.

Faint'ing (*Syncope*), a more or less complete and sudden loss of sensation and of the power of motion, unaccompanied by convulsions, but usually attended by feebleness of the circulation and respiration. Fainting is attended by anæmia of the brain, its proximate cause; more remotely it may be caused by loss of blood, by profound emotional disturbance, or by heart-disease. Closely akin to it, but more permanent and dangerous, are the collapse which occurs in cholera (caused by loss of the fluid constituents of the blood) and the shock which follows severe injuries. Fainting is to be treated by placing the patient on his back in a horizontal position, or with the head and chest slightly depressed below the level of the rest of the body; by admission of fresh air to the patient; and, in prolonged cases, by applying diffusive stimulants to the nostrils and resorting to artificial respiration. Fainting is seldom mortal, unless in cases of severe disease.

REVISED BY WILLARD PARKER.

Faioum. See FAYUM.

Fair [a word kindred to the Lat. *feria*, a "holiday"]. This name was originally given to stated temporary markets containing many kinds of goods and wares. When population was sparse, and the means of travelling and transportation were extremely limited, it was found most convenient to expose merchandise for sale at the largest gatherings of the people. Hence, European fairs were early identified with religious festivals, and were often designated by the name of the saint in whose honor each festival was held. However, as the difficulties and dangers of intercommunication diminished, and the number of cities and villages increased, factories, shops, and warehouses became more accessible, and the inhabitants generally found it more convenient, as well as more profitable, to buy goods as they needed them, from time to time, than to purchase a year's supply in advance. Thus, fairs for the sale of goods constantly decreased in number and importance with the growth and improvement of each country, until not more than two or three of any note were held in all Europe. The most famous of these—and, it is said, the largest in the world—is held annually during the months of July and August at Nijni-Novgorod in Russia, situated at the confluence of the rivers Volga and Oka, about 265 miles E. of Moscow. The amount of sales at this fair is reported to have reached the enormous sum of 150,000,000 roubles (about $112,000,000). Yet it is not improbable that the proposed Siberian railway will, when completed, open new places of business along its line through Northern Russia and Central Asia, and thus eventually cut off the supplies which are now gathered annually at Nijni-Novgorod. In Arabia, Hindostan, and other Eastern countries such fairs are still held, and will continue to be so until the general introduction of railways and other modern improvements.

In the U. S., temporary markets containing the effects of itinerant merchants are entirely unknown, although the term *fair* is often applied to such collections of fancy articles as are generally sold by ladies for the benefit of religious and charitable associations. This term has, however, a far higher meaning, and now more frequently designates a collection of superior products which are exposed, not for sale, but solely for public inspection, and for careful examination by experts as to their respective qualities. Numerous annual fairs, embracing rare specimens of skill, industry, and inventive genius, and furnishing abundant evidence of progress and improvement, form a feature peculiar to this country. They are identified with a grand movement for bettering the material condition of man, which, by enlisting all classes, and thus securing the hearty co-operation of the mass of the people, has already gathered irresistible force, and must therefore be regarded as the most significant sign of advancement in the nineteenth century.

Several attempts were made at an early day in this country to encourage art and invention by offering prizes for superior specimens of a few kinds of goods, but no permanent system for improvement was established until the year 1810. Elkanah Watson, a merchant of Albany, N. Y., whose original plans regarding inland navigation, uniform currency, and general education entitle him to a prominent place among American philanthropists, was the real author of the present system of fairs and cattle-shows sustained and directed by agricultural societies. Having retired from active business, and removed to his farm near Pittsfield, Mass., he conceived the idea of interesting the farmers of Berkshire county in holding an exhibition of improved breeds of cattle and superior products of the soil, for the purpose of proving what might be accomplished by proper culture; and to compensate and reward exhibitors for the care and labor bestowed on their specimens, prizes were to be awarded for the best. The first fair was quite a success, and for the purpose of enlarging the next he appealed to the citizens of Boston for pecuniary aid, but failed to get a single favorable response. Ex-President John Adams, in his reply, made it quite apparent that the leading men of that day did not appreciate the importance of this new step for encouraging the useful arts. This was pithily expressed in a single sentence: "You will get

no aid from Boston: commerce, literature, theology, medicine, the university, and universal politics are against you." Watson was not thwarted by this rebuff; he redoubled his exertions at home, and for several years annual fairs were held. In 1816 he returned to Albany, and immediately proceeded to organize an agricultural society and to establish fairs and cattle-shows in the neighboring counties. In 1819 the legislature of the State of New York passed an act appropriating $10,000 annually, for six years, for the promotion of agriculture and family manufactures, which was to be divided among the agricultural societies of the several counties in proportion to their population, provided a like sum was raised in each by voluntary subscription. In 1832 the present State Agricultural Society was incorporated, and in 1841 a law was passed similar to that of 1819, appropriating the sum of $8000. Under the present system each county agricultural society is required to report annually to the State society, which embraces the essential parts of the whole in its report to the legislature. This plan of organizing State and county agricultural societies, with power to hold fairs, was adopted before 1858 in the States of Michigan, New Hampshire, Indiana, Wisconsin, Massachusetts, Connecticut, Illinois, Vermont, Tennessee, California, Maine, and Iowa. Many other States have been added to this list since that time. Nothing illustrates the rapid extension of this system, and the popular sentiment in its favor, better than the announcement of a great fair at Omaha, Neb., and another at Colorado Springs within the Rocky Mountain range, in the fall of 1874. These societies are, as a general rule, under the guidance and patronage of the best and most influential farmers, who take a natural pride in the efficient management of their respective fairs. The collected transactions of State agricultural societies, including reports on annual fairs, printed by order of the several legislatures, already form a large and valuable library on the subject of agriculture and the allied arts.

Other fairs of a more varied and comprehensive kind have been held in many of the large cities of this country, prominent among which are those of the American Institute of the city of New York, the Franklin Institute of Philadelphia, the Maryland Institute of Baltimore, the Massachusetts Charitable Mechanics' Association of Boston; also the industrial exhibitions of Chicago, Cincinnati, St. Louis, New Orleans, and San Francisco.

These exhibitions embrace not only agricultural products, but superior specimens of the fine, ornamental, and useful arts, including working models of recent inventions, machinery in motion, improved chemical and mechanical processes, with the material resulting therefrom, and practical illustrations of the best methods of generating and utilizing force. The articles composing these displays are arranged according to various systems of classification: that of the American Institute is the simplest and most comprehensive of any yet devised. It consists of seven departments, each of which is divided into seven groups; and every possible product or device can be readily assigned to a proper place in one of these forty-nine divisions. The remarkable feature of these fairs is the spirit of emulation evinced by exhibitors. This desire to excel, although it may be stimulated by both rewards and rivalry, springs from a longing to accomplish a given end by the best and most economical methods. Their highest ambition is to add something to the stock of useful knowledge. Fortunately, this friendly strife for supremacy in skill and ingenuity has a constant tendency to expand and give greater variety and value to every display. Competition is not solely an incentive to improvement, for by demanding the severest tests it becomes the means of exposing the advantages and defects of every construction, thus ensuring the adoption of the best.

Few persons are aware of the great expense incurred by many exhibitors for the purpose of making an imposing display at these fairs, or of the large sums expended by their respective managers to render them attractive, instructive, and of real benefit to their patrons. Complete returns of the number of persons attending the numerous agricultural and other fairs have never been made, but from careful estimates it may be safely assumed that the average total number of visitors during each year exceeds 5,000,000.

The advancement of man is clearly indicated by invention and discovery. Whatever may be the state of his shifting opinions on social and political questions, his actual progress and elevation mainly depend on increased facilities for supplying his wants of body and mind by means of new devices which will lessen the rigor of manual labor and render knowledge more accessible. The highest evidences of the increasing skill of our artists and artisans, and of the constant growth and prosperity of this country, are to be found in its numerous autumnal fairs, and together they form a reliable index of the annual progress made in developing its material resources.

Samuel D. Tillman.

Fair'bairn (Patrick), D. D., a farmer's son, was b. at Greenlaw, Berwickshire, Scotland, in 1805, graduated at the University of Edinburgh, was settled in 1830 in one of the Orkney Islands, at Bridgeton, a suburb of Glasgow, in 1837, and at Saltoun, near his birthplace, in 1840. After being for some years professor at Aberdeen, he was in 1856 made principal and professor of systematic theology and New Testament exegesis in the Free Church Theological College at Glasgow. He d. suddenly Aug. 6, 1874. His principal works are *The Typology of Scripture* (1847; 5th ed. 1870); *Commentary on Ezekiel* (1851; 2d ed. 1855); *Prophecy, its Nature, Functions, and Interpretation* (1856); *Hermeneutical Manual* (1858); *Revelation of Law in Scripture* (1868); and a commentary on *The Pastoral Epistles of Paul* (1873). He visited the U. S. in 1871.

R. D. Hitchcock.

Fairbairn (Robert Brinckerhoff), D. D., a clergyman of the Episcopal Church, was b. in the city of New York May 27, 1818; educated at the Mechanics' School in Chambers street, New York, and at Trinity College, Hartford, where he graduated B. A. 1840, and also at the General Theological Seminary, New York. Immediately after his ordination as deacon July 2, 1843, became the rector of Christ Church, Troy, N. Y. From 1853 to 1862 was the principal of the Catskill Academy, as well as rector of Calvary Church, Cairo, N. Y. In 1862 was appointed the professor of mathematics and natural philosophy in St. Stephen's College, Annandale, N. Y., of which institution he became warden in 1863, and also professor of moral philosophy. He still continues to preside over this college. Is the author of several printed sermons, addresses, and pamphlets on religious and educational subjects.

Fairbairn (Sir Thomas), Bart., C. E., eldest son of Sir William Fairbairn, b. at Manchester 1823. As "Amicus" in the *London Times* and in other ways he has sought the social progress of England, writing upon trade-unionism, art, etc. Was active in arrangements for the great English exhibitions of 1851 and 1862.

Fairbairn (Sir William), Bart., F. R. S., LL.D., a noted British civil engineer, b. at Kelso, Scotland, in 1789; received his early education at a parish school, with some instruction from his uncle, and was apprenticed to an engine-wright at a British colliery. On the termination of his apprenticeship worked for two years in London, when he visited various places in England, Wales, and Ireland, working for a brief time in each, in order to acquire a practical knowledge of mechanical engineering. In 1817 began business on his own account at Manchester. His first important improvement was the substitution of iron for wood in the shafting of cotton-mills, and the use of lighter shafting where metal was already in use. By this change the cost of machinery was reduced and the speed increased fourfold. His attention was next directed to the use of iron for ships, and he was the first in England to construct an iron ship. This branch of industry he subsequently developed to a great extent, making it his principal business. More than one hundred iron ships were constructed by his firm, varying in size from the smallest to the war-vessel of 2600 tons. By invitation of the British Association (1834–35), in connection with Mr. Hodgkinson, he investigated the causes of certain supposed defects in iron produced by hot-blast furnaces, and submitted a valuable report upon the subject. Also, at the instance of scientific bodies, and for his own information, made a protracted series of experiments to test the strength of various kinds of iron; also on the resistance of hollow tubes or cylinders to outside pressure, which led to valuable practical results. Mr. Fairbairn co-operated with Robert Stephenson in designing and constructing the great tubular bridge across the Menai Strait, and at his instance the plan suggested by Mr. Stephenson was modified to better meet the required conditions, and it was owing to his "determined perseverance" that Mr. Stephenson's conception became realized. Sir Wm. was one of the founders of the British Association for the Advancement of Science, and the author of many valuable professional books and papers, among which may be mentioned *Mills and Millwork*, *Iron, its History and Manufacture*, *Application of Iron to Building Purposes*, *Iron Shipbuilding*, *Useful Information for Engineers*, 1st, 2d, and 3d [illegible] President of the British Association, corresponding member of the National Institute of France, and chevalier of the Legion of Honor. Created a baronet in 1869. D. Aug. 17, 1874.

G. C. Simmons.

Fair'bank, post tp. of Buchanan co., Ia. Pop. [illegible].

Fair'banks, tp. of Sullivan co., Ind. Pop. [illegible].

Fairbanks (Erastus), LL.D., an American manufacturer, b. at Brimfield, Mass., Oct. 28, 1792, formed a partnership with his brother for the making of scales in 1825 at St. Johnsbury, Vt., and their works there have a world-wide reputation. Was member of the Vermont legislature 1836–38, governor of the State in 1852–53 and 1860–61, and d. at St. Johnsbury, Vt., Nov. 20, 1864. Governor Fairbanks was a man of unusual business abilities, a faithful and disinterested public officer, a citizen of spotless virtue and integrity, and a liberal benefactor of many religious and charitable enterprises, in the success of which he took a deep interest.

Fair Bluff, tp. of Columbus co., N. C. Pop. 1309.

Fair'burn, post-v. of Campbell co., Ga., 18 miles S. W. of Atlanta, on the Atlanta and West Point R. R. P. 305.

Fair'bury, post-v. of Indian Grove tp., Livingston co., Ill., at the crossing of the Toledo Peoria and Warsaw and the Chicago and Paducah R. Rs., 10 miles S. E. of Pontiac, Ill. It has 2 banks, 3 grain-elevators, a fine hall, 6 churches, 1 weekly newspaper, and a general publishing and printing house; also coal-mines, mills, shops, factories, etc. It is in a thickly-settled and fertile region, abounding in coal, limestone, fire-clay, sandstone, and a micaceous quartz which affords a fine fireproof building-material. Clays of nearly all colors abound. Pop. 1493.
O. J. & L. W. Dimmick, Eds. and Pubs. "Independent."

Fairbury, post-v. and tp., capital of Jefferson co., Neb., is situated on the Little Blue River and on the line of the St. Joseph and Denver City R. R. It has a splendid water-power, a fine flouring-mill, a good school-house, 2 churches, a steam saw-mill, 1 weekly newspaper, 1 bank, 2 drug and 5 general stores, 4 lumber yards, etc. Pop. of tp. 370. Geo. Cross, Ed. "Gazette."

Fair'child (James H.), D. D., president Oberlin College, b. 1817 at Stockbridge, Mass., was removed to Ohio when a year old; at seventeen years of age entered Oberlin College as freshman, and has been connected with the college thenceforth to the present time. In 1838 was tutor, in 1842 professor of languages, in 1847 of mathematics, in 1858 of theology, and in 1866 became its president. Has published *Moral Philosophy,* and pamphlets on questions connected with his college, particularly on the education of women, besides contributing to periodicals.

Fairchild (Lucius) was b. at Franklin Mills, Portage co., O., Dec. 27, 1831, served in the war of 1861–65 from Wisconsin, becoming a brigadier-general of volunteers Aug. 5, 1863; was secretary of state of Wisconsin 1864–65, and governor 1866–71. In 1874 he was U. S. consul at Liverpool, England, and in 1880 U. S. minister to Spain.

Fair'fax, county of Virginia, bounded on the E. chiefly by the Potomac. Area, 430 square miles. The surface is undulating. The soil is in part productive. Grain is the principal crop. Carriages and wagons are among the more important manufactures. The county is intersected by the Washington City Virginia Midland and Great Southern and the Washington and Ohio R. Rs. Cap. Fairfax Court-house. Pop. 12,952.

Fairfax, a v. of New Garden tp., Wayne co., Ind. P. 21.

Fairfax, post-tp. of Linn co., Ia., on the Chicago and North-western R. R., 9 miles S. W. of Cedar Rapids. Pop. 1193.

Fairfax, post-v. of Concord and Jackson tps., Highland co., O. Pop. 84.

Fairfax, post-v. and tp. of Franklin co., Vt., 37 miles N. W. of Montpelier. It has four churches, manufactures of woollens, leather, lumber, and other goods, and is the seat of the New Hampton Theological and Literary Institution (Baptist). Pop. 1956.

Fairfax (post-office name **Culpeper**), post-v., cap. of Culpeper co., Va., in Catalpa tp., on the Washington Virginia Midland and Great Southern R. R., 69 miles S. W. of Washington. It was an important strategic point during the civil war. It has two newspapers. Pop. 1800.

Fairfax Court-house, a post-v., cap. of Fairfax co., Va., 14 miles W. by N. of Alexandria and 4 miles from Fairfax Station. It has 1 weekly newspaper, 2 churches, 4 schools, a carriage and wagon manufactory, 4 stores, 2 hotels, and 1 bakery. Principal business, farming, stock-raising, and dairying. It is elevated about 160 feet above tide-water, is very healthy, and is handsomely situated. Pop. about 300.
Saml. Simpson, Ed. and Prop. of the "News."

Fairfax (Bryan), Lord, was b. about 1730, and d. at Mount Eagle, near Cameron, Va., Aug. 7, 1802. Was an Episcopal clergyman at Alexandria, Va., during the last of his life. Was a loyalist in the war of the American Revolution, but preserved the friendship of Washington.

Fairfax (Donald McN.), U. S. N., b. Aug. 10, 1823, in Virginia, entered the navy as a midshipman Aug. 12, 1837; became a passed midshipman in 1843, a lieutenant in 1851, a commander in 1862, a captain in 1866, a commodore in 1873. Commanded the steamer Cayuga in 1862 on the Mississippi River; in command of the monitor Nantucket participated in the first attack upon Fort Sumter, Apr. 7, 1863, and commended by Rear-Admiral Dupont, in his report of that action, for "the highest professional capacity and courage." In command of the monitor Montauk took part in all the fights with the forts and defences of Charleston harbor which occurred during July and August, 1863, and for his excellent service on these occasions received the thanks of Rear-Admiral Dahlgren in general orders and in official communications to the navy department. Foxhall A. Parker.

Fairfax (Edward), English poet, son of Sir Thomas Fairfax, b. at Denton, Yorkshire, about the end of the sixteenth century, translated Torquato Tasso's "Jerusalem Delivered" into English, verse for verse, and this work is still of standard excellence. A *History of Edward the Black Prince,* in verse, and a *Discourse of Witchcraft,* etc., are also his works. The American edition of his great translation, last ed., 12mo (1855), gives the text of Charles Knight's edition from the old folio edition of 1600.

Fairfax (John Contee), M. D., the eleventh Lord Fairfax, a resident of Bladensburg, Prince George co., Md., b. in 1830, a younger son of Hon. Albert Fairfax, succeeded to the title in 1869 on the death of his brother, the tenth Lord Fairfax. Dr. Fairfax formerly practised medicine at Woodburne, Md., and in 1857 married a daughter of Col. Edward Kirby, U. S. army. His cousin, Mr. Raymond Fairfax, is the heir-presumptive to the title. The Fairfaxes are of the Scottish peerage, and never had a seat in the British House of Lords. The first of the title was Ferdinando, a nephew of the poet; made a peer in 1627, d. in 1648. He was the author of some extant writings.

Fairfax (Thomas), Lord, English general, b. at Denton, Yorkshire, Jan., 1611, was son of Ferdinando, Lord Fairfax, and Mary, daughter of Edmund Sheffield, Lord Mulgrave; served in Holland as a volunteer under Horace, Lord Vere, whose daughter he afterwards married; at the outbreak of civil war in 1642 received from Parliament a commission as general of cavalry, his father being commander-in-chief of the northern forces; defeated the royalists under Col. Bellasis, Apr., 1644, and July 2 of that year was especially distinguished by bravery and activity at the king's defeat at Marston Moor, where he commanded the right wing; in Jan., 1645, became commander-in-chief of the Parliamentary or "new model" army, with Oliver Cromwell as lieutenant-general; gained the battle of Naseby, June 14, 1645, and on the 18th of June took Leicester; on the 22d of July took Bridgewater, on the 10th of Sept., Bristol; in June, 1646, captured Oxford, and Charles I. fled to Scotland. Fairfax was then commissioned by Parliament to carry £200,000 to the Scotch army, who agreed to deliver the king to him for that sum. He met the king near Nottingham Feb. 11, 1647. Soon after this he yielded to the genius of Cromwell, and when, in Mar., 1648, he succeeded to his father's titles, continued to fight for him. Appointed one of the High Court of Justice in 1649, he attended but a single session of the court. In the spring of 1649 he was made commander of all the forces in England and Ireland, but refused to fight the Scots, and resigned his commission in June, 1650. In Sept., 1654, he was a member of Cromwell's first Parliament, and in Dec., 1659, took part with Monk in the defeat of Lambert; Jan. 1, 1660, was a member of the council of state, and in May chairman of the committee delegated by the House of Commons to prevent the return of Charles II. D. of a fever at Nun Appleton, on his estates, Nov. 12, 1671. Fairfax was a warm friend to learning, wrote *Short Memorials of Thomas, Lord Fairfax,* besides theological, poetical, and other MS. compositions.

Fairfax (Thomas), Lord, of the same family as the preceding, was b. in England 1691, but settled in the county of Frederick in Virginia, where he had large estates. Making the acquaintance of George Washington in 1748, the friendship between them was unbroken by the American Revolution, although Fairfax was ever a frank and avowed loyalist. Such were his qualities, indeed, that his property was always equally respected by the Americans and the English. D. at Greenway Court, Frederick co., Va., Dec. 12, 1781, and his immense domain of 5,282,000 acres was then confiscated.

Fair'field, south-westernmost county of Connecticut, having the Housatonic River on the E., Long Island Sound on the S., and the State of New York on the W. Area, 650 square miles. The surface is hilly and well cul-

tivated. Grain, cattle, hay, tobacco, butter, and cheese are staple products. Hardware, brick, building-stone, metallic wares, boots, shoes, hats, clothing, flour, harnesses, sewing machines, and carriages are among the various manufactured products. The county is intersected by the New York New Haven and Hartford, the Housatonic, and the Danbury and Norwalk R. Rs. Caps. Danbury and Bridgeport. Pop. 95,276.

Fairfield, county of Ohio, in the S. central part of the State. Area, 490 square miles. The S. part is broken, the remainder level, and the soil is very fertile. Grain, cattle, wool, hay, and dairy products are the staples. Flour, carriages, saddlery, and harnesses are among the manufactures. The Columbus and Hocking Valley and the Cincinnati and Muskingum Valley R. Rs. traverse the county. Cap. Lancaster. Pop. 31,138.

Fairfield, county of South Carolina, in the N. central part of the State, between the Wateree River on the E. and the Broad on the W. Area, 680 square miles. The surface is hilly, but very fertile. Cotton and corn are the chief crops. It is intersected by the Charlotte Columbia and Augusta and the Spartanburg and Union R. Rs. Cap. Winnsboro'. Pop. 19,888.

Fairfield, tp. of Pickens co., Ala. Pop. 2132.

Fairfield, a v. of Suisun tp., Solano co., Cal., on the California Pacific R. R. Pop. 329.

Fairfield, post-v., formerly one of the capitals of Fairfield co., Conn., near Long Island Sound, and on the New York New Haven and Hartford R. R., 52 miles N. E. of New York. The village was burned by the British troops under Tryon in 1779. Fairfield was the scene of the last conflict with the Pequot Indians in 1637. It is a port of entry, and one of the most beautiful villages in the State. Fairfield township includes also the villages of Southport, Greenfield Hill, and Black Rock, all beautiful places. Southport is the chief business-centre, and Black Rock has a fine harbor; lat. 41° 8′ 30″ N., lon. 73° 12′ 44″ W. Fairfield has a national and a savings bank, 7 churches, 16 public schools, some manufactures, and considerable foreign and coastwise traffic. The village of Fairfield is half a mile from the sound, and is a place of summer resort. Since 1870 some 3 square miles of the township have been annexed to Bridgeport. Pop. of tp. in 1870, 5645.

Fairfield, tp. of Bureau co., Ill. Pop. 748.

Fairfield, post-v., cap. of Wayne co., Ill., 90 miles E. of St. Louis, is on the Springfield and Illinois South-eastern and Louisville New Albany and St. Louis Air-line R. Rs. It has 1 bank, 2 newspapers, 3 churches, 2 hotels, an extensive woollen-factory, and large flouring and saw-mills. Principal business, farming. Pop. 719.

D. W. Barkley, Ed. "Press."

Fairfield, tp. of De Kalb co., Ind. Pop. 1554.

Fairfield, post-tp. of Franklin co., Ind. Pop. 845.

Fairfield, tp. of Tippecanoe co., Ind. P. 2230.

Fairfield, tp. of Cedar co., Ia. Pop. 754.

Fairfield, tp. of Fayette co., Ia. Pop. 1026.

Fairfield, tp. of Grundy co., Ia. Pop. 720.

Fairfield, tp. of Jackson co., Ia. Pop. 889.

Fairfield, city, capital of Jefferson co., Ia., at the crossing of the Chicago Rock Island and Pacific and the Burlington and Missouri River R. Rs., 50 miles W. of Burlington, situated on a fertile, high-rolling, and well-wooded prairie. It is the seat of Parsons College (Presbyterian) and a female seminary, and has a weekly newspaper and one national bank. Pop. 2226; of the tp., exclusive of the city, 1640.

Fairfield, post-v. of Nelson co., Ky. Pop. 167.

Fairfield, post-v. and tp. of Somerset co., Me., on the W. bank of the Kennebec River, 21 miles N. of Augusta, with which it is connected by the Maine Central R. R. It has an excellent water power. The township contains 6 post offices, 6 churches, 2 hotels, 32 stores, 1 savings-bank, 1 newspaper, an extensive corn and fruit canning factory, 2 large furniture-factories, 6 wood-shops, 13 saw-mills, 1 tannery, and 1 machine-shop and foundry. P. of tp. 2998.

George H. Colby, Ed. "Fairfield Chronicle."

Fairfield, post-tp. of Lenawee co., Mich., on the Chicago and Canada Southern R. R. Pop. 1725.

Fairfield, tp. of Shiawassee co., Mich. Pop. 632.

Fairfield, tp. of Cumberland co., N. J., on Delaware Bay. Pop. 3011.

Fairfield, a post-v. and tp. of Herkimer co., N. Y. It has an academy, limestone quarries and 5 cheese-factories, producing 1,000,000 pounds of cheese a year. Pop. of v. 281; of tp. 1653.

Fairfield, post-tp. of Hyde co., N. C., near Mattamuskeet Lake. Pop. 1145.

Fairfield, tp. of Butler co., O. Pop. 2431.

Fairfield, tp. of Columbiana co., O. Pop. 2652.

Fairfield, post-v. of Greene co., O. Pop. 397.

Fairfield, tp. of Highland co., O. Pop. 2565.

Fairfield, tp. of Huron co., O. Pop. 1332.

Fairfield, tp. of Madison co., O. Pop. 1210.

Fairfield, tp. of Tuscarawas co., O. Pop. 781.

Fairfield, tp. of Washington co., O. Pop. 824.

Fairfield, post-v. of Hamiltonban tp., Adams co., Pa., 8½ miles S. W. of Gettysburg. Pop. 258.

Fairfield, tp. of Crawford co., Pa. Pop. 871.

Fairfield, tp. of Lycoming co., Pa. Pop. 479.

Fairfield, tp. of Westmoreland co., Pa. Pop. 1895.

Fairfield, post-v., cap. of Freestone co., Tex., 155 miles N. E. of Austin. It is the seat of two colleges. Pop. 800.

Fairfield, post-tp. of Franklin co., Vt., 41 miles N. W. of Montpelier. It has 4 churches, and manufactures of boots, shoes, leather, lumber, wagons, sleighs, farming-tools, etc. Pop. 2391.

Fairfield, tp. of Henrico co., Va. Pop. 4980.

Fairfield, tp. of Northumberland co., Va. Pop. 1645.

Fairfield, tp. of Sauk co., Wis. Pop. 689.

Fairfield (Genevieve Genevra), American writer, a daughter of S. L. Fairfield, mentioned below, was b. in New York 1832, wrote *Genevra, or the History of a Portrait*, *The Vice President's Daughter*, *The Wife of Two Husbands*, *The Innkeeper's Daughter*, etc.

Fairfield (John), b. at Saco, Me., Jan. 30, 1797, became a lawyer of Saco, and reporter of the supreme judicial court 1832; published (1835–37) 3 vols. of law-reports; was in Congress 1835–39; governor of Maine 1839–40, 1842–43; U. S. Senator 1843–47. D. at Washington, D. C., Dec. 24, 1847.

Fairfield (Sumner Lincoln), American poet, b. at Warwick, Mass., June 25, 1803, studied at Brown University, Providence, R. I., and sailed for London in Dec., 1825. Returning to the U. S., he married Miss Jane Frazee of Rahway, N. J., and subsequently was principal of Newtown Academy, 30 miles from Philadelphia. He published *Cities of the Plain*, *Père la Chaise*, *Westminster Abbey*, *The Sisters of St. Clara* (1826), *Abaddon*, *The Last Night of Pompeii* (1832), *Lays of Melpomene* (1824), and *The Heir of the World* (1829). From 1833 to 1838 he published the *North American Magazine*. D. in New Orleans, La., Mar. 6, 1844. (See his *Life* by Mrs. Fairfield, 1846.)

Fair Forest, tp. of Spartanburg co., S. C. Pop. 1129.

Fair Grove, tp. of Dickinson co., Ia. Pop. 172.

Fairgrove, post-tp. of Tuscola co., Mich. Pop. 928.

Fair Haven, former post-v. of New Haven co., Conn., now the seventh ward of the city of New Haven. It is celebrated for its oyster-trade. Pop. 3991. (See New Haven.)

Fair Haven, tp. and post-v. of Carroll co., Ill. P. 1169.

Fair Haven, post-v. and tp. of Bristol co., Mass., on the E. side of New Bedford harbor (which is the estuary of Acushnet River). Fair Haven is the terminus of a branch of the Cape Cod R. R., and is 60 miles S. of Boston. It has 1 national and 1 savings bank, 5 churches, manufactures of cooperage, ships' furniture, metallic wares, tacks, castings, etc., besides oil refineries and some fishing interests. It is a beautiful town. The harbor is good. The village is connected with New Bedford by a bridge three-fourths of a mile long. Sept. 7, 1788, it was attacked by the British, who were repulsed by the militia under Major Israel Fearing. Pop. 2626.

Fair Haven, tp. of Huron co., Mich. Pop. 528.

Fair Haven, post-tp. of Stearns co., Minn. Pop. 320.

Fair Haven, post-v. of Sterling tp., Cayuga co., N. Y., is the northern terminus of the Southern Central R. R., [illegible] miles N. from Auburn. It is on Little Sodus Bay, which is one of the best harbors on the S. shore of Lake Ontario. Pop. 532.

Fairhaven, tp. and post-v. of Rutland co., Vt., on the Rensselaer and Saratoga R. R., 8 miles N. E. of Whitehall, N. Y. It has a national bank, eight churches, great water-power, and extensive manufactures of slate and marble goods, the materials for which are quarried here. Pop. [illegible].

Fair Havens [Gr. Καλοὶ Λιμένες], a harbor on the S. side of the island of Crete, mentioned by Luke (Acts xxvii.

8), and by no other ancient writer. Saint Paul sailed out of this harbor shortly after the middle of October, and was shipwrecked about the first of November, 60 A. D. It appears to have been the port of Lasæa, the ruins of which were discovered in 1856 by the yachting party of Hugh Tennent, Esq. (See JAMES SMITH'S *Voyage and Shipwreck of Saint Paul*, 1st ed. 1848; 2d ed. 1856; 3d ed. 1866.)

Fair Head, or Benmore Head, a lofty promontory of the coast of Antrim co., Ulster, Ireland, opposite Rathlin Isle. It consists of carboniferous strata overlaid by greenstone columns, and rises 636 feet perpendicular above the sea. Lat. 55° 13′ N., lon. 6° 8′ W.

Fair Hill, a post-tp. of Cecil co., Md. Pop. 2219.

Fair′holme (GEORGE), English writer on the connection of the Bible and science, published a *General View of the Geology of Scripture* in 1838, and *New and Conclusive Physical Demonstrations both of the Fact and Period of the Mosaic Deluge* (1830; 2d ed. 1840).

Fair′holt (FREDERICK WILLIAM), English artist and writer, b. in London 1814, published *Costume in England, a History of Dress to the Close of the Eighteenth Century* (1846), *The Home of Shakspeare Illustrated and Described* (1847), *Remarkable and Scientific Characters* (1849), *Dictionary of Terms in Art* (1854), etc. D. Apr. 3, 1866.

Fair Isle, a solitary isle, 4 by 2½ miles in extent, between Orkney and Shetland. It rises 708 feet above the sea, and is accessible for ships only at one point, on the S. E. In 1588 the duke of Medina Sidonia, admiral of the Spanish Armada, was wrecked here, and most of his crew were murdered. Lat. 59° 33′ N., lon. 1° 38′ W.

Fair′land, post-v. of Shelby co., Ind., at the junction of the Martinsville R. R. with the Indianapolis Cincinnati and Lafayette R. R.

Fair′lee, tp. and post-v. of Orange co., Vt., on the Connecticut and Passumpsic Rivers R. R. and on the Connecticut River, 22 miles N. N. E. of White River Junction. It has manufactures of lumber, etc. Pop. 416.

Fair′mont, post-v. of Fillmore co., Neb., 100 miles W. of the Missouri River, on the line of the Burlington and Missouri River R. R. in Nebraska. It has one newspaper and printing office. The principal business is trade in dry goods, groceries, provisions, grain, agricultural implements, etc. Pop. about 250.

W. T. STROTHER, PUB. "FILLMORE CO. BULLETIN."

Fairmont, post-v. and tp., capital of Marion co., W. Va., 77 miles W. of Wheeling, at the head of navigation of the Monongahela River and on the Baltimore and Ohio R. R. It has a national bank, two newspapers, a State normal school, several large mills and shops, the usual number of stores, and several large coal-mines. Principal business, mining. Pop. of v. 621; of tp. 1781.

FLEMING & POWELL, EDS. "WEST VIRGINIAN."

Fairmount, tp. of Pike co., Ill. Pop. 1120.

Fairmount, post-v. of Vance tp., Vermilion co., Ill., on the Toledo Wabash and Western R. R., 12 miles W. by S. of Danville.

Fairmount, tp. and post-v. of Grant co., Ind. Pop. of v. 337; of tp. 1573.

Fairmount, tp. and post-v. of Leavenworth co., Kan., on the Leavenworth branch of the Kansas Pacific R. R., 11 miles S. of Leavenworth. Pop. 749.

Fairmount, post-v., county-seat of Martin co., Minn. Pop. of Fairmount tp. 699.

Fairmount, a v. of West Farms, Westchester co., N. Y. (annexed in 1873 to New York City). Pop. 508.

Fairmount, a v. of Goshen tp., Belmont co., O. P. 125.

Fairmount, tp. of Luzerne co., Pa. P. O., FAIRMOUNT SPRINGS. Pop. 1031.

Fairmount Park. See PHILADELPHIA, by T. WESTCOTT, Ed. "PHILADELPHIA SUNDAY DISPATCH."

Fair Oaks, locality in Henrico co., Va., on the Richmond and York River R. R., 7 miles E. of Richmond.

BATTLE OF. In the movements of Gen. McClellan's army in its advance from Yorktown, after reaching a point near Roper's Church on the Williamsburg and Richmond road, the right wing, consisting of the corps of Gens. Sumner, Porter, and Franklin, took the road *via* Cumberland and the White House, striking the Chickahominy at New Bridge, while the left wing, comprising the corps of Heintzelman and Keyes, kept the Richmond road to Bottom's Bridge; the advance-guards reaching these points about May 16, 17, 1862. The Chickahominy here is a stream of no great volume, flowing through a belt of heavily-timbered swamp (averaging from three to four hundred yards wide), sometimes in a single channel, more frequently divided into several, and when but a foot or two above its summer level overflows the whole swamp. The bottom-lands between the swamp and the highlands are little elevated above the swamp, so that a few feet rise of the stream overflows large areas of them. Thus, while the stream was no obstacle for infantry, the swamp and bottom-lands were impracticable for cavalry and artillery. On the 20th of May, Gen. Naglee crossed the Chickahominy with his brigade near Bottom's Bridge, and pushed forward to within two miles of the James River without meeting serious resistance. The rest of the Fourth corps, commanded by Gen. Keyes, crossed on the 23d. On the 25th the corps was advanced about a mile in front of Savage Station, which position was fortified; on the 28th, Casey's division moved forward to a point half a mile in advance of Seven Pines, where a new line of rifle-pits and a redoubt for six guns were commenced, and timber felled in front of the line; Couch's division, in support, advanced and encamped along the Nine-mile road. On the 25th the Third corps had crossed the Chickahominy, and taken a position two miles in advance of Bottom's Bridge; Gen. Heintzelman, its commander, was placed in command of both corps. On the 30th, Heintzelman obtained permission to advance the Third corps to a better supporting position. The position of the left wing just previous to the battle of the 31st was as follows: Casey's division (5000), in advance, extended from the Williamsburg road to the York River R. R.; Couch's (7000) along and in front of the Nine-mile road, its right near Fair Oaks Station, its left near Seven Pines; Kearny's (6500) 1½ miles to the rear, in advance of Savage Station; Hooker's, guarding the approaches to White Oak Swamp. The right wing still remained on the N. side of the river. Gen. Johnston, the Confederate commander, perceiving the possibility of destroying the Fourth corps in its advanced and (as he supposed) isolated position, ordered, on the 30th, a concentrated attack with his whole force (57,000 men) to be made early next morning; a heavy rain, however, which fell during the afternoon and evening of the 30th, so swelled the streams that his plans could not be fully executed, and at 1½ P. M. the division of D. H. Hill advanced alone, striking Naglee's brigade, posted in front of the intrenchments, and to which, after a gallant struggle, it was compelled to retire. A messenger sent to Gen. Heintzelman for reinforcements was delayed, and it was nearly 5 P. M. before Kearny's division arrived. Gen. Hooker was ordered up from White Oak Swamp, arriving after dark. As soon as the firing was heard, Gen. McClellan, still at New Bridge, ordered Sumner to have his corps, encamped on the N. side of the river, some six miles above Bottom's Bridge, in readiness to move. This corps consisted of Sedgwick's and Richardson's divisions, each division having now a bridge over the stream opposite its own position. At 2 P. M. these divisions were ordered to cross without delay, and push forward to support Heintzelman; which movement was at once commenced. In the mean time, Naglee's brigade, with the artillery of Casey's division, under command of Col. G. D. Bailey, and reinforced by a regiment from Peck's brigade, struggled gallantly to maintain the redoubt and rifle-pits against the superior attacking force. The left of this position was, however, turned, and the whole line driven back, with the loss of six guns, beyond the position occupied by Couch. Gen. Couch had previous to this time been ordered to advance two regiments to relieve Casey's right flank. In making this movement he discovered large masses of Confederates crossing the railroad, as well as a heavy column moving towards Fair Oaks Station. This column he engaged with two regiments, but, though reinforced by two additional regiments, was overpowered. The Confederates pushed between him and the main body of his division; falling back with these four regiments and one battery about half a mile, Couch, learning that Sumner had crossed, at once formed line of battle, facing towards Fair Oaks, and prepared to hold the position. Kearny's division had now arrived in front of Seven Pines. Berry's brigade was ordered to deploy to the left, so as to have a flank fire upon the hostile lines; which movement was brilliantly executed, materially retarding the pursuit in that direction. This position was held till after dark, when, being cut off from the main body, he fell back, and succeeded in bringing his men by a circuitous route in good order within the Federal lines. Jameson with two regiments, moving rapidly to the front on the left of the Williamsburg road, succeeded for a time in keeping the abattis clear, but was forced back, gaining camp under cover of night. Gen. Devens, holding the centre of Couch's division, after gallant efforts to regain portions of the lost ground, finally withdrew behind the rifle-pits near Seven Pines. The Confederate attack here had been made by Hill's and Longstreet's divisions, reinforced by Smith's. Meantime (6 P. M.), Gen. Sumner had arrived with Sedgwick's division at the point held by Couch, the road being so muddy that

Sedgwick was able to get but one of his batteries to the front. The First Minnesota was deployed to protect the flank: the rest of the division formed in line of battle, Kirby's battery near the centre, and a regiment was sent to open communication with Gen. Heintzelman. These dispositions were no sooner made than a heavy fire was opened by the Confederates along the line, and several charges were made, which were repulsed with great loss. Gen. Sumner now ordered a charge to be made, which was brilliantly executed, and the Confederates driven from the field in confusion. At this moment Gen. Johnston was severely wounded, and shortly afterward Richardson's division arrived upon the field. Darkness now ended the battle for that day. During the night dispositions were made for its renewal. Couch's division, and as much of Casey's as could be collected together, with Gen. Kearny's, occupied the rifle-pits near Seven Pines: Hooker brought up his division about dark, and bivouacked in rear of the rifle-pits on the other side of the railroad; Sedgwick's division held about the same position as when the fight ceased: and Richardson was ordered to place his division on the left to connect with Kearny. French's brigade was posted along the railroad, and Howard's and Meagher's in second and third lines. During the night three batteries of Sedgwick's division arrived, it being impossible to move the rest; but the corps of Franklin and Porter were not brought forward, these 35,000 fresh troops remaining on the other side of the Chickahominy during the next day. The command of the Confederate army had, upon Johnston being disabled, devolved upon Gen. G. W. Smith. About 5 A. M. June 1st skirmishers and cavalry appeared in front of Richardson's division, which were soon dispersed. Richardson's line was extended to close the wide interval between him and Kearny: and scarcely had this position been gained when the Confederates appeared in large force from the woods in front, and opened a heavy musketry-fire along the line, approaching rapidly in columns of attack, supported by infantry in line of battle on each side, cutting Gen. French's line, and appearing determined to carry all by one crushing blow. The first line of Richardson's division withstood this fire nearly an hour, Howard being finally ordered to French's assistance; which order being obeyed, the fire of the Confederates ceased, and their whole line fell back from that part of the field. On the opening of the fire in the morning, Hooker advanced on the railroad with two regiments, followed by Sickles' brigade. On coming near the woods, which were held by the Confederates in force, Hooker found Birney's brigade in line of battle. Sending back to hasten Sickles' brigade, he found it had been turned off to the left by Gen. Heintzelman to meet a column advancing in that direction. Calling upon Col. Ward (in command of Birney's brigade) to support him, Hooker at once attacked with two regiments, pushing the Confederates before him; and a final charge being ordered, the Confederates fled in confusion, abandoning their arms. Sickles, who had been ordered to the left, formed in line of battle on both sides of the Williamsburg road, and after a brief interchange of musketry the brigade pushed into the timber and put the Confederates to flight. On the right, vigorous efforts had been made to break through Gen. Richardson's lines, which were frustrated. In about an hour Richardson's whole line advanced, pouring in a heavy fire at close range, and forcing the Confederates back. This was followed by a bayonet charge, led by Gen. French in person, which turned the Confederate retreat to flight. The Confederates were now retreating in confusion along the whole line toward Richmond. The pursuit was continued until the lines held by the Union forces before the attack on May 31st were regained. On the field were found large supplies of arms and stores abandoned by the Confederates in their flight. On the next morning the Confederate pickets were pressed back to within five miles of Richmond, but Gen. McClellan did not pursue farther, and the old lines were resumed. The loss on either side was probably about equal, but the result was against the Union forces, inasmuch as the opportunity of striking a decisive blow was not improved; for there is scarcely a doubt that had McClellan followed up with his whole army, Richmond would have fallen into his hands; and the occasion thus presented did not return. The Union loss in killed, wounded, and missing is officially reported at 5739; the estimated Confederate loss is somewhat greater.

Fairplains', tp. of Montcalm co., Mich. Pop. 974.

Fairplay', post-v., capital of Park co., Col., at the head of South Park, on the mountain route between Denver and Santa Fé, 95 miles from the former place. It is noted as the supply point for the Mount Lincoln mining district. It has several stores, hotels, and saloons, besides two banks and a weekly newspaper. Its altitude is 9761 feet—nearly two miles above sea level—and 3500 feet above Mount Washington. Its inhabitants, though never experiencing the "heated term," yet from June to September have the luxury of moderately warm days and cool nights, the monotony being occasionally relieved by a snow storm in August. Mount Lincoln towers above the plain to a height of over 16,000 feet, and along its sides to within a few yards of the top, often enveloped by clouds, and frequently above them, miners and prospecters are developing or seeking new discoveries. Pop. about 1000.

Fairplay, tp. of Greene co., Ind. Pop. 780.

Fairplay, post-v. of Jamestown tp., Grant co., Wis.

Fair'port, a v. of Sweetland tp., Muscatine co., Ia. Pop. 136.

Fairport, post v. of Perinton tp., Monroe co., N. Y., on the New York Central R. R., 11 miles E. of Rochester, and on the Erie Canal. It has a banking institution, manufactures of sal-aëratus, cream-tartar and baking-powder, a flouring and three planing-mills, a furnace, manufactures of barrels, staves, agricultural implements, carriages, confectionery, etc., a fruit-canning establishment, marble-works, five churches, a union school, a weekly newspaper, and a large local trade. Pop. about 2000.

Frost & Newman, Props. "Fairport Herald."

Fair'view, tp. of Independence co., Ark. Pop. 243.

Fairview, tp. of Bond co., Ill. Pop. 1044.

Fairview, post-tp. of Fulton co., Ill. Pop. 1317.

Fairview, tp. of Fayette co., Ind. Pop. 601.

Fairview, post-v. of Greene tp., Randolph co., Ind. Pop. 142.

Fairview, tp. of Allamakee co., Ia. Pop. 630.

Fairview, tp. of Emmett co., Ia. Pop. 56.

Fairview, tp. of Jasper co., Ia. Pop. 2332.

Fairview, tp. and post-v. of Jones co., Ia. Pop. 238; of tp. 3085.

Fairview, tp. of Monona co., Ia. Pop. 281.

Fairview, tp. of Shelby co., Ia. Pop. 647.

Fairview, tp. of Labette co., Kan. Pop. 461.

Fairview, tp. of Caldwell co., Mo. Pop. 910.

Fairview, tp. of Livingston co., Mo. Pop. 1006.

Fairview, tp. of Sarpy co., Neb. Pop. 381.

Fairview, post-v. and tp. of Buncombe co., N. C. Pop. 779.

Fairview, post-v. of Oxford tp., Guernsey co., O. Pop. 377.

Fairview, tp. of Butler co., Pa. Pop. 1078.

Fairview, post-b. and tp. of Erie co., Pa., on Lake Erie and on the Pittsburg and Erie and the Lake Shore R. Rs. Pop. of b. 480; of tp. 1674.

Fairview, tp. of Mercer co., Pa. Pop. 920.

Fairview, tp. of York co., Pa. Pop. 1941.

Fairview, post-tp. of Greenville co., S. C. Pop. 1749.

Fairview, post-v., capital of Hancock co., West Va., 3 miles E. of the Cleveland and Pittsburg R. R. It has 1 newspaper, several large mills and shops, the usual number of stores, 2 hotels, 2 churches, and 3 public schools. Principal business, farming. Pop. about 400.

J. W. Plattenburg, Ed. "Hancock Courier."

Fairview, a v. of Paw Paw tp., Marion co., West Va. Pop. 72.

Fair'ville, post-v. of St. John co., N. B., on the St. John River and the European and North American Railway, 2½ miles from St. John. It is the seat of the New Brunswick Lunatic Asylum. Pop. about 1500.

Fairville, post-v. of Arcadia tp., Wayne co., N. Y., on the Sodus Point and Southern R. R., 4 miles N. of Newark. Pop. 154.

Fair'y Lore is closely allied to mythology, fairy tales being mere remnants of myths which remain lingering in popular superstition for some time after the myths themselves have died out of popular belief. Only those races which have created a mythology possess a fairy lore—as, for instance, the Hindoos, Greeks, Scandinavians, and Finns—while those races which never formed myths—as, for instance, the Jews and the Arabs—never produced any fairy tales either. There are stories enough, both in the Jewish and Arabic literatures, which tell of wonders wrought by spirits and other supernatural beings, but they are *fairies* like Spenser's *Faerie Queen* or Shakspeare's *Midsummer Night's Dream;* that is to say, they are literary treatments of fairy tales, and not fairy lore; they express a certain taste, not a certain state of consciousness in general. The true fairy tale was originally a myth. All mythological creations have a double character. The materials of which

they are produced are either fused into form around moral ideas which place the human mind in a relation of absolute obligation, or they are kept in a floating state, which leaves the mind free in pure contemplation, and allows almost unlimited play to the imagination. Of these two elements, the former, the religious, dies out when a mythology is supplanted by a higher form of religion; but the latter, the poetical, may remain for centuries, and live on among the people as its fairy lore, modified and developed in a most striking manner by influences from the new religion, from the climate and surface of the country, from the occupations and history of the nation, etc. The same story, originally based on some truth, will be differently colored by the miners in the mountain-regions, the sailors along the coasts, and the shepherds on the prairies. Having no moral substance which commands obedience, and addressing people through their imagination only, it will hardly come into collision with the religion; on the contrary, it will shift and change till it falls into harmony as well with the interior spiritual conditions as with the external surroundings. And it is this character of being an unconscious, natural, and living expression of the spirit of a people in its most mysterious activity which gives to the study of fairy lore its peculiar charm and its paramount importance.

Fairy Rings are imperfectly circular or annular patches in grass-land in which the vegetation is either richer or more scanty than that around it. They are common in the British Islands and other parts of Europe, where, according to folk-lore, they are caused by the dancing of fairies. After much investigation, it has been shown that they are caused by the growth of mushrooms (*Agaricus*), which spread from the centre outward, and at first check, but afterwards by their decay accelerate, the growth of the grass.

Fai'son's, post-tp. of Duplin co., N. C., on the Wilmington and Weldon R. R., 63 miles N. of Wilmington. Pop. 1918.

Faith [Lat. *fides; fidere*, to "trust"] is belief, conviction, assurance, or trust, resting on any sort of evidence whose force is affected subjectively—that is, by the mental condition of the recipient. An assurance resting on purely objective grounds relies upon the common state of all minds, not on the special condition of any, and involves knowledge. We *believe* there is a God, but there are temptations to unbelief which have led men to atheism. We *know* that twice two are four, and it is not possible to tempt us to doubt it. One and the same thing may be an object of faith at one stage of evidence, and of knowledge at another. There may be a subjective difficulty which is invincible to the sort and degree of evidence which is ordinarily sufficient for faith, yet is overcome by the evidence which produces knowledge. The mind may pass therefore from unbelief to belief, from belief to knowledge, or from unbelief to knowledge. It may pass from unbelief to belief without addition to evidence, solely by change in itself, but it cannot pass from either to knowledge, except by additions to evidence. The faith of one man may rest on the presumed knowledge of another, and thus be confounded with knowledge itself. The great body of scientific fact is actually the object of knowledge to a few, and is supposed to be a part of the knowledge of the many only because the many have faith in the statements of the few, though they can neither verify them, nor even understand the processes by which they are reached. "We *believe*," says Lewes (*Problems*, i. 21), "that the sensation of violet is produced by the striking of the ethereal waves against the retina more than seven hundred billions of times in a second. . . . These statements are accepted *on trust* by us who know that there are thinkers for whom they are irresistible conclusions." Knowledge involves intellectual *coercion*—faith involves *freedom*. We are not *responsible* for the fact that under the conditions of knowledge we *know*, or in defect of them do not know; we are responsible if under the conditions of a well-grounded faith we disbelieve. In the history of philosophy the names of Hobbes, Huet, Leibnitz (*Faith and Reason*), D'Alembert, Kant, and Daub are connected with special views of faith. (For the philosophy of faith or belief, see Jacobi, F. H.)

In theology the relations of faith to knowledge and the question of precedence have long been agitated. Augustine and his school held that faith precedes understanding: Jacobi confessed that to him the dualism of the two was hopeless; Hegel proposed to relieve the antagonism by absorbing faith into knowledge; Schleiermacher says they are the two foci of one ellipse. In the Bible, faith is by pre-eminence trust, a conjoint movement of the intellectual powers, the affections, and the will. Its object is the supersensuous, God, and God in Christ. It involves knowledge or mental vision, voluntary reception, personal adhesion, and obedience. The Scholastics distinguish between believing that God is, believing God, and believing *in* God. Faith *informis* is merely intellectual; faith *formata* involves love, and is a virtue. Faith was regarded as a general intellectual assent to revealed truth as interpreted by the Church. In contradistinction to this, the Reformers laid stress on faith as a personal assurance of the forgiveness of sins for Christ's sake. This faith involves knowledge, assent, and trust. It justifies not by the merit, or on the ground of the works which follow it, but as the medium, the hand which lays hold of and appropriates Christ and his merit. (See Justification.) C. P. Krauth.

Faith, Articles of. See Faith, Confessions of.

Faith, Confessions of, official statements of doctrine—Symbols (which see) in the theological sense. As distinguished from Creeds (which see), confessions of faith are fuller presentations. We speak of the Apostles' Creed, the Westminster Confession. Confessions are, with reference to time, ancient or modern. In the extent of reception they are (1) œcumenical, catholic, or general, as accepted by the whole Church catholic; (2) particular, as accepted by particular parts of the Church. The term has also been applied to the carefully prepared statement of the faith of individuals. Articles of faith are the separate parts of confessions. A confession is an organic body or *corpus* of faith, its parts are members or *articuli*, such as the articles concerning God, sin, Christ, the Church. (See the articles on the particular systems, as Arminianism, etc., the Confessions, as the Augsburg Confession, etc., and the various churches.) C. P. Krauth.

Faith, Rule of (*Fidei Regula*), that to which Faith (which see) appeals as its source and guide. *Why* do I believe this or that? and *what* am I bound to believe? are questions answered by the rule of faith, while the confession of faith, as such, simply states what I do believe. The confession is drawn from the rule. In the Roman Catholic Church the rule of faith is the body of revealed truth embraced in Holy Scripture and tradition ("in libris scriptis et sine scripto traditionibus"—*Council of Trent*, Sess. IV.), in the sense in which the Church holds that truth. In the Protestant churches the canonical Scriptures are regarded as the sole rule of faith.—Rule of Faith, Analogy of Faith, have been applied also from very ancient times to the body of most necessary and saving doctrines, so explicitly and clearly set forth in the Scriptures as to form a general guide in interpreting the more obscure parts. The Apostles' Creed (which see) was frequently so styled by the Fathers. The *Regula Fidei* is valid on the assumption that there is absolute unity in all parts of the doctrinal teaching of the Bible. C. P. Krauth.

Faith'full (Emily), Miss, was born at Headley rectory, Surrey, in 1835; educated at Kensington, and at an early age displayed the firmness and independence which have characterized her subsequent life; becoming interested in the condition of women, she devoted her time to extending their sphere of labor, establishing in 1860, in spite of great opposition, a printing establishment in which women were employed. Queen Victoria gave this project her approval, and a printing business was formed styled "The Victoria Press," which is still conducted with steam machinery in Farringdon street. A fine specimen of workmanship, entitled *Victoria Regia*, and dedicated, by special permission, to the queen, secured the approbation of Her Majesty, who appointed Miss Faithfull publisher in ordinary to Her Majesty. In 1863 the *Victoria Magazine*, a monthly publication, was commenced, being devoted to the claims of women to remunerative employment. Miss Faithfull has established a publishing-office, with all the appliances of bookseller, stationer, and bookbinder connected. In 1873 she visited the U. S., and her lectures on her favorite topic were largely attended.

Fai'thorne (William), English engraver, b. in London about 1616, was imprisoned as a loyalist, and then banished from England under Cromwell. He went to France and studied engraving. From 1650 to 1680 he was a printseller in London, and d. there in May, 1691. He engraved *Christ at Prayer in the Garden of Olives*, *The Marriage of Cana in Galilee*, etc., and wrote a treatise on the art of engraving.

Fa'kir [from an Arabic word signifying "poor"], a class of religious mendicants in India, found there now in large numbers, and with evidence of their existence very early in Hindoo history. Rules for some of their practices are found in the *Institutes* of Manu, 1000 b. c., while they are distinctly mentioned by the Greek historians at the time of Alexander's conquest, by whom they were termed Gymnosophists—a name, it would seem, indicative much more of their bodily than of their mental state. Some of them are ascetics, who practise surprising mortifications

and bodily tortures, such as swinging on hooks thrust through their flesh, lying on a bed of spikes, walking on sandals through which spikes are driven, hanging suspended during life before a slow fire, fulfilling a vow to continue in one position during life, holding the limbs in a fixed position till they become immovable, carrying a cumbrous load or drawing a heavy chain, crawling on their hands and knees for years, rolling on the earth from one end of the land to the other, etc. By these means they acquire a reputation for sanctity which gives them a great hold upon the superstitions and the fears of their countrymen, though there is little religious sense displayed in all these performances, which are adopted, for the most part, as a mode of obtaining notoriety or a livelihood. The Hindoos have apparently little respect for these men, but they dread their curses, and the powerful rajah will rise up on his elephant and salute one of these "saints" as he passes by.

Formerly, the fakirs often banded together in robber hordes, sometimes numbering thousands, which carried devastation through whatever region they visited. The English government has put a stop to all this, as it has to many of their self-inflicted tortures. These men rarely appear now in absolute nudity, as was formerly often the case, but one meets them in the streets of any Hindoo city, daubed with ashes and paint, a bit of sackcloth depending from their loins, their long, coarse hair hanging in a tangled mat over their face and shoulders or wound in a thick mop around their heads, and presenting a most hideous and revolting spectacle. They number hundreds of thousands, and perhaps two millions in India, at the present day.

J. H. SEELYE.

Falaise, a town of France, in the department of Calvados, 22 miles S. S. E. of Caen. It is picturesquely situated on a lofty platform bordering on a rocky precipice (*falaise*), which position made it a very strong fortress in olden times, before the invention of gunpowder. Its old castle, now mostly in ruins, was the seat of the dukes of Normandy and the birthplace of William the Conqueror. Pop. 8061.

Fal'ashas, those Abyssinian Jews inhabiting the mountainous regions of Samen and the plains along Lake Tzana, and numbering about 250,000. Their origin is as uncertain as that of all Abyssinians. (See ABYSSINIA.) The name *Falashah* signifies "exile" or "wanderer," and hence it is inferred that he is not a native of the soil. According to Falashah tradition, their forefathers, who were of the tribe of Levi, came to Abyssinia in the days of Solomon, but ethnologists hold that they must have come there some time in the seventh century, during the Mohammedan invasion of Egypt, while some of the German missionaries who have been in Abyssinia believe that the Falashas came originally from the kingdom of YEMEN (which see) in the tenth century. But, however uncertain their origin, they have become thoroughly Abyssinian, and are distinguished from their fellows only by their religion. Like the native Christians, they are handsomely built, and resemble the [illegible] of [illegible]. They are of medium height, with face oval, nose finely sharpened, mouth well proportioned, lips properly formed and by no means exuberant, sparkling eyes and well-set teeth, and hair somewhat curled or straight. (See FIGUIER, *Les Races Humaines*, Paris, 1872, 8vo, p. 406.) Until the beginning of the nineteenth century they constituted an independent tribe, and were governed by their own prince; in the tenth and twelfth centuries it appears that they even ruled over the Abyssinians. They were subjected by the Amharas about 1800, and are now under the rule of the princes of Tigré. The Falashas speak both the Amharic and a dialect of the Agaou tongue, and are very industrious, devoting themselves to the various trades, particularly architecture; also largely to agriculture. During the late war between Great Britain and their country, many of their number distinguished themselves as able warriors. Unlike other Semites, they are averse to commerce, regarding traffic an obstacle to fidelity and rigor in religious observances. The Falashas, although they possess the whole of the Old Testament or Jewish canon in the Geez language, a sister-tongue of the Hebrew, Arabic, and Aramæan dialects and the mother of the Amharic, together with the apocryphal books accepted by the Abyssinian Church, deviate in many instances from Jewish usages. Thus, the fringed "praying-scarf" (*taleth*) and the "phylacteries" are not used in their devotions; and while they retain the usage of offering sacrifices, it is rather a commemorative ceremony than a real sacrifice. The most common is the offering for the repose of the dead; but no sacrifice is permitted on the sabbath or on the day of atonement. Like other Jews, the Falashah hopes for a return to Jerusalem. Very peculiar are their priests, who live round the enclosures of the temples (which are situated near the edge of the villages, and have more the appearance of the ancient sanctuary than the modern synagogue), observe the laws of purity with rigor, prepare their own food, and keep aloof from the world. They are principally engaged in the education of youth, making the Bible and tradition the basis of their instruction. Polygamy, though tolerated, is nevertheless discouraged. Slaveholding is suffered, but slave-dealing is strictly forbidden. Slaves are kindly treated, instructed in the laws of Moses, and on conversion are manumitted. Attempts on the part of the London Missionary Society and the Scottish Church Mission to convert the Falashas to Christianity induced the Jewish Alliance Universelle in 1867 to send among them M. Halévy of Paris, to secure their education and to counteract the Christianizing influence of the missionaries. (See, besides works on Abyssinia, HOTTEN, *Abyssinia and its People* (London, 1868), and particularly the articles by HALÉVY in the *Bulletin* of the French Geographical Society for Mar. and Apr., 1869.)

JAS. H. WORMAN.

Falcid'ian Law, a law under the civil or Roman law system, proposed by a tribune Falcidius during the reign of Augustus, in the year of Rome 714 (A. C. 37), by which it was enacted that testators should not have power to dispose of more than three-fourths of their property by will, and that the remaining one-fourth should descend to the heir. This fourth was termed the "Falcidian portion." No such restriction exists at common law, a testator having an unqualified power to distribute his property entirely among strangers, and leave his family unprovided for if he desires. Among the American States, Louisiana, which has adopted the civil law, has a provision similar to the Falcidian law. In some of the other States restrictive enactments have been made in regard to bequests to charitable corporations or associations. For instance, in New York a testator having a husband, wife, child, or parent living can only leave to such institutions one-half of his property after the payment of his debts. (*Laws* 1860, ch. 360.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Falck'enstein, von (EDUARD VOGEL), Prussian general of infantry, was b. in Silesia Jan. 5, 1797. He was the son of a Prussian major, but the father d. early, and the mother, unable to educate the boy herself, asked assistance from her relative the prince-bishop of Breslau. The prince-bishop promised to help, but on the condition that the boy should be a clergyman. But at the rising of the Prussian people against Napoleon in 1813, the boy left the ecclesiastical career, and entered as a volunteer into the West Prussian grenadier battalion of Colonel von Klück. He distinguished himself in the battle of the Katzbach, and at Montmirail, when all the officers had fallen, he led the battalion with imperturbable calmness, though a youth of hardly seventeen years. After the war he studied topography with great zeal, and founded a school for glass-painting in Berlin, under the auspices of Friedrich Wilhelm IV. On Mar. 18, 1848, in the riots in Berlin, he was wounded, but took part in the same year in the campaign in Holstein, and became commander of the foot-guards in 1849, and in 1851 colonel and chief of the staff of Wrangel. He held the same position in 1864 during the second war with Denmark, but after the war he was made commander-in-chief of the seventh army corps. In the war of 1866 he commanded against Hanover, Hesse, Nassau, Baden, Würtemberg, and Bavaria, and displayed considerable strategic talent. After the war he received a dotation, was elected to the North German Diet by the city of Königsberg, and spoke energetically for a triennial military service and a strong military budget. During the war of 1870 he held the chief command of the maritime provinces, and organized the whole defence of the Baltic and of the North Sea.

AUGUST NEUMANN.

Fal'con [Lat. *falco*], a name applied to various accipitrine (raptorial) birds (birds of prey) of the family Falconidæ, and especially to those of the group Falconinæ, including the genus *Falco* and others closely allied to it. In the language of Falconry [illegible] *falcon* designates those birds of whatever species which may be trained for use in [illegible]. Others designate the high-flying [illegible] upon the prey as *noble*, while those which [illegible] the prey, are *ignoble*. The most [illegible] high-flying falcons are the [illegible] the [illegible], the lanner, the peregrine, and the white falcon. Of the ignoble birds we may mention the [illegible], the goshawk [illegible] gentle, the [illegible] *Hypotriorchis* and [illegible] Of these, the more important are noticed in this work under their alphabetical heads. Anciently, the term *falcon* designated [illegible] female bird, while the [illegible] smaller and weaker, was called a [illegible] over the species. The [illegible]

or *communis*, of Europe and North America and the gyrfalcon (*Falco candicans*) are typical species. The true

Gyrfalcon (*F. candicans*).

falcons are of numerous species, both in the Old and the New World. (See FALCONIDÆ.)

Falco'ne (ANIELLO), one of the first and best painters of battle-scenes, a pupil of Spagnoletti and master of Salvator Rosa, b. in Naples in 1600, and d. in 1665. His paintings are in high esteem, and there are many engravings ascribed to him.

Fal'coner (HUGH), M. A., M. D., F. R. S., b. at Forres, Scotland, Sept. 29, 1808; graduated M. A. at Aberdeen 1826; M. D. at Edinburgh 1829; went to India as a surgeon 1830; commenced palæontological explorations in the Siwalik Hills 1831; became superintendent of the botanical garden at Seharanpoor 1832; received the Wollaston medal 1837; became F. R. S. 1845; superintendent of the botanical garden at Calcutta 1847; d. in London Jan. 31, 1865. Published *Selections from the Bostân of Saadi*, 1838; *Fauna Antiqua Sivalensis* (1846, jointly with T. P. Cautley); *Palæontological Memoirs*, 1868.

Falconer (WILLIAM), a poet, b. in Edinburgh about 1730, was a barber's son. His brothers and sisters were deaf and dumb. Falconer was bred a sailor, and is best known by his great poem, *The Shipwreck* (1762); published also a *Marine Dictionary* (1769), and various minor poems. Lost at sea in 1769, while purser of the Aurora frigate.

Falcon'idæ [from *Falco*, one of the genera], a family of the birds of prey (order Raptores) which is by most naturalists made to include all the order except the vultures and the owls. It includes the eagles, true buzzards, kites, falcons, hawks, etc., which are generally arranged in seven or more sub-families. They all have a bill sharp, curved, and compressed, with a partial cere, a broad tail, long, pointed wings, sharp and curved claws, a sunken eye, and a feathered head and neck.

Fal'conry is the art of capturing, rearing, and training falcons for the chase of other birds, and even of small quadrupeds. The name *falconry* was also applied to the aviary or enclosure where the falcons were kept. It appears that the practice of hunting with falcons was introduced into Europe from the East, for Ctesias alludes to the existence of such a custom in India in his time. Marco Polo also, in his *Milione*, speaking of the Tatars, says that their great khan "took with him full ten thousand falconers and good five hundred ger-falcons, with falcons *peregryne* and falcons *sacre* in great abundance; also he had a great number of goshawks for fowling along the waters," etc. Hawking seems to have passed over from the Tatars to the czars of Muscovy, who took great pleasure in this amusement. (See *Prince Serebrianni*, by Alexis Tolstoi, London, 1874.) In Europe this pastime is anterior to the Middle Ages, as, among the later Romans, Martial, Apuleius, and Julius Firmicus make special mention of it. On the descent of the Lombards into Italy, hawking became much more general, and from this it may be inferred that the ancient Germans were acquainted with it. Charlemagne took great delight in it, and he is said to have kept as many falconers as huntsmen. Pope Gregory IX. appears to have kept falcons. (See DU CANGE, *v. Falco.*) Henry the *Fowler* received his surname from his passion for this sport. The emperor Frederic II. not only enjoyed hunting with falcons, but he was a master of the art, and even wrote a treatise upon it, annotated by his son Manfred, with the title *De arte venandi cum avibus*. Another treatise on the same subject is attributed to Edward the Confessor of England. Brunetto Latini, in his *Tesoro* (chs. ix., x., xi., xii.), speaks of falconry; Dante reminds him of it in the *Divina Commedia*.

To English readers the most interesting treatise on this subject is that ascribed to Dame Julyana Berners, forming the first part of the *Boke of St. Albans*, first printed in 1481. Among the many continental writings upon falconry should be mentioned *La Venerie et Fauconnerie de Jacques du Fouilloux*, Paris, 1585, and the Italian work of Federigo Giorgi, who published in Venice in 1578 a volume entitled *Del Modo di conoscere i buoni falconi, astori e sparvieri, di esercitarli e farli perfetti, di governarli e di medicarli*, describing the various qualities of the falcon and the methods of keeping and caring for it. We learn from the *Glossary* of Du Cange that the privilege of keeping falcons was, in the Middle Ages, confined to the nobility. This, however, does not seem to have been the case in all countries, for in the *Boke of St. Albans* it is stated that certain falcons belonged by right to certain ranks; for instance: "an Egle, a Bawtere, a Meloune, . . . thyse thre by theyr nature belonge unto an Emperor. A Gerfawkon, a Tercell of a Gerfawkon, are dewe to a kyng. There is a Fawkon gentyll; and a Tercell gentyll; and thyse be for a prynce. There is a Fawkon of the rocke: and that is for a duke. There is a Fawkon peregryne; and that is for an erle." Then follow various other classes, till we come to "the Merlyon; and that hawke is for a lady;" and finally, "there is a Goshawk; and that is for a yoman. There is a Tercell; and that is for a poore man," etc. From this we must infer that in England, at least, the amusement of hawking was not wholly confined to the nobility. The office of grand falconer at the Byzantine court, in that of England, and in the ducal court of Savoy, was one of the highest dignity. Both the art of falconry and the practice of it, hawking, had their special vocabularies or "kindly speche," the thorough knowledge and accurate use of which were thought highly important as a test of good-breeding and as a means of distinguishing "a gentylman fro a yoman, and from a yoman a vylayne."

A great number of these terms and much other quaint matter on this subject will be found in the *Boke of St. Albans* and the other treatises above quoted. In the fifth chapter of Cibrario's *Della Economia Politica del Medio Evo* is a full description of this sport: "The time of the chase was either early in the morning or towards evening. The sportsmen rode out, with their falcons resting upon their strongly-gloved wrists. When a bird was discovered suited to the nature and the habits of the falcon, the little hood which covered its eyes was drawn off, and the falcon rose in rapid circles high above its destined prey; if the quarry was a small bird, she then suddenly swooped (or *stooped*, as the phrase was) directly upon her victim; but if the latter was a large and powerful bird, formidable in beak and wing, the falcon was cautious and cunning in her advances, turned and wheeled with great dexterity, seizing only the favorable moment to strike. Having secured the prize, she swept in large circles over the head of the falconer, and finally presented him the booty; the falconer put it in the game-bag, and then set before his falcon the food prepared for her. Falcons which soared high and pursued birds of lofty flight were called *altani*; others took a lower but more extended range; some were for the inland country, others for aquatic birds. These last were assisted by dogs. When, for example, a flock of herons is discovered, the falconer approaches them secretly, and suddenly beats a drum before the herons can get sight of the falcon, otherwise they would not dare to rise. Frightened by the drum, they take to flight; then the sportsman lets loose his falcon, and while she prepares to seize the herons in the air, the barking of the dogs prevents the poor birds from hiding again in the water. Eagles and falcons of the largest species may be trained for this chase, and they will even take foxes and hares." With Eastern sovereigns hawking is still in great favor, but it has almost entirely disappeared from Europe. The rare occasions in which the falcon is now employed are rather scenic representations of the old custom than attempts to revive it. The history of this pastime is especially interesting, as being almost the only outdoor amusement in which women of rank, in the Middle

Ages, took an active part, and it has furnished the writer of fiction with many a romantic situation, the poet and the painter with many a happy illustration. (For more complete information we refer to G. E. FREEMAN, *Falconry, its Claims, History, and Practice*, London, 1859, and the authorities there cited.) ANGELO DE GUBERNATIS.

Fal'eme, a river of Senegambia, Western Africa. It is one of the most important tributaries of the Senegal, which it joins in lat. 14° 40′ N., lon. 11° 48′ W.

Fale'rii, powerful city of ancient Etruria, situated N. of Mount Soracte and W. of the Tiber. It is believed to have been one of the twelve cities of the Etruscan confederation. It was often at war with Rome, but in 241 B.C. was conquered and destroyed by that power. A new Roman Falerii was founded near by, whose ruins, 5 miles distant from Nepi, are of great interest. The old Falerii probably stood at Civita Castellana.

Faler'nian Wine [so called from *Falernus Ager*, a region of Campania Felix, where it was grown], the most celebrated of the wines of the ancient Romans, was of three varieties—a light, a sweet, and a dry—as we learn from Pliny. It was very strong and generous, so that it would take fire from a lighted taper. When new it was very harsh and unpleasant. The excellent Massic wines came from the same region, and the two sorts were often confounded. Indeed, the better qualities were called indiscriminately by either name. These regions still produce good wine. From all accounts, the Falernian must have resembled the modern sherry wine.

Falie'ri (MARINO), doge of Venice, b. of an eminent family in 1274; served the republic with applause in war and on important embassies; and in 1354, when seventy-nine years old, was chosen to the dogate, soon after which the Venetian fleet was lost in a great battle with the Genoese. Not long after, at a carnival feast, he was grossly insulted, as he conceived, by a young nobleman, and in revenge determined to destroy the whole body of nobles, who were detested by the people. His conspiracy was detected and suppressed, and the doge, after a full confession, was beheaded Apr. 17, 1355. His story has been a favorite one with the poets and dramatists.

Fal'kington, tp. of Sangamon co., Ill. Pop. 973.

Fal'kirk, parliamentary borough of Scotland, 24 miles W. N. W. of Edinburgh, on the Edinburgh and Glasgow and Scottish Central Railway, near the old Roman wall of Antoninus and the well-known Carron Iron-works. Its three annual trysts are the largest cattle-fairs in Scotland, sales being made to the amount of nearly £1,000,000. In 1298, Sir William Wallace was defeated here by Edward I., and in 1746 the Highlanders under Prince Charles Edward defeated the royal troops. Pop. 9547.

Falk'land, royal borough of Scotland, in the county of Fife, 22 miles N. of Edinburgh. It is situated at the base of the Lomond Hills, which rise so abruptly behind it as to intercept the rays of the sun from it for several weeks during winter. The remains of Falkland Palace are very interesting, both in architectural respects and on account of their connection with the history of James IV. and James V. Pop. 2938.

Falkland (LUCIUS CARY), VISCOUNT, an English statesman, warrior, and writer of the eventful reign of Charles I., was b. at Burford, Oxfordshire, in 1610, and was educated at St. John's College, Cambridge, where he was noted for his remarkable attainments in the classics. At the age of nineteen he came into possession of a valuable estate, and a few years after married and settled at Great Tew, Oxfordshire. His house, situated so near Oxford, became at once the centre of all the learned of that noted school. He is said to have been not only a friendly critic to Chillingworth, but to have largely assisted the doctor in his work on the *Religion of the Protestants*. In 1633, upon the death of his father, Lucius succeeded as viscount, and was made by King Charles gentleman of the royal bedchamber. After the outbreak of the rebellion in Scotland, in 1638, Falkland hoped for an appointment in the army, but, disappointed in this, he entered it as a volunteer in 1639. In 1640 he was chosen member of the Short Parliament, and was re-elected to the Long Parliament, where he distinguished himself by his independent and fearless course. He was identified with the "reform party," and hence his sudden change after the execution of Strafford, and his espousal of the royal cause, were hardly explicable to his contemporaries. His political consistency is made plain, however, when we accept him as one of those who sought, in those disturbing times, a middle course between the Puritans and the aggressions of Anglicanism. He was a liberal Churchman, "but, shrinking from revolution in Church or State, would have liberalized both, in a truer and nobler sense than his contemporary revolutionists, ecclesiastical or political." (*Tulloch.*) Opposed to what seemed to him the excesses and illegalities of the popular party, he entered the lists in defence of the king, and became secretary of state. When civil war seemed inevitable he joined the army, and was therefore removed from the Commons, and placed on the list with those to whom no mercy was to be accorded. Falkland behaved admirably at the battle of Edgehill, and had his advice been followed Charles would have been successful in his military and civil career, and the rupture with the people been promptly healed. Unfortunately for his king, Falkland was killed at the battle of Newbury, Sept. 20, 1643. He wrote various treatises, of which is best known the *Discourse of the Infallibility of the Church of Rome* (best ed. London, 1660, 4to). (See, besides, the English historians, FORSTER, *Historical and Biographical Essays* (London, 1858); TULLOCH, *Rational Theology and Christian Philosophy in England in the Seventeenth Century* (London, 1872, vol. i.); LODGE, *Portraits of Illustrious Personages of Great Britain*, vol. iv.)

JAS. H. WORMAN.

Falkland Islands [Fr. *Malouines*], a cluster of islands in the South Atlantic Ocean, between lat. 51° and 53° S. and lon. 57° and 62° W., consisting of nearly 200 islands and presenting an area of about 13,000 square miles. Of the two largest islands, respectively called East and West Falkland, and separated from each other by a narrow sound, the former has an area of 3000 square miles, the latter of 2000 square miles; the rest are small islets. On account of the peculiar climate, the thermometer ranging in the winter between 30° and 50°, and in the summer between 40° and 65°, with frequent rain and high winds, the soil is much better adapted to pasturage than to cultivation. No trees, no fruits, scarcely anything but a few vegetables, are raised in the settlement, but the natural grass is extremely luxuriant, and horses and cattle, originally imported by the Buenos Ayreans and others, have gone on increasing in an astonishing degree. Pigs and rabbits are also abundant, and the coasts teem with fish. The islands were first discovered by Davis in 1592. In 1690 they were visited by Strong, who gave them the name which they now bear. French, Spanish, and English settlements have alternately been formed on them, but the English have ultimately retained possession of them. Port Stanley, a thriving town with an excellent harbor on East Falkland, is an entirely English settlement. Pop. of colony in 1870, 812.

Fal'köping, town in Sweden, Westergöthland, known by the battle of 1389, in which the Danish queen Margrethe conquered the army of the Swedish king Albrecht, and took him prisoner. This victory led to the famous Union of Calmar, 1397.

Falk'ville, tp. of Morgan co., Ala. Pop. 1198.

Fal'lacy [Lat. *fallacia*, from *fallax*, "deceitful;" *fallo*, to "deceive"], in logic, is produced by an incorrect performance of the process of reasoning. Not every wrong notion is a fallacy. If the process of reasoning is performed correctly, and the wrong notion rises either from a biassed and prejudiced assumption of distorted premises or from a weak and groping confidence in insufficient premises, it is in the first case an error, in the last, a mistake. Only when the wrong notion is the result of a fault in the reasoning process itself is it a fallacy, properly speaking.

As the whole process of reasoning can be reduced to the making of inferences, and as the fundamental character of all inferences is the syllogism, the fallacy may be defined as the result of some fault in the formation of the syllogism. And furthermore, as all faults which can be committed in the formation of a syllogism rise either from the two propositions being a repetition of each other, and consequently incapable of producing any legitimate third proposition, or from their being wholly incongruous, lacking the true middle term, which alone could draw the premises together into a conclusion, all fallacies fall into two classes corresponding to these two divisions of faulty syllogisms, and may be characterized either as a reasoning in a circle or as a jumping to the conclusion.

The first kind of logical fallacy, the reasoning in a circle—which, in the terminology of the old logical systems, was called a *petitio principii*—consists in proving one position by assuming another which is identical with it. Of all kinds of logical fallacies, this is the most desperate. When a person is caught by such a fallacy, debate must stop; when an age is caught, civilization must stop. It acts on the mind like a magical ring. A person or an age may move around in it, around and around, with steadily increasing passions, and there is no escape from it unless through a revolutionary concussion of the whole mind. It is of most frequent occurrence in theological matters, and in those questions of politics which it seems

impossible to solve satisfactorily by the mere application of the principle of expediency, without any intermediate agency of moral principles.

The other kind of logical fallacy—which, in accordance with a striking expression from every-day conversation, I have characterized as a "jumping to the conclusion"—is much less dangerous, though much more frequent, and comprises a great number of distinct forms, which the old logic describes as the fallacy of the *æquivocatio, accidens, argumentum ad hominem, post hoc ergo propter hoc, undistributed middle*, etc. The general characteristic of all these different forms is the application of a middle term composed not of truly constituent, but of merely accidental, qualifications of the two ideas which it is put to combine. Thus, in a comedy of Holberg, Erasmus Montanus proves that his mother is a stone in this way:

A stone cannot fly; you cannot fly. *Ergo*, You are a stone.

A more thoroughgoing definition of the terms will, in most cases, be able to destroy this kind of logical fallacy, which, however, has become dangerously frequent in our days in cases in which statistics are applied to the solution of historical or moral questions. Thus Mr. Buckle, in his "History of Civilization in England," reasons as follows: "Necessary laws exclude free will. Statistics show the existence of necessary laws in history. *Ergo*, free will is excluded from history." Any definition of history which in any way can pretend to cover the field which in reality belongs to the idea will break this syllogism to pieces, and show the fallacy of the conclusion.

It must be noticed, however, that even when a fallacy of this kind shows us a fault in the construction of the syllogism, thus making the incorrectness of the performance of the process of reasoning perfectly apparent, it generally originates in a wilful or otherwise unwarranted assumption of premises; and in his book on logic Mill treats fallacies of this kind as errors and mistakes, though he retains the name of fallacy. CLEMENS PETERSEN.

Fall Brook, post-b. of Ward tp., Tioga co., Pa., the southern terminus of the Tioga R. R., 48 miles from Corning, N. Y. It has important mines of semi-bituminous coal. Pop. 1390.

Fall Creek, post-tp. of Adams co., Ill., on the Mississippi River, and on the Quincy Alton and St. Louis R. R., 12 miles S. E. of Quincy. Pop. 990.

Fall Creek, tp. of Hamilton co., Ind. Pop. 1530.

Fall Creek, tp. of Henry co., Ind. Pop. 2005.

Fall Creek, tp. of Madison co., Ind. Pop. 2483.

Fall Creek, tp. of Yadkin co., N. C. Pop. 1192.

Falling Bodies. Among the earliest ideas derived from experience are those of *weight* and of the direction *up and down*. All material bodies tend downward with more or less force, and the measure of this tendency in each is the weight of that body. The tendency itself is imputed to an influence called *gravitation* inherent in matter universally (see GRAVITATION), and is the resultant of the mutual attractions which take place between all the material particles of the body and those of the earth. When this tendency is adequately resisted, the body is said to be supported, and it remains at rest; when the resistance is withdrawn, the body falls. Observation of bodies falling naturally shows that all do not fall equally fast. A metal bullet descends with great rapidity; shreds of paper flutter downward slowly; some very light substances, like the down of feathers or the winged seeds of plants, seem scarcely to descend at all; and some, relatively lighter still, like bubbles and balloons, even rise. But when we observe that if heavy bodies be immersed in water the differences and seeming anomalies of this kind which occur are much more numerous and more remarkable still, we soon learn to attribute the unequal velocities with which bodies fall in the atmosphere to the buoyant power of the air, and the resistance it opposes to bodies moving through it. If, in order to test the truth of this hypothesis, we make the experiment of dropping from the same support, at the same instant, in a tall receiver exhausted of its air, two substances so physically different as a bullet and a bit of thistle-down, we shall find our anticipation confirmed; for the velocity of fall will be the same for both, and the two will reach the bottom together. If we would inquire, therefore, the laws which govern the fall of bodies, we must consider bodies as falling *freely*—that is to say, *in vacuo*. The buoyant power of the air simply diminishes the downward tendency and velocity of descent; it is the resistance to motion which disturbs the law of fall.

This resistance is proportioned to extent of surface; the weight or urging force is proportioned to density. Bodies of large specific gravity, exposing small surface, are very little interfered with in their fall (at least, through the heights to which observation can extend) by atmospheric resistance. But the densest substances, when spread out into thin laminæ, such as gold and silver in leaf, fall as irregularly and as slowly as tissue-paper or down.

The earliest experiments on the fall of bodies were made by Galileo at Pisa, who took advantage of the favorable opportunity offered by the famous leaning tower of that city—which is 180 feet in height, and overhangs its base by about 14 feet—to observe the effects produced upon the time and velocity of fall by changing the form and the material of the body subjected to experiment. He deduced the correct conclusion that in the absence of the air all bodies, without regard to their form or density, would fall with the same velocity; but in his time this truth could not be experimentally demonstrated, since the air-pump was then unknown.

The law governing the motion of a body falling freely may be abstractly inferred by considering the relation of force to motion. Velocity in a given body is proportional to the force impressed. As gravity is a *constant* force (that is, a force which acts all the time), it imparts every instant to the falling body a minute addition, always the same in amount, to the velocity which the body had before. Thus, this velocity goes on increasing, and increases equally in equal times—in technical language it is uniformly accelerated—and the final velocity is always proportional to the time which has elapsed since the fall began. By experiment it is found that a body, in falling from a state of rest, acquires, in one second of time, a velocity which, continued uniformly, would carry it over 32.2 feet in a second. If, then, we put 32.2 ft. $= g$, and represent any other time in seconds (whole or fractional) by t, and also represent the final velocity by v, we shall have $v = gt$.

The expression for space s, fallen through in time t, is not so obvious, because the velocity is not uniform. But since, for uniform velocity, we have $s = vt$, if we suppose the time t to be divided into an indefinite number ($= n$) of minute parts, during each one of which the velocity remains uniform, while the velocities, in the successive instants denoted by $v_{,}$, $v_{,,}$, $v_{,,,}$, etc., uniformly increase, and the final velocity v_n is equal to v—that is, to the velocity acquired by falling through the whole time, t—then the sum of all the spaces $s_{,} = v_{,}\frac{t}{n}$, $s_{,,} = v_{,,}\frac{t}{n}$, ... $s_n\frac{t}{n}$, will be equal (with only a very minute error) to s, the whole space fallen through in time t. By making n infinitely great, $\frac{t}{n}$ becomes infinitely small, and $s_{,} + s_{,,} + s_{,,,} + \ldots s_n = s$. But $s_{,} + s_{,,}$, etc. is an arithmetical series, of which the sum is equal to half the sum of the extremes multiplied by the number of terms. Hence,

$$s = \frac{s_{,} + s_n}{2} = \frac{v_{,} + v_n}{2}.\frac{t}{n}.n.$$

Or as, on this supposition, $v_{,}$ is too small to be appreciable, $s = \frac{1}{2}v_n t = \frac{1}{2}vt$. And as $v = gt$, we have, finally, by substitution, $s = \frac{1}{2}gt^2$. If $t = 1$ second, $s = \frac{1}{2}g = 16.1$ feet. That is, the space fallen through in one second from rest is half that through which the acquired velocity would cause it subsequently to move if continued uniform for another second. This proposition may be stated conversely and generally thus: The velocity acquired by a body in falling from rest during the time t is such as, continued uniform, would carry it in an equal time over twice the space through which it has fallen to acquire that velocity. The following table shows the spaces fallen during the number of seconds or fractional parts of seconds specified in it, the distances through which the acquired velocity, continued uniform, would carry the body in a time equal to the time of fall, and the acquired velocity (per second) itself:

t = time of fall, seconds or fractions	s = space fallen, feet and decimals	d = distance in time t, with vel. = v.	v = vel. acquired by fall, in feet.
0.001	0.000016	0.000032	0.0322
0.01	0.00161	0.00322	0.322
0.1	0.1610	0.3220	3.220
$\frac{1}{8}$	0.2516	0.5031	4.025
$\frac{1}{4}$	1.0062	2.0135	8.050
$\frac{1}{2}$	4.0250	8.0500	16.100
$\frac{3}{4}$	9.0562	18.1125	24.150
$\frac{7}{8}$	12.3284	24.6568	28.175
1	16.1	32.2	32.2
2	64.4	128.8	64.4
3	144.9	289.8	96.6
4	257.6	515.2	128.8
5	402.5	805.0	161.0
6	579.6	1159.2	193.2
7	788.9	1577.8	225.4
8	1030.4	2060.8	257.6
9	1304.1	2608.2	289.8
10	1610.1	3220.0	322.0
12	2318.4	4636.8	386.4
15	4622.5	9245.0	483.0
18	5216.4	10432.8	579.6
20	6440.0	12880.0	644.0

The value of $g =$ the velocity acquired in one second of fall, is commonly said to represent the accelerating force of gravity; and this varies slightly with the latitude of the place, being greatest at the poles of the earth and least at the equator. The value 32.2 ft. corresponds to about latitude 45°, and for ordinary uses may be taken as true everywhere.

Of the three quantities s, v, and t, if any one be known, the other two may be found from the following formulæ, of which two have been given above and the rest are deducible from them:

$$1.\ s = \tfrac{1}{2}gt^2. \qquad 3.\ t = \frac{v}{g}. \qquad 5.\ v = gt.$$

$$2.\ s = \frac{v^2}{2g}. \qquad 4.\ t = \sqrt{\frac{2s}{g}}. \qquad 6.\ v = \sqrt{2gs}.$$

If a body be projected downward with the velocity v_a, it is obvious that, for the space passed over in the time t, there must be added the space $v_a t$ due to the velocity of projection, to $\frac{1}{2}gt^2$ due to gravity; hence $s = v_a t + \frac{1}{2}gt^2$. But if the body be projected directly upward, the gravity opposes the ascent, and $s = v_a t - \frac{1}{2}gt^2$. Substituting for gt from (5) we have $s = v_a t - \frac{1}{2}vt$. The space s is maximum when the projectile force is exhausted, and the body then falls again as from rest. On reaching the point from which it was projected, it will have re-acquired the velocity v_a, lost in ascending, which will also be the velocity v imparted by gravity. Hence, when the space s described by a body projected vertically upward becomes maximum, $v_a = v$; and $s = v_a t - \frac{1}{2}vt = vt - \frac{1}{2}vt = \frac{1}{2}vt$: that is, the body will ascend to the same height from which it must have fallen to acquire the velocity of projection. A cannon-ball leaves the gun with a velocity of about 1200 feet per second. If fired directly upward, it ought to rise $1200^2 : 64.4 = 22{,}360$ feet, or nearly $4\frac{1}{4}$ miles, and be absent 74.534 seconds (time of rise and fall), when it should return with the original velocity of 1200 feet. But the resistance of the air at such high velocities is so great that these anticipations will be far from being realized.

The motions of bodies descending inclined planes (without friction) are governed by the same laws as those of bodies falling freely, the urging force being reduced, however, in the ratio of radius to the sine of inclination. If a be the angle of inclination, all the foregoing formulæ will be made applicable to this case, by substituting g sin. a for g wherever this letter occurs. As $v = \sqrt{2gs}$, and as $s = l$, the length of the plane, when the body descends it to the bottom, we have $v = \sqrt{2gl \text{ sin. } a}$. But l sin. $a = h$, the height of the plane, or $v = \sqrt{2gh}$. Hence the velocity acquired by a body in descending an inclined plane is precisely the same as that attained in falling freely through the vertical height of the plane. Also, putting $t_{,}$ for the time of descent of the plane,

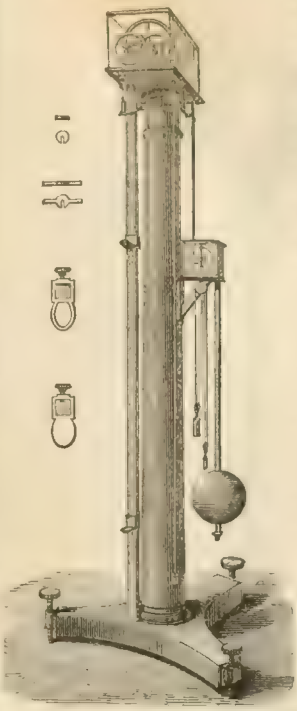
$$\text{Since } t_{,} = \sqrt{\frac{2l}{g \text{ sin. } a}} = \sqrt{\frac{2l \text{ sin. } a}{g \text{ sin.}^2 a}} = \frac{1}{\text{sin. } a}\sqrt{\frac{2h}{g}} = \frac{t}{\text{sin. } a};$$

hence, $t_{,}$ sin. $a = t$; or $t_{,} : t :: 1 : \text{sin. } a :: l : h$.

That is, the time down the plane is to the time of falling through the height of the plane as the length of the plane is to its height; and if any number of planes have the same height, the several times of descent down them will be as their respective lengths. Hence, if a plane be one foot high and forty feet long, a body will be ten seconds in descending it; if of the same height and twenty feet long, five seconds. With four feet height and eighty feet length, the time will be ten seconds; with the same height and forty feet length, five seconds. Owing to the retardation of velocity and the protraction of the time of descent of bodies upon inclined planes, the experimental investigation of the motion of falling bodies is much easier upon such planes than when bodies fall freely, the resistance of the atmosphere being also greatly reduced. Hence, Galileo made use of such planes for the purpose of determining the laws of fall. Since his time more elaborate instrumental means have been devised for accomplishing the same result, of which the most important are the machines of Atwood, Morin, and Bourbouze.

Atwood's machine is briefly described under that name in our first volume, but this is the proper place to explain its uses. The appearance of the machine is shown in Fig. 1. An upright column about eight feet high sustains a small platform on which the essential part of the machine rests. This consists of a light wheel delicately supported upon large friction wheels, and carrying two equal weights suspended at the extremities of a slender and very flexible silken cord, which runs in a groove upon its circumference. While these two weights continue to be equal the system remains at rest, but if an additional weight, however small, be placed upon either, this one will descend, and in descending will generate a velocity in a given time as many times less than that produced in the same time by gravity in bodies falling freely as the added weight is less than the entire mass moved. It is common, in experimenting with this machine, to employ weights having a definite proportion to this mass. Thus, if the whole mass is sixty-four times as heavy as the added weight which furnishes the motive-power, the velocity generated in one second will be the sixty-fourth part of thirty-two feet (disregarding for the moment the fraction); that is to say, six inches. And as the space fallen through in the first second from rest is only half as great as that which expresses the acquired velocity, the weights of the machine will move only three inches in this first second. In preparing for experiment, one of the weights is loaded and raised nearly to the platform at the top of the column, where it is detained by a movable arm brought beneath it, and is held at rest at the zero of a divided scale, shown in the figure, on which the distances of descent are to be noted.

FIG. 1.



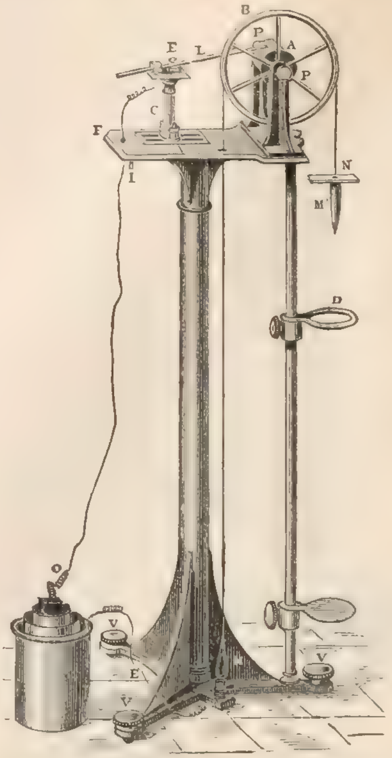
Atwood's Machine.

A clock, supported by a bracket on the side of the column, is connected with the movable arm above mentioned by a mechanism which causes the arm to drop just as the second-hand marks zero. Sliding on the scale is a small movable brass stage, which may be placed at any point at which it is desired to arrest the fall. And there is also a ring sliding on the same scale, on which the load of the descending weight may rest, leaving the weight afterwards to descend unloaded. The forms of the weights used as loads may be seen represented on the left in the figure, where also are given direct views of the stage and ring. The loading weights designed to be arrested by the ring are constructed with arms. The others are simple disks notched to the centre, that they may not interfere with the suspending hook and cord. The clock marks the seconds with a loud tick. The moment at which the load is taken off by the ring, or at which the moving weight strikes the stage, is indicated by the sound of the contact. The law of motion is illustrated by noting the points on the scale at which coincidence takes place between these sounds and the beats of the clock. Thus, if as above supposed, the load is one sixty-fourth of the whole moving mass, and the stage is fixed three inches below zero, the stroke of the weight on the stage will coincide exactly with the first beat of the clock heard after the movement begins. But in order that coincidence may occur at the second beat, the stage must be placed at four times as great a distance down, or at twelve inches. For coincidence at the third beat the distance must be nine times as great, or twenty-seven inches. In like manner four seconds require sixteen times as great a distance; and five seconds, twenty-five times, or seventy-five inches, which is equal to six feet and three inches. This illustrates the law of uniform acceleration theoretically established above—viz. that the space is as the square of the time. If, however, the moving weight be unloaded at the distance *three*, by placing the ring at that point, then its subsequent motion will not be accelerated, but uniform, and its velocity will be $2 \times 3'' = 6''$; so that it will take it twelve additional seconds (or thirteen in all) to reach the stage at the seventy-fifth inch—a point which, under the previously supposed conditions, it reaches in five.

The apparatus of Bourbouze, represented in Fig. 2, offers some advantages, in respect to the accuracy of its indications, over that just described. This has the pulley, weights, ring, and stage of Atwood's. The pulley also sometimes runs on friction wheels, though none are shown in this figure. But this machine differs from the other in being provided with a light cylinder on the same axis with the

pulley, on which rests the extremity of a delicate tracer, L. This tracer is an elastic spring capable of a slight lateral

FIG. 2.

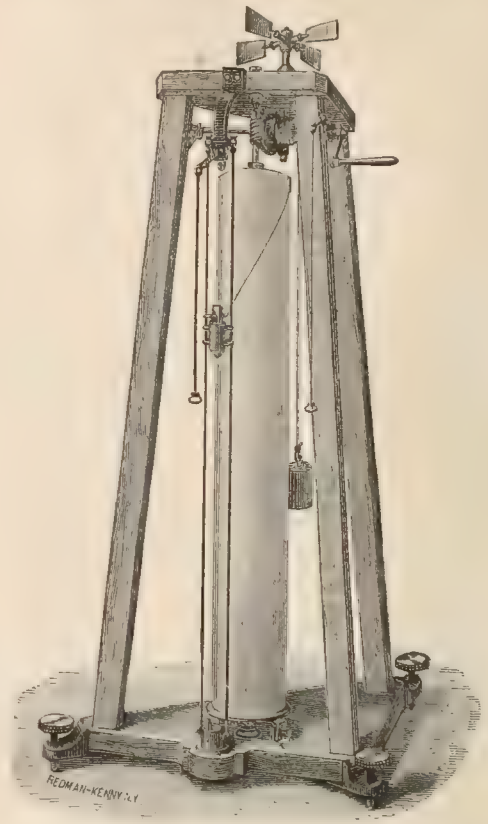


Bourbouze's Modification of Atwood's Machine.

vibratory motion, which is maintained during the experiment by an electro-magnet, E, of which the exciting battery is seen at O; the battery circuit being alternately closed and broken by the vibration itself. The same battery excites an electro-magnet at M, which holds one of the pulley-weights at M′, though loaded with the additional weight N. If the circuit is momentarily broken, the weight M is released and M′ falls. The tracer then describes upon the surface of the cylinder A a sinuous curve, in which the summits of the successive undulations will be equidistant if the motion is uniform, and gradually increasing in distance if it is accelerated. As the vibrations of elastic bodies are isochronous, the undulations are described in equal times, and the distances of the successive summits from the beginning of the trace are proportional to the distances simultaneously passed over by the weight M′. In order to prevent the curves described in the successive revolutions from confusing or obliterating each other, the cylinder is made to run upon a helicoidal axis which gradually displaces it laterally. And since it is necessary that the motion shall be as little interfered with as possible by the friction of the tracer, the surface of the cylinder is covered with paper coated with lampblack from the smoke of burning camphor. It adds to the exactness of the measurements between the successive sinuosities to allow the machine, after having prepared it for the experiment, to run for a few seconds without attaching the battery. The trace will then be a simple line without sinuosities. Afterwards, on restoring the original arrangement, connecting the battery, and experimenting in the usual manner, the undulating line described by the tracer will cross the mean line previously traced, at intervals of time exactly equal, and the intersections thus formed will afford more definite points of reference in measurement than are found in the rounded summits of the undulations.

Morin's machine, which remains to be described, is represented in Fig. 3. The essential part of this machine is a vertical cylinder six or seven feet high, turning easily upon its axis of figure, and driven by clockwork and a descending weight. A wind-vane regulator serves to maintain uniformity of motion. The cylinder is closely covered with white paper, which ought to be ruled with equidistant parallel lines, both horizontally and vertically. A weight, which is perfectly free to fall when released from a detent at the top of the machine, is guided in its fall by a couple of wires stretched vertically, and carries in its descent a pencil, of which the point is kept by a light spring in contact with the paper wrapping the revolving cylinder. The machine, after being started, is allowed to run until the

FIG. 3.



Morin's Apparatus.

rotation becomes sensibly uniform, when the detent is touched and the weight allowed to fall. The velocity of descent being accelerated, while that of the rotation is uniform, a trace will be described by the pencil, which, as the resultant of these two motions, will be necessarily a curve. By measuring the co-ordinates of this curve, which the regular ruling of the paper will make an easy process, it will be found to have the properties of a parabola; and from this the law of acceleration is at once deduced, and is found to be identical with the law determined by theory.

F. A. P. BARNARD.

Falling Spring, post-tp. of Greenbrier co., West Va. Pop. 1138.

Falling Stars. See METEORS, by PROF. H. A. NEWTON, LL.D., M. N. A. S.

Fal′lington, a v. of Falls tp., Bucks co., Pa. P. 211.

Fall′ing Wa′ter, post-tp. of Berkeley co., West Va. Pop. 1218.

Fall of Man, in theology, the lapse of the first man, and through him the lapse of the human race, from the state of integrity into the state of corruption. The doctrine is placed usually as the systematic link between creation and redemption. The narrative in Gen. iii. is treated throughout the Bible as historical. The myths and legends of paganism have many parallels with the Scripture account of the Fall. The tree of knowledge is generally regarded as simply affording the means of testing man, not as having in its fruit any special objective character. The serpent is simply organic and instrumental, the mask of the real tempter, the devil. The sin of the Fall is apostasy from moral fellowship with God, caused by abuse of the freedom of the will, and followed by the loss of the divine image and by liability to temporal and eternal death on the part of Adam and his posterity. Various explanations have been urged as substitutes for the historical sense of the narrative, both in ancient and modern times. The Ophites regarded the serpent as incarnate Wisdom. Many modern German thinkers consider the Fall as a necessary part of man's development in reason and character, "the happiest event in human history." Hase calls it "the image of that which occurs in every man." Nitzsch says, "it is true history, but not actual." (A statement and vindication of the received view will be found in KRAUTH'S

Conservative Reformation, 376–455, and HODGE'S *Systematic Theology*, ii. 123–129.) C. P. KRAUTH.

Fallo'pian Tubes [named from Fallopius, long reputed as their discoverer], or more properly **O'viducts,** in the higher animals, two canals in the free margin of the broad ligaments of the uterus, one on either side, extending from the ovary to the uterus. In woman the tubes are each about four inches long, with a very narrow passage along the inner half of the length, but much larger outward. The inner end opens into the cavity of the uterus, and the trumpet-shaped outward end opens into the abdominal cavity. The outward end is fimbriated with fringe-like processes, and has been called *morsus diaboli.* The oviducts are identical with what are called Müller's ducts in the fœtus. Birds have but one developed oviduct. In most marsupials each tube serves as a separate uterus. In the higher animals the uterus and vagina are regarded as formed by the union of the oviducts. The office of the Fallopian tubes is to convey the ovum from the ovary to the uterus. REVISED BY WILLARD PARKER.

Fallo'pius, or **Fallopio** (GABRIELE), an illustrious anatomist, b. at Modena in 1528, or, according to Tomassini, in 1490. With Vesalius and Eustachius (the latter his rival) Fallopius has the honor of being the chief restorer of anatomical science; he taught at Ferrara and Pisa, and in 1551 became professor of anatomy and surgery at Padua and director of the botanic gardens. His name is given to the Fallopian tubes, which he did not first discover, though he first suggested correctly their use.

Falloux, de (FRÉDÉRIC ALFRED PIERRE), VICOMTE, b. at Angers, France, May 7, 1811, became distinguished as a political leader of the Catholic party, but retired from public life in 1851; became one of the editors of the *Correspondant* in 1855; and is known by his *Histoire de Louis XVI.* (1840), a Legitimist work; *Histoire de Pie V.*, 1844; *Madame Swetchine, sa vie et ses œuvres*, 1859; and another volume of Madame Swetchine's letters, 1866; also some devotional and other works.

Fal'low, a name formerly applied to land which is allowed to rest after cropping for one or more seasons with no tillage, except perhaps one or more ploughings. Such are now called *naked* fallows. The custom is a very ancient one, and is chiefly useful on heavy soils, where it acts probably by way of liberating plant food from hitherto unavailable compounds. It has, among the best farmers, given way to what is called the green fallow, of which the clover-fallow is one of the best kinds. Some green crop, as clover or buckwheat, is grown and allowed to rot on the surface, or is ploughed under. This crop serves at once to choke the weeds and to fertilize the land, and the growing crop saves the soil from blowing away in the winds, which in naked fallows causes a serious loss.

Fallow Deer [*fallow* means "pale yellow"], the most common deer of Europe, found also in Northern Africa, is the *Dama vulgaris.* Though now very common in England, it was introduced there, but very early, it is supposed by the Roman colonists. In a wild state it only exists in Southern Europe, but in the later Tertiary its range extends farther N. In summer it is beautifully mottled. The male is called a buck, the female a doe, the young a fawn. The doe is without horns. The venison of the fallow deer is regarded as the most savory known. It is smaller than the stag, and has more spreading and palmated horns. It goes in herds, and each herd has its master, an old buck which all the others obey.

Fallow Deer (*Dama vulgaris*).

Fal'lowfield, tp. of Washington co., Pa. Pop. 834.

Fall Riv'er, tp. of La Salle co., Ill. Pop. 523.

Fall River, post-tp. of Greenwood co., Kan. P. 1119.

Fall River, tp. of Wilson co., Kan. Pop. 896.

Fall River, city of Bristol co., Mass., in lat. 41° 42′ 3″ N., lon. 71° 9′ 37½″ W., on the Rhode Island border, on the eastern side of Mount Hope Bay, the north-eastern arm of Narragansett Bay, and along Taunton River, some 20 miles from the sea. It is about 9 miles in length, comprising 27½ square miles; is 48½ miles S. of Boston, Mass., 20 from Providence, R. I., 15 from Taunton, Mass., 13 from New Bedford, Mass., and 18 from Newport, R. I., being central to them all and connected with each by railway. It is at the head of deep-water navigation, and the terminus of a line of steamers from New York. Its industries comprise iron-works that run 105 nail-machines and turn out 120,000 kegs of nails yearly; 2 large calico print-works (the American and the Bay State), one of which has over 900 employés and runs 16 machines, and together they turn out 75,000,000 yards of calico per annum; 1 woollen-factory; 38 cotton-mills, turning out some 300,000,000 yards per annum, mostly print cloths; a large bleachery, and a multitude of mechanical enterprises connected with the cotton manufacture. The capital employed in these industries is over $20,000,000, keeping in motion 1,269,788 spindles and 29,521 looms. The city contains water-works, nearly completed, bringing the water from Watuppa Lake, a beautiful sheet of water 10 miles long in the eastern part of the city; an efficient paid fire department with fire-alarm telegraph; 6 national and 4 savings banks; 2 daily and 3 weekly newspapers; immense granite-quarries; a large coastwise shipping trade; a children's home; a free public library and reading-room; a high school, 3 large graded grammar and many primary schools; 23 churches; and a public park of 60 acres. Fall River was first settled in 1659, incorporated as a town in 1803, and became a city in 1854. Pop. 26,766.

WILLIAM REED, ED. "DAILY EVENING NEWS."

Fall River, post-v. of Fountain Prairie tp., Columbia co., Wis., on the Milwaukee and St. Paul R. R. Pop. 259.

Falls, county of Texas, in the E. central part. Area, 795 square miles. The surface is fertile, one half prairie and one half timbered land. Cattle, corn, and cotton are the staples. It is traversed by the Houston and Texas Central R. R. and by the Brazos River. Cap. Marlin. P. 9851.

Falls, tp. of Cerro Gordo co., Ia. Pop. 553.

Falls, tp. of Chase co., Kan. Pop. 459.

Falls, tp. of Hocking co., O. It contains Logan, the county-seat. Pop. 3760.

Falls, tp. of Muskingum co., O. Pop. 3361.

Falls, tp. of Bucks co., Pa. Pop. 2298.

Falls, post-tp. of Wyoming co., Pa. Pop. 1096.

Falls, tp. of Fayette co., W. Va. Pop. 1411.

Falls'burg, tp. and post-v. of Licking co., O. P. 865.

Falls'burgh, post-tp. of Sullivan co., N. Y., on the New York and Oswego Midland R. R. The township contains several villages. Leather, lumber, and dairy products are manufactured. Pop. 3206.

Falls Church, post-tp. of Fairfax co., Va., on the Washington and Ohio R. R., 11 miles from Alexandria. Pop. 2161.

Falls City, post-v. and tp., capital of Richardson co., Neb., 9 miles W. of the Missouri River in the Great Nemaha Valley and on the Atchison and Nebraska R. R. It has a brick court-house, nearly completed, 2 hotels, good schools, 5 churches, 25 stores, excellent flouring-mills, two weekly newspapers, and a broom-factory; also a pork-packing house, nearly completed. Pop. of v. 607; of tp. 1166. W. S. STRETCH, ED. "NEMAHA VALLEY JOURNAL."

Falls City, post-v. of Fayette co., Pa., on the Pittsburg Washington and Baltimore R. R.

Falls of Montmorenci, a celebrated waterfall and village in the counties of Quebec and Montmorenci, province of Quebec, Canada. Here the river Montmorenci falls

from a precipice 250 feet high directly into the St. Lawrence, 7 miles below Quebec. The village at this point has a population of about 850, and has manufactures of lumber. The falls are visited by great numbers of travellers in summer, when the scene is one of great beauty. In winter very large and remarkable cones of ice form here.

Fall'ston, post-v. of Harford co., Md.

Fallston, b. of Beaver co., Pa. Pop. 629.

Falls'town, tp. of Iredell co., N. C. Pop. 879.

Falls Vil'lage, post-v. of Canaan tp., Litchfield co., Conn., on the Housatonic R. R., 67 miles N. of Bridgeport, at the romantic falls of the Housatonic River, has a national and a savings bank, and manufactures of iron.

Fal'mouth, parliamentary and municipal borough of England, in the county of Cornwall, on a branch of the estuary of the Fal, which here forms one of the best harbors in England, 5 by 1 to 2 miles in extent, 12 to 18 fathoms deep, and capable of sheltering 500 vessels at a time. It is a rendezvous for fleets and mail-packets. Pop. 5294.

Falmouth, post-v., county-seat of Pendleton co., Ky. on the Kentucky Central R. R., 39 miles S. by E. of Covington, and on the Licking River. It has a weekly newspaper. Pop. 614.

Falmouth, post-tp. of Cumberland co., Me., 7 miles N. of Portland, on the Grand Trunk and the Maine Central R. Rs. Portland and the neighboring towns were included in the old town of Falmouth. It borders on Casco Bay, has three churches, great water-power, and manufactures of bricks, machinery, carriages, etc. Pop. 1730.

Falmouth, post-tp. of Barnstable co., Mass., at the extreme W. end of Cape Cod, on the shores of Buzzard's Bay and Vineyard Sound. It has a spacious harbor at Wood's Hole, which is safe, never freezes, and is of sufficient depth for the largest ships or steamers. It contains 9 churches, 4 hotels, 7 post-offices, 1 national bank, and 2 manufactories. The Pacific Guano Co. at Wood's Hole has a capital of $1,000,000. Falmouth is rapidly becoming noted as a watering-place, and Falmouth Heights has already attained a wide reputation as a seaside resort. Pop. 2237. Ed. of "Falmouth Chronicle."

Falmouth, tp. and post-v. of Stafford co., Va., on the Richmond Fredericksburg and Potomac R. R. and on the Rappahannock, opposite Fredericksburg. Pop. 1694.

False [Lat. *fallo, falsum,* to "deceive"]. In music this term is often applied to that which is incorrect, faulty, or in direct violation of rule. To *sing* falsely or with false intonation is to deviate from the true pitch of the notes sung. False *harmony* is that which disregards the laws of counterpoint and correct taste. A false *progression* is a wrong resolution of a discord, two perfect fifths or octaves in succession, or other similar error. A *melody* also may be false, not only in performance, but in its construction, when certain notes proceed otherwise than the harmony of the accompaniment demands. A falsetto voice is an abnormal series of sounds ranging above the pure and natural tones of a man's voice, and produced only by more or less of constraint. William Staunton.

False Bay is an inlet on the E. side of the mountainous district of South Africa which terminates in the Cape of Good Hope. As it is sheltered from the N. W. monsoon, to which the harbor of Cape Town is exposed, it receives periodically all trading-vessels from Cape Town for temporary protection, and it is the permanent station of the naval force of the colony.

False Cross Rela'tion, in musical composition, a certain progression, by a skip, in which a note in its natural form is followed by the same note altered by a sharp or flat, or *vice versâ,* in another part of the harmony, as in the example, at *a*:

The disagreeable effect of this arises from an apparent contradiction between the two parts, the one being major, and the other minor. The error is avoided by placing the change on the *same grade* or the *same part of the harmony,* as at *b.* William Staunton.

False Impris'onment, an unlawful deprivation of personal liberty. It is not necessary to constitute this offence that there should be an actual incarceration of the person, or that any actual force should be employed in procuring the wrongful restraint. An unwarrantable detention in a private apartment, or even in a public highway, is sufficient, and there need be no other exercise of power than a mere command or direction to submit to arrest, provided it is accompanied with such a display of authority, or such threats of compulsion, or exhibition of means to procure compliance, as naturally lead the person accosted to believe that he is submitting to legal authority, or that he will be forced to yield if he attempts resistance. It is enough that one's voluntary control and direction of his own movements is wrongfully interfered with. False imprisonment usually occurs from the unjustifiable exercise of pretended legal authority, as by arresting without process when process is known to be necessary, or when there is a mistaken assumption that a case is one in which no process is required to sanction an arrest. For instance, a constable or other peace-officer has power to arrest without warrant if he have reasonable ground of suspicion that a felony has been committed and that the person whom he seeks to detain is the offender. In like manner, a private individual needs no legal process to justify him in taking into custody the supposed perpetrator of a felony whose guilt is reasonably presumable. A private person's privilege in this respect, however, is more restricted than that of a constable, for mere suspicion that the offence has been committed is not enough, but it must be shown to have actually occurred, even though the party suspected be in fact innocent. Furthermore, any person, whether he be an officer or not, in whose presence a breach of the peace is committed, may detain the wrongdoer and deliver him to the proper legal authorities for punishment. But whenever the right of arrest without warrant is exercised, a just occasion must be shown to exist by the entire correspondence of the circumstances of the case with those requirements which alone afford a sufficient cause for detention without process, or the person making the arrest will be guilty of false imprisonment. In all other grades of offence legal process is necessary to justify an arrest, and without it any restraint or detention of a person is unlawful. So an arrest is invalid and wrongful, even if made under color of process, if the process be void from some irregularity or defect, or if the arrest be made on an unlawful occasion, as on Sunday or a legal holiday, upon civil process merely. All who are engaged in a wrongful interference with a person's liberty, either as principals or instigators, or those who are indirectly its cause, as by suing out illegal process, knowing it to be unjustifiable, are guilty of an unlawful arrest, and equally punishable.

The remedies for false imprisonment are adapted to secure either a restoration of the person confined to liberty, as by writ of Habeas Corpus (which see), or the punishment of the party who is chargeable with the wrongful confinement, as by a civil action for damages or a criminal indictment. The jealous care and watchfulness with which the right of personal liberty is protected at common law, and the numerous safeguards which have been provided to secure its unhampered exercise, are abundantly indicated by this variety of remedies, and by the strict rules which confine the power of arrest without process within narrow limits, only permitting its exercise when offences of a particularly criminal character are to be punished, and when any requirement of delay for the purpose of obtaining a warrant would be attended with danger to the welfare of the community. The high degree of civil liberty which English-speaking peoples have developed and maintained so sedulously is an outgrowth of that sense of personal independence and individuality of which the law of false imprisonment furnishes so ample and noteworthy an exemplification. George Chase. Revised by T. W. Dwight.

False Pretences. See Cheat, by Prof. T. W. Dwight, LL.D.

Falsetto. See False, by William Staunton, S. T. D.

Fal'ster, Danish island in the Baltic, separated from Seeland, Möen, and Laaland by very narrow straits. It is very low, entirely flat, and somewhat unhealthful, but it is very fruitful and well cultivated. It has an area of 178 square miles, and a population of 32,413. The principal town is Nykjöbing, on the Guldborgsund, between Falster and Laaland.

Fa'lun, or **Fah'lun,** town of Sweden, situated at Lake Runn, 120 miles N. W. of Stockholm. It is famous for its copper-mines, which gave Gustavus Adolphus occasion to call it "the treasury of Sweden," but at that time the mines yielded 3000 tons annually, while at present they yield only 400 tons. Pop. 4618.

Faluns, a name given to a sub-division of the miocene tertiary in the valley of the Loire, France. The Falunian beds of D'Orbigny include the *grès de Fontainebleau*—the upper portion of the eocene—and also the overlying miocene strata.

Famagos'ta, or **Famagusta,** city on the eastern coast of Cyprus. From the twelfth to the eighteenth century, while Cyprus was under the Venetian rule, Famagosta was one of the principal commercial cities of the

Levant, but now its defences, warehouses, palaces, and churches are in ruins, and its harbor is choked up by sand. It is inhabited by 200 or 300 Greeks.

Famil'iars [so called because they belonged to the official family of the inquisitor], officials of the Inquisition, whose office it was to take suspected persons and convey them to a place of confinement. Familiars received large indulgences from various popes. The office was highly honorable in the popular view, and even noblemen and their sons were willing to possess it.

Familiar Spirits [derived by some from *familia*, denoting intimacy; by others from *famulus*, denoting subjection and service], demons supposed to be in attendance upon fortune-tellers, necromancers, and the like. The original Hebrew word (אוב; plu. אובות) which is rendered in our English version *familiar spirit* or *spirits* occurs in the Bible at least fifteen times (Lev. xix. 31; xx. 6, 27; Deut. xviii. 11; 1 Sam. xxviii. 3, 7, 8, 9; 2 Kings xxi. 6; xxiii. 24; 1 Chron. x. 13; 2 Chron. xxxiii. 6; Isa. viii. 19; xix. 3; xxix. 4). The primary meaning of אובות, *oboth*, is *leathern bottles*, suggesting the idea of *inflation* by the familiar spirit, with some reference, perhaps, to the tricks of ventriloquism. The Hebrew word has also two secondary senses. In some of the passages referred to above it denotes the persons who "have" or employ familiar spirits; in others, it denotes the spirits themselves. For example, persons are meant in Lev. xix. 31, and spirits in Deut. xviii. 11. Nothing is said in the Bible to justify the inference that such spirits were actually in attendance upon fortune-tellers and necromancers. The Witch of Endor (1 Sam. xxviii.) was generally *supposed* to have a familiar spirit. But the coming of Samuel in answer to her incantations appears to have been more than the Witch herself was expecting. R. D. Hitchcock.

Fam'ilists, or Family of Love, an English mystic sect, was founded in Holland by Henry Nicholas, a native of Westphalia, and originally an Anabaptist, and was finally transferred to England near the middle of the sixteenth century. They taught that religion consists wholly in love, independently of any form of truth held and believed. Through love man could become absolutely absorbed in and identified with God in a subjective sense; that God regards not the outward actions, but only the heart; that to the pure all things are pure, even things forbidden. Nicholas, as the apostle of this "service of love," claimed, it is said, superiority over Christ, on the ground that Moses only preached *hope*, Christ *faith*, but he preached *love*. Much misrepresentation of their confession of faith (given in Strype's *Annals*, ii. 57) brought out an *Apology* in 1575, in which they seek to identify themselves with evangelical Christianity. In 1580, Queen Elizabeth instituted an investigation into their practices, and in consequence they were dispersed and their books publicly burned. They continued to flourish, however, for another century, and in 1604 petitioned King James for permission to publicly clear themselves of the charges preferred against them. This request was denied them, because they were known to have been guilty of grossly immoral practices. (Baxter, *Autobiography*, p. 77.) (See a curious book by J. R. (John Rogers) entitled *The Displaying of an Horrible Sect naming themselves the Family of Love*, London, 1579; and Knewstub, *Confutation of Monstrous and Horrible Heresies taught by H. N., etc.*, London, 1579; Mosheim, *Ecclesiastical History*, ch. xvi., § iii., p. xii., § 25; Collier, *Ecclesiastical History of England*, vi. 609; vii. 311; Hardwick, *History of the Reformation*, ch. v.; Carrière, *Philos. Weltanschauung d. Reformationzeit*, Stuttgart, 1847.) Jas. H. Worman.

Fam'ily [Lat. and Span. *familia*; Fr. *famille*; It. *famiglia*]. The word is said to have its origin in the Oscan root *famul*, which signifies a "slave." The idea of subjection is thus identified with it always. In its early use this idea was most prominent. Latin writers often use the word for the collective body of slaves owned by one master. In a wider sense they made it comprehend all, both free persons, slaves, and objects of property, that were subjected to the will of an individual head of a house. By Roman law, children and grandchildren, as well as slaves, were subject to the almost absolute power of the head of the family.

The English word properly represents a household living together under one head, including parents, children, servants, and such other persons as may have a continuous place in the association. It is also extended to embrace the descendants of a common ancestor regarded collectively; and in the widest sense mankind are spoken of as the family of Adam.

By divine ordinance the family is the germ of all human society: "God setteth the solitary in families." It is an arrangement of highest economy and efficiency to provide, by detailed responsibility and care, for the increase, nurture, and best development of the human race. It begins at the best time of life, and under the most favorable circumstances, the training of men in subjection to legitimate authority, in self-sacrifice of individual choice for a common good, in the recognition of the rights of others, in the exercise of kindness and good-will to benefit others, and so in habits most favorable to social harmony and peace and order. The family is in its ideal a little commonwealth under government of rightful authority, sustained by the bond of mutual respect and love between its members. The simplest form of government for the state is the patriarchal—just an extension of family rule and order. Hence, it is true, as Plato says, "Whatever is most excellent in the state must always begin at the fireside." Hence a nation's prosperity and civilization are best secured by influences which first pervade, and then flow from, its families. The family lies at the foundation of social science, and a prime object of that science is to promote the order, the freedom, the purity, and the refinement of social life in the family. A. L. Chapin.

Family, in zoology, indicates a group of animals intermediate between the genus and order: it is based on structural features of a more general character than the genus, while the limits are determined by the range and extent of the differential characters which exist between the typical form and the next allied: a family may therefore be monotypic (*i. e.* limited to a single known species), or exceedingly polymorphic (*i. e.* embracing thousands of species). Examples of family groups are found among mammals in the cat-like animals (Felidæ), the dog-like animals (Canidæ), and the bear like animals (Ursidæ), in the order of Carnivora; in the horses and asses (Equidæ), the rhinoceroses (Rhinocerotidæ), the tapirs (Tapiridæ), and the hollow-horned ruminants—*i. e.* cattle, sheep, goats, and antelopes (Bovidæ)—in the order of Ungulates, and in man (Hominidæ) in the order of Primates. Inasmuch as a distinctive similarity of form is associated with the structural characters which distinguish most of these and many other families, especially of mammals, the group has been defined, by Prof. Agassiz, as the embodiment of form determined by structure. This definition, however, entirely fails in many, and even perhaps most, cases; for example, in the Unionidæ some forms are higher than long, while others are extremely elongated; and in the Primates there is a greater difference in form between some monkeys of one family than there is between others of different families. Families are therefore distinguished on account of certain differences in structure which may or may not be correlated with corresponding modifications of form. No exact criterion can be given, discrimination being a matter of judgment.

The term *family* was originally introduced by French naturalists as the vernacular equivalent of the Latin *ordo*, and in this sense it is still used by botanists—*e. g.* by Dr. Asa Gray, who combines certain forms in groups, for which he employs the word *order* as the scientific term, and *family* as the popular; thus, *Order 1. Ranunculaceæ* (*crow-foot family*). By Lamarck and Latreille, however, the two terms were restricted in meaning, the word *order* being retained in the sense in which it was employed by Linnæus, while the word *family* was re-established for a section of the order. Later (in 1811), William Kirby (*Trans. Linn. Soc.*, London, xi., p. 88) proposed that all families should have the patronymic termination *-idæ;* and this was gradually adopted, and now it is almost universally employed by zoologists. Although, strictly speaking, the use of this termination may not always be in exact accordance with grammatical purity, its great convenience as a uniform indicator of the taxonomic value of the group outweighs the objections, and has ensured its present currency. Theodore Gill.

Fam'ine [from the Lat. *fames*, "hunger"], a failure of the supply of food for any region, usually caused by drought or other climatic influences, such as excessive and unusually protracted cold in the summer of northern regions, but also liable to be produced by swarms of devouring insects, such as locusts, or by blights and diseases affecting vegetation, like the potato-rot, which produced the terrible famines of Ireland in 1846 and the years which followed. The dreadful famines which have occurred in Egypt, that most fruitful of lands, have been generally due either to deficiency or excess in the annual floods of the Nile. That of Persia (1871–72), the most terrible of modern times, was produced by the great drought of 1870. Long continued and exhausting wars have led to famines, by breaking up the routine of farm-labor and rendering industry impossible. Great pestilences have in a like manner caused famine, while famine, in turn, has been a most fruitful cause of epidemic disease. Such a disease is the relapsing or

famine fever, or hunger-pest, which, though not remarkably destructive of life at ordinary times, becomes a great scourge in times of general want.

Famines are now much less to be dreaded than in former times. The introduction of steam-navigation, the submarine telegraph, and the other recent commercial improvements will do much to alleviate the horrors of famine; but the experience of Ireland shows the importance of a system of mixed agriculture, so that if the potato-crop or the wheat-crop should fail, some other accessory product may be at hand to take its place. The same lesson was taught in the famine of India, 1872–73, which followed the failure of the rice-crop. (See FAMINE, in FIRST BIENNIAL SUPPLEMENT.)

Fan [from the Ang.-Sax. *fánn*, allied to the Latin *vannus*], an implement used to agitate the air for coolness, seems to have been in use from the remotest times with all people living in hot or warm climates. China, however, is generally called the fatherland of the fan, and there and in Japan it is as indispensable to a gentleman as his boots. It is used in all different ways, even as a newspaper, since on important occasions news, libels, and political caricatures are transmitted on it. During the riots when missionaries were attacked at Pekin in 1873, popular ill-feeling was excited by inflammatory pictures on fans; and the first locomotive-engine seen in Japan was promptly published in the same manner. Also is the common Chinese palm-leaf fan generally supposed to be the oldest form of this implement, as it is still by far the best for simple utility. It is manufactured in immense quantities in China, especially at Canton and Nankin, where also fans of great elegance are produced from bamboo, palm leaf, silk, sandal-wood, tortoise-shell, and ivory. A very singular style of Chinese fan consists of a round paper disk mounted in a split handle on a pivot like a wheel. When not in use it is turned around and folded up, so as to make a straight stick. In Persia, Egypt, Greece, and Rome fans were known at a very early period, and in each country they attained great elegance. The Egyptians knew the peculiar fan made of a bird's wing extended, and so beautifully manufactured by the Chippeway Indians and in England. From a passage in Euripides it appears that Greek fans were round and made of feathers, and when the Greeks obtained the peacock (about 500 B. C.) they began to use its plumes for fans. In Herculaneum there is a fresco representing a youth holding a peacock fan, and in an ancient representation of the twelve months, published by Lambecius, one of the same kind hangs up by the genius of August. The Roman fan for ladies was often made of thin tablets of perfumed wood, and as branches of myrtle, acacia, and palm were the first fans or materials for them, these shapes were preserved in imitations for centuries. A fan with a wooden handle, and a *feuille* provided with a picture of a love-affair or a view of a city, with a corresponding inscription, was much in use in Italy during the Middle Ages. In a work of costumes which appeared at Venice in 1664, containing several hundred dresses, especially the Lombard from the eleventh century, women often hold fans, some of them of very eccentric shapes. The *tuft*-fan of peacock's feathers was set on an ivory handle adorned with gems, and one like this, but with a horse's tail, appears on the sculptures of Persepolis. In a volume of Italian costumes of the Middle Ages in the *Wolfenbüttel Library* (A. L. Millen) fans may be seen made of the feathers of parrots and many other kinds of birds. In Queen Elizabeth's wardrobe twenty-seven fans are enumerated, one of which cost £40, and about 1660 the manufacture of this article was quite extensive in England, as appears from a petition of the fan-makers, who complained that 550,000 fans having lately been brought over, "great numbers of poor people, continually employed in the work, must perish unless a stop be put to the importation." In the twelfth year of the reign of Charles II. a protecting duty of 40s. per dozen was imposed on fans, and the importation of all painted fans was prohibited. The folding fan was introduced in France by Catharine de Medicis, and under Louis XIV. the manufacture became a great industry. Those who exercised it formed a corporation, established in 1673, and four years of apprenticeship were required, though the masters who made this regulation wisely set it aside in favor of their own sons or of any man who should marry their daughters or widows. One of the most original patterns of French fans was the so-called Pompadour, consisting of brins without *feuilles*, and forming, when opened, a beautiful oval. During the Revolution fans went out of fashion, but in this century, especially of late, the manufacture has again become very prosperous. Large quantities of costly fans are produced in Paris, made of what is called chicken skin (a very thin yet tough preparation of kid skin), satin, gauze, tulle, crape, or parchment, and provided with beautiful pictures by great artists, such as water-colors by Marie Bonheur, A. Soldé, Edouard Moreau, Tony Faivre, and others, priced at from £50 to £130. Large numbers of these fans are exported to Spain, where the fan is as essential an article as in China or Japan. The native Spanish product, however, is rather coarse and ungainly, and, although Spain has laid a heavy duty on French fans, the Spanish workmen are yet not able to compete with the French. A curious but very elegant exhibition of fans was held at the South Kensington Museum, London, in 1870. The empress of France, who had been instrumental in developing this branch of industry, as of all kinds of luxury in dress, sent to it all her finest fans, thirty-four in number. An illustrated catalogue of this exhibition was published at London. In the U. S. the production of anything beyond the cheapest grades of paper fans is one of our more recent enterprises. The character of the cheap goods, palm leaf, paper, etc., is well known, but the ivory, bone, and composition fans have been among the rarer Oriental luxuries. We have imported very largely a variety of grades of fans of what are known as the wood stick, as well as ivory, pearl stick, and bone fans, from France; our importation of these, mostly in muslin, linen, silk, and satin, decorated or plain, amounting to about 2,000,000 francs ($400,000) per annum. We have also imported large quantities of the finest leather fans from Austria, in kid and imitation or genuine Russia leather. The attempt to compete in our market with the European manufacturers is of recent date, and met at first with serious difficulties. In this, as in most articles of luxury, the popular prejudice was strongly in favor of imported goods. Our people are very slow to be convinced that any description of fancy goods or articles of luxury can be made as well and as tastefully here as abroad. At first the carving, perforating, and polishing of the sticks were done by hand, by slow and laborious processes. But ingenious machines have been invented, working rapidly and with great precision. Also the painting and decoration are now carried to such perfection by American manufacturers that they are able to compete successfully with the finest imported painted fans. According to the census of 1870, there were then six fan manufactories in the U. S., employing 117 hands, $28,000 capital, paying $23,426 wages, using $37,179 of material, and producing 92,000 fans of all sorts. Of these, two were in Massachusetts, employing 59 hands and $17,000 capital, paying $8740 wages, using $21,989 of raw materials, and producing $43,000 worth of fans: two were in New York, employing 16 hands and producing $22,000 worth of fans; and one each in Connecticut and New Jersey, employing together 42 hands and producing $26,500 worth of fans.

CHARLES G. LELAND.

Fana'riotes [from *Fanar*, one of the quarters of Constantinople where they dwell—from φανάριον, the "beacon" there situated], a body of Constantinopolitan Greeks who claim a noble Byzantine descent. Spared by the Turkish conquerors, they artfully insinuated themselves into public affairs, and until 1822 held many important civil, military, and naval positions, in which they displayed, as a rule, selfish and ungenerous qualities. Their power as a class is now completely broken.

Fan'cy [from *phantasy*, the Gr. φαντασία, from φαίνω, to "show"], a term used by philosophers, sometimes as synonymous with IMAGINATION (which see), but the better practice would appear to conform more or less closely to that of Dugald Stewart, who says: "The office of this power is to collect materials for the imagination; and therefore the latter power presupposes the former, while the former does not presuppose the latter. . . . It is the power of fancy which supplies the poet with metaphorical language, and with all the analogies which are the foundation of his allusions; but it is the power of imagination that creates the complex scenes he describes and the fictitious characters he delineates. To fancy we apply the epithets of rich or luxuriant; to imagination, those of beautiful or sublime." Others make the two powers the same, but call it imagination when its exercise conforms more nearly to nature—fancy, when its exercise is more extravagant and unrestrained.

Fancy Creek, tp. of Sangamon co., Ill. Pop. 1195.

Fancy Gap, post-tp. of Carroll co., Va. Pop. 1530.

Fandan'go, a national dance of Spain and Spanish America, usually in 3-4 or 6-8 time. It is thought by some to have been introduced by African slaves into the colonies, and thence carried to Spain. It is danced generally to the guitar and the castanets, and is a favorite dance with the people.

Faneuil (PETER), merchant of Boston, Mass., was b. of a French Huguenot family at New Rochelle, N. Y., in 1700. In 1740, at a public meeting in Boston, he offered to erect a suitable edifice for a public market-house at his

own expense and give it to the town. Faneuil d. at Boston Mar. 3, 1743.

Faneuil Hall, in Boston, Mass., was built by Peter Faneuil in 1742, and given to the town. It was burned in 1761, its walls of brick remaining. It was rebuilt at the expense of the town. It is called the "Cradle of Liberty," from the fact that the "Sons of Liberty" held many meetings there during the early years of the final struggle of the colonies with the mother country. The British troops, during the occupation of the city, used it as a theatre. In 1805 it was made forty feet wider and one story higher. The hall, which is used for public meetings, is now about eighty feet square, and contains several good paintings. Its vane, in the form of a grasshopper, was copied from that of the Royal Exchange, London. A grasshopper was the crest of Sir Thomas Gresham, the founder of the Royal Exchange.

Fanfa'ni (PIETRO), b. at Pistoia in 1817, was well known as a writer on philological subjects, and also produced novels and tales for children. In 1859 became director of the Marucellian Library at Florence. D. Mar. 4, 1879.

Fanfare [Fr.; Sp. *fanfarria*], a loud flourish of trumpets, or any short, lively military air played upon brass instruments.

Fani'no, or Fan'nio (FAVENTINO), one of the earliest martyrs during the reformatory period in Italy, was a native of Faenza, then in the Papal dominions; was won over to the Protestant cause by the reading of the Scriptures (probably Bruccioli's version, 1532) and of Protestant apologies, and became so enthusiastic for the new religion that he gave himself to proselyting efforts, which came to the ear of the ecclesiastics, and he was imprisoned. Being the head of a family, he was persuaded to recant for the sake of his wife and children. Upon his release, however, he became dejected in mind, and found peace only in the resolve to openly battle for liberty of conscience; and he set out on a tour through the Romagna, preaching everywhere the Reformed religion. He was arrested in 1548 at Bagna Cavallo, and conducted in chains to Ferrara. During his imprisonment he was visited by many distinguished Italians, among them the princess Lavinia della Rovere and Olympia Morata, who were edified by his instruction and prayers, and took a deep interest in his fate. But his repeated and emphatic refusals to recant caused his condemnation to the stake by Pope Julius III. Fanino was strangled at dawn, and his body burned at noon in Sept., 1550. (See for interesting details YOUNG, *Life of Paleario*, ii. 111; MCCRIE, *History of the Reformation in Italy*, pp. 259–261.) JAS. H. WORMAN.

Fan'net, tp. of Franklin co., Pa. Pop. 2146.

Fan'nettsburg, post-v. of Franklin co., Pa., 17 miles N. W. from Chambersburg.

Fan'nin, county of Georgia, bounded on the N. by North Carolina and Tennessee. Area, about 300 square miles. The surface is broken by mountains. Gold, iron, and marble of excellent quality are found. Corn and dairy products are the agricultural staples. Cap. Morganton. Pop. 5429.

Fannin, county in the N. of Texas, on the Red River. Area, 900 square miles. Cattle, grain, tobacco, hemp, cotton, and fruit are produced. The lands are mostly extremely fertile prairie and bottom lands. Cap. Bonham. Pop. 13,207.

Fannin (JAMES W.), COLONEL, Texan, was b. in North Carolina, fought in the war for Texan independence, and was one of 357 prisoners shot at Goliad by order of Santa Anna, the Mexican general, Mar. 27, 1836.

Fan'ning (ALEXANDER C. W.), lieutenant-colonel in the U. S. army, was b. in Massachusetts 1788, graduated at West Point Military Academy 1812, was lieutenant Third Artillery, Mar. 1812, captain Mar. 13, 1813, was made brevet major for gallant conduct in the defence of Fort Erie Aug. 15, 1814, major Fourth Artillery Nov. 3, 1832, brevet colonel for meritorious service in battle near the Withlacoochie and in defence of Fort Mellon, Fla., Feb. 8, 1837, and lieutenant-colonel Fourth Artillery Sept. 16, 1838. D. at Cincinnati, O., Aug. 18, 1846.

Fanning (Col. DAVID), b. in Wake co., N. C., about 1756; became the leader of a band of Tories or "loyalists," chiefly of Chatham and Randolph counties, who during the later years of the war of the Revolution performed in Central North Carolina many daring exploits, tarnished by wholesale cruelty and the desolation of settlements. In 1781 he took the town of Pittsborough, and soon after Hillsborough, then the State capital, carrying off Gov. Burke and his whole suite. He was one of the three persons excluded by act of the North Carolina legislature from the amnesty proclaimed after the peace; escaped into Florida, traded with the Indians, made his way to New Brunswick, and thence to Digby, N. S., where he d. in 1825. He wrote a curious *Autobiography*, which was copied in 1860 by Porter C. Bliss, and printed in limited number at Richmond, Va., in 1861, as vol. i. of *Historical Records of the Old North State*, with introduction by Col. John H. Wheeler and T. H. Wynne, and instructive notes by ex-Gov. David L. Swain. A 2d ed. of 100 copies was printed by J. Sabin, New York, 1865.

Fanning (EDMUND), LL.D., American Tory in the Revolution, was b. on Long Island 1737; graduated at Yale College 1757, settled in Hillsborough, N. C., and became colonel of Orange co.; took part against the people in their struggle for independence of Great Britain, raising and commanding the king's American regiment of foot. After the war he was appointed councillor and lieutenant-governor of Nova Scotia and governor of Prince Edward's Island (1786–1805) by the English. He was successively major general, lieutenant-general, and general in the British army, and d. in London Feb. 28, 1818.

Fan'ning-machine, or Fanning-mill, an agricultural implement for winnowing grain. Anciently, the wind was the agent chiefly employed for separating chaff and dirt from grain; and the *mystica vannus Iacchi*, like the winnowing-fan of the Bible, seems to have been at first a mere shovel for throwing up the grain and exposing it to the action of the wind. The artificial combination of sieves and fans which now makes the farmer independent of the uncertain action of the wind is a Dutch invention, probably of no great antiquity. There have been many improved forms invented, particularly in the U. S.

Fan'nius (CAIUS) **Stra'bo,** son-in-law of Lælius, is introduced by Cicero as one of the speakers in his works *De Amicitia* and *De Republica*. Served in the third Punic war under Scipio Africanus (B. C. 149–146). Was distinguished as an orator, and was one of the earliest Roman historians who wrote in Latin. His *History* treated of contemporary events, and the eighth book is referred to, though the extent is not known. The few fragments remaining are collected in Krause's *Hist. Rom. Fragm.*, pp. 173–174. (See GERLACH, *Geschichtschreiber der Römer*, pp. 70–71.) This Fannius is often confounded with C. Fannius Strabo, who was consul B. C. 122, and from whose speech on the allies and Latins, directed against Gracchus (praised as good and noble by Cicero), certain fragments are preserved. These are given by MEYER, *Orat. Rom. Fragm.*, pp. 199–200. H. DRISLER.

Fa'no, town and seaport in Central Italy, in the province of Urbino e Pesaro, on the shore of the Adriatic, lat. 43° 51′ N., lon. 13° 1′ E., 30 miles N. W. of Ancona. It is a well-built and beautifully-situated town, containing many splendid paintings by Domenichino and Guido, and the remains of a triumphal arch of white marble erected in honor of Augustus. Pop. 6901.

Fans, a cannibal race found upon the Gaboon River in equatorial Africa. They are coffee-colored, have rather thin lips, and are slight of frame. They eat their own dead, and purchase the dead of other tribes as food, use poisoned arrows and the cross-bow, and are fast becoming the dominant people of that region, where they first appeared since 1847.

Fanshawe, or Fanshaw (Sir RICHARD), D. C. L., English diplomatist and translator, b. at Ware, in Hertfordshire, 1608, studied at Cambridge, and was minister resident at the court of Spain under King Charles I. of England. He was a royalist, and at the battle of Worcester, 1651, was taken prisoner and kept captive for years. Was privy councillor of Ireland 1661, the same year ambassador to Portugal, and negotiator of the marriage between Charles II. and the princess Catharine. In 1664 was ambassador to Spain, and died at Madrid June 16, 1666. His translations were those of Guarino's *Pastor Fido*, *The Lusiad* of Camoens, etc.

Fantail. See PIGEON.

Fanta'sia [Fr. *fantaisie*; It., Span., Port., and Lat. *fantasia*], in music, a species of composition nearly identical with the capriccio, in which imaginative and fluent writers express their thoughts with the highest freedom compatible with an observance of the fundamental laws of harmony. Originally, the fantasia was probably nothing more than simple improvisation—a transient, unstudied, and unwritten creation of the performer's fancy. But as extempore playing naturally leads to the recording of the ideas, themes, and general course of thought pursued in any successful effort, the transition was easy to the writing, at leisure, of compositions resembling improvisations in peculiarities of movement, form, modulation, expression, and harmony. In many of these compositions

writers give free play to the impulses of a luxurious fancy, regardless of method and design, but still preserving a certain continuity of outline amid much that is wild, rugged, and abrupt. The term "fantasia," however, is now often given to compositions which are perfectly regular in time and harmony, and even more symmetrical in their structure than many pieces not so designated. WILLIAM STAUNTON.

Fan'tee, or **Fan'ti,** is the name of a tribe, and of the country it inhabits, in Western Africa, on the coast of Guinea. The country consists of a small strip of land extending along the Atlantic from the Sakum on the E. to the Kaku on the W., and separated N. from the dominions of the Ashantees by a belt of impenetrable forests crossed only by a few narrow and intricate paths. But this strip of land is very fertile, densely peopled, and rich in gold-dust. The inhabitants belong to the same family and speak nearly the same language as the Ashantees, though they are inferior to them both in skill and vigor. They succeeded, however, in defending their independence. They started an individual civilization. They built large cities, such as Yankumasi, Abrah, Annamabu, etc., and they began trading and manufacturing. But early in this century they came in contact with the English, who built a fort and established a commercial station at Cape Coast Castle. Their labor became subservient to English enterprise and speculation. Their political organization became weakened and almost dissolved under English influence and authority. Their civilization faded away, and they became a prey for the Ashantees, who in their turn were conquered by the English. (See ASHANTEE.)

Fantoccini. See PUPPETS.

Fan-tracery, a species of vaulting peculiar to the English Gothic of the fifteenth century and later times, characterized by divergent ribs, which spring from the cap of the shaft and radiate at equal intervals with a uniform curvature, and terminate in the ribs of the roof. Between the divergent fan-ribs there are cusps and foils, forming a rich tracery, whence the name.

Fan'wood, a v. of Westfield tp., Union co., N. J., on the Central R. R. of New Jersey, 21½ miles W. S. W. of New York. Here is Fanwood Park, and the residences of persons doing business in New York. It is surrounded by beautiful scenery. The post-office name is SCOTCH PLAINS.

Far'ad [from *Faraday*], the unit of quantity in electrometry. It is the quantity of electricity with which an electro-motive force of one *volt* would flow through the resistance of one *megohm* in one second. One farad per second is the British Association's unit of current. A million farads equal one megafarad. One farad contains a million microfarads. Some electricians name the common farad *microfarad*, and call the ordinary megafarad by the name of farad.

Far'aday (MICHAEL), D. C. L., F. R. S., was b. at Stoke Newington, a suburb of London, Sept. 22, 1791. He d. on Hampton Court Green, in a house presented to him for his lifetime by the queen, on Aug. 25, 1867. His education he describes as being "of the most ordinary description, consisting of little more than the rudiments of reading, writing, and arithmetic." His hours out of school were passed at home or in the streets. The love of nature, which was with him so deep, was ancestral instead of individual. In 1804 he went as an errand-boy to a bookbinder named Ribeau, his father's homely dwelling being in Jacob's Well Mews, close by. In 1805 he was taken as an apprentice. One line of his indentures reveals the moral stuff out of which the future philosopher and gentleman was made: "In consideration of his faithful service no premium is given." He read many of the books he bound. He mentions specially Mrs. Marcet's *Conversations on Chemistry* and the articles on electricity in the *Encyclopædia Britannica*. He also made electrical experiments, and went occasionally to evening lectures on natural philosophy given by a Mr. Tatum at 53 Dorset street, Fleet street. The charge was a shilling a lecture, and his elder brother's purse often helped him here. To enable him to draw the apparatus employed by Mr. Tatum he took lessons in perspective. It was his habit to enter in a note-book jottings of such volumes, papers, and magazines as interested him. This he called his "philosophical miscellany." It was intended "to promote both amusement and instruction, and also to corroborate or invalidate those theories which are continually starting into the world of science."

His letters to his friend Benjamin Abbott show him to be occupied during his leisure hours with electrical experiments. The friends work at the same subject and discuss their results. Alertness and tenacity are the traits which mark Faraday. He holds his convictions resolutely and defends them cleverly. But his letters are even less remarkable for the keenness of his logic than for the courtesy of his style. Nature sends into the world beings physically beautiful and physically ugly, subsequent culture making but comparatively small impression upon her firm outlines. So it is in the intellect and morals; in respect to which beauty and nobleness were potential in Faraday at his birth, requiring but the smallest stimulus from favoring circumstance to unfold them into actual life.

After his apprenticeship he worked for a time as a journeyman bookbinder. And now we come to the hinge of circumstance on which his life turned. Davy was giving his last course of lectures at the Royal Institution. Faraday was taken to hear them by a Mr. Dance, to whom and to the event he thus subsequently refers: "Under the encouragement of Mr. Dance I wrote to Sir H. Davy, sending as a proof of my earnestness the notes I had taken of his last four lectures. The reply was immediate, kind, and favorable. After this I continued to work as a bookbinder, with an exception of some days, during which I was writing as an amanuensis for Sir H. Davy."

On Mar. 18, 1813, Davy reported to the managers of the Royal Institution his engagement of Faraday at weekly wages. He travelled subsequently with Davy on the Continent, returning to the institution in 1815. On the Continent he saw many interesting experiments and made the acquaintance of many distinguished men. Even in those days, when he was fresh from the press of the bookbinder, there must have been something remarkably cultivated in his demeanor. During the journey, however, the independence of his character often blazed out into resentment against Lady Davy, who wished to treat him as an underling. Davy himself, though yielding for the sake of quietness to the caprices of his wife, was always considerate and kind. After his return, Faraday became connected with the City Philosophical Society, where he sometimes lectured to the delight of all hearers.

Three years after his appointment in the Royal Institution he made his first published contribution to science: it was an analysis of some caustic lime from Tuscany. Under Davy's advice and encouragement he thus began. Both skill and insight are revealed by a short paper on sounding flames published in 1818. Other smaller contributions followed. Mr. Brande was at that time lecturer on chemistry, and his occupation was described by his hearers as "lecturing on velvet," so skilfully, quietly, and effectively was he assisted by Faraday. In 1820 a chemical paper opened the long series with which Faraday subsequently enriched the *Philosophical Transactions*. On June 12, 1821, he married, and an entry made by himself six and twenty years subsequently shows how he regarded the most important occurrence of his life: "Amongst these records and events I here insert the date of one which, as a source of honor and happiness, far exceeds all the rest. We were *married* on June 12, 1821. M. FARADAY."

Œrsted's discovery in 1820 directed all minds to the interaction of magnetism and electricity. In 1821, Faraday wrote *A History of the Progress of Electro-Magnetism*, and thus prepared, he succeeded on Christmas morning, 1821, in making a magnetic needle rotate round a wire carrying an electric current. To Faraday's intense annoyance, it was whispered that he had plagiarized the experiment from Wollaston, but he completely cleared himself of this charge. Jointly with his friend Mr. Stodart he conducted experiments on the alloys of steel; and I still possess a razor given to me by Faraday, formed from one of his alloys. In 1823 he liquefied chlorine and other gases, and hence originated a difference between him and Davy which everybody must regret, but which, in my opinion, involved not a shade of dishonor on either side. In 1824, Faraday was elected a fellow of the Royal Society. In 1825 and 1826 he published chemical papers in the *Philosophical Transactions*. In one of these he announced the discovery of benzol, which afterward became the basis of our splendid aniline dyes. From 1825 to 1829, in conjunction with Herschel, he tried to improve the manufacture of glass for optical purposes. Practically considered, this investigation was a failure, but the "heavy glass" they produced led afterward to two of Faraday's greatest discoveries. It was at this period that the respectable artilleryman, Anderson, who subsequently became such a prominent figure in Faraday's lectures, was engaged as an assistant.

Disciplined and strengthened by his previous work, Faraday, in 1831, made his great discovery of magneto-electric induction, opening thereby a vast and novel electrical domain. Enigmas which had previously challenged and defeated the efforts of the greatest men ceased to be enigmas. The magnetism of rotation, for example, discovered by Arago and experimented on by Babbage and Herschel, was shown to be due to a special manifestation of Faraday's induced currents. It is needless to say that all our induction coils, our medical machines, and the electric light so far as it has been applied to lighthouses, are the direct

progeny of Faraday's discovery. In the paper here referred to he for the first time calls the "magnetic curves" formed when iron filings are strewn around a magnet "lines of magnetic force." All his subsequent researches upon magnetism were made with reference to those lines. They enabled him to play like a magician with the magnetic force, guiding him securely through mazes of phenomena which would have been perfectly bewildering without their aid. The spark of the *extra current*, which I believe was noticed for the first time by Prof. Joseph Henry, had been noticed independently by Mr. William Jenkin. Faraday at once brought this observation under the yoke of his discovery, proving that the augmented spark was the product of a secondary current evoked by the reaction of the primary upon its own wire.

The desire to refer diverse natural energies to unity of principle is the strongest of the scientific mind, and soon after the period at which we have now arrived Faraday illustrated this desire by his attempt to prove experimentally the "identity of electricities." He operated upon the electricities of the machine, the pile, the gymnotus, the torpedo, thermo-electricity, and magneto-electricity, examining and comparing their phenomena in various ways, and finally deciding in favor of their identity. He then passes on to electric decomposition, both by the machine and the pile. The amazing difference in point of "quantity" and "intensity" is strikingly brought out; Faraday concluding, though he is almost afraid to publish the conclusion, that the amount of electricity involved in the decomposition of a single grain of water equals that produced by 800,000 discharges of his large Leyden battery. In May, 1833, he published a paper on a *New Law of Electric Conduction*, in which he forcibly shows the influence of the "state of aggregation" on the transmission of the current. Water, for instance, allows the current to pass—ice does not. Why? This leads him to a profound consideration of the subject of electrolysis. Again, in June, 1833, he published a paper on this subject, profoundly thoughtful and profoundly skilful at the same time. While holding fast to his general line of thought, he did not close his eyes to the smaller offshoots from his great inquiries: with such an offshoot, *On the Power of Metals and other Solids to Induce the Combination of Gaseous Bodies*, he closed his labors in 1833.

But these researches, considered in the light of subsequent achievements, take rank as mere preliminary disciplines, leading him to the final establishment of the great doctrine of "definite electro-chemical decomposition." He measures the strength of his currents by their chemical action in his voltameter, comparing the quantity of this action with that of other chemical actions in his circuit. He includes in the same circuit water and fused chloride of tin, and finds that for every atom of hydrogen and oxygen liberated in the one cell, there is an atom of tin liberated in the other. "Both the water and the chloride were broken up in proportions expressed by their respective chemical equivalents. The amount of electricity which wrenched asunder a molecule of water was competent, and neither more nor less than competent, to wrench asunder the constituents of a molecule of the chloride of tin." The fact is typical. With the indications of his voltameter he compared the decompositions of other substances, both singly and in series. He submitted his conclusions to numberless tests; he purposely introduced "secondary actions;" as a true son of science, he endeavored to hamper those very laws which it was the intense desire of his mind to see established. From all these difficulties, however, emerged the truth, "that under every variety of circumstance the decompositions of the voltaic current are as definite in their character as those chemical combinations which gave birth to the atomic theory."

With regard to the origin of power in the voltaic pile scientific opinion had been divided. Volta found the source of power in the contact of heterogeneous metals, and he proved beyond a doubt that electricity arises from such contact. But it would be difficult at the present day to enter into the state of mind which could accept simple contact as the origin of the floods of energy obtainable from the pile. Faraday could not help taking a side here. His experience had showed him that chemical action was the invariable accompaniment of the current; it had led him to conclude that the one was proportional to the other, and therefore forced upon him the conviction that the "contact theory," as maintained by Volta, was a delusion. The origin of power in the pile he referred to its chemical actions. He thus became the strongest pillar of the "chemical theory," which had been previously enunciated by Fabroni and Wollaston. His researches in frictional electricity occupied him from 1836 to 1838. Here he enters with keen insight into the subject of conduction and induction, regarding both from a wholly original point of view. To this hour these questions, to the advantage of Faraday's notions, engage the attention of experimental philosophers. One of his principal results here is the establishment of the specific inductive capacity of insulators—a subject of supreme importance in connection with submarine cables. As a striking illustration of Faraday's insight, it may be mentioned that as early as 1838 he had virtually foreseen and predicted the retardation produced by the inductive action between the wires of submarine cables and the surrounding sea-water.

Toward the close of 1840 he suffered the penalty of all great workers, who first learn the limits of their powers by transgressing them. Faraday broke down, and for two years was prohibited from working. He went to Switzerland in 1841, and slowly improved after his return. He knew that polarized light was a most subtle investigator of molecular condition, and he had tried it frequently in investigating the state of electrified bodies. Though baffled oft, his thoughts on his return from Switzerland returned to the subject. He placed a piece of his heavy glass between the poles of an electro-magnet. Including both magnet and glass between two Nicol's prisms, he sent a beam of light through the system. When the Nicols were parallel the light was transmitted—when they were crossed the light was cut off. On exciting the magnet in the case of the crossed Nicols, the light was instantly transmitted, and one of the Nicols had to be turned through an angle depending on the strength of the magnet and the length of glass traversed to again quench the light. The experiment proved that by the act of magnetization "the plane of polarization" is caused to rotate. Faraday proved the direction of the rotation to be determined by the polarity of the magnet, being reversed when the polarity is reversed. He also proved that the voltaic current exercised a similar power. He pointed out the difference between this effect and the rotation of the plane of polarization by quartz and certain other bodies, and entitled his discovery "the magnetization of light."

This was the first reward of Faraday's long and apparently futile inquiry on the manufacture of optical glass. His second reward was the discovery of diamagnetism, the name given to a force of repulsion exerted by a magnet on the great majority of known bodies. He called it diamagnetism because an elongated diamagnetic body acted upon by a magnet sets *across* the lines of magnetic force, while a paramagnetic body, like iron, sets parallel to the lines of force. He pushed his inquiries in diamagnetism into the heart of the subject, exploring it experimentally in all directions. Faraday's antecedent culture and his notions regarding molecular force are strikingly illustrated by this inquiry and the subsequent one on magno-crystallic action.

To these discoveries succeed his investigations on the magnetism of gases, his elaborate papers on atmospheric magnetism, his speculations on the nature of matter and force, and his researches on "lines of magnetic force, their definite character, and their distribution within a magnet and through space"—inquiries marked by profound insight and illustrated with refined experimental skill. "Taking him for all in all, it will, I think, be conceded that Faraday was the greatest experimental philosopher that the world has ever seen; and I would hazard the opinion that the progress of future research will tend not to diminish but to enhance the labors of this mighty explorer."

It might perhaps be considered culpable on my part if I omitted to state that this extraordinary man, in whom force of intellect and beauty of character were so wonderfully united, drew his spiritual nutriment from his faith as a Christian. In reply to a question of Lady Lovelace (Byron's "Ada"), Faraday thus renders an account of his religious position: "There is no philosophy in my religion. I am of a very small and despised sect of Christians, known, if known at all, as *Sandemanians*, and our hope is founded on faith that is in Christ. But though the natural works of God can never, by any possibility, come in contradiction with the higher things that belong to our future existence, and must, with everything concerning Him, for ever glorify Him, still, I do not think it at all necessary to tie the study of the natural sciences and religion together; and in my intercourse with my fellow-creatures that which is religious and that which is philosophical have ever been two distinct things." JOHN TYNDALL.

Faradiza'tion, in medicine, the application to the animal frame of the Faradic or induction electricity. Faradic electricity (named from Faraday, who thoroughly studied this force) is obtained from a variety of apparatuses called batteries (some magneto-electric, composed of a revolving magnet and coil of wires, others of a "cell" giving a galvanic current) and coils. In cell-batteries the current of the cell never reaches the patient; each current delivered by the battery is distinct (not continuous with any

other), and is the result of induction—*i. e.* the production of electricity in a conductor by its adjacency to another current. The batteries in common use give primary, secondary, or ternary currents (so named because of their derivation from a first, second, or third coil). The coils added to the first are progressively made of finer and longer wire, and yield currents not essentially different, but stronger. We owe to Dr. Duchenne of Paris the best methods for making use of Faradism in therapeutics. It is used for two purposes: (*a*) to produce muscular contractions (passive exercise); (*b*) to excite the nerves of sensation. The first object may be attained in two ways—first, by placing both electrodes (ends of insulated conductors armed with sponge, of various shapes) upon the moistened skin covering the muscles we wish to cause to contract; or, second, by placing one electrode as above and the other over the nerve-trunk which sends branches to that muscle. To excite the nerves of sensation, a portion of skin should be made dry by means of starch-powder, a wire-brush electrode held upon or drawn lightly over this dry skin, while the other sponge electrode is held (wet) on the integument not far away. The current can be made to reach the internal organs (bladder, uterus, etc.) by means of peculiarly shaped electrodes. The popular use of Faradism by holding both electrodes in the hands is worthless. E. C. SEGUIN.

Farallo'ne Islands, a group of six small lofty and rocky islands of the Pacific, lying 30 miles W. by S. of the Golden Gate, or entrance to San Francisco Bay, Cal. They are owned by a company, which here collects the eggs of the gull and the murre, a sea-bird of the auk family. These eggs are furnished in great numbers for the San Francisco market. The south-easternmost and largest island (lat. 37° 41′ 49″ N., lon. 122° 59′ 5″ W.) has a lighthouse, with a flashing white light of the first order, 360 feet above the sea. The islands breed great numbers of rabbits, and their coasts abound in sea-lions. They are in San Francisco co., Cal.

Farce [Lat. *farcio*, to "stuff," so called from its varied ingredients] is the name of a peculiar kind of comedy in which the characters are without psychological truth and the plot without moral impression. When in a comedy the *dramatis personæ* are not characters representing complete mental organisms, but figures representing only one single feature of the human mind, and when the situations of which the plot consists are formed without any intention of imitating life, but so as to show off this single mental feature in its most extravagant appearance, a high degree of comical effect can be attained; and there is in the principle itself on which the farce rests no reason why its comical effect should not be accompanied with perfect elegance and gracefulness. The farce originated in the southern European countries from rustic festivities, in which masks and every other description of disguise were used. There are traces of it in the so-called Fabulæ Atellanæ, far back in the days of the old Roman republic, and we meet it every now and then during the Dark Ages, until in the sixteenth century it enters the stage, where it led a brilliant life under the name of *commedia dell' arte*, as a kind of improvised drama. Molière introduced it among the arts. Many of his plays are simply farces. But after his time it was utterly neglected, and sank down to be low comedy, comedy for the mob, and it showed no signs of revival until the middle of the nineteenth century. But at our time it seems once more to come to the foreground. The present French farce is often indecent, but its mirthfulness cannot be denied. It needs only some purification to be brilliant art. And here in America the "minstrels" often perform small farces which are exceedingly comical, without indulging in improprieties. CLEMENS PETERSEN.

Far'cy, the more chronic form of glanders, a disease attacking horses, asses, and mules, and from them transmissible to men. This disease is highly contagious, and thus far generally incurable. Farcy differs from glanders in having a slower course, and is characterized by the formation of tumors involving the glands of the lymphatic system alone ("button farcy"), the glands and the adjacent areolar tissue ("bud farcy"), or the lymphatic vessels ("farcy pipe"), and is followed by fever. Where farcy runs a somewhat rapid course it is generally fatal; while if its course proves very slow, a recovery may be looked for, at least in man. Glanders, however, which is the same disease, primarily attacking the nasal mucous membrane instead of the lymphatics, is almost always fatal. The treatment of acute cases is palliative chiefly; that of very chronic ones is expectant, the strength being maintained by nutritious food. In horses the disease is most common in those which are overworked, exposed to the weather, and kept in ill-ventilated stables. Farcied horses should be killed at once, without any attempt at treatment. (See GLANDERS.)

Far'del-bound, a disease of sheep and neat cattle, known in its milder form as "loss of cud." The animal refuses to chew the cud, is stupid, feverish, has a dry nose, and sometimes grunts as if in pain. The disease is an irritation or inflammation of the third stomach (*omasum*, manyplies, or fardel), the folds of which are dry and often inflamed. Sometimes this organ is impacted with food. The treatment is gentle purgation, as with Epsom salts, followed by liquid food, such as mashes sweetened with molasses and flavored with a little ginger. As a preventive, avoid the use of coarse and overripe hay. The animal will generally recover within three weeks.

Fareham, town and sea-bathing place of England, in the S. of Hampshire, on a creek of Portsmouth harbor. Pop. with surroundings, 10,796.

Farel (GUILLAUME), the boldest of the French Reformers and father of Swiss Protestantism, was b. in 1489 in a little hamlet near Gap in Dauphiny. His parents, of noble descent and pious Romanists, subjected him to rigid religious training, and intended him for the army. But William gave himself to study, and when all opposition seemed fruitless he was suffered (about 1500) to set out for Paris, there to study philosophy, Greek, and Hebrew at the university. The shining light of the Paris school was, at that time, the brilliant Lefèvre d'Étaples, around whom were gathered disciples from every country. Young Farel became one of the most devoted of these. This illustrious connection was, moreover, the means of withdrawing Farel from obscurity, and securing him a large circle of acquaintance, and a chair in the College of Cardinal le Moine. Gradually, however, Lefèvre's influence declined and Farel's hold weakened. Lefèvre had espoused the doctrine which became the corner-stone of the Reformed structure—justification by faith—and had dared to declare the Bible the sole guide of the Christian. The Sorbonne condemned these innovations, and Parliament pronounced against them. Farel had accepted the views of his instructor, and was therefore in danger from persecution. In 1521, Lefèvre retreated to Meaux, but Farel remained in the capital, and for a time boldly continued to maintain his cause with professors, priests, students, and citizens wherever he could do so, in the university and in the city. The doctors of the Sorbonne, however, proved the stronger party, and Farel soon found it expedient to join Lefèvre at Meaux. Here, also, persecution found them out, and "the heretics of Meaux" were obliged to quit the town. Farel dared to return to Paris, but, finding himself in great danger, retired to Dauphiny. His three brothers became converts, and many adherents were gathering when the authorities, civil and ecclesiastical, combined against him, and he was obliged to quit the vicinity of Gap. He now visited other parts near the foot of the Alps and labored successfully. His life becoming endangered, he crossed over, early in 1524, into Switzerland, where he was warmly welcomed by the Reformers. He tarried for a while at Bâle, making his home with the learned Œcolampadius, who was charmed "with the learning, piety, and courage of the young Frenchman." Bâle was at this time much exercised by the religious innovations prevalent there, but officially no action had been taken in favor of the Reformed doctrines. Farel published thirteen theses covering the chief points of dispute, and defended them publicly without answer from the Romanists. In consequence, the Reformed doctrines became quite popular, and their success might have been established had not Farel fallen into angry dispute with Erasmus, who heaped such abuse upon the young Frenchman that he left Bâle in May, 1524, and repaired to Schaffhausen, Zurich, and Constance. On his return to Bâle he was ordered to leave the place. He retired to Strasburg, and there enjoyed the companionship of Capito and Bucer until secretly recalled to Bâle to be set apart by Œcolampadius for the ministry at Montbéliard. Farel had from the first been rather turbulent. Made priest, he by intemperance in language and conduct soon made himself an object of much hatred. He was driven from his parish in 1525. His friends were disappointed, yet would they not forsake him, for they knew well that he was as honest as he was fearless. After a brief visit to Œcolampadius, Farel joined Capito and Bucer at Strasburg, where he had another meeting with his beloved teacher, the saintly and now aged Lefèvre. In 1527 he went to Aigle, where he taught school, at first under an assumed name (*Ursinus*), but no sooner had he secured a sufficient hold on the people to warrant his safety than he boldly made known his real mission, and when Berne became Protestant (1528) extended his labors throughout its territory. "Honest and fearless," says Fisher, "Farel fulminated against the tenets and practices of Rome in city and country, in the church and by the wayside, wherever he could find an audience." "To this gospel missionary," writes D'Aubigné, "every place was a

church; every stone, every brick, every platform, was a pulpit. . . . No sooner did this man of small stature rise up in any place, with his pale yet sunburnt complexion, with red and unkempt beard, with sparkling eye and expressive mouth, than the monks' labor was lost: the people collected around; . . . all eyes were fixed on him: with open mouth and attentive ears they hung upon his words." He communicated his zeal to the Switzers, and by 1531 secured the reformation not only of the western cantons, but also "caused the balance to incline in favor of the new doctrines throughout the confederation." Sent to the Waldenses, then in synod in the valley of Angrogna, he returned in 1532 by way of Geneva, which was at this time agitated by great religious strife. Though a stranger, he dared to preach while in the city. In consequence he was driven from the place, and only escaped with his life by the bursting of a gun that was aimed at him. He returned again in the next year, and was again expelled. Still undaunted, he returned a third time, and was successful. The new doctrines were now largely heard and accepted. Farel was full of toil, and his triumph came Aug. 27, 1535, when the city council, by special edict, proclaimed Geneva as an adherent to the Reformation. In 1536 his cause was strengthened by a visit from Calvin, who was persuaded by Farel to take up his residence at Geneva. Farel and Calvin henceforth labored unitedly for the good of the Genevese; Calvin, by common consent, assuming the leadership in ecclesiastical organization. An able assistant these men found in Viret. In consequence of their bitter attack on the sensuality which many of the Genevese had fallen subject to under Savoyard rule, and the strict enforcement of ecclesiastical discipline, the Reformers became unpopular, and (Apr., 1538) were expelled from the city. They went together to Berne, Zurich, and Bâle, where they separated, Farel going to Neufchâtel, whose Reformed society was then in deplorable disorder. Farel soon restored harmony (1542). Went to Metz to organize a society, but was persecuted, and finally obliged to retire to the neighboring town of Montigny, and afterwards to Gorze, where he enjoyed the protection of Count Fürstemberg. Attacks upon his life caused his removal to Strasburg, and ultimately his return to Neufchâtel, where he married, when sixty-nine years old, a young wife, very much to Calvin's disgust. In 1560 he visited his native Dauphiny, and by his bitterness excited the roughs of Gap, who put him in prison, from which he was rescued by his friends. He now returned to Neufchâtel, and d. Sept. 13, 1565. "Of all the Reformers," says D'Aubigné, "Farel and Luther are the two most memorable for the struggles they had to pass through. . . . Farel is the pioneer of the Reformation in Switzerland and in France. He threw himself into the work, and with his axe cleared a passage through a forest of abuses. Calvin followed, as Luther was followed by Melanchthon, resembling him in his office of theologian and 'master-builder.' And yet if Farel reminds us of Luther, we must allow that it is only in one aspect of the latter that we are reminded of him. Luther, besides his superior genius, had, in all that concerned the Church, a moderation and prudence, an acquaintance with past experience, a comprehensive judgment, and even a power of ardor, which were not found in an equal degree in the Reformer of Dauphiny." Farel was certainly a learned man, though he showed more skill as a speaker than writer. He was a missionary rather than an organizer, an iconoclast rather than a theologian. He may be called "the Swiss John Knox," and, like the renowned Scotchman, moved the world by his eloquence, intensity of zeal, and honesty of purpose. His writings are of interest only to the student of the Swiss Reformation. (See KIRCHHOFER, *Life of Farel* (in German, 2 vols., Zurich, 1831–33; in English, London, 1837); GOGUEL, *Vie de Farel* (1841); SCHMIDT, *Études sur Farel* (1834); SCHMIDT, *Farel und Viret* (1860); BLACKBURN, *Farel and the Story of the Swiss Reformation* (Philadelphia, 1865).) J. H. WORMAN.

Fa'rey (JOHN), English civil engineer, b. in London Mar. 20, 1791, obtained a silver medal from the Society of Arts in 1807 for making perspective drawings, and in 1813 a gold medal for a machine for drawing ellipses. He was employed in Russia in 1819, and died in London July 17, 1851. His treatise on the steam-engine was published in 1827.

Far'go, post-v., capital of Cass co., Dak., on the W. bank of the navigable Red River of the North, opposite Morehead, Minn., and on the Northern Pacific R. R., 254 miles W. of Duluth. It has considerable trade, two weekly newspapers, machine-shops, and a U. S. land office.

A. J. HARWOOD, ED. "FARGO EXPRESS."

Fa'ria Sou'za (MANOEL), Portuguese historian and poet, b. at Pombeiro, or Souto, Mar. 18, 1590, was envoy to Rome 1630–34, and died at Madrid June 3, 1649 or 1647. His histories are in Spanish, and among his works are *Commentary on the Lusiad of Camoens* (2 vols. 1639), *Asia Portuguesa* (3 vols. 1666), *History of Portugal to 1557*, etc., besides various poems.

Far'ibault, county of Minnesota, bordering on Iowa. Area, 720 square miles. The surface is undulating prairie and very fertile. Dairy products, grain, hay, and wool are the staples. It is watered by the Maple and Blue Earth rivers, and is traversed by the Southern Minnesota R. R. Cap. Blue Earth City. Pop. 9940.

Faribault, post-v. and tp., capital of Rice co., Minn., on the Milwaukee and St. Paul R. R., at the junction of Straight and Cannon rivers, 53 miles S. of St. Paul. It contains the State asylum for the deaf, dumb, and blind, an Episcopal divinity college, 5 seminaries, 10 churches, a public reading-room and library, 2 parks, 5 flouring-mills, 2 national banks, 2 weekly newspapers, and a number of manufactories and stores. It is lighted by gas and provided with a steam fire-engine. Pop. of v. 3045; of tp. 4103. A. W. MCKINSTRY, ED. "REPUBLICAN."

Fari'na [Lat., "meal"], a name applied to powdered cereal grains, and even powdered pulse (pease, beans, etc.). In a still wider sense it includes the starchy foods prepared from various roots and stalks, such as arrow-root, sago, tapioca. From the fact that such substances abound in starch, starchy food is often called farinaceous.

The pollen of flowers, after it has been gathered by bees, is also called farina. This is made into bee-bread, to serve as food for the larvæ, and probably enters into the paste which covers the larva-cells of honeycomb.

Farina, post-v. of Laclede tp., Fayette co., Ill., on the Illinois Central R. R., 224 miles S. S. W. of Chicago. P. 232.

Farina'to (PAOLO), Italian painter, b. at Verona 1525, was pupil or imitator of Titian and Giorgione, painted in oil and fresco, excelled in design, and d. in 1606. *The Miracle of the Loaves and Fishes* is one of his best works.

Farinel'li (CARLO), Italian soprano singer (proper name CARLO BROSCHI), b. at Naples Jan. 24, 1705, studied under Porpora, performed with applause in London 1734–35, and in 1737 went to Madrid to sing to and soothe King Philip V., and, succeeding, became his favorite, as also the favorite of Ferdinand VI., Philip's successor. Farinelli d. at Bologna July 15, 1782. He was a eunuch, and perhaps the best singer of the eighteenth century. He displayed brilliant talents for court-intrigue at Madrid, but possessed many amiable and even generous traits.

Fari'ni (CARLO LUIGI), Italian statesman, historian, and orator, b. at Russi, in the Roman States, Oct. 22, 1822, studied medicine and wrote medical treatises. Proscribed for political offences in 1843, he returned after the amnesty proclaimed by Pope Pius IX. in 1846, and was chosen a member of Parliament for Faenza; then exiled again 1848–49, but was minister of the interior in Piedmont in 1850. He took part in negotiations with Napoleon III., and was named dictator of Modena 1859. In 1860 he was commissioner extraordinary to the court of Naples. In the last cabinet of Cavour he was minister of commerce, and was president of the cabinet Dec., 1862, holding the position until Mar. 24, 1863, when he retired on account of ill-health, and died Aug. 1, 1866. *Lo Stato Romano dell' anno 1815 dell' anno 1850* (1850), *Letters to Lord John Russell* (1859), and *Letters to Mr. Gladstone* (1852), are among his works.

Far'ley, post-v. of Dubuque co., Ia., at the junction of the Dubuque and South-western and the Iowa division of the Illinois Central R. R., 23 miles from Dubuque. It has the machine shops of the former road.

Farley (HARRIET), American writer, b. at Claremont, N. H., edited and contributed to the *Lowell Mills Offering*, sustained by factory girls. *Shells from the Strand of the Sea of Genius* (1847) and *Mind among the Spindles*, issued in London in 1849, are her publications.

Farley (JAMES LEWIS), Irish correspondent and author, was b. at Dublin Sept. 9, 1823, and in 1860 was accountant general of the State Bank of Turkey at Constantinople. In 1863 he was correspondent of the London *Daily News* during the present Turkish sultan's visit to Egypt. In Mar., 1870, he became Turkish consul at Bristol, England. *Two Years in Syria* (1858), *The Druses and Maronites* (1861), *The Resources of Turkey* (1862), *Banking in Turkey* (1863), and *Turkey* (1866), have been published by Mr. Farley.

Farm. See AGRICULTURE, by HORACE GREELEY, LL.D.

Farm'dale, post-v. of Franklin co., Ky.

Far'mer, post-tp. of Defiance co., O. Pop. 1184.

Farmer (HENRY T.), M. D., physician and poet, was b. in England, emigrated to Charleston, S. C., and after his medical education in New York settled there in the

practice of medicine. He published *Imagination, The Mariner's Dream, and Other Poems*, 1819, and d. in 1840, forty-six years of age.

Farmer (Rev. Hugh), an English dissenting clergyman of great learning and ability, b. near Shrewsbury in 1714, studied under Dr. Doddridge at Northampton, and from about 1746 was pastor of a congregation at Walthamstow, where he d. Feb. 6, 1787. Published *Inquiry into the Nature and Origin of our Lord's Temptation in the Wilderness* (1761), designed to show that the temptation was not objective and real; *A Dissertation on the Miracles* (1771); *Essay on the Demoniacs of the New Testament* (1775; 3d ed. 1818); *Prevalence of the Worship of Human Spirits in Ancient Heathen Nations* (1783). R. D. Hitchcock.

Farmer (John), American genealogist, born at Chelmsford, Mass., June 12, 1789, was a founder and the corresponding secretary of the New Hampshire Historical Society, and published an edition of Belknap's *History of New Hampshire*, *Genealogical Register of the First Settlers of New England* (1829), *History of Billerica* (1806), *History of Amherst* (1820), *Gazetteer of New Hampshire* (1823), etc. He died at Concord, N. H., Aug. 13, 1838.

Far'mer City, post-v. of De Witt co., Ill., at the crossing of the Gilman Clinton and Springfield and the Indianapolis Bloomington and Western R. Rs. It has 2 weekly newspapers, 3 churches, 3 hotels, steam flouring-mill, 2 banks, and a large lumber business. Pop. 537.

Far'mers, tp. of Fulton co., Ill. Pop. 1058.

Far'mersburg, post-tp. of Clayton co., Ia. Pop. 1236.

Far'mers' Clubs are associations of agriculturists, generally those of some one community or neighborhood, who meet at stated times for the discussion of questions affecting the interests of agriculture, and more especially for considering the methods of practical farming—the relative values and uses of different fertilizers, the adaptation of special crops to particular soils, the choice of breeds of live-stock and of varieties of cultivated plants, and the like. Mr. Solon Robinson and the late Hon. Horace Greeley were among the early and influential advocates of farmers' clubs. They were associated with the Farmers' Club of the American Institute in New York, the discussions of which were for many years printed weekly in the *New York Tribune*, and widely read. Some farmers' clubs have libraries and invested funds, and sustain regular courses of lectures in the winter season, and in general ladies are admitted. The constitution and by-laws are, or should be, simple in plan, and the meetings are social rather than formal. In many places, besides the regular discussion, there is the reading of one or more original papers, usually agricultural; and music adds variety to the exercises. To some extent the old farmers' clubs have recently been converted into, or replaced by, the granges of the Patrons of Husbandry. (See Grange, by L. P. Brockett, A. M., M. D.)

Farmer's Creek, post-tp. of Jackson co., Ia. P. 1502.

Far'mers-Gen'eral, an association of persons in France, under the old monarchy, to whom the privilege of levying certain taxes, as imposts on salt or tobacco, or town-dues in particular districts, was farmed or let out for a given sum paid down. This system of raising the public revenue was employed by the Roman state. (See Publicans.) It was introduced into France in the thirteenth century, when Philip the Fair gave to Lombard Jews and brokers the privilege of collecting the *gabelle*, or tax on salt, to provide means for carrying on war against the English. It continued to be employed under various modifications down to the Revolution of 1789. The system involved such extortions and cruelties to the people, and such frauds on the government, that it excited general odium. Great financial ministers like Sully and Colbert had to grapple with it for the temporary correction of evils, but it could not be dispensed with till the old order of things passed away. In 1720 the farmers of the taxes formed a regular association, called the *ferme générale*. It included originally forty, and afterwards sixty, *fermiers généraux*, who held, for a specified number of years, the exclusive management of the *gabelle*, the tax on tobacco, the *octrois* of Paris, and other excise duties. These men accumulated enormous wealth, and by bribing ministers of state, courtiers, and functionaries of all classes had influence enough to keep up the ruinous system. Turgot and Necker, in the reign of Louis XVI., attempted to change the arrangement, but the nobility, clinging to their privilege of exemption from taxation, effectually resisted their efforts. By the revolutionary constitution of 1791 the system was swept away, and many of the farmers-general were executed. A. L. Chapin.

Far'mers' Mills, manufacturing post-v. of Kent tp., Putnam co., N. Y.

Far'mersville, post-tp. of Lowndes co., Ala. P. 1116.

Farmersville, post-tp. of Tulare co., Cal. Pop. 807.

Farmersville, post-v., capital of Union parish, La., is 1 mile from the head of navigation of the Bayou d'Arbonne, and 200 miles by water N. N. W. of Baton Rouge. It has a weekly newspaper. Pop. 272.

Farmersville, post-v. and tp. of Cattaraugus co., N. Y. Pop. 1114.

Farmersville, post-v. of Jackson tp., Montgomery co., O. Pop. 312.

Farmersville, post-v. of West Earl tp., Lancaster co., Pa., has one monthly periodical. It is 5 miles S. of New Berlin Station.

Far'mer Vil'lage, post-v. of Covert tp., Seneca co., N. Y., has a machine-shop, foundry, and three churches.

Farming. See Agriculture, by Horace Greeley, LL.D.

Farming Class, The, in America. In the U. S. the word *farming* has a meaning quite unlike that given to it in Europe. In England, the farmer is a tenant paying rent, generally to some holder of entailed lands. In France, the census shows that 36,000,000 acres of land are divided into farms, none of them of more than eight acres in extent. (*Mark Lane Express*, Apr. 13, 1874.) In England, the farmer has little influence in directing society, for he has no permanent interest in the land. In France, his ownership is of so small a possession that it is virtually a garden—too small to permit the raising of cattle or sheep, to produce manure; and where chemical manures must be depended upon to sustain the three-course system, consisting of two crops of cereals and a bare fallow, and where the cows that supply milk, butter, and cheese must be made to do the work of tillage, the fact that the cultivator is the owner gives him no political importance.

Here the cultivator of the soil almost always is the owner, and except in the vicinity of great cities less than fifty acres would hardly be called a farm. Thus, the American farmer generally possesses the advantages that follow combined occupancy and ownership of landed estates, not too large to be directed by one man, and yet large enough to employ all the energies and ability of an active and enterprising mind.

The fathers of our government by law for ever swept out of our institutions all that had been for ages crystallizing in the countries from which we sprung into impassable walls between different orders of society, and not only provided against hereditary government, but against the establishment of families upon foundations of wealth in real estate that they cannot alienate. Equal political and social rights create an active condition of society, for each youth feels that there is no place so high as to be beyond the possibilities that are before him.

A century has not elapsed since we commenced our career as a nation under our own institutions. With a population of scarcely 3,000,000, inhabiting a narrow belt along the sea-coast, with no accumulated capital, with a heavy national debt, the future was bravely faced, and the line of settlements was extended into the interior, where fertile lands covered with forests invited the enterprising to leave the granitic soils of the coasts. Along the only river that reached by its navigable waters through the mountain-range next the sea the lands were largely held in great estates, upon which it had been attempted to plant the institutions of the Old World. The manors of the Livingstones and the Van Rensselaers and their compeers, stretching along the Hudson River, are sufficient illustrations of the influence of such estates upon the public interests.

Immediately after independence was established armies were sent beyond the ranges of coast-mountains to terminate the war with the Indians, that by the treaty with England had been left unsettled. The return of the soldiers brought news of a wonderful country in Central and Western New York, which speculators grasped in large part; but they were wise enough to invite purchasers on liberal terms, and in a wonderfully short time the far-famed Genesee county was settled and brought into cultivation. The State of New York constructed a canal connecting the waters of the interior lakes with the Hudson, and the tide of moving pioneers carried agriculture to Ohio, to Michigan, and finally to the great prairies of the West.

The government of the U. S. adopted a wise policy in regard to its lands lying in the North, and sold at low prices, but for pay down except in cases of settlement before survey, when pre-emption privileges were given.

The general law of emigration is, that the most energetic take the lead, leaving the less enterprising to stay behind and enjoy the old home. To this native energy, that first prompted the movement, in due time is added the self-reliance and quick use of all the powers of body and mind

that comes of frontier life. Those who escape death in becoming inured to the change in climate and habits become men of great deeds if occasion calls out their powers. To realize this discipline we have only to consider the hardships that must be encountered by an early settler of such a country as was Central New York three quarters of a century ago. A man from New England starts on horseback, and following a scarcely passable road, lodging in the wayside cabins of the early settlers, who at distances of a few miles apart furnish entertainment for man and beast, he, after a month or so of travel, finds himself on the long-sought "lot" that he had perhaps purchased unseen. Here, cutting away a few trees, he clears a space for a hut of logs, that the pioneers who have come before him help to raise. Planting, if the season is right, some important seeds, he leaves for home, in due time to return with his family and a few domestic animals. Once settled, the work of removing the trees commences, and many lofty ones fall before the axe and are destroyed. For food, the new comer must depend upon the nearest settlement and his own skill with the rifle, aided by the fish that the lakes and streams furnish.

The second year gives a crop of corn and potatoes, and perhaps some other food. The work of clearing goes on, and each added year sees new acres producing crops; and soon this pioneer has become, in the language of the place and times, "an old settler," and has food to sell to new-comers, and is possessed of flocks and herds. He is now a man of consequence, called upon to organize new counties, towns, school districts, to lay out roads, to bridge the streams, to construct school-houses and churches—to organize society and to make and enforce the laws. In the mean time, sons and daughters have been born, grown up, and now demand more of education than the little district school can give. There must be an academy established and in active operation. When this high school is doing its work the pioneers feel that they are living in an old country, and ready to send their sons farther on into the wilderness to repeat the work. This is the way in which the timbered lands that reached from the sea-coast to the Prairies have been converted into fruitful farms, owned by the men who cultivate them.

We must not forget that the hardest part of the task devolved upon the women, and that the greatest obstacle in the way of rapid progress were the diseases incident to the cultivation of the new soil. Malaria was everywhere, and fever wasted and destroyed. The women must prepare the food, manufacture cloth, and make garments for the family, nurse the sick, and bear and rear the children. Both men and women by this stern education received an energy and power of execution unknown in more elegant life. Self-reliance, personal independence, and manhood proud of its muscular prowess were the result. From this training has come the American farmer of the grain-growing States.

What influences and results such a body of men, thus nurtured, may produce on the policy of our nation is an interesting matter of inquiry. Society has been so long in the habit of receiving its leadings either from an hereditary aristocracy, or from some class especially educated and trained to execute the governing powers, that it is no easy task to break away from customs so firmly established. But causes are in active operation here that never before influenced society, and they are quite likely to materially change the old order of things. The means of universal education are more abundant than were ever before given any great people. The school-district library brings to every hamlet a collection of standard works that are too costly to be otherwise furnished for the people, and the newspaper is everywhere, and in no society is its influence more pervading than among the cultivators of the soil. By the newspaper every event of the least public importance is speedily known in the hut of the far-off pioneer, and as fully as in the great centres of wealth and commerce. The policy of the government, the decisions of the courts, and all the changes that are going on are discussed everywhere among the farmers, and they form and freely express opinions as to the influence of public measures upon their own special interests and those of every other class.

Thus stands this body of industrious, active, and well-informed men, having many millions in their ranks, vast aggregate wealth in lands, and votes sufficient to dictate the policy of the country—generally not so ambitious of office as desirous of having wise laws honestly administered.

It would have been strange if such men had not required, as supplementary to the general newspaper literature of the country, a press devoted to their own special wants. The general tendencies of our times to accurate and scientific knowledge in regard to the things in which we have the greatest interest have nowhere had more influence than among farmers. The laws of life in animal or vegetable are to the farmer matters of the greatest importance. The chemistry of vegetation—how plants grow, and how to make them grow at the least cost—is a matter of vital interest. Scientific books especially devoted to agricultural matters soon followed the agricultural newspaper, and no class of men entertains higher respect for the really scientific writer than the practical farmers of our country.

The old men insist upon their sons having advantages of education greatly in advance of anything known in their school-boy days. They demand that their sons' time shall not be consumed in the acquisition of a learning that, however well it may be adapted to other pursuits, is of little value on the farm; they demand that the education of their children shall be directed in such a way as will make it of actual practical value in their future work. Out of this feeling has grown the attempt to establish colleges especially devoted to agricultural education. Experience had shown that to send a farmer's son through the usual collegiate course, devoting most of his time to the study of the languages of nations that no longer influence public affairs, was the almost certain way to create a distaste for life in the fields, and generally landed him in the pulpit, the bar, or among the doctors of medicine. The slow processes that had led his father to independence and public consideration were connected with an amount of physical exertion that the softened muscles revolted from. The liberal grant made by the nation to promote agricultural education has in many cases been so perverted as to strengthen institutions established for other ends. In some States new colleges have sprung into being on this endowment that are somewhat improved in their course of study, but thus far the result of this effort has been anything but satisfactory to the farmer. A college in Michigan, founded before the national grant was made, has perhaps come nearer the end aimed at than any other. That State wisely gave the lands that came to it under the national grant to its agricultural college, that had already become well started. There each student is required to perform a considerable amount of manual labor every day, for which he is paid in proportion to its value, and all are required to live on the farm. The course of study is well adapted to the supposed special wants of farmers and to active life generally, and the habit of labor is preserved; and the graduates, thus far, have shown a marked willingness to adopt farming as a business.

It is an unsettled question whether special agricultural education can be successfully had in connection with other courses of study—in fact, whether actual manual labor on the farm is not a condition without which there can be no marked success. The various plans adopted by the several institutions that have received the national grant will ultimately solve these questions in a practical way. And when a large part of this national fund has been wasted on old institutions in vain efforts to give them adaptation to a special end, it may at last come to pass that there will be several real agricultural colleges. When this is the character of a half score or more institutions, situated in unlike climates, and dealing with unlike soils, but all acting in concert, the real wants of our agriculture will be found out, and some of the questions that so much perplex the individual farmer may find a solution, and the labor of food-production may become vastly lessened and the fruits of the earth greatly multiplied.

To further aid in the advancement of the agriculture of the country, Congress has established what is called a department of agriculture, but the practical results of this undertaking have thus far been unimportant.

Agricultural interests have been greatly aided in the several States by appropriations of money made by them to assist the local agricultural societies. The State of New York has taken the most prominent position in this work, and for something more than thirty years has had in successful operation a State society, and county and town societies auxiliary thereto. The policy of the State society has been from the day of its first fair, held at Syracuse (1841), to instruct rather than amuse the immense multitudes who attend these annual meetings. All "side shows" are excluded, and there has never been on the grounds during a fair the least attempt to test the speed of horses, or any other thing to draw the public attention from the objects that the society had in view. These fairs have been held at points far apart, and never two successive years in the same place. From the city of New York to Buffalo, Poughkeepsie, Albany, Utica, Syracuse, Auburn, Rochester, on the central line of travel, and on each side Saratoga, Watertown, and Elmira, have in their turn been visited, and now the society has become firmly established in three central positions—Albany, Elmira, and Rochester. The railroads centering at these places give such advantages of transportation that the society has determined,

for at least twelve years, to test the policy of having more permanent buildings, better accommodations for both exhibitors and spectators, than could formerly be secured. The State has provided at Albany a building to be used jointly by the Agricultural Society and the Museum of Natural History. In this building are the library, lecture-room, and offices for the secretary and for all the business of the society not connected with the field-operations of its annual shows. The secretary is employed all the time, and makes his head-quarters at this centre, and keeps up a correspondence with like institutions in all countries, and has the doors open to all visitors to the rooms devoted to the exhibition of objects of interest to farmers, embracing, among other things, tools used many hundreds of years ago alongside the most improved of modern genius. Thus, this department of agriculture of New York exercises an important influence in the education of, and interchange of information among, the farmers of the whole country. No influences of political parties have ever disturbed its councils, and leading men have given their best efforts to the organization. The volumes of its *Transactions* (32) now published constitute the most valuable collection of agricultural information extant.

The settlement of the timbered country was attended with so much labor that agricultural development did not so rapidly advance as to entirely outstrip the other industries. Manufactures and commerce kept nearly even march with agriculture; and the connection of the great lakes with the sea by the Erie Canal gave a very cheap line of water-communication with the commercial world for the surplus land-products. The result was a healthy growth of all the great industries, without any very great or undue stimulus to any one of them. The pioneers found a market for their surplus food in supplying such as came immediately after them, and mills and factories followed in regular sequence. These remarks are measurably true of the settlement of all the country lying E. of Lake Michigan and between the lakes on the N. and the Ohio River on the S., but not of the prairie countries beyond.

The locomotive steam-engine and the facility of rapidly turning the treeless prairies into productive fields, pastures, and meadows have caused a more rapid development of agriculture beyond Lake Michigan than was possible under the circumstances that were connected with the settlement of the lands E. of that lake, and the production of food has greatly outstripped other important branches of industry. Thus, agriculture there has become comparatively unprofitable for want of a home-market for its surplus productions. The true balance of the great industries must be brought about in order to secure real prosperity. The coal that underlies so large a proportion of the great West, and the minerals that abound, furnish raw material for a vast manufacturing interest that must in time give employment to many millions of consumers of the fruits of the soil. Though the Mississippi, with its navigable branches, and the lakes and rivers and canals of the North and East, give a way to market, and though railroads have been so extended as to reach nearly every hamlet, yet the vast distances that intervene between the wheat-fields of the West and the workshops of the Eastern States and Europe will for ever remain, and real prosperity can only come when producer and consumer are brought much nearer together.

The balance between the several great branches of industry is already being restored. The tendency of our people to city and village life, and the necessities of all parties, will, very soon it is to be hoped, correct the evils under which the grain-growers of the West are suffering so severely, and give them a home-market. The resources of the North-western States, the fertility of the soil, and the small proportion of waste or untillable lands, together with the minerals that underlie them, must soon support in affluence a great number of people. Already 12,000,000 persons are engaged in advancing the great interests of these ten States, and the tide of immigration from the Old World is so established in that direction that prosperous times must be near at hand.

The settlement of the country has been so rapid that it has not been possible to establish any systematic methods of cultivating the soil. When the country took its place among the nations less than one hundred years ago, it was poor in everything but the undeveloped capacities of the land. There was very little accumulated capital, and men cleared away the forests to find a place on which they could raise their food, and from which they could raise the wool and flax to be wrought in their own houses into clothing. Almost necessarily these first-cleared fields were cultivated with very little attempt at keeping up their fertility, until they were exhausted of those stores that Nature had been ages in accumulating. This policy was continued until the crops became so small as to no longer pay for the labor bestowed. Then followed a more rational system, in which herds of cattle and flocks of sheep were combined with grain-raising. Cities and villages had grown up, and manufacturing centres made a brisk demand for all that the tillers of the soil had to sell; and in the Eastern States the increase of consumers was such that very soon food had to be imported from the fast-settling West. The cost of transportation from these Western fields gave the food-producers of the East such advantages that they found it profitable to resort to improved methods of cultivation, to which their lands responded by giving them abundant crops. The city and village markets all around them enabled them to produce the crops that would not bear long and expensive transportation.

In localities especially adapted to certain crops, like hops, tobacco, potatoes, beans, fruits, or to the feeding of animals, these special branches have had, under favoring circumstances, extraordinary attention, while the cereals have perhaps been raised in only sufficient quantities for supplying the family and dependants. This change in the character of the crops raised in the older parts of the country has led superficial observers to think that the total agricultural product has greatly fallen off, and that the owners of the farms are gradually destroying them. Census tables have helped to spread this opinion, and statisticians have been predicting speedy ruin. The answer to all this is the fact that the Eastern cultivators of the soil are enlarging their barns and giving every indication of prosperity, convincing an observing traveller that they are well rewarded for their labor. Taking the State of New York as representing a fair mean between the older States of the East and the newer of the West, we find that while this State does not raise much more than one-quarter of the bread consumed within it, the farming lands have risen in selling value to twice or more the prices they bore in the days when millions of bushels of wheat were annually produced. Leaving out of a survey of this State the old counties, and not considering that vast forest that lies in its north-eastern part, where the climate forbids profitable cultivation, we shall find that prosperity based upon fertility is the almost universal law, as is shown by the fine houses and capacious barns that are everywhere being constructed out of the profits derived from the land.

The question is constantly asked, Does farming pay? It would be a short way of answering this question to say that within a time that would not average more than the lives of two generations all the capital in that part of New York under consideration has been created out of the land by its owners' industry; and if we were to find the cost of the buildings, fences, roads, farm-stock, tools, and machinery, and add to this the reasonable cost of clearing the land from its forests, we should have a sum so vast, representing the earnings of only two generations, that we could form some just opinion upon this oft-repeated question, and our minds would be ready to grasp in some measure the probabilities of the future of the descendants of the people who, in addition to raising and educating families and living in luxury, have accumulated this vast capital in so short a time.

The facilities for acquiring lands have been so great that the sons of farmers, if they intended to follow the avocations of their fathers, have generally themselves become owners soon after arriving at man's estate; thus the labor on farms has commanded very high prices, and the demand has very generally been supplied by persons of foreign birth. Out of this scarcity of men who would work for wages has grown a demand for improved machinery and implements. The old hand-winnowing fan, made of willows and shaped like a clam-shell, used by expert hands to throw grain into a current of brisk wind, has been superseded by a machine that threshes and cleans a bushel of wheat in a minute. The cast-iron plough has been perfected from inventions of our own farmers by our own mechanics, so as to take the highest prize at the World's Fair in England in 1851. This has been followed by the cast-steel plough; and the old wooden plough, having a wrought-iron share and point, that was fifty years since considered to be a good implement, can now only be found in collections of curiosities. With the great improvement of the plough came in rapid succession improvements in harrows, cultivators, and machines for sowing grain and harvesting it. The first successful mowing-machine was the beginning of a revolution in the management of farms. In 1852 the New York Agricultural Society had a trial of farm implements at Geneva, and there and then were brought face to face the various manufacturers of implements used in hay and grain raising. The trial was full and exhaustive, and from it the great advance in perfecting these implements may be dated. The mowers there used far surpassed in quantity and quality of work anything that could be done by hand-labor. But since that

time the improvements have been so decided that no progressive farmer could now be induced to use the premium machines of 1852 if given to him. It has been computed (JOHN J. THOMAS, *Farm Implements and Farm Machinery*, p. 8) that the reaping machines introduced throughout the country up to the beginning of 1861 performed labor, while working in harvest, equal to that of 1,000,000 men with hand implements. Since that estimate was made the mower and reaper have been greatly improved, so that it is safe to say that in cutting, raking, and housing hay and grain the labor performed by men has been reduced, except in binding grain and loading grain and hay, so as not to exceed one quarter the amount required before the introduction of modern implements. The authority before quoted says, "The reaper filled the void caused by the demand on the workingmen for the army. An earlier occurrence of the war must have resulted in the general ruin of the grain interests, and prevented the annual shipment of the millions during that gigantic contest."

The threshing-machine, driven by a steam-engine, that by one process threshes the grain, taking from it the chaff and delivering the straw on top, if required, of high stacks, enables the grower to hasten his crop to market, and dispenses with much barn room that would be required to keep the crops while the old ways of threshing and winnowing had to be employed. The wheat-grower ploughs his land with a plough that takes less than half the power once required, and that does the work as perfectly as it can be done by hand-spading. Improved harrows and wheel-cultivators, on which he rides, fit the ground for the seed, which is sown with mathematical accuracy by a drill drawn by horses. The grass seeds are sown at the same time and by the same machine, and the gypsum or other fertilizer is distributed by the power of horses, and with a precision unattainable by hand-labor. The grain is cut and cast off the harvesting-machine by the power of two horses driven by a boy, and the work is better done than by hand; and this one machine, boy, and horses can go over as many acres as could six ordinary laborers with the tools of the olden times. The bundles must be cared for in the old way, but the steel toothed wheel rake, driven by the boy, goes over the field and gathers gleanings that formerly were lost to an amount often sufficient to pay for harvesting the crop. The cost of making and housing the hay-crop is lessened by modern implements more than is that of grain, for the hay is spread by a tedder that is drawn by horses, the driver riding, and which goes over more ground and does the work better than could six men in the old way. The wheel-rake gathers the hay when made and gleans all scatterings. The horse-pitchfork takes it off the wagon and carries it to the back side of the deepest bay in the barn. The advantages growing out of the improved implements are not so decided in some other branches of farming. The expenditure in human labor in feeding and caring for animals, and in making butter and cheese, is not materially lessened, and in the management of sheep very little has been gained except in providing forage for their winter's consumption. The census tables show that there are about one-third less men now employed in proportion to the whole population in producing food than there were twenty years ago. This may be accepted as indicating that the manual labor employed in farming has been lessened 33⅓ per cent.; and this, all branches being considered, is probably very near the truth.

Who is most benefited by this lessening of the labor necessary to produce food and raw material for clothing the people? The price paid for manual labor on the farm, when reduced to gold, is fully double the price paid for like service thirty years ago. So the first benefit of the improvements in machinery inures to the laborer. The employer pays more to his men than is saved by the improved implements. If three men, at $1 each per day, did the work now accomplished by two men, each receiving $2 per day, then the sum paid is $3 against $4, the extra dollar going to the laborer. The prices of farm products are higher than they were thirty years ago, or the employer could not pay the present prices of labor. The liberating of one third of the agricultural laborers, and setting them free to engage in other occupations, is felt in all branches of business. The laborer now has money to provide his family with comforts unknown in his mode of life thirty years ago. The immediate consequences of this plenty, with people who will work, are better education and more independence and elevation of character. Savings banks have larger deposits, merchants sell more goods, and all branches of business are quickened. Mr. Thomas estimates the value of the implements of American farming at more than $400,000,000. Our mechanics have not only to keep good this supply, but, because of superior materials and workmanship, they export largely to Europe.

The tendency of the improvements in implements has been in favor of large farms, as it is only a large farm that will justify the outlay of capital necessary to have a full supply and to keep up with the latest improvements; and the large farm justifies the construction of comfortable houses for the accommodation of families, which find permanent homes and employment. Systematic and organized labor comes next. Rotation, draining wet lands, removal of all stones and other obstructions to the use of machinery, the careful preservation of manure, the raising of live-stock with grain and the dairy-products,—these things bring the whole into harmony, and the use of green crops, stimulated by special manures when necessary, gives large returns and constantly increasing fertility. The first settlers, partly from necessity, partly from ignorance of their own interests, do indeed impoverish their lands, but they are succeeded by men who follow the rational system, under which the lands are made to produce crops far more remunerative than were raised by those who went before them. In the new States the farming of to-day must generally be classed as of the exhaustive kind. The farming of the older States is fast assuming the most healthy condition.

Aside from the labors that have been described as having been performed by the farmers of our country, and their advance in wealth, they have not failed to give their attention to the improvement of their animals. The horse in the hands of our breeders has had his useful powers developed beyond anything done elsewhere. The more practical American mind has discarded the running horse, and tried to produce one "of all work," good for the plough, the carriage, or the saddle. Substance, endurance, strength, and speed in the useful movements of the walk or trot have been the objects aimed at, and the result has been a better horse "for all work," and for any work except profitless racing, than has before been known. The American farmer has purchased the best neat-cattle of the Old World and brought them here, and by his skill in breeding has given them a reputation so high that at public sales their descendants have sold to men representing breeders of England at prices ranging from four to eight times as much as has been paid at any time in England. The sheep that a short time ago produced the clothing of Europe have been brought from their native hills of Spain to this country, and by the skill of our farmers their fleeces have been fully doubled in quantity to any raised elsewhere, without any deterioration in quality; and there appears to be no point yet reached in this improvement beyond which it may not go.

These victories are proofs that men who combine in themselves the interests of both cultivator and owner of the lands have inducements that must lead to thorough knowledge of the laws of production of both animal and vegetable food, and that must ultimately lead them to the highest social and political position.

The next generation, with its increased capital and more cultivated tastes, will devote more means and attention to making the homes of farmers attractive. Carefully cultivated ornamental trees and shrubberies, flowers, and walks will add to the charms of country life, and increase self-respect and public consideration. GEORGE GEDDES.

Far'mingdale, a v. and tp. of Kennebec co., Me., 5 miles S. of Augusta, on the W. side of the Kennebec and on the Kennebec and Portland R. R. Ice and stone-ware are produced here. Pop. 859.

Farmingdale, thriving post v. of Howell tp., Monmouth co., N. J., on the New Jersey Southern and the Freehold and Jamesburg R. Rs., 26 miles S. S. W. of Sandy Hook. It has marl-works and some manufactures.

Farmingdale, post v. of Oyster Bay tp., Queens co., N. Y., on Long Island and Stewart's Central R. Rs., has 2 hotels, stores, weekly newspaper, union school, and large brickyard (Stewart's). J. [illegible], Ed. "[illegible]."

Farm'ington, tp. and post-v. of Hartford co., Conn., on Farmington River and on the New Haven and Northampton R. R., 31 miles N. of New Haven. It has a national and a savings bank, a ladies' seminary, and important manufactures. Pop. 2616.

Farmington, tp. and post-v. of Fulton co., Ill., on the Chicago Burlington and Quincy R. R., 11 miles N. of Canton. The village [illegible]. It has a weekly and a monthly newspaper. Pop. of tp. 2066.

Farmington, tp. of Cedar co., Ia. Pop. 1249.

Farmington, tp. and post-v. of Van Buren co., Ia., on the Des Moines River and the Burlington and Southwestern and the Keokuk and Des Moines R. Rs., has 1 school, 6 churches, 1 hotel, mill, machine-shop, and a weekly newspaper. Pop. of v. 640; of tp. 11[illegible]9.

L. M. MOORES, ED. "GAZETTE."

Farmington, tp. of Republic co., Kan. Pop. 219.

Farmington, post v. and tp., capital of Franklin co., Me., 80 miles N. E. of Portland, and at the terminus of the Androscoggin R. R. It has a national bank, a savings bank, 1 weekly newspaper, a State normal school, Abbott's Family School for boys, Wendell Institute for boys and girls, "The Willows" school for young ladies, a library, 8 churches, 3 hotels, an iron-foundry, 3 grist and flour mills, several saw, shingle, and clapboard mills, 2 drum-manufactories, a box-factory, a steam sash, door, and blind manufactory, a cheese-factory, about 30 stores, etc. Its schools make it one of the best educational centres in the State. Principal business, mercantile, farming, and dairying. Several valuable slate-quarries were discovered here in the fall of 1873, and the legislature of 1854 granted charters to two companies for opening and manufacturing. The slate is a superior quality for mantels, billiard-tables, etc. Pop. of tp. 3251. A. H. S. Davis, Ed. and Prop. "Farmington Chronicle."

Farmington, post-tp. of Oakland co., Mich. Pop. 1927.

Farmington, post-v. of Dakota co., Minn., 27 miles from St. Paul, on the Milwaukee and St. Paul R. R., also junction of the Hastings and Dakota R. R. It is in an almost exclusively farming country, mainly devoted to wheat-raising. It has 2 hotels, 1 newspaper, 1 flouring-mill, 2 shoe-manufactories, several manufactories of carriages, 1 large wheat-elevator, and the usual number of stores. Pop. about 2000. J. W. Emery, Ed. "Press."

Farmington, tp. of Olmsted co., Minn. Pop. 937.

Farmington, post-v., capital of St. François co., Mo., 2½ miles from the St. Louis and Iron Mountain R. R., on the turnpike leading from Iron Mountain to Ste. Genevieve. It has 2 newspapers, 4 churches, 1 good public-school building, an excellent jail, and other good buildings. Pop. 393. Wash. Hughes, Ed. "New Era."

Farmington, tp. and post-v. of Strafford co., N. H., on the Dover and Winnipiseogee R. R., 10 miles S. E. of Alton Bay. It has 1 national and 1 savings bank, 3 churches, a high school, and manufactures of boots, shoes, and lumber. Pop. 2063.

Farmington, post-tp. of Ontario co., N. Y. Pop. 1896.

Farmington, post-tp. of Davie co., N. C. Pop. 2047.

Farmington, post-tp. of Trumbull co., O. Pop. 1056.

Farmington, tp. of Clarion co., Pa. Pop. 1642.

Farmington, tp. of Tioga co., Pa. Pop. 997.

Farmington, tp. of Warren co., Pa. Pop. 1101.

Farmington, post-v., county-seat of Davis co., Ut., on the Utah Central R. R., 21 miles S. of Ogden and 16 miles N. of Salt Lake City.

Farmington, post-v. of Lincoln tp., Marion co., West Va., on the Baltimore and Ohio R. R., 10 miles W. of Fairmont. Pop. 85.

Farmington, post-tp. of Jefferson co., Wis. Pop. 2416.

Farmington, tp. of La Crosse co., Wis. Pop. 1522.

Farmington, tp. of Polk co., Wis. Pop. 593.

Farmington, tp. of Washington co., Wis. Pop. 1885.

Farmington, tp. of Waupacca co., Wis. Pop. 734.

Farm'land, post-v. of Monroe tp., Randolph co., Ind., on the Cleveland Columbus Cincinnati and Indianapolis R. R., 13 miles E. of Muncie. Pop. 532.

Farm Ridge, post-tp. of La Salle co., Ill. Pop. 1042.

Farm'ville, post-v. and tp., capital of Prince Edward co., Va., on the Appomattox River and the Atlantic Mississippi and Ohio R. R., 70 miles S. W. of Richmond and 7 miles N. of Hampden-Sidney College and the Union Theological Seminary. It has 3 banks, 1 insurance company, 1 weekly newspaper, 1 female college, 6 churches, 33 stores, 2 hotels, and several large tobacco-factories and warehouses. Principal business, tobacco-trade. Pop. of v. 1543; of tp. 2496. C. E. Madison, Ed. "Mercury."

Farne (or **Fern**) **Islands,** a group of seventeen islets and rocks, some of which are visible only at low tide; they are situated 2 to 5 miles off the E. coast of England, opposite Bamborough, Northumberland. On two of the islands lighthouses have been built, as navigation is extremely dangerous in these waters. On another of the isles is a tower raised in honor of Saint Cuthbert, who lived there during the last two years of his life. Lat. of Farne lights, 55° 37′ N., lon. 1° 39′ E.

Farne'se (Alexander), duke of Parma and governor of the Netherlands, b. about 1546, and went with his mother to the Netherlands in 1559. Nov. 18, 1565, married the princess Mary of Portugal. At the naval battle of Lepanto, Sept. 16, 1571, greatly distinguished himself. He assumed the government of the Low Countries in 1578, and gained important victories. In 1588 was appointed commander of the Spanish "Invincible Armada," but was so shut up in Antwerp by the Dutch fleet as not to take any part in its fortunes. In the French civil war in 1590 he invaded the country, and compelled Henry IV. to raise the siege of Paris. Opposing Henry IV. of France and Maurice of Nassau, he was so wounded before Caudebec as to die at Arras 3d of Dec., 1592.

Farn'ham is a town of England, in the W. of Surrey, on the left bank of the Wey. It contains the fine old castle of the bishops of Winchester, first built by Bishop de Blois, but razed by Henry III., then rebuilt by Charles I., and restored to its present state in 1684. Pop. with suburbs, 39,872.

Farnham, post-tp. of Richmond co., Va. Pop. 1354.

Farnham (Eliza Woodson), Mrs., authoress and philanthropist, was b. at Rensselaerville, N. Y., Nov. 17, 1815, went to Illinois in 1835, and in 1836 married Thomas J. Farnham. In 1841 she returned to her native State, visited prisons and lectured to the women convicts until 1844, when she was four years matron of the Sing Sing (N. Y.) State prison. In this period she published *Life in Prairie-Land* and edited Samson's *Criminal Jurisprudence*. In 1848 she was connected with the Boston (Mass.) Institution for the Blind. In California from 1849 to 1856; she then returned to New York, and published *California, Indoors and Out*. *My Early Days* appeared in 1859, and in that year she organized a society to aid and protect destitute women in emigration to the West. *Woman and Her Era* was published in 1864, and Dec. 15 of that year she d. in New York City. Her maiden name was Burhans.

Farnham (Luther), American Congregational clergyman, b. at Concord, N. H., Feb. 5, 1816, was pastor at Northfield, Mass., and at Marshfield, Mass.; secretary of the Southern Aid Society (1855–61), and then secretary of the General Theological Library at Boston. *Glance at Private Libraries* was published in 1855.

Farnham (Noah L.), an American officer of volunteers, b. at Haddam, Conn., June 6, 1829, removed to New York at an early age, and soon became an active member of the City Guard, being on duty at the Astor Place riot. On the outbreak of the civil war he left for Washington with the Seventh New York, but soon after his arrival accepted the appointment of lieutenant-colonel of Ellsworth's Zouaves, succeeding as colonel on the death of Ellsworth. Though confined to a sick bed at the time of his regiment being ordered to Manassas, he insisted upon leading his regiment, and while gallantly fighting at the head of his men he received a wound which resulted in his death, Aug. 14, 1861. George C. Simmons.

Farnham (Ralph), American Revolutionary soldier, b. at Lebanon, Me., July 7, 1756; d. at Acton, Me., Dec. 26, 1861, the last surviving soldier of the Bunker's Hill fight. In 1780 he was at Acton, its first inhabitant.

Farnham (Thomas Jefferson), a traveller, husband of Eliza W. Farnham, b. in Vermont 1804, in 1839 organized and led a small expedition across the continent to Oregon. In California in the same year he procured the release of a large number of American and English prisoners from the Mexican government. *Travels in Oregon Territory* appeared in 1842, *Travels in California* and *Scenes on the Pacific* in 1845, a *Memoir of the North-west Boundary Line*, with *Mexico, its Geography, People, and Institutions*, in 1846. D. in California, Sept., 1848.

Farns'worth (Benjamin Franklin), D. D., American clergyman and educator, b. at Bridgeton, Me., Dec. 17, 1793, graduated at Dartmouth College 1813; was Baptist pastor at Edenton, N. C.; principal of the Bridgewater (Mass.) Academy from Sept., 1821, to 1823, then of a female high school at Worcester, Mass. He was professor of theology at the New Hampton Theological Institute from May, 1826, to 1833, and in 1836 president of Georgetown College, Ky., subsequently of Louisville (Ky.) University from 1837 to his death, June 4, 1851.

Farnsworth (Elon J.), American brigadier-general of volunteers, b. in Livingston co., Mich., 1835, was killed at the battle of Gettysburg, July 3, 1863. In the summer of 1861 he was battalion quartermaster of the Eighth Illinois Cavalry, then captain. Was in the Peninsular and in Gen. Pope's campaigns, aide to Gen. Pleasanton in May, 1863, and brigadier-general June 29, 1863.

Farnsworth (John F.), American Congressman and soldier, b. in Eaton, Lower Canada, Mar. 27, 1820, is a lawyer and has been representative from Illinois in the 35th, 36th, 38th, 39th, and 40th Congresses. In 1861–63 he served in the civil war, at first commanding the Eighth Illinois Cavalry. In 1863–64 he raised the Seventeenth Illinois Volunteers, having been brevetted brigadier-general in 1862.

Farn'worth, town of England, in the county of Lancaster, manufactures sail cloth, watches, files, and all kinds of iron tools. Pop. 8720.

Fa'ro, the capital of the province of Algarve, Portugal, is situated at the mouth of the Formosa, where three small islands form a somewhat confined but otherwise convenient and safe harbor. Faro exports considerable quantities of oranges, figs, anchovies, and cork, and is a bishop's see. Pop. 8361.

Fa'ro, a game at cards, used only in playing for money. It is played in different ways in different countries, but in all the player contends against a bank, represented by a professional faro banker; and the chances, though apparently only slightly in favor of the bank, are in reality quite strongly so. The game is illegal in many cities and in some of the States.

Farochon (JEAN BAPTISTE EUGÈNE), b. at Paris in 1807, was a pupil of David, attained fame as a sculptor and medallion cutter, and in 1863 attained a professorship in the Paris School of Fine Arts.

Fa'röe, or **Faerö** [Dan. *Färöerne*], a group of islands, twenty-two in number, of which only seventeen are inhabited, belonging to Denmark, and situated in the North Atlantic, nearly midway between the Shetlands and Iceland, between lat. 61° 20′ and 62° 20′ N., and between lon. 6° and 8° W. Their entire area is about 500 square miles; the population, 9992. The principal island is Stromö, with the cap. Thorshavn. All these islands are basaltic formations, rising conically to a height of 3000 feet, with steep and lofty coasts, abruptly broken by deep inlets, which often afford the safest and most convenient anchorage, but which sometimes cause whirlpools or form currents, thereby making navigation very dangerous. The trap rock is covered with a thin layer of vegetable soil, which yields a superb pasturage. Of trees there are none, on account of the furious gales which always prevail here; peat and miocene coal, of which a seam of good quality has recently been discovered on Suderöe, are used as fuel. Of the common cereals and vegetables, only barley, turnips, and potatoes can be raised, on account of the high northern latitude; yet the oceanic influences modify the climate so greatly that snow rarely lies long on the ground, and the cattle graze the greater part of the year in the open air. Cattle and sheep are not the only resources, however, of the inhabitants. The waters abound with fish, and the feathers and eggs of the myriads of fowls which swarm around these coasts are often sources of considerable wealth. The inhabitants are of Norwegian origin. In the ninth century the islands were discovered by the Norwegians and peopled by Norwegian settlements, but during the long connection between Denmark and Norway the islands passed into possession of the Danes, and they are now governed by a Danish *amtmand;* they send a representative to the Danish *rigsdag*.

Far'quhar (GEORGE), Irish dramatist, b. at Londonderry, 1678, was educated at the University of Dublin, settled in London, and d. there in Apr., 1707. *Love and a Bottle* (1698), *Twin Rivals* (1703), and *The Beaux' Stratagem* (1707), comedies, were among his productions. His works have been recently published in the same volume with those of Wycherley, Congreve, and Vanbrugh, London, 1849, by Moxon.

Farquhar (NORMAN H.), U. S. N., b. Apr. 11, 1840, in Pennsylvania, graduated at the Naval Academy in 1859, became a lieutenant in 1861, a lieutenant-commander in 1865, a commander in 1872. Served as executive officer of the steamer Mahaska, North Atlantic blockading squadron, in 1862–63, during which period he was frequently under fire afloat, and several times engaged, in co-operation with the army, in expeditions on shore. His character and services are thus honorably mentioned by Commander Foxhall A. Parker in an official report dated Nov. 26, 1862: "I should do injustice to my own feelings and to the service were I to close this report without making special mention of Lieut. Farquhar, upon whom the major portion of the labor attending our little enterprises devolved. Always reliable and always efficient, his high standard of professional character is apparent in everything he undertakes." As executive officer of the Santiago de Cuba, Farquhar participated in both attacks on Fort Fisher, and led the men of that vessel in the assault on the fort of Jan. 15, 1865, when he behaved with his usual coolness and intrepidity.

FOXHALL A. PARKER.

Farr (WILLIAM), M. D., F. R. S., D. C. L., English writer and superintendent of the statistical department of the registrar general's office at Somerset House, b. at Kenley, Shropshire, 1807, was educated at Dorington and Shrewsbury and at the Universities of Paris and London. Practising medicine in London, he edited the *Medical Annual* and the *British Annals of Medicine*. He has written much for medical journals, the "Vital Statistics" in *McCulloch's Statistics of the British Empire*, official reports on the public health, and on the *Causes of Death in England* (1857–70), reported in detail the cholera epidemic of 1849, framed a new *Statistical Nosology*, etc.

Far'ragut (DAVID GLASGOW), America's great admiral, was b. at Campbell's Station, East Tenn., July 5, 1801. Descended, on his father's side, from Don Pedro Ferragut, one of the "conquerors" of Majorca, he inherited from him, in all likelihood, that love of adventure and fearlessness of danger which, according to the Aragonese troubadour of the thirteenth century, Mossen Jaime Febrer, were the distinguishing traits in the character of the renowned Don Pedro. On his mother's side he came from the good old Scotch family of McIven.

Entering the navy as a midshipman Dec. 10, 1810, he had the good fortune to serve first under Capt. David Porter, who had procured him his appointment, and who now instilled into his youthful mind those ideas of devotion to duty from which he never swerved during his long and eventful career. "The boy is father to the man," and on the quarter-deck of the Essex, under the watchful eye of her commander, was formed the hero who was to lead his country's fleets to victory up the "River of Death," and by Forts Morgan and Gaines into Mobile Bay.

In 1823, Midshipman Farragut took part in the severe fight between our naval forces under Com. Porter and a large band of pirates strongly intrenched at Cape Cruz, Cuba, which lasted twelve hours, and resulted in the utter defeat of the latter and the suppression of piracy in the West Indies. This was his last battle-service as a young man, and he now entered upon the regular routine duties of his profession, broken only by a year's residence in Tunis with our consul, Mr. Charles Folsom, afterward a distinguished professor of Harvard, who kindly directed his studies and gave him that "thirst for information," says Mrs. Farragut in a letter to the writer, "which, as his eyes were not strong, kept all his household busy reading to him." His knowledge was varied, and in matters relating to his profession profound, and he was one of the best linguists in the navy. Passing in succession through the grades of lieutenant and commander, the war of 1861–65 found him a captain and living in Norfolk, Va., where every inducement was held out to him to unite his fortunes with the seceding States. But, "intimately connected with the South as he was by birth, marriage, and residence, he was a son of the republic rather than a citizen of a State;" and so, leaving Norfolk on Apr. 19, 1861, he took his family to Hastings on the Hudson, and then hastened to offer his services to the government.

The capture of New Orleans being resolved upon, Farragut was chosen to command the fleet destined to effect this purpose, his force consisting of the West Gulf blockading squadron and Porter's mortar flotilla. In Jan., 1862, he hoisted his broad pennant on board the Hartford at Hampton Roads, and sailing thence on Feb. 3d, reached Ship Island on the 20th, where he at once began his preparations for the work before him.

On the 20th of April, after a council of war had been held, Farragut issued a general order to his fleet, in which he gives his views at length as to the proper mode of attack to be adopted by it, and adds: "The flag-officer having heard all the opinions expressed by the different commanders, is of the opinion that whatever is to be done will have to be done quickly. When, therefore, the propitious time has arrived, the signal will be made to weigh and advance to the conflict." In accordance with this order, at 5 minutes before 2 o'clock on the morning of Apr. 24th, two red lights were hoisted at the mizzen-peak of the Hartford, and immediately each vessel commenced heaving up her anchor. At half-past 3 the whole fleet was under way, and standing up the river in two columns, the right column being instructed to engage Fort St. Philip, the left, Fort Jackson. It is not our province here to relate the particulars of the battle that ensued—to describe the fire of hell rained upon the forts from Porter's flotilla; their fierce fire in reply; the sinking of two Confederate vessels by the Varuna, and her foundering, at the moment of victory, almost by their side; the duel between the Mississippi and the ram Manassas; the silencing of Fort St. Philip by the Brooklyn; the Hartford in flames halfway up to her tops, and yet never for a moment relaxing her fire. Suffice it to say, that a great victory was won and New Orleans ours, and that, in recognition of his glorious services, Farragut received the thanks of Congress and was made a rear admiral. In the summer of 1862 he "ran the Vicksburg batteries up and down the river," and on Mar. 14, 1863, passed through the frightful fire of the forts at Port Hudson, and opened communication with Flag-officer Porter, who commanded on the Upper Mississippi. On May 24th, in con

junction with the army, he commenced active operations against Port Hudson, and when it fell, on July 9th, he turned over to Porter, who five days previously had been made a rear-admiral, the entire control of the Western waters above New Orleans. He now enjoyed a short respite from his labors, but on Jan. 20th of the following year we find him making a reconnoissance of Forts Morgan and Gaines, and expressing the opinion that "with a single iron-clad and 5000 men he could take Mobile."

At length, on the morning of Aug. 5, 1864, with four iron-clads and fourteen wooden vessels, the rear-admiral filled up the measure of his fame by the victory of Mobile Bay.

The fleet was in two columns, as at New Orleans, the iron-clads being on the right and a little in advance, with the Tecumseh leading, the wooden vessels, lashed together by twos, forming the port column, with the Brooklyn and Octorora leading. Next astern of the Brooklyn was the Hartford, carrying now, as at New Orleans, the flag of the commander-in-chief. In this order the attacking fleet steamed steadily up the main ship-channel, "the Tecumseh firing the first shot at 47 minutes past 6 o'clock. At 6 minutes past 7, Fort Morgan opened, and was replied to by a gun from the Brooklyn, and immediately after the action became general." Suddenly, however, the Tecumseh reeled as from an earthquake-shock, and went down almost instantaneously—sunk by a torpedo—while the Brooklyn, observing "a row of suspicious buoys directly under her bows," stopped and backed, thus arresting the advance of the whole fleet. A moment's hesitation now on the part of the rear-admiral and the battle is lost! But Farragut, high up in the main rigging, overlooking the whole scene of action, is equal to the emergency. "Go ahead at full speed!" he cries to Drayton, the captain of the Hartford; and the order being instantly obeyed, the Hartford dashes onward, and the other ships follow, "the officers and men believing they are going to a noble death with their commander-in-chief." At this supreme moment the gallant seaman raised his heart in supplication to the Almighty. "O Thou Creator of man! who gave him reason," he prayed, "guide me now. Shall I continue on, or must I go back?" "A voice then thundered in my ear," said he afterward in speaking of this battle, "'Go on!' and I felt myself relieved from further responsibility, for I knew that God himself was leading me to victory."

The rest is a tale we all know—how the forts were passed, the gunboats dispersed or captured, and the formidable ram Tennessee forced to strike her colors to the old flag she had so long set at defiance.

The fall of Mobile was now reduced to a mere question of time. Fort Powell was blown up Aug. 6th, and a few days thereafter Forts Gaines and Morgan surrendered. "The navy will do its whole duty," wrote the rear-admiral to Secretary Welles shortly before the great fight, and well had the navy justified his prediction.

In November, Farragut returned to his home, and on Dec. 22d he was made a vice-admiral. But the people demanded that the nation's hero should be further rewarded, and in July, 1866, the grade of admiral was created for him whose name had become a household word throughout the land. But he was not destined long to enjoy his earthly honors. His arduous services had greatly impaired his health, and in the summer of 1870, at Portsmouth, N. H., Aug. 14, after a long and painful illness, he died as he had lived—a Christian gentleman, and mourned by the whole nation. In battle he was as fearless as Nelson, in public virtue and patriotism not excelled by the greatest heroes of antiquity, while in his spotless purity of character he rivalled the illustrious Collingwood. There are many naval names dear to the American heart, but

"A brighter name must dim their light
With more than noontide ray—
The Viking of the river-fight,
The conqueror of the bay!
Shape not for him the marble form,
Let never bronze be cast,
But paint him in the battle-storm,
Lashed to his flag-ship's mast."

FOXHALL A. PARKER.

Far'rar (ELIZA WARE) was b. in Flanders, Europe, in 1791, and was the daughter of Benjamin Rotch of New Bedford, Mass. In 1828 she married Prof. John Farrar of Harvard University. *Congo in Search of his Master* was written and published in England. It was followed by *Children's Robinson Crusoe*, *The Story of La Fayette*, *The Life of Howard*, *Youth's Letter-writer*, *Young Lady's Friend* (1837), and *Recollections of Seventy Years* (1866). D. at Springfield, Mass., Apr. 22, 1870.

Farrar (FREDERIC WILLIAM), D. D., F. R. S., son of a clergyman, b. in the Fort, Bombay, in 1831; graduated at Cambridge in 1854; became assistant master at Harrow in 1855, and master of Marlborough College in 1871. He is also chaplain in ordinary to the queen. He has published the following works of fiction: *Eric* (10th ed. 1858); *Julian Home* (4th ed. 1859); *St. Winifred's* (4th ed. 1863). His philological works are *The Origin of Language* (1860); *Chapters on Language* (1865); *Greek Grammar Rules* (6th ed. 1865); *Greek Syntax* (3d ed. 1867); and *Families of Speech* (1870). His more important theological works are *Seekers after God* (1869); *The Witness of History to Christ* (1871); *The Silence and Voices of God* (1873); and *The Life of Christ* (in two vols., 1874). He has also been a contributor to Smith's *Dictionary of the Bible* and other similar works. He is master of a singularly fresh and brilliant style. R. D. HITCHCOCK.

Farrar (JOHN), LL.D., American mathematician, b. in Lincoln, Mass., July 1, 1779, graduated at Harvard University, Mass., 1803. In 1805 he was Greek tutor at Harvard; from 1807 to 1831 professor of mathematics and natural philosophy at the same institution. In 1820 he married Lucy M. Buckminster, who d. in 1824; in 1828 he married Eliza Rotch. His *Elements of Algebra*, translated from La Croix, was published in 1818; in succeeding years he published eleven other translations of mathematical works, contributed to the *North American Review*, and d. at Cambridge, Mass., May 8, 1853.

Farrar (JOHN), b. at Alnwick, Northumberland, July 29, 1802, was educated near Leeds, became a minister in Aug., 1822, was governor of Abney House Wesleyan Theological Institution in 1839, and subsequently of Headingley College (1868); has been secretary and president of the Wesleyan Conference, the latter in 1854 and in 1870. A *Biblical and Theological Dictionary*, *Ecclesiastical Dictionary*, *Proper Names of Scripture*, and *A Manual of Biblical Geography* are his works.

Farrar (SAMUEL), b. at Lincoln, Mass., 1784, graduated at Harvard in 1797, and in 1800 became a tutor there. He afterwards was a lawyer at Andover, Mass., for thirty years was president of the Andover Bank, and for thirty-eight years treasurer of the Theological Seminary and Phillips Academy, of which institution he was a liberal benefactor. D. at Andover, Mass., May 13, 1864.

Farrar (TIMOTHY), LL.D., American judge, b. at Concord, Mass., July 11, 1747, graduated at Harvard University 1767, was a major in the American Revolution, and after its close a justice of the common pleas in New Hampshire for forty years. Feb. 22, 1802, he was appointed chief-justice. D. at Hollis, N. H., Feb. 21, 1849.

Farrar (TIMOTHY), LL.D., son of the preceding, b. at New Ipswich, N. H., Mar. 17, 1788, graduated at Dartmouth in 1807, was a law-partner of Daniel Webster from 1813 to 1816, from 1824 to 1833 judge of the New Hampshire court of common pleas, and vice-president of the New England Historical and Genealogical Society 1853–58. He has published the *Dartmouth College Case*, *Review of the Dred Scott Decision*, and articles in the *North American Review* and *New Englander*.

Far'rer (HENRY), a younger brother of THOMAS C. FARRER (which see), a rising artist, working principally in water-colors. B. in London Mar. 23, 1843, and followed his brother to New York in 1863, where he has since continued to reside. CLARENCE COOK.

Farrer (THOMAS CHARLES), an English artist, some time resident in New York, b. in London Dec. 16, 1838. His father was a radical of an extreme type, who, on principle, refused his son all means of education, and, as far as was possible, kept him from all companionship with his fellows. Farrer was seventeen years old before he learned to read or write. He early gravitated, however, to the light, and, encouraged by his mother, developed a love and aptitude for art, still further helped by the profusion of opportunity which London affords by the National Gallery, the British Museum, the Royal Academy, and, though last, not least, the print-shop windows. About 1855, Mr. Ruskin set up a free drawing-school in London, and here Farrer received his first and only definite instruction in drawing. In 1858, his father being dead, Farrer came to America, and after struggling for a considerable time he made the acquaintance of a number of young Americans of about his own age—artists, architects, and literary men, who, like himself, were enthusiastically devoted to the ideas and principles developed in the writings of Mr. Ruskin. This society welcomed Farrer as the ablest, and indeed the only, exponent of the faith that was in them, and they rallied so cordially about him as artist and teacher that his success was soon assured. He was a zealous and able teacher, and the influence he exerted through his classes at the Cooper Institute, his private pupils, his pictures in the Academy exhibitions, was very important. He insisted on close study from nature, on accuracy of drawing, on the importance of detail, and showed a prodigious industry and a skill in execution far

from common. But more important was the moral influence he exerted in counteracting the mercenary, worldly, and mechanic spirit that prevailed in the artist world here, and which was doing infinite harm to the artists themselves and to the public. Farrer's high personal character, his patient perseverance in poverty and neglect, his refusal to work otherwise than he thought right, were a tonic of which we stood in great need. We owe him more for this than for his pictures. He formed several artists—Henry R. Newman, Charles H. Moore, Margaret I. McDonald—and was not without influence on the Hills, father and son, though to them also, as independent teachers, the development of art in this country owes a great deal. In 1869, Farrer went to England, where he has since remained, and where he will probably continue to live, as he has been very successful there, taken cordially in hand by Mr. Ford Madox Brown, Mr. Ruskin, Mr. Morris, and other leaders in that circle of painters, poets, and teachers. While living in America, Mr. Farrer was devoted to those progressive ideas which we love to call American, and when the war for the Union broke out he entered the ranks as a common soldier, showing then, as always, that his devotion to principle was not mouth service merely. In 1864, Mr. Farrer married Anne Richards, daughter of the late Rev. James W. McLane. By this lady he has several children.

CLARENCE COOK.

Far'riery [remotely from the Lat. *ferrum*, "iron"]. From its derivation and the early use of the word, farriery means the trade of applying iron to the horse's foot. However, as all horse-surgery was of the coarsest and often of the most brutal kind, performed by the common smith with the tools and implements at hand, it is natural that veterinary surgery as it grew into a profession should have been called *farriery*. Now, however, the treatment of the diseases of our domestic animals is no longer of necessity left to the guesswork of the blacksmith, nor surgical operations to the tongs and searing-iron. Therefore we return to the original definition.

The foot of the horse is wonderfully guarded against injury from without, and equally protected against painful jars and disease which one might suppose would arise from the tremendous blows which the feet sustain when travelling upon hard roads. The hoof is a tough, elastic, horn-like substance, completely boxing in the delicate tissues, cushions, and bones of the foot. In the living animal and in the recent state it is in one piece, but after maceration it may be separated into the crust or wall, the sole, and the frog. The front part of the crust of each hoof is called the toe, the hindmost parts the heels, and the intermediate parts the quarters. The corresponding parts of the shoe have the same names. The *crust* grows from the coronet, at the top of the hoof next the hair, and from the sensitive laminæ which surround the pedal or coffin bone upon its upper sides. It is about half an inch in thickness at the edge, and in many horses so hard and tough that they hardly need shoeing at all except in icy weather or when used upon paved roads. The *sole* is a slightly-arched dome with a large segment removed, in the place of which the frog is found. The horn of the sole differs essentially from that of either the crust or the frog, it being more granular and shelly, wearing off naturally with comparatively little abrasion. At the rearward portions of the sole, divided as they are by the frog, two elevated ridges, of a character of horn more resembling the crust, occur. These are called the *bars*, and are really the ends of the crust reflected inward at the heels. The *frog* is a wedge-shaped body in form like a sharp pointed V, the point being turned forward. It is of an exceedingly spongy and elastic kind of horn, and is placed as a cushion between the navicular bone and joint and the ground, to relieve concussion and to distribute jars so as to break their force. With every step of the natural foot, unshod as well as when at rest, the frog communicates a pressure directly upon the navicular joint and the tendons which underlie it. In ordinary shoeing the frog never touches the ground, being cut away and left reduced in size, while at the same time the foot is lifted up from the earth by thick-heeled or calked shoes. That a foot so treated becomes diseased is not to be wondered at. The wonder is that acute diseases of the foot are not much more prevalent. The flexibility and elasticity of the hoof, concerning which so much is written, rests chiefly, indeed almost altogether, in the frog, slightly in the sole, and practically very little or not at all in the crust or walls of the foot. Much has been written about the expansion and elasticity of the quarters and heels. It may be disregarded. There is indeed elasticity in the crust, but it is only brought into play perceptibly under extraordinary circumstances.

When an unshod natural hoof is placed upon hard ground, the parts which bear upon it are the edge of the crust all around and the frog. Upon uneven ground the sole is frequently called upon to sustain its share of the weight, and when the horse steps upon frozen clods or stones the sole often bears the whole. In travelling upon ordinary country roads the hoof wears very evenly; upon gravelly roads the toe usually wears fastest, and will first become tender. If the toe and quarters be protected from wear by a narrow shoe, for ordinary service no other shoeing will be necessary. If such a shoe, which is the "half-moon shoe" of Coleman, drawn out thin at the quarters, be seated nearly level with the sole by cutting out the crust of the hoof upon the toe and quarters, it is evident that the horse will have his natural foot, with simply an iron front edge to take the wear. This is the lightest and best shoe a horse can wear when his work is not too severe nor upon too rough ground. Were the same principle to be carried out in a shoe similarly seated (level with the sole), much wider in the web, and extended to the heels, so as to protect the foot thoroughly, the foot would still have its natural bearings, and be guarded against even extraordinary wear and tear. The frog would bear upon the ground, and so would the sole, nearly as much as if the hoof were not shod.

The presence of a shoe prevents the natural wear of the hoof; hence, sooner or later, according to the rapidity of growth of the horn, it must be reset and the horn pared back as nearly as possible to the condition it would have been in if it had not been shod and had worn off evenly and naturally. The earliest shoes worn by horses were probably plates of iron, having a similar shape to our present horseshoes, but covering a much larger portion of the hoof. This necessitated a paring away of both crust and sole when the shoes were reset. The sole is very easily cut by the smith, and so is the frog, while the crust is hard and tough. It is easily rasped off, however, after the sole is cut away, and the smith has plain sailing.

When a horse is brought to a common blacksmith to be shod, the "clinches" at the ends of the nails are first cut off; then the shoe is wrenched off with the tongs, a portion of the crust coming off frequently with it. This is done by an apprentice, who then proceeds to pare out the sole all around, cutting close to the frog. The cutting down of the crust is done by the smith himself, if he is a very careful man, or by an experienced journeyman, but quite as often trusted to an apprentice, who forms roughly, at his discretion, the seat for the shoe. Then the shoe is shaped, heated red hot or nearly so, and a seating burned level by the application of the hot shoe—an operation liable to do serious harm. When the shoe is formed to fit the foot it usually happens that if flat at first the heels are made nearly twice as thick as the toe, if indeed they be not turned down into calks, making the shoe at the heels half an inch to an inch or more in thickness; and thus it is applied. The result is that no part of the hoof touches the ground. The frog, upon which so much depends, is gradually reduced in size, both by the paring of the smith and (especially) by lack of use: it shrivels often to one-third its proper size. The paring out of the sole is usually accompanied by the cutting away of the bars entirely, which the smith says he does "to open the heels." The foot, thus weakened and placed in a most unnatural position, becomes the seat of disease. When the bars are cut away, or the soles pared too thin near the heels, and the frog has no bearing upon the ground, ulcers occur near the heels, which are called *corns*.

The frog should, by its constant pressure at every step, give healthy action to the navicular bone and joint; this wanting, inflammation or fever of these parts, *navicular disease*, results. To this, horses with strong, solid-looking hoofs are especially liable. Flat-footed horses are liable to another trouble from the same cause—namely, [illegible]. As already said, the weight of the horse is sustained naturally upon the crust of the hoof and upon the frog. Where the frog can bear none the crust must sustain all. The crust grows in part from the sensitive laminæ enveloping the pedal-bone, and is attached to them by laminæ of horn interlocking, or, rather, interleaved, with them, and it is upon these sensitive laminæ that all the weight is thus placed. They can bear a great deal naturally, but inflammation (*laminitis*) is almost sure to come when there is a provoking cause, and the [illegible] [illegible] [illegible]. *Seedy toe* is a form of laminitis, where the crust separates from the laminæ at the toe. *Pumiced foot* is a name given to another form of laminitis, wherein the sole becomes convex instead of concave, and the horn is spongy within and externally brittle, the whole foot being in a highly feverish condition. *Contraction of the* [illegible] [illegible] from the same general cause—namely, want of frog-pressure. *Thrush* is a disease of the frog, made apparent by a very offensive discharge from the cleft, and [illegible] [illegible] generally from lack of use of the frog, and, except the frog be wounded, probably altogether from this cause. *Quittor* is an ulcer or abscess of the foot, result

ing from bruise, nail-prick, thrush, or any other cause which may finally, if neglected, affect the coffin or pedal bone. It cannot be treated by the farrier, but presents a problem which only a surgeon can properly solve. Taken in time, a cure is possible. *Sand-crack, quarter-crack,* etc.—The fibres of the horn in the wall of the hoof run from the coronet to the ground direct. In hoofs subject to inflammation the secretion of horn is often of a weak character, and the fibres separate, forming a crack, or, in case of an injury to the coronet, a soft, spongy streak in the horn, causing lameness. The cause of the former is bad shoes and bad shoeing—of the latter, usually, "calking," the horse treading on his own coronet. The cure for both is causing healthy horn to be secreted by rest and counter-irritants, and shoeing so as to give bearing to the frog and sole. *Nail-prick* in shoeing shows itself either at once, in which case little harm usually results, or after the horse has been used a day or so, in which case suppuration may take place. The horse will tell which nail is at fault when the hoof is tapped by the hammer around the clinches. The offending nail must be taken out, the shoe being removed, the hole probed, and if any fetid odor be perceptible and the hoof be hot, the hole must be enlarged, and, in case of any discharge, cut out until blood flows, and the opening syringed out with chlorinated soda, chloride of zinc, or some other active prophylactic. The shoe may be replaced if necessary, provided the animal is not seriously lame, the nails being lightly driven. The foot must be kept cool and rest given. Nails picked up on the road will seldom enter the sole to do injury if it be not pared down, and thus softened and weakened; but they may be found between the frog and the bars, in which situation they seldom do much injury unless neglected. The wound should be cleaned out and syringed with some corrosive as above mentioned. *Overreaching* is when a horse throws his hind foot into the heels or against the sole of the fore foot as it is partially raised to take the step in trotting. It occasions bruises on the heels or in the sole near the toe. The former are treated by external applications—tincture of arnica, etc.; the latter like a prick or any bruise of the sole. A horse well shod will seldom overreach, but long hoofs or big toe-calks on the fore feet will cause the foot to be placed upon the ground an inch or two short of where it should rest, and this is sufficient cause for the trouble. *Interfering, or "cutting."*—A horse allowed to tread fairly on the ground seldom or never cuts himself, if the shoe does not extend outside the crust.

So far as we are aware, the most rational system of horseshoeing ever proposed is that invented by Mr. Goodenough, and called the Goodenough system. It has been for several years, and is now, extensively used by street-railroad companies in New York and Brooklyn and elsewhere, and by omnibus, express, and transfer companies also. The superintendent of one of these stables informed the writer that the simple use of the Goodenough shoe and system, without any other application, had cured corns, quarter-cracks, thrush, etc. throughout his stables, and had developed previously shrunken frogs, spread out contracted heels, and given his horses almost uniformly sound feet. The shoe is applied by cutting out a seating for it, leaving the sole and frog as much exposed as possible, and never applying the knife to either. It is light, has five calks or bearings, a lower surface, similar to the edge of the natural foot, is beveled on both surfaces, the nail-holes are countersunk, and the shoes are applied *cold*.

M. C. Weld.

Far'rington (William George), D. D., an American clergyman, b. Dec. 15, 1832, in the city of New York; graduated from Columbia College in 1853, and from the General Theological Seminary, New York, in 1856. Was ordained deacon on St. Peter's Day and priest on St. Thomas' Day of the same year, and entered upon the rectorship of St. John's church, Huntington, L. I., which he held until July 4, 1858. Assisted in Trinity parish, New York, from Dec. 15, 1858, to Easter, 1862. In the spring of 1863 he organized the parish of Christ Church, Hackensack, N. J., and continued rector of the same for seven years. In 1870 accepted a call to St. Barnabas' church, Newark, and in 1872 took charge of the church of the Holy Innocents, Orange, N. J., where he resides (1874). Published a tractate on *The Historical Church* in 1861, and has edited *The Church Almanac* since 1868. Was elected secretary of the diocese of New Jersey in 1867, and secretary of the General Theological Seminary, New York, in 1869, both of which offices he still holds. The degree of master of arts was conferred upon him by his alma mater in 1856, and the degree of doctor of divinity by the College of William and Mary, Va., July 4, 1873.

Far Rock'away, bathing-place upon Rockaway Beach (Long Island), is in Hempstead tp., Queens co., N. Y., on a branch of the Southside R. R., 21 miles S. E. of Brooklyn.

Fars, or **Farsistan'** [a name etymologically identical with *Persia*], a province of Persia, lying between lat. 28° and 32° N. and lon. 50° and 55° E., presenting an area of 55,000 square miles, with a population of 1,700,000, and bounded by the Persian Gulf and the provinces of Khoozistan, Irak-Ajemee, Yezd, Kerman, and Laristan. Along the gulf the land is low, sandy, or argillaceous, scorched by the sun—a desert; farther back it rises through broad terraces, separated from each other by high and wild mountain-ranges, into a flat, sandy table-land, where the large salt lake Bakhtegan occurs. The terraces belong to the most fertile and beautiful regions on earth. They are well watered by the Bundemeer (Araxes), which flows into Bakhtegan, and by the Nabou and the Tab (Arosis), which fall into the Persian Gulf. They produce tobacco, wine, rice, dates, opium, linen, cotton, silk, and kermes. They are the home of the rose, from which is manufactured the celebrated perfume, attar. They have iron and lead mines and marble and alabaster quarries. The principal towns are Shiraz, Jehroom, Darab, and Bushire. In this province occur the ruins of Persepolis, Pasargadæ, and Shapoor, and the celebrated sculptured rocks called by the Persians *Naksh-i-Rustam*.

Far'thing [from the Ang.-Sax., and signifying a "fourth part"], a British coin, the fourth part of a penny. It was coined by the Saxons, and again by King John (1210), but the quarter of a penny, cut twice across, also passed for a farthing. In Edward VI.'s time the coinage of silver farthings ceased. An act 9 Henry V. mentions a *gold* farthing. Copper farthings were first struck in 1665; tin farthings appeared in 1684 and 1692; half farthings were coined in 1843 and 1852. A farthing is worth about half a cent.

Farthingale. See Crinoline.

Far'well, post-v., capital of Clare co., Mich., 55 miles N. W. of Saginaw, on the Flint and Père Marquette R. R. It has a union school, 2 churches, 1 newspaper, 2 hotels, 1 ladies' library, 1 public park, 1 manufactory of hemlock extract, 1 large saw-mill, and 8 stores. It was organized on temperance principles, and is so conducted. Principal business, farming and lumbering. Pop. about 700.

James S. Holden, Ed. "The Register."

Fasa'no, town in Southern Italy, in the province of Terra di Bari, on the road from Bari to Brindisi. It is celebrated for its olive-plantations. Pop. 11,022.

Fas'ces [Lat., plu. of *fascis*, a "bundle"], a bundle of rods of birch or elm, sometimes having an axe (*securis*) tied up within it. Such fasces were borne by the lictors before the superior magistrates of ancient Rome. The ancient kings, the consuls, the prætors, the dictator, etc. had the fasces carried before them; while the quæstors had this distinction in the provinces only. Generals who had been saluted as imperatores had fasces crowned with laurel, a custom anciently observed with some of the other magistrates. The number of the fasces and lictors varied with the rank of the dignitary, and was different in different ages.

Fas'cia [Lat., a "bandage;" plu. *fasciæ*], in the anatomy of man and most of the vertebrate animals, a laminated tissue of fibrous or aponeurotic character found in nearly all parts of the body. There are two kinds, the superficial and the deep fasciæ. The superficial fascia lies under the skin, is of varying thickness, and is disposed into several layers of fibro-areolar substance, containing particles and layers of fat. Between its layers blood-vessels and nerves run. Its fat serves to keep the body warm. The deep fasciæ are composed of unyielding fibrous substance. They sheathe the several muscles and the entire limbs (aponeuroses of investment), or serve instead of bones for the insertion of certain muscles (aponeuroses of insertion).

Fascina'tion by Serpents. Popular opinion has for a long time attributed to certain serpents a power of so charming weak animals by their eyes and movements of body that they are easily secured as prey. This is not a blind, overpowering force, but one which the doomed animal seems to partly appreciate, but is unwilling to entirely resist. Squirrels, mice, and the weaker birds are the animals which are most often captivated by this power. They are described as running in front of the fascinator by short vibrations of distance or passing round in a circle, gradually shortening the intervals until they are seized by the serpent. Often the animal during the process utters piercing cries, as if aware of its danger, and yet unable to resist. Sometimes a diversion of the animal's attention by a sudden noise, or the interposition of some material obstruction to the vision, breaks the charm and sets the captive free.

Though the whole process is often ridiculed as impossible, yet it seems to bear a striking analogy to the so-called mesmeric influence which one human being sometimes has over

another, or to the more undefined od or odylic force. Or perhaps it is the diseased mental or bodily element manifested in a desire often expressed by persons to throw themselves from a tower or precipice; and even still further, where the mind or body or both are so diseased that there is a morbid impulse to commit an insane act, or destroy its own self or some other person. EDWARD HITCHCOCK.

Fash'ion [remotely from the Lat. *facere, factum*, to "make"], in dress, in customs, on every field where it reigns, arises from our desire of beauty, and changes with our ideas of what is beautiful. Dress is by itself a product of physical necessity, determined by a regard, first, to what is useful under a certain climate (*national costume*); then, to what is convenient for a certain occupation (*uniform*); and lastly, to what is beautiful (*style*). Customs are by themselves a product of moral necessity, determined by a regard, first, to what is due to certain authorities (*religious rites*), next, to what is proper at certain occasions (*social etiquette*), and lastly, to what is beautiful (*good manners*). The true cause of any change of fashion in dress or customs is a regard to beauty, purposing to produce a new and more refined harmony, or at least to avoid something harsh and discrepant; and although in details it would be very difficult to demonstrate the relation between a certain piece of dress and the ruling ideal of beauty, still in all the great movements of fashion the connection is apparent. The enormous change which took place between 1789 and 1799 in dress corresponded exactly to a similar change of taste in general from the *rococo* to the classic ideal. Fashion thus being the expression of the ideal of beauty in a certain stage of its development, stubborn disregard makes people as unfit for refined society as stupid acceptance; the uncouth independence of the "original" is generally neither more valuable nor more agreeable than the conceited silliness of the "swell."

Fasquelle (JEAN LOUIS), LL.D., b. in France in 1808, became a resident of the U. S. in 1834; was professor of languages in the University of Michigan 1846–62; author of a series of French text-books. D. in Michigan 1862.

Fast [Ang.-Sax. *fæstan*], to abstain from food from any cause, particularly through religious discipline. When the mind is much excited the claims of the body are less felt; if disturbed by grief, there cannot be much regard for the gratifying of appetite. The Psalmist expresses what is common to man when he says, "My heart is smitten down, so that I forget to eat my bread." Fasting thus becomes an expression of mental engagement. It is natural that a man should observe what is seen to attend the state of mind which he would cultivate. It is also wise that any outward rule intended to enforce special spiritual duty should impose, as an aid, the outward attendant on the spiritual state. Hence it is that men are severe with themselves in proportion as they consider it proper to discipline their souls, and that in all ages and in all countries religion has imposed fasting. The proper state of mind can be indicated only, but the outward signs of such a state can be exacted; and so fasts belong to all religions. All ancient nations with whom history makes us acquainted had their fasts—the Egyptians, the Phœnicians, the Assyrians, the Indians, and after these the Greeks and Romans. Extraordinary religious acts were preceded by fasts. The mysteries demanded this discipline, especially from those about to be admitted to them. In consequence of certain prodigies the Sibylline books directed "a fast in honor of Ceres to be instituted and to be kept every fifth year." (*Livy*, lib. 36, c. 37.) A stated fast imposed by Jupiter is spoken of by Horace (*Satire*, ii. 3). Fastings were sometimes practised before undertaking military enterprises, or whenever there was special cause to seek the favor of the gods or to avert their anger. A notable instance is given in the book of Jonah. When Nineveh was threatened with destruction, to avert the calamity a fast was proclaimed, and the order given, "Let neither man nor beast, herd nor flock, taste anything; let them not feed nor drink water." Among heathen philosophers and religious people fasting was reckoned a duty—markedly so by the Pythagoreans, who lived a life of constant asceticism, abstaining always from flesh and fish, and at times from food altogether. At the present day, fasting as a religious act is confined to no land or faith. The nations of the East and our Western red men are alike exceedingly severe in this respect. The Mohammedans keep as an annual fast their ninth month, Ramadan; during every day of this month, from sunrise to sunset, they eat nothing, drink nothing, and give up the solace of their pipe and every other usual indulgence. Their months being lunar, each in the course of thirty-three years occurs in every season. When the Ramadan happens in summer, the long hot days are exceedingly trying to those who must labor. The Jews from their earliest existence to the present day have observed stated and special fasts, national and private. Under the Law, as first given, there was but one day imposed on the nation—the great day of the Atonement. In the course of time four other days were added in commemoration of sorrowful events in Jewish history. These days, especially the first, have been always, and are now, observed with great rigor: no food, no water, is allowed to pass the lips, not even for the rinsing which, on first rising, must always make clean the mouth before the pronouncing of God's name; even the swallowing of the saliva is carefully avoided. The fast lasts from sunset, when the Jewish day begins, until the shining of the stars the night after. Besides the public fasts, there were and are many observed by individuals in consequence of vows, or because of personal cause for affliction, or by way of discipline. The Pharisees fasted statedly twice in the week—Monday and Thursday. These fasts are not all of equal severity.

Under the New Testament there is no fast-day appointed by the Lord or by his apostles, nor does the practice rest upon direct command from them. It is even clear that Jesus imposed no special abstinence on his disciples, but it is also clear that he assumed that this exercise would not be neglected by any who desire the rewards given by God. He gave directions for fasting, for the shunning of hypocritical show, saying, "When ye fast be not of a sad countenance," etc., and by his example he taught the duty. It may be said that he thus taught and acted as a Jew. But we know that when it was objected that his disciples did not fast as did those of other Jewish teachers, he gave as a reason why they did not that he being with them the signs of sorrow were not expedient; and he added that the time would come when they should fast, referring to a time after the fulfilling of the Law. If the apostles gave no rule on the subject, there is no room to doubt as to their practice. One reference is sufficient. In Acts xiii. it is said that as certain prophets and teachers at Antioch "ministered to the Lord, and fasted, the Holy Ghost said, Separate Barnabas and Saul for the work whereunto I have called them. And when they had fasted and prayed, and laid their hands on them, they sent them away."

It is not so stated in the New Testament, but we cannot but believe that from its first recurrence the day of the crucifixion was observed as a day of humiliation, as it has been through the many centuries since. We know that very soon rules were laid down touching this and other seasons of bodily mortification. Wednesday and Friday in every week were kept as such, and early writers who speak of these days of abstinence refer the observance to apostolic usage. The duty of bodily mortification at times of repentance or humiliation or of special spiritual exercises (for fasting does not of necessity imply sorrow) is recognized, it is believed, in this day by all classes of Christians without exception. There are some bodies of believers who have rejected the seasons so long observed, but yet these, on what they deem proper occasions, appoint days to be kept by all their members. Even the early Puritans of New England had their yearly Fast-day.

In the West, the churches of the Roman obedience, together with the Church of England, impose as stated fasts, first, Lent, the *spring* fast, beginning with Ash Wednesday in the seventh week before Easter, and counting forty days, Sundays being excluded. This long fast is of very early observance, but the time of its commencement and the period of its duration were not always the same, it being an expansion of the observance of the time of the passion of our Lord. As now kept, Lent was fixed by Saint Gregory the Great in the sixth century. Second, the Ember Days, which are Wednesday, Friday, and Saturday preceding the four quarterly seasons of ordination. It has been already shown that in apostolic days fasting preceded ordination. The name is variously accounted for: probably it is a corruption of the Latin name for the seasons—*quatuor tempora*, or *tempora*. Third, the Rogation Days, the three preceding Ascension Day. This fast is not older than the close of the fifth century; it was first instituted in Vienne in France, to accompany a season of special rogations (petitions) that God would withdraw certain temporal chastisements. It was probably fixed because of its being a meet introduction to a great festival. Fourth, every Friday, this day being the weekly commemoration of the crucifixion, even as the first day, the Lord's Day, is a joyful remembrance of his resurrection. Fifth, the vigils on the eves of certain great festivals. At one time these vigils were literally kept as watches, the whole night, or a part, being spent in devotions in the churches. They are not so kept now. Advent, the four weeks before Christmas, bears some analogy to Lent, but its Wednesdays and Fridays are alone kept as fasts. The Protestant Episcopal Church in the U. S. follows the Anglican rule, excepting that vigils are not imposed.

The rule of the Orthodox, the Armenian, and other

churches of the East is nearly like that of the Western, having the same origin, that of the usage before the schism, but in some details they differ, *e. g.* in the Holy Orthodox Church on the 1st of August begins the fast of the Mother of God, which lasts until the feast of her repose—fourteen days. It is to be observed, however, that in the East the strict idea of a fast is preserved to a greater extent than in the West. From earliest times a distinction in food was recognized, and allowance made for those who through bodily weakness could not wholly abstain. To whatever due, it is a fact that in the West the rules of fasting have always been more lenient than in the East. Very few of the days spoken of as fast-days are strictly such; they are days of abstinence, when less food and of a coarser character is taken. In the Holy Orthodox Church 266 days in the year are kept as fasts with scrupulous fidelity.

A practice so universal as that of fasting must be based on some necessity of man. Nevertheless, the objection is sometimes heard that it tends to spiritual pride and formalism. This must be granted, but abuse is no argument against due use. A Christian, who knows that his Lord joined together prayer and fasting, can hardly advance the objection. It is also objected that health is frequently injured by religious fasting. It may be so. But on the other hand, it can admit of no doubt that in an age and country particularly luxurious a stated abstinence from food, a weekly putting aside of self-indulgence, and supporting the body on plainer, less attractive food, would go far towards freeing men from many of the evils that wait on appetite. WILLIAM F. BRAND.

Fast-and-Loose, a game formerly much played at fairs and popular assemblies in England. The exhibitor places a girdle, belt, or garter upon a table in such a way that it seems certain that a skewer thrust through it in a certain direction must hold it fast to the table. Upon this point the rustic visitor is induced to wager his money, when the exhibitor takes the belt by both ends and pulls it away without any difficulty.

Fas'ti, the court-days or festival-days of the ancient Romans. The word is used absolutely to denote these. But as *fastus, -a, -um* is, properly speaking, an adjective, derived, probably, from *fari*, it is necessary to supply *dies*. In accordance with this derivation, *dies fasti* were days on which it was allowed to speak, hence days on which judgment could be pronounced, on which courts could be held—court-days. A *dies nefastus* therefore denoted the opposite, and *dies nefasti* were esteemed unlucky days. To the *dies fasti* belonged the *dies comitiales*; to the *dies nefasti*, the *dies religiosi*, which were considered days of evil omen. The institution of these days is ascribed to Numa Pompilius, and belongs, therefore, to the earliest days of Rome. Their order or succession was long known only to the priests, who thus acquired great political power, until Cn. Flavius made it public about 304 B. C. From this time onward the lists of the *dies fasti et nefasti* received more particular attention, and contained, gradually enlarged and perfected, an accurate description of the whole year according to its months, with exact specification of the *dies fasti*, *dies comitiales*, festivals and holidays, days appointed for the celebration of public games, etc. Thus, they assumed the form of our calendars or almanacs. As they were still, notwithstanding the care taken in their preparation, unavoidably inaccurate and imperfect, we are told of Cæsar "fastos correxit," etc. As the fasti or calendaria of ancient Rome were engraved on stone and set up in public places, remnants or fragments of such records, more or less complete, have been preserved and united together, in order to produce as perfect a representation as possible of one of these ancient Roman calendars or almanacs. If the ordinary fasti or calendaria are valuable as affording a correct knowledge of the Roman year, much more important are those which Livy calls "fasti consulares," and which, because they were set up on the Capitoline, are also called Capitolini. The Fasti Capitolini contain lists of the annual consuls, of the censors, dictators, magistri equitum, and also of generals who celebrated triumphs (*fasti triumphales*) and a record of the services for which a triumph had been granted. Of such Fasti Capitolini important fragments, discovered in 1547 at Rome, are extant. (For further particulars, see PAULI'S *Real Encyklopädie*, etc.)

Fasti is also the title of a well-known but unfinished poem by Ovid, the subject of which is the Roman festivals—the festival-calendar. It may be regarded as "a poetical year-book or companion to the almanac, having been composed to illustrate the Fasti published by Julius Cæsar," who corrected and entirely reformed the calendar.

HENRY I. SCHMIDT.

Fa'ta Morgan'a [the *Fairy Morgana*—*i. e.* castles or palaces of], a remarkable and singularly beautiful effect of mirage, occasionally observable in the Sea of Reggio, Straits of Messina, between Sicily and Calabria. It presents a series of magnificent architectural structures and landscape views, embracing columns, arches, towers, castles, palaces, trees, avenues, and wooded plains, with crowds of moving men and animals, all constantly varying and assuming new aspects, and in certain conditions of the atmosphere becoming resplendent with prismatic colors. There can be no doubt that these images are derived from objects on the shore, their singular forms and transformations being the result of extraordinary refractions in the atmosphere (for the explanation of which see MIRAGE). F. A. P. BARNARD.

Fate [Lat. *fatum;* literally, "something spoken," as a decree, and involving the thought that events come out of an inevitable destiny]. Fatalism is the belief in such a destiny. It has various forms. The old Chaldaic or astrological fatalism looked upon the visible heavens as the book of this destiny, and found all things necessarily prefigured in the positions of the stars. The old Stoical fatalism considered the rise and the decay of the world as controlled by an absolute necessity, but while this necessity, with them, was a fate (εἱμαρμένη) which determines, it was also a providence (πρόνοια) which governs all things. The fatalism of the Greek dramatists made all events fixed through the control of Dike and Nemesis, Justice and Retribution. Mohammedan fatalism regards all things, great and small, as so inexorably predetermined from the foundation of the world that no accident is possible, and any attempted defence against danger is futile. Pantheistic fatalism considers the infinite substance which it calls God to be developed in space and time by a procedure so changeless that things extended or things thought are equally necessary; and which not only destroys all freedom of the will, but obliterates all distinction between good and evil. The modern philosophical conception of fate is that of a blind causality undirected and undetermined by any conditions. J. H. SEELYE.

Fates, The [Gr. Μοῖραι, plu. of μοῖρα, "one's part, lot, or destiny;" Lat. *Parcæ*], in the Greek mythology, three goddesses who ruled the fates of men and all things. They are generally named Clotho, who spins the thread of life; Lachesis, who marks off the allotted span; and Atropos—the inflexible—who cuts the thread. Their genealogy, and the whole mythus, are quite variously given in different authors. The Homeric poems speak usually only of one Moira, and the personification is not complete; no particular appearance of the goddess, no attributes, and no parentage are mentioned. Nor is the Homeric Moira an inflexible fate to which the gods themselves must bow; on the contrary, Zeus, as the father of gods and men, weighs out their fate to them. With Hesiod the personification of the Fates is completed, but they are still represented as depending on their father Zeus, and subject to his commands. And it was not until the time of Æschylus that they appeared as the divinities of fate in the strict sense of the word, independent of the Olympic gods, the messengers of the eternal necessity to which even the gods must bow. They are generally associated with the Erinnyes, who inflict the punishment for evil deeds, and they are sometimes called their sisters. By authors still later their genealogy is changed, and they are called children of Erebus and Night (Cicero), of Cronos and Night (Tzetzes), of Ge and Oceanus (Athenagoras), or of Ananke and Necessity (Plato).

Fa'ther Lash'er, or **Luck'y Proach**, the *Aspicotta bubalis*, a marine fish of the European and Arctic American coasts, from six inches long up to a much larger size. It belongs to the Cottidæ or sculpin family, its head is covered with spines, and it has a repulsive aspect. It can live a long time out of water, and though regarded with aversion and seldom used, it affords a palatable article of food.

Fa'ther Point, a small post-v. of Rimouski co., Quebec, Canada, on the S. shore of the St. Lawrence, 207 miles below Quebec. It is important only as a landing-place for passengers and mails from ocean steamers. Father Point lighthouse is in lat. 48° 31′ N., lon. 68° 27′ W. Pop. about 100.

Fa'thers (of the Church), the distinguished earlier laborers in the Christian Church. (See APOSTOLIC FATHERS.) The Roman Catholic Church distinguishes between Church Fathers, Church teachers, and Church writers. The Church teachers are men of acknowledged orthodoxy, authorities for the doctrines of the Church, while the Church writers are of less, or even doubtful, authority. The greatest of the Church teachers are also Church Fathers. Such were Athanasius, Basil the Great, Gregory of Nazianzen, and Chrysostom in the Oriental Church—Jerome, Ambrose, Augustine, and Gregory the Great in the Church of the West. Thomas Aquinas and Bonaventure may be named

as Church teachers who were not fathers, and Tertullian in his second era and Origen as Church writers. The line of Church Fathers is generally regarded by Protestant theologians as terminating with the sixth century; the Roman Catholic writers extend it to the thirteenth. The scientific treatment of the matter contained in the writings of the Fathers is embraced in PATRISTICS (which see), while their lives and topics related to the externals of their works come under the head of PATROLOGY, but this distinction is not always observed. The Fathers are of great value in the history of biblical interpretation, the history of dogmas, creeds, rituals, the constitution of the Church, and indeed in every part of historical theology; nor is there any part of theology in which they may not be made highly useful. In the greatest internal struggles of the Church the importance of the Fathers as witnesses or as authorities has been recognized on both sides, as in the Reformation, and in our own day in the controversies of the Anglican Church. (The principles to be observed in interpreting the Fathers are stated in KRAUTH's *Conservative Reformation*, 726 *seq.*) Next to the Apostolic Fathers in value are the Apologists, or APOLOGETIC FATHERS (which see); the Alexandrians, Clement and Origen, Athanasius, Gregory of Nyssen, Chrysostom, Augustine, and Jerome. (All the earlier writers on patrology, beginning with Jerome, were edited together by Fabricius, 1718.) The greatest laborers in the issue of editions of the Fathers have been the BENEDICTINES. (See that word and BENEDICTINE EDITIONS OF THE FATHERS.) Next to them have been the Anglican divines. The most recent interest in patristics in Great Britain has been shown in the issue of translations of the Fathers. In the Roman Catholic Church, among the names illustrious in patristics are Bellarmin, Oudin, Du Pin, Le Nourry, Tillemont, and Hefele; in the Protestant churches of the Continent, Scultetus, Walch, Danz, Bunsen, Otto; in Great Britain, Cave, Cureton, Routh, and Pusey. Among the editions of the collected writings of the Fathers, the most complete are De la Bigne's, 17 vols. fol., 1654; the Lyons *Maxima Bibliotheca*, 27 vols. fol., 1677; Cailleau and Guillon, 1829 *seq.*, 148 vols., and still in issue; Migne, 1844 *seq.* The last is, *in bulk*, the greatest of the collections. The very numerous editions of particular Fathers are mentioned under their names. Books of selections, Rösler, Augusti, Orelli, Philo, Œhler; epitomes, introductions, Moehler (1839); monographs on the lives and literature of the Fathers, Ullmann (Gregory of Nazianzen); Neander (Chrysostom, 3d ed. 1858); Wiggers (Augustinismus, 1821–1831) have been characteristic of our century. C. P. KRAUTH.

Fath'om [from a Teutonic root denoting a "seizure:" Gothic, *fahan*, to "take"], originally the length which a man can measure by extending both his arms. It now denotes a measure equal to two yards, or six lineal feet, and is chiefly employed in nautical affairs. It is the unit of measure in soundings, and is employed in the measurement of cables, etc. The early colonists of the present U. S. reckoned the Indian wampum-chains, then current as money, in fathoms.

Fat'imites, a family of Arabian caliphs who took their name from the fact that they claimed descent from Fatima, the daughter of the prophet Mohammed. They ruled from 909 till 1171, chiefly at Cairo, and at the period of their widest sway ruled all North Africa, with Syria and Palestine. They professed the Shiite doctrines, while the subjects of the Bagdad caliphs were orthodox. After the death of the last Fatimite of this line (Adhid), the great sultan Saladin assumed authority.

Fat Lute, a mixture of pipe-clay and linseed oil, mixed and worked together like putty. It will stand considerable heat. It is used by chemists and pharmacists to cover joints in apparatus, and especially to prevent the escape of corrosive vapors.

Fats. (See OILS.) In the common sense, fats are those unctuous parts of animal and vegetable bodies secreted in the cellular tissues, and separable therefrom by fusion at a moderate temperature. The animal fats do not differ chemically from those of vegetable origin. Both are definite compounds of certain fatty acids, chiefly oleic, stearic, and palmitic acids, with a peculiar base called GLYCERINE (which see), or the sweet principle of fats. The fats are, as a rule, nearly insoluble in water, but dissolve readily in ether, which is their proper solvent. They are also soluble in naphtha, benzine, and the oils from coal; in oil of turpentine and other essential oils; bisulphide of carbon, chloroform, fusel oil, etc. They are scarcely at all soluble in cold ordinary alcohol. In absolute alcohol they dissolve much more readily than in weaker alcohol, and especially with the aid of heat.

The fats stain paper permanently, and are not volatile by heat, a high degree of heat being required to make them boil. They distil over at a high heat, but not without complete, or nearly complete, decomposition, and the evolution of a peculiar pungent, disagreeable odor, irritating the eyes and known as *acroleine*. Those fats which are fluid at ordinary temperatures are called oils. All the fats burn with a bright flame and with little smoke.

Chemically, the fats form part of a very large group of organic bodies (the fatty group), distinguished as containing no nitrogen or its analogues, being hydrocarbons with little or no oxygen.

M. Chevreul, in a series of six memoirs concluded in 1816 (*Ann. de Ch. et Phys.*), first revealed to us the true constitution of the fats—that they are mixtures of several fats of different degrees of fusibility—*e. g.* oleine, stearine, palmitine—the hard fats being chiefly stearine and palmitine, and the soft fats oleine. The hard fats are beef fat, mutton fat, human fat, cholesterine, Chinese tallow, cacao butter, wax, spermaceti, etc.; the soft fats, hog's lard, butter, etc., which are greasy at ordinary temperatures; while the liquid fats, or oils, are fluid at ordinary temperatures.

The researches of Chevreul showed that fats were either saponifiable or non-saponifiable; *e. g.*, if boiled with an alkaline solution, certain fats, so called, were unaffected (as spermaceti, wax, paraffin, etc.), while others were broken up and soaps formed, the fatty acids combining with the alkali, while the glycerine was set free; and that this change was accompanied by a gain of weight in the products as compared with the weight of the factors employed; which could be accounted for only by the assumption that hydrogen and oxygen from the water must contribute to form the product. This led him to the conclusion that the saponifiable fats were analogous in constitution to compound ethers—*i. e.* the fats are compounds of fatty acids with glycerine, *minus* a certain quantity of water, just as ethers are compounds of alcohol with acids, *minus* a certain quantity of water. In later years the researches of Berthelot have demonstrated the accuracy of Chevreul's views by the synthesis of fats from the union of fatty acids with glycerine, and the separation of one, two, and three molecules of water. (See GLYCERIDES, OILS, and SOAP.)

The memoirs of Chevreul on the fatty bodies are among the most remarkable examples of a chemical research which has remained for more than half a century almost without important addition or change from the labors of subsequent investigators. B. SILLIMAN.

Fat'ty Degenera'tion, in pathology, a condition in which the minute structural elements of the tissues of living organisms are gradually replaced by fat-globules. In man this diseased condition has been observed in nearly all the tissues, though some authorities state that the nerves and the red corpuscles of blood are not liable to this change. Fats, though always of organic origin, and often closely associated with living tissues, are never, it is believed, truly organized bodies; and consequently they are not regarded as ever truly vitalized, any more than are the water and the lime which are found in living organisms. In this view, fatty degeneration is a molecular death, a necrobiosis, of the tissues. It has been likened to the change of dead bodies into adipocere.

In the great closed glands of the fœtus, and in the corpus luteum of the ovary, fatty degeneration is a normal process. In the liver, it is merely an excess of the normal fatty element contained in the acini, which, however, encroaches upon the organized elements of those structures, and becomes a true fatty degeneration. It also attacks the muscles, and especially the heart; the bones (in some forms of *mollities*), the brain (yellow softening), the cornea (*arcus senilis*), and the kidney in many cases of so-called Bright's disease. The fatty degeneration of the heart is a rather frequent disease, but very difficult to detect, even by the trained diagnostician. When suspected, a quiet life, a nourishing but not too stimulating diet, with the judicious use of tonics and iron, are to be recommended. For the disease there is no cure known.

REVISED BY WILLARD PARKER.

Fatu'ity [from the Lat. *fatuus*, "insipid, tasteless, foolish"], is a state of mind characterized by absence or great deficiency of the will and the intellect, and by apathy with regard to those things which usually arouse the feelings and impulses. If congenital, it constitutes complete or partial idiocy. When it is associated with, or consequent upon, acute disease, it has no significance except as a symptom of that disease; while if it be long continued, obscure in its origin, and progressive in character, it is almost certain to result in dementia, one of the most hopeless forms of mental disorder.

Fau'ces Ter'ræ [Lat., "jaws of the land"], projecting headlands or promontories, including arms of the sea, as, *e. g.*, bays, creeks, lakes, basins, harbors, rivers, etc., where the tide ebbs and flows. In England the general rule is

that such bodies of water, as far as the point to which the flow of the tide extends, and unless they are within the body of a county, are under the jurisdiction of the courts of admiralty. In these exceptional instances the common-law courts exercise exclusive jurisdiction, except in a few classes of questions to which admiralty powers have been extended by statute. A stream is said to be "within the body of a county" (*infra corpus comitatus*) when a person standing on one shore can see what is done upon the other. In the U. S. the admiralty jurisdiction is not confined to tide waters, and is not excluded from waters "within the body of a county," but extends over the great lakes and over all rivers, etc. capable of navigation for practical commercial purposes. The whole subject is fully developed in the decisions of the Supreme Court of the U. S., as found in the volumes of reports.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fau'cett's, tp. of Alamance co., N. C. Pop. 1327.

Fauche (HIPPOLYTE), b. at Auxerre in 1797, inherited a fortune and became a Sanscrit scholar. His translations of the *Rámáyana* (9 vols., 1854–58) and the *Mahâbhârata* (7 vols., unfinished, 1863–67) are among his most important works. He published an original tale and some poems. D. at Juilly, Seine-et-Marne, 1869.

Faucher (LÉON), French state minister, political economist, and financial writer, b. in Limoges Sept. 8, 1803, was in youth a designer of embroidery-patterns, and then a teacher; wrote for the *Courrier Français* and the *Revue des Deux Mondes*. In 1846, in the French Chamber of Deputies, acted with the *Gauche;* minister of the interior from Dec., 1848, to May, 1849, and from Apr. to Oct., 1851; was liberal but not republican in politics. *Studies on England* (1845) and *Miscellanies of Political Economy and Finance* (2 vols., 1856) were his productions. D. at Marseilles Dec. 15, 1854, having always declined office under the emperor Louis Napoleon.

Fau'cit (HELEN), an English actress of renown, b. in 1816, made her *début* at Covent Garden, London, Jan. 5, 1836, in the character of Julia in the ***Hunchback***, in which she achieved great success and at once took high rank as an actress, becoming a leading member of Mr. Macready's companies during the production of his Shaksperian revivals. She was the original representative of the heroines in Bulwer's *Lady of Lyons*, *Richelieu*, etc., and in many other plays of different authors; married in 1851 to Theodore Martin, but has continued to appear on the stage at intervals. GEORGE C. SIMMONS.

Faugeres (MARGARETTA V.) was b. at Tombanick, near Albany, N. Y., in 1771. Her mother, Mrs. Ann E. Bleeker, had considerable fame as a poet. In 1792 she married Dr. Peter Faugeres of New York, whose irregular habits brought his wife to poverty. She afterwards became a successful teacher, and was well known for her poems and prose-writings, which at that time were highly prized. *Belisarius* (1795), a tragedy, was her most ambitious work. D. at New York Jan. 9, 1801.

Faul'horn, a mountain of the Alps, in the canton of Berne, between the valley of the Grindelwald and the Lake of Brienz. It is 8802 feet high.

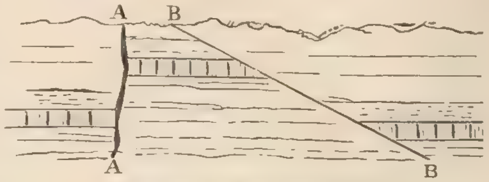
Faulk, county of S. E. Central Dakota. Area, 900 square miles. It is chiefly on the Couteau de Missouri, and is traversed by the watershed or divide between the valleys of the Dakota and the Red River of the North. It was formed after the census of 1870.

Faulk'ner, county of Central Arkansas. Area, 810 square miles. It is bounded W. by the Arkansas River and the north fork of the Cadron Creek. It is undulating, well timbered, well watered, and fertile. It was formed since the U. S. census of 1870. Cap. Conway.

Faulkner (CHARLES J.), American Congressman, b. in Berkeley co., Va., in 1805, received a collegiate education, and was admitted to the bar in 1829. In 1832–33 was elected to the house of delegates, in 1841 to the senate of Virginia, in 1848 again to the house of delegates, and in 1850 was a member of a convention to revise the constitution of the State; representative in Congress from Virginia 1851–1860, when appointed minister to France by President Buchanan. Returning to the U. S. in 1861, was imprisoned, on suspicion of disloyalty, in Fort Warren, Boston harbor, and exchanged in December of that year for Hon. Alfred Ely. In 1874 was elected to Congress from West Virginia.

Faulkner's Island, a small elevated island lying off the harbor of Guilford, Conn., in Long Island Sound. It is within the limits of New York, and has a lighthouse with a flashing light, and a fog-bell, lat. 41° 12′ 41″ N., lon. 72° 38′ 54″ W.

Fault, in geology, a vertical displacement of rocks accompanying a line of fracture. "The amount of dislocation measured in a *vertical direction* produced by a fault is termed its 'throw,' a fault being said to be an 'upthrow' or a 'downthrow,' or an 'upcast' or a 'downcast,' according to the side from which we view it." (*Jukes.*) The "dislocation" may have been caused by the mass on one side of the fracture having subsided by reason of its weight, or the displacement may be the result of an upward thrust. Faults may be vertical or inclined at various angles. In the accompanying cut two faults are represented, the one



Vertical and Inclined Faults (Jukes).

vertical at A and the other inclined at B, and have clearly been the result of a subsidence of the two lateral masses. Faults may extend indefinitely downward, and the throw may amount to many thousand feet. Horizontally also, faults extend for long distances; one in Virginia, according to H. D. Rogers, has been traced for upwards of 80 miles. The fissure accompanying a fault may be wide and the interval filled up with subsequent deposits, thus in many instances giving rise to mineral veins, or the faces of the fracture may remain in apposition. In the latter case the sliding of the one surface over the other will have smoothed and polished both, thus causing the appearance known as "slickensides." Miners in different districts use the terms "slip," "slide," "heave," "dyke," "thing," "throw," "trouble," "check," etc. to express a fault; and one of the chief difficulties and causes of expense in coal, and indeed in other mining, is caused by the displacements of the veins or beds by faults. Geology, by establishing the facts which determine the sequence of sedimentary strata, has done much to simplify the difficulties caused by faults in coal-mines. E. C. H. DAY.

Fau'na [from *faun*, a rural divinity in the Latin mythology] is a term given to the assemblage of animals inhabiting any given locality, either in the present or past ages of the globe. In palæontology, however, it is sometimes used with more latitude, and is given to an assemblage of animals characteristic of a given period. Inasmuch as there are no very abrupt demarcations for any given region, the idea of a *fauna* is based, to a greater or less extent, on the forms combined in a central, or, as it is called, metropolitan district. Various combinations of animals are more or less characteristic of certain countries or portions of the earth's surface, many forms being limited by climatal or physiographical or unknown conditions.

Various names have been applied to these combinations, or to the regions of which these combinations are characteristic, but the most restricted ones are generally designated *regions* or *districts;* and to the more comprehensive into which they are combined, among others, the names *realm*, *range*, or *fauna* have been given, the last having at one time been applied by Agassiz in this sense. (The consideration of the faunas of the respective regions of the earth is the subject of a particular branch of science, ZOOLOGICAL GEOGRAPHY; and under that head the principles and facts involved will be treated, while the principal features of the geographical distribution of the various groups of animals—the subject of GEOGRAPHICAL ZOOLOGY—will be presented in the articles on such groups.) THEODORE GILL.

Fau'nus, a Roman woodland deity, corresponding to the Grecian Pan, many of whose attributes were assigned to him. He possessed the power of prophecy, and his oracles were in the groves. A festival, named Faunalia, was celebrated in his honor by the country-people. As a frolicsome wood-deity, represented with the horns of a goat and the feet of a satyr, he became multiplied by the poets, and the Fauni or Fauns corresponded to the Greek satyrs. Poetic tradition represented him as an early king of Latium, son of Picus, grandson of Saturn, and father of Latinus.

H. DRISLER.

Fau'quier, county of Virginia, in the N. E. part of the State. Area, 680 square miles. It has the Rappahannock on the S. W. and the Blue Ridge on the N. W. The surface is pleasantly diversified and the soil is productive. Grain, cattle, and wool are produced, and flour is manufactured. Soapstone, magnesia, gold, etc. are found, and there are important mineral springs. It is traversed by the Washington City Virginia Midland and Great Southern R. R. Cap. Warrenton. Pop. 19,690.

Fauquier (FRANCIS), lieutenant-governor of Virginia 1758–68, was a popular and able governor, a man of culture, a free thinker in religion, and a friend of Jefferson. He published some financial writings in England, and d. Mar. 3, 1768.

Fauquier White Sulphur Springs, in Fauquier co., Va., 56 miles W. S. W. of Washington and 10 miles N. W. of Bealton Station on the Great Southern R. R., have strong saline sulphur waters. The buildings were to great extent destroyed during the war. The situation is delightful, and the waters have a wide range of usefulness in chronic diseases.

Faure (JEAN BAPTISTE), a French baritone singer of great reputation, b. at Moulins Jan. 15, 1830, went upon the stage in 1852, and became in 1857 a professor at the Conservatoire. His wife, CONSTANCE CAROLINA LEFEBVRE, b. at Paris Dec. 21, 1828, has also attained distinction as an operatic singer.

Fauriel (CLAUDE CHARLES), French philologist and historian, b. at St. Étienne Oct. 21, 1772, was nephew of the abbé Sieyès, and d. in Paris July 15, 1844. In 1830 a chair of foreign literature was founded for him in Paris. Among his principal works are a *History of Southern Gaul under the Rule of the German Conquerors* (1836), *History of Provençal Literature* (1846), and *Popular Songs of Modern Greece*, with a French version (1825).

Faust (JOHANN), DR., a German magician who flourished during the first thirty years of the sixteenth century, is generally supposed to have been a native of Knittlingen in Würtemberg, b. about 1480, d. about 1538. His history is obscured by extravagant fiction, and it is impossible to state with certainty the place of his birth or decease. Regarding his existence there is undoubted testimony, and we learn that he spent some time at Wittenberg, at one time enjoying the association of Melanchthon. (See SCHEIBEL, *Kloster*, ii. p. 11.) Conrad Gesner, and even Luther (*Tischreden*, p. 216) also, make mention of him. Dr. Faust seems to have been a learned man who had studied magic and astrology, and, travelling about the country performing various feats, came to be regarded as a dealer in the black art, and one maintaining an intimate relation with evil spirits. The belief in witchcraft was universal in Europe in the Middle Ages, and nowhere did it prevail so universally as in Germany. A bull of Pope Innocent IV. (1243–54) declares that it having come to his ears that in parts of Germany persons forgetting or denying the Christian faith have dealings with the devil, he commands all such individuals to be seized and punished forthwith with loss of property and life; and soon after appeared a work on sorcery and witchcraft—the *Malleus Maleficarum*, or "Witch's Hammer"—which enjoyed the approbation of the theological faculty of Cologne. "Germany indeed seemed to live and breathe in an atmosphere of sorcery. The ground which Faith had lost Superstition made her own." Even the Reformers believed in witchcraft and in the bodily presence of the Spirit of Evil upon the earth. According to tradition, Faust enjoyed in his youth a large fortune, gave himself to a life of extravagance and licentiousness, and soon squandered his vast possessions. He then devoted himself to the study of magic at Cracow, determined to regain his wealth and enjoyments, and after a mastery of the secret sciences made a compact with Satan, according to which the latter was to serve Faust for twenty-four years, when the Evil One should possess the soul of Faust. The contract signed by Faust with his own blood contained the following conditions: "1. He shall renounce God and all celestial hosts; 2, he shall be an enemy of all mankind; 3, he shall not obey priests; 4, he shall not go to church nor partake of the holy sacraments; 5, he shall hate and shun wedlock." Mephistopheles, a devil "who liked to live among men," was given Faust as an attendant, and the two together roamed over the land, Faust enjoying every form of sensual pleasure, and performing magical feats never before performed, until at last the time arrived when the fatal debt was due, and Satan appeared in the most hideous form imaginable between twelve and one o'clock at night, and finished Faust's earthly career, bearing away with him the soul of the unhappy being. Such is the monstrously mythical form in which Faust's life appears in the popular tradition. Its aim evidently is to describe that tendency to sacrifice the future, however precious—nay, salvation itself—to immediate gratification. Embodying all the dire superstitions, the idle terrors, the thirst for the strange and wondrous, the story of Faust entertained the popular mind, while the clergy availed themselves of the moral it taught to recall men from sensuality and vice, and from the foolish attempts to fathom the mysteries of the supernatural.

The story of Faust was first published by the printer Spies of Frankfort-on-the-Main in 1587, under the title *Historia von D. Johann Fausten, dem weitbeschreyten Zauberer und Schwarzkünstler*, and already in 1588 another edition was called for: in this year appeared also a rhymed edition and a version in Low German and Danish. In 1590 two English translations came out—one entitled *A Ballad of the Life and Death of Doctor Faustus, the great Cunjurer*, and the other, *The History of the Damnable Life and Deserved Death of Dr. John Faustus* (which was probably used by MARLOWE [which see] in 1591 in the preparation of his drama). In 1592 appeared a Dutch, and in 1598 a French version. In 1599, G. R. Widmann published an "improved" edition, entitled *Wahrhaftige Historien von den greulichen und abscheulichen Sünden und Lastern, auch von vielen wunderbarlichen und seltzamen abentheuren so D. Johannes Faustus hat getrieben* (Hamburg, 3 vols.); still further improved by Pfitzer in 1674 (Nuremberg). Widmann's edition, but without his or Pfitzer's notes, was published at Reutlingen in 1834. A large number of books on necromancy have inserted Faust's cabalistic formulas, charms, talismans, etc. All of these publications, and also all important monographs bearing upon this subject, are found in SCHEIBEL, *Das Kloster, weltlich u. geistlich* (Stuttgart, 1847). German literature abounds in elegies, pantomimes, tragedies, and comedies on Faust. As far back as 1594 appeared a work by Tholeth Schotus, purporting to be from the Spanish and treating of Faust and his disciple Wagner. Its form intended it for the marionettes, and it was promptly taken up. (See *Puppenspiel*, edited by Charles Simrock (Leipsic, 1850); MAGNIN, *Histoire des Marionnettes* (Paris, 1854, 8vo); HAGEN, *Ueber die ältesten Darstellungen der Faustsage* (1844); and SCHEIBEL'S work.) In a dramatic form, Faust was first treated in the German by Lessing in his masterly fragment entitled *Faust und die Sieben Geister*, but the grandest of all on this subject is Goethe's *Faust*, of which Bayard Taylor has recently furnished a masterly English version (Boston, 1870, 2 vols., 4to). Goethe, however, introduced an element foreign to his model—that of the ardent, inextinguishable thirst for knowledge for its own sake alone. (Compare KREYSSIG, *Vorlesungen über Goethe's Faust*, Berlin, 1866, 12mo, p. 3–36.) Goethe's *Faust* has furnished Gounod with the subject of his opera. (See DUNTZER, *Die Sage von D. Joh. Faust* (Stuttgart, 1846); PETER, *Literatur der Faustsage* (2d ed., Leipsic, 1851); and especially KUHNE, *Das älteste Faustbuch* (Leipsic, 1868).)

JAS. H. WORMAN.

Faust, or **Fust** (JOHANN), a rich goldsmith, a native of Mentz, Germany, who shares with Gutenberg and Schöffer the honor of establishing the art of printing. He was (1450–55) Gutenberg's partner in the new business of printing books, but Faust probably did nothing but furnish capital. In 1455, Faust prosecuted Gutenberg for money advanced, took the business into his own hands, and associated with himself his son-in-law, Peter Schöffer, who originally was a calligrapher of great repute. They carried on the business successfully until 1462, when, at the sack of Mentz, the workmen were scattered and the art of printing was no longer a secret. Faust still went on with his business, and is thought to have died of the plague at Paris in 1466. There are in existence copies of quite a number of books printed by Faust and his partners, some of them beautifully executed.

Fausti'na (THE ELDER) **Annia Galeria,** wife of the emperor Antoninus Pius. Her character was in marked contrast to that of her husband, who nevertheless retained his regard for her, and at her death caused a temple to be erected to her honor, remains of which are still standing.

Faustina (THE YOUNGER) **Annia,** daughter of the preceding, was married by her father to Marcus Aurelius, her cousin, who had been adopted by Antoninus at the suggestion of Hadrian. She d. A. D. 175, near Mt. Taurus in Asia Minor, and though, like her mother, she had proved unworthy of the affection of her virtuous husband, yet at the request of Aurelius divine honors were decreed to her by the senate. As a further testimonial of his regard for her memory, Aurelius established, as Antoninus had done in the case of the elder Faustina, an asylum for female orphans, to which the name "Faustinian" (*Faustinianae*) was given.

H. DRISLER.

Faus'tulus, in the early legends of Rome, the herdsman of Amulius, who found the twin brothers Romulus and Remus, when they had been exposed by the order of Amulius, and took them to his home and reared them as his own children. (See ROMULUS.)

H. DRISLER.

Fauveau, de (FÉLICIE), b. in 1803 at Florence of a family of Breton legitimist exiles, attained distinction as a sculptor under the patronage of the restored Bourbons; took part in the legitimist movements of 1832; was condemned to deportation, but escaped, and has since chiefly lived at Florence, and practised her art with success.—Her

brother, HIPPOLYTE DE FAUVEAU, has considerable fame as a sculptor.

Fauvelet (JEAN BAPTISTE), a French genre and flower painter, b. in Bordeaux in 1822, first began to exhibit in 1845; attained reputation for the gracefulness and fidelity of his paintings, which are numerous, and in style somewhat resemble the works of Meissonier.

Fauvette [Fr.], a name applied to several song-birds in France, and used to some extent in England. The term is nearly equivalent to warbler.

Fava'ra, town of Sicily, celebrated for its rich mines of sulphur. Pop. 12,829.

Favart (CHARLES SIMON), b. at Paris Nov. 13, 1710, published many plays, and was the inventor of the modern vaudeville. D. May 12, 1792.—His wife, MARIE JUSTINE BENOÎTE, *née* DE RONCERAY (1727–72), was a famous singer, comic actress, and dancer, and wrote some plays.—His son, CHARLES NICHOLAS JOSEPH JUSTIN (1749–1806), and grandson, ANTOINE PIERRE CHARLES (b. in 1784), had great repute—the first as a comedian, the second as a politician, *littérateur*, and painter.—MARIE FAVART, the adopted daughter of the last-named, *née* PIERRETTE IGNACE PINGAUD, b. Feb. 16, 1833, went upon the stage in 1848, and attained a most brilliant fame as an actress in comedy.

Fa'ver's, tp. of Tuscaloosa co., Ala. Pop. 467.

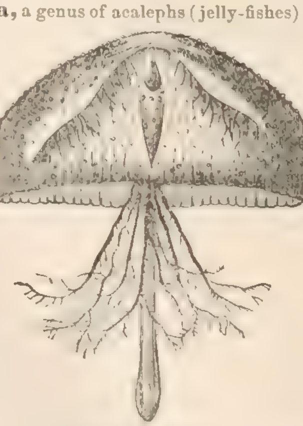
Fa'versham, municipal borough and seaport of England, in the N. of Kent. It has valuable oyster-fisheries. Pop. 7189.

Favigna'na, the chief of the Ægades, a group of islands in the Mediterranean, 6 miles off the W. coast of Sicily. It is fruitful, has good pasturage, excellent wine, and a town of the same name with a population of 3245. Lat. 37° 57' N., lon. 12° 18' W.

Fa'ville (ORAN), b. at Manheim, Herkimer co., N. Y., Oct. 13, 1817, graduated at the Wesleyan University in 1844, became in 1852 professor of ancient languages at McKendree College, Ill., in 1853 president of Ohio Wesleyan Female College, removed in 1855 to Mitchell co., Ia., where he was a county judge, lieutenant-governor, and president and afterwards secretary of the State board of education. In 1863 he was one of the visitors to the U. S. Military Academy; was (1863–67) editor of the *Iowa School Journal;* State superintendent of public instruction 1864–66, and president of the Iowa Teachers' Association. D. at Waverley, Ia., Oct. 3, 1872.

Favistel'la, a genus of fossil corals found in the Silurian rocks, having the general structure of *Favosites,* but the columns are furnished with numerous vertical radiating septa.

Favo'nia, a genus of acalephs (jelly-fishes) of the order



Favonia Octonema.

Discophora, including some of the most characteristic organisms of that order. The *Favonia octonema* of the South Seas has a somewhat hemispherical body, with a long proboscis and eight branchiferous appendages.

Favo'nius (MARCUS), a Roman politician, whose career was marked by strong personal opposition to Pompey and admiration for Cato. In 55 B.C. he was ædile, and probably was prætor in 49; went over to Pompey's party in 48, and after the battle of Pharsalia was reconciled to Cæsar, but after Cæsar's murder was a partisan of Brutus, and was outlawed and put to death 42 B.C.

Favori'nus, a philosopher and rhetorician in Rome under Trajan and Hadrian, b. at Arelate (now Arles) in the south of Gaul. He received his education in Rome, and became distinguished for his knowledge of Greek, in which language he had Dion Chrysostom as instructor. He stood high in the favor of Hadrian, and numbered among his friends Demetrius of Alexandria, Fronto, Plutarch (who dedicated to him his treatise περὶ τοῦ πρώτου Ψυχροῦ), and Herodes Atticus, to whom he bequeathed his library and his house in Rome. Wrote numerous works on a great variety of subjects, all in Greek, and was famed also as an orator, on which account the Athenians raised a brazen statue to his honor, but when he lost the favor of Hadrian they tore it down. Among his numerous writings two are of an historical character, his Παντοδαπὴ Ἱστορία and his Ἀπομνημονεύματα, from both of which a few fragments are preserved. His orations have all perished. (See J. L. MARRES, *Dissertatio de Favorini Arelatensis vita, studiis, scriptis, accedunt Fragmenta,* Utrecht, 1853. The fragments are collected also in MÜLLER'S *Hist. Græc. Fragm.,* vol. iii. pp. 577–585.) H. DRISLER.

Favosi'tes, an extinct genus of corals exceedingly common in the Devonian and carboniferous rocks, of which a large number of species are described. The corallum of *Favosites* is compound, and usually forms hemispherical or conical masses, composed of a large number of prismatic columns divided horizontally by transverse septa or "*tabulæ,*" and usually having the vertical walls pierced by one or several rows of pores. The name is derived from *favus,* a "honeycomb," which some of the species very much resemble. J. S. NEWBERRY.

Favre (JULES CLAUDE GABRIEL), b. in Lyons, France, Mar. 21, 1809, became a prominent lawyer and liberalist of Paris, and in 1848 held positions in the revolutionary ministry, opposed Louis Napoleon during the presidency of the latter, and more especially after the *coup d'état* of 1851. In 1858 he ably defended Orsini, the would-be assassin, and in the Corps Législatif eloquently and irreconcilably opposed the policy of the emperor on all leading public questions; opposed the measures which ended in the Franco-German war, and after the fall of Sedan advocated the deposition of the imperial dynasty, and became minister of foreign affairs and vice-president in the provisional government. As minister of foreign affairs he took an important part in the negotiations for peace with Bismarck. He was for a time, during the siege of Paris, acting minister of the interior; but withdrew in 1871 from the government during the presidency of Thiers, and devoted himself to law and literature. He was author of *Rome et la République Française* (1871), and *Le Gouvernement du 4 Septembre* (1871–72). D. at Versailles, France, Jan. 20, 1880.

Favula'ria, a sub-genus of *Sigillaria,* which includes some of the most remarkable trees of the coal-flora. The name was given by Sternberg to those species in which the trunks are fluted and the leaf-scars are closely approximated. (See SIGILLARIA.) J. S. NEWBERRY.

Fa'vus [Lat., "honeycomb"], or **Scald Head** (*i. e.* "scabby head," from *scall,* a "scab"), a disease formerly known as *tinea* and *porrigo,* generally seated on the hairy part of the scalp, but sometimes attacking the roots of the nails and other parts. This disease is now known to be caused by a parasitic vegetation of low forms of fungus. These fungi are known as *Achorion Schönleinii,* and *Puccinia favi,* but are now believed to be aberrant forms of the species known as the yeast-plant, *Cryptococcus cerevisæ.* Favus is a contagious disease, best prevented by cleanliness, and best cured by carefully removing the hair and applying parasiticide medicines, such as have the power of destroying low organisms. Sulphurous and carbolic acids and weak solutions of corrosive sublimate are the best applications. It is called *favus* because the diseased surface often assumes a honeycombed appearance. It leads to permanent baldness.

Faw'cett (HENRY), M. A., b. at Salisbury, England, in 1833; graduated with honors at Trinity Hall, Cambridge, 1856; lost his sight by an accident in 1858; attained a fellowship at Cambridge, and in 1863 became professor of political economy there. Has several times sat in Parliament, where he advocated republican principles. Author of *Manual of Political Economy* (1863, 1869), *The Economic Position of the British Laborer* (1868), *Pauperism* (1871), etc. His wife, MILLICENT GARRETT, is also a writer on topics kindred to those treated of by her husband, and is the author of some books.

Fawkes (GUY or GUIDO), English conspirator in the reign of James I., was a Roman Catholic, born in Yorkshire. In 1605, with Robert Catesby, Thomas Percy, and others, he endeavored to blow up the English House of Parliament, with king, Lords and Commons, having hired a vault under the House of Lords and lodged in it thirty-six barrels of gunpowder, but was arrested on the night of Nov. 5th in the vault, and executed at Westminster Jan. 31, 1606.

Fawn, tp. of Allegheny co., Pa. Pop. 681.

Fawn, tp. of York co., Pa. Pop. 1457.

Fawn Creek, post tp. of Montgomery co., Kan. P. 505.

Fawn River, post tp. of St. Joseph co., Mich. P. 680.

Fax'on, post tp. of Sibley co., Minn. Pop. 587.

Fay (HEMAN A.), b. at Bennington, Vt., 1778, graduated at West Point Military Academy in 1808, and d. at Bennington Aug. 20, 1865. He wrote *Official Account of the Battles of 1812–15.*

Fay (JONAS), M. D., b. at Hardwick, Mass., Jan. 17, 1737, was surgeon under Col. Ethan Allen at the surrender of Ticonderoga, a member of the convention of 1777 which declared Vermont an independent State, and author of the declaration of the fact and their reasons for it to Congress; secretary of the convention to form the State constitution in July, 1777, and one of the council of safety to administer the government; member of the State council (1778–85); judge of the supreme court (1782); of probate (1782–87); agent of the State in Congress Jan., 1777, Oct., 1779, June, 1781, and Feb., 1782. He published a pamphlet, with Ethan Allen, in 1780, on the New Hampshire and New York controversy. D. at Bennington, Vt., Mar. 6, 1818.

Fay (THEODORE SEDGWICK), American author and diplomatist, was b. in New York City Feb. 10, 1807, and admitted to the bar in 1828, but not practising, soon began contributing to the *New York Mirror,* which he finally edited. *Dreams and Reveries of a Quiet Man* was published in 1832. This was succeeded by *Minute Book,* a journal of travel in Europe. *Norman Leslie,* his first novel, published in 1835, went to a second edition in the same year. Other works are *Sydney Clifton* (1839), *The Countess Ida* (1840), *Hoboken* (1843), *Robert Rueful* (1844), *Ulric, or The Voices,* poems (1851). His best known fugitive contributions are his papers on Shakspeare. He has also published a *History of Switzerland,* in which country he was U. S. minister-resident from 1853 to 1861. Prior to this appointment he was U. S. secretary of legation at Berlin from 1837 to 1853.

Fayal' [from the Port. *faya,* a "beech tree," but its so-called beech trees are myrtles of the species called *Myrica Faya*], one of the most important of the Azores, a group of islands in the Northern Atlantic belonging to the Portuguese. It contains 37 square miles, with 25,000 inhabitants. It is very fertile, and besides its considerable transit-trade with America it exports a great quantity of oranges and wine. Its principal town, Horta, lies in lat. 38° 30′ N. and lon. 28° 41′ W.

Faye (HERVÉ AUGUSTE ÉTIENNE ALBANS), French astronomer, b. in the department of Indre Oct. 5, 1814, was a member of the French Institute, and discovered the comet bearing his name Nov. 22, 1843. He was elected a member of the section of astronomy Jan. 18, 1841, and of the bureau of longitudes Mar. 26, 1862. In 1864 he was appointed a member of the imperial council of public instruction, with the rank of officer of the Legion of Honor; was professor of geodesy at the École Polytechnique from 1848 to 1854; became rector of the Académie Universitaire at Nancy in 1854; and is the author of some valuable papers and several text-books of astronomical science.

Faye's Comet was discovered by M. Faye Nov. 22, 1843. It has been shown by Leverrier that it came into the solar system in 1747, and that the attraction of Jupiter then gave it its present orbit. Its mean distance is 3.8118 times that of the earth; its eccentricity is .5576; its inclination, 11° 22′ 7″, its period, 7.414 years, and its motion is direct.

Fayette, county in the W. N. W. of Alabama. Area, 670 square miles. The surface is well watered, uneven, and fertile. Cotton and corn are the chief products. Cap. Fayette Court-house. Pop. 7136.

Fayette, county of Georgia, in the N. W. central part of the State. Area, about 215 square miles. Its surface is generally level. Iron and granite are found. Dairy products and grain are the agricultural staples. It is traversed by the Savannah Griffin and North Alabama R. R. Cap. Fayetteville. Pop. 8221.

Fayette, county of Illinois, in the S. W. central part. Area, 720 square miles. Its surface is level prairie and timber-land, and is very fertile. Grain, cattle, wool, hay, tobacco, and dairy products are the staples. Lumber, carriages, and flour are extensively manufactured. The Kaskaskia River and the Illinois Central and the St. Louis Vandalia and Terre Haute R. Rs. traverse the county. Cap. Vandalia. Pop. 19,638.

Fayette, county in the E. S. E. of Indiana. Area, 196 square miles. It is a highly cultivated and densely peopled county. The surface is level and based on limestone. Grain, cattle, and wool are produced, and carriages and wagons extensively manufactured. This county is traversed by the west fork of the Whitewater River, by the Whitewater Canal, and the Fort Wayne Muncie and Cincinnati and the Cincinnati and Indianapolis Junction R. Rs. Cap. Connersville. Pop. 10,476.

Fayette, county in the N. E. of Iowa. Area, 720 square miles. Its surface is undulating, fertile, well timbered, and well watered, and the water-power is quite extensive. Grain, cattle, wool, flour, and lumber are the chief products. It is traversed by the Milwaukee division of the Burlington Cedar Rapids and Minnesota R. R. Cap. West Union. Pop. 16,973.

Fayette, county of E. Central Kentucky, in the "Blue-grass region." Area, about 300 square miles. It is a beautiful and highly fertile limestone county. Grain, live-stock, and wool are staple products. There are manufactures of clothing, carriages, flour, woollen and cotton goods, bagging, and other commodities. It is traversed by the Kentucky Central and other railroads. Cap. Lexington. Pop. 26,656.

Fayette, county of S. W. Central Ohio. Area, 414 square miles. Its soil is generally quite level and very fertile. Cattle, grain, and wool are produced. Bricks are quite extensively manufactured. It is intersected by several creeks and by the Cincinnati and Muskingum Valley R. R. Cap. Washington Court-house. Pop. 17,170.

Fayette, county of Pennsylvania, bordering on West Va. Area, 800 square miles. It is bounded on the W. by the Monongahela, is intersected by the Youghiogheny and its branches, and by the National Road and the Pittsburg Baltimore and Washington R. R. The soil is very fertile. Grain, cattle, wool, and hay are produced. Bituminous coal is very extensively mined and iron ore abounds. Metallic wares, cooperage, leather, carriages, flour, clothing, lumber, and saddlery are among the articles manufactured. Cap. Uniontown. Pop. 43,284.

Fayette, county in the S. W. of Tennessee. Area, 500 square miles. Its soil is very productive. Cattle, corn, and cotton are staple products. It is traversed by the Memphis and Louisville and the Memphis and Charleston R. Rs. Cap. Somerville. Pop. 26,145.

Fayette, county of S. E. Central Texas, intersected by the navigable Colorado River. Area, 1025 square miles. The soil is fertile prairie, timber, and bottom lands. Live-stock, corn, wool, cotton, and lumber are the chief products. Grazing is excellent. The climate is generally healthful. Cap. Lagrange. Pop. 16,863.

Fayette, county of West Virginia, in the S. central part. Area, 770 square miles. The surface is mountainous and heavily timbered. The soil is very fertile. Tobacco, timber, wool, and fruit are staple products. Coal and iron ore abound. The New River and its tributaries furnish extensive water power. It is traversed by the Chesapeake and Ohio R. R. Cap. Fayetteville. Pop. 6647.

Fayette, tp. of Calhoun co., Ark. Pop. 220.

Fayette, tp. of Livingston co., Ill. Pop. 257.

Fayette, tp. of Vigo co., Ind. Pop. 1912.

Fayette, tp. of Decatur co., Ia. Pop. 318.

Fayette, post-v. of Fayette co., Ia., 8 miles S. of West Union, the county-seat, and on the Davenport and St. Paul R. R.

Fayette, tp. of Linn co., Ia. Pop. 914.

Fayette, post-v. and tp. of Kennebec co., Me., 18 miles N. W. of Augusta, has manufactures of edge tools and carriages. Pop. 900.

Fayette, tp. of Hillsdale co., Mich. Pop. 2172.

Fayette, post-v., capital of Jefferson co., Miss., 23 miles E. N. E. of Natchez. It has a weekly newspaper. Pop. 120.

Fayette, post-v., capital of Howard co., Mo., 12 miles from the Missouri River, on the Missouri Kansas and Texas R. R. It has 2 weekly newspapers, 1 college, 1 female seminary, 1 colored school, 6 churches (2 of which are colored), and one hotel. The L. and Mo. R. R. R., now being graded, will pass through Fayette. Pop. 815.

C. J. WALDEN,

ED. AND PROP. "HOWARD CO. ADVERTISER."

Fayette, post tp. of Seneca co., N. Y., extends from Cayuga to Seneca Lake. It is a fertile tract. Lime is manufactured and building-stone is extensively quarried. Pop. 3364.

Fayette, tp. of Lawrence co., O. Pop. 2082.

Fayette, tp. of Juniata co., Pa. Pop. 2041.

Fayette, tp. and post-v. of La Fayette co., Wis., on the Western Union R. R. Pop. 1195.

Fayette City, post-b. of Fayette co., Pa., on the Monongahela River. Pop. 880.

Fayetteville (P. O. name, FAYETTE COURT-HOUSE).

post-v., capital of Fayette co., Ala., on the survey at the crossing of the Columbus Fayette and Decatur and Aberdeen and Elyton R. Rs. It has 1 news-paper, an academy, 2 churches, 2 hotels, 1 tannery, several shops, the usual number of stores, etc. Pop. about 640.

ED. OF "WATCHMAN."

Fayetteville, tp. of Talladega co., Ala. Pop. 1337.

Fayetteville, post-v., capital of Washington co., Ark., in the Ozark Mountains, 60 miles from the Atlantic and Pacific R. R. in Missouri, and 55 miles from the Arkansas River. It has 1 bank, 2 newspapers, flour-mill, sash and blind factory, 4 hotels, 4 churches, a number of private schools, free schools for both colors, the usual number of shops, stores, etc. The Arkansas Industrial University is situated here. Pop. 955. SAMUEL BARD, PROP. "NEWS."

Fayetteville, post-v., county-seat of Fayette co., Ga., 25 miles S. of Atlanta.

Fayetteville, a v. of Hazle Hill tp., Johnson co., Mo. Pop. 139.

Fayetteville, post-v. of Onondaga co., N. Y., about 8 miles E. of Syracuse. The manufacture of hydraulic cement, quick-lime, and land-plaster is extensively carried on here. There are 5 churches, 1 excellent union school, a public library, 2 banks, several large flouring-mills, manufactories of pearl barley, 2 paper-mills, a machine-shop, 15 stores, 3 hotels, and 1 weekly newspaper. Pop. 1402.

F. A. DARLING, ED. "THE WEEKLY RECORDER."

Fayetteville, post-v., capital of Cumberland co., N. C., on Cape Fear River and the Western R. R. of North Carolina, 60 miles from Raleigh and 90 from Wilmington. It has 8 churches, 3 banks, about 125 stores and business-places (including 5 jobbing-houses), a building and loan association, 3 fire companies, 3 uniformed and armed volunteer military companies, a gas company, water-works, 3 hotels, 2 livery stables, a public cemetery, 1 female college (not in operation now), a male institute, a dozen or more private and primary schools, and a large and excellent school for colored children; 4 weekly newspapers, 1 large carriage-factory, a wagon-manufactory, 4 mills, 2 extensive coppersmith establishments, and a large grape-vineyard. There are also 4 cotton-factories near the village. It contains 3 public halls, the county court-house, prison, etc., a large opera-house, a town clock, and a market-house. It has a large trade in rosin, turpentine, and cotton, is a great horse and mule market, and has 8 steamboats running to Wilmington. It enjoys a large trade from the surrounding country. Fayetteville suffered largely from invasion and destruction to property at the close of the war. Pop. 4660. M. J. McSWEEN, ED. "EAGLE."

Fayetteville, post-v. of Perry tp., Brown co., O. Pop. 397.

Fayetteville, post-v. of Franklin co., Pa., 5 miles E. by S. of Chambersburg, and near the Mont Alto R. R.

Fayetteville, post-v. and the capital of Lincoln co., Tenn., 82 miles S. of Nashville, 12 miles N. of the Alabama State line, on Elk River, terminus of the Winchester and Alabama R. R. It has 1 savings and 1 national bank, 2 newspapers, a manufactory of woollen goods, broadcloths, cassimeres, etc., a carriage-manufactory, 3 churches, 2 academies, and 3 other schools, and the usual number of stores and shops. About 4500 bales of cotton and large quantities of corn, wheat, hogs, etc. were shipped during the winter season of 1873–74. Pop. 1206.

N. O. WALLACE, ED. "OBSERVER."

Fayetteville, post-v., county-seat of Windham co., Vt. It is in New Fane tp., 12 miles N. W. of Brattleboro'.

Fayetteville, post-v., county-seat of Fayette co., West Va., in a tp. of the same name. Pop. of tp. 1977.

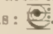
Fayoom' [also written **Faioum, Fayoum,** and **Fayum,** from the Coptic *Pi-om*, which means, Wilkinson says, "the cultivated land," or, according to Mariette, "the sea"], a province of Egypt, on the W. side of the Nile, between lat. 29° and 30° N. and lon. 30° and 31° E. Its capital, Medeeneh (pop. about 13,000), is about 65 miles S. W. of Cairo and 30 miles N. W. of Benisooef. The Fayoom is a basin formed by a depression in the Libyan range, its main plateau being on about the level of the Nile, but in its lowest point 100 feet below that level. Its area, anciently somewhat greater, is now about 750 square miles, more than 100 of which are occupied by the natural lake Birket el Keroon. It is still the most fertile province of Egypt, abounding in figs, grapes, apricots, olives, and other fruits. But its ancient renown was much greater. It contained the LABYRINTH (which see), and the artificial lake MOERIS (which see), both built by Amenemka III., the great king of the twelfth dynasty, according to Wilkinson, nearly 2000 B. C., according to Mariette, nearly 3000 B. C. (See HERODOTUS, ii. 148–150; *Aperçu de l'Histoire d'Égypte*, by AUGUSTE MARIETTE-BEY, 2d ed. 1870; and ZINCKE'S *Egypt of the Pharaohs and of the Khedive*, 1871.)

R. D. HITCHCOCK.

Fays'ton, tp. of Washington co., Vt., 10 miles S. W. of Montpelier, has manufactures of lumber and leather. Pop. 694.

Fay'ville, flourishing post-v. of Southborough tp., Worcester co., Mass., on the Boston Clinton and Fitchburg R. R., 28 miles W. of Boston. Boots and shoes are the leading articles of manufacture.

Fazy (JEAN JACQUES), Swiss statesman and journalist, b. at Geneva May 12, 1796, liberal editor at Paris from 1826 to 1835, then leader of democratic party at Geneva, which triumphed in 1846, and president of council of state in his canton. He published several works. D. Nov. 5, 1878.

F Clef, in music, a curved mark resembling the reversed letter C placed across the fourth line of the stave, with two dots enclosing the line, thus: . Every note on that line is called F, and the others, above and below, derive their names from this. The F clef indicates the stave on which the bass is written, and the notes placed on this stave are an octave and a sixth below those in a similar position on the G (or treble) stave. In ancient music the F clef was occasionally transferred to another line; in which case that line became F, and the other notes were named in conformity with it. WILLIAM STAUNTON.

Fe'alty [Fr. *fealté*, from Lat. *fidelitas*], loyalty or faithfulness to the ruling power; especially used of submission to a feudal superior or the duty owed by a tenant to his lord in mediæval times.

Fear'ing, tp. of Washington co., O. Pop. 1358.

Feast, or **Fes'tival** [Fr. *fête;* Lat. *festum*, a holy day; kindred with *fastus* and *fas*, originally terms of the religious language; and with *feriæ*, days of rest, of sacrifice—"*feria, a feriendis victimis vocata*"], a joyful commemoration of a fact or teaching. Most persons are under the influence of times and seasons, and to them the recurrence of a day associated with any important event will revive the feelings which the day brought to them. Individuals and families keep days of glad remembrance; communities observe with signs of rejoicing the anniversaries of striking events, or they appoint days on which facts connected with their history shall be celebrated, in order that these facts may be kept fresh in memory, and have an influence on the tone of mind of the nation or of those concerned. There has probably never been any community which has not had its festivals, and which has not owed much to the spirit of vigor resulting from them. Such aids were more important to earlier communities, for higher civilization multiplies bonds of union. As their history shows, a marked influence on the segregated states of Greece was produced by their common festivals, the Olympic, Pythian, Isthmian, and Nemean games. To these all of Hellenic race were admitted, and none other, as competitors for the prizes given. The right to contend was highly esteemed. Each state habitually sent representatives, and so did colonies when scarcely any other tie was maintained with the mother-country. It could not be that the associating thus as members of one family on equal footing did not keep alive to some extent a feeling of common interest. Whatever their dissensions among themselves, as against the rest of the world they were of one blood; they made a clear distinction between Greeks and Barbarians, and their national games helped to draw this line of separation and to draw them to each other. The most important of these games were those celebrated in honor of Jupiter Olympius every fourth year at Olympia in Elis. The institution of the festival is lost in the obscurity of the mythic ages. It was revived in the year B. C. 776, and when afterwards the Olympiads were used as a chronological era they were dated from this revival. During the month in which the games were held all hostilities ceased throughout Greece, and a religious sanctity protected the territory of Elis. It need hardly be said that besides these four great festivals, open to all of Hellenic blood, there were many others observed—some peculiar to each state or town, others more general as belonging to the service of gods worshipped by all; for here and in all early nations festivals and their ceremonies were intimately connected with all religion. Among the Romans there were many festivals, private and public; the latter were *stativæ*, fixed, or *conceptivæ*, movable, or *imperitivæ*, occasional; these were divided into days of sacrifice and days of banqueting, days of games and days of rest, or *feriæ*. Some of the feasts of ancient nations were celebrated with very great pomp. Herodotus tells us of one at Bubastos in Egypt that "at this solemnity 700,000 men and women assemble." The sums spent by the later Romans were enormous. A like enthusiasm

for the honor of their deities is shown in the East in our day: the lavish expenditure on some of the Hindoo feasts far surpassing the common Christian estimate of what religion demands.

We have said that the observance of seasons is in obedience to an instinct with most persons. The believer in revelation recognizes also that it was commanded by God. The Son of Sirach asks (Ecclus. xxxiii.), "Why doth one day excel another, whenas all the light of every day in the year is of the sun? By the knowledge of the Lord they were distinguished: and He altered the seasons and the feasts. Some of them hath He made high days and hallowed, and some of them hath He made ordinary days." In Leviticus xxiii. is given a list of the "feasts of the Lord:" *α*. The Sabbath, which was observed from the beginning, dividing time into weeks of seven days, and which, after the Exodus, was imposed with burdens. Connected with the weekly Sabbath was the rest of the sabbatical year, which returned every seventh year, and the year of Jubilee, which was at the end of seven times seven years. *β*. The Passover, a commemoration of the night when the angel of the Lord slew all the first-born in Egypt, and passed over the houses marked by the blood of the slain lamb. The passover lamb was offered at even in the fourteenth day of the first ecclesiastical month, and the next day was the first day of the Feast of Unleavened Bread. *γ*. The Feast of Weeks, called afterwards Pentecost, a feast of first-fruits, also the anniversary of the delivery of the Law. *δ*. The Feast of Trumpets, said by the rabbins to be in commemoration of the offering of Isaac by Abraham, when a ram was sacrificed in his stead. The cause of the institution is not given in Holy Scriptures. This feast is on the first day of the seventh month, being the beginning of the civil year. Modern Jews mark, as do most nations, by special observances their New Year's Day. Their frequent salutation on this day is, "May you be inscribed for a happy year!" having reference to their belief that on this day God passes sentence on each man—not definitely, for the doom is not fixed until the Day of Atonement, before which time it may be modified by repentance. The first of each month, or new moon, is also kept. *ε*. The tenth day of the seventh month is the Atonement—a most solemn fast, though now preceded by a banquet. *ζ*. Five days after, and lasting seven days, is the Feast of Tabernacles, reminding all Israelites that God made their fathers to dwell in booths when he brought them out of the land of Egypt. These are the "holy convocations" of the Mosaic Law. Other feasts were afterwards added, the chief of which are the Purim and the Dedication. The former is in memory of the escape from total annihilation plotted against the Jews by Haman, as recorded in the book of Esther. Haman had cast lots (*purim*) to discover a suitable time for the accomplishment of his purpose; he did so in the first month, and the lot indicated the twelfth month, and thus time was given for the deliverance. This feast (*Purim*) is kept now by Jews with masqueradings, banquetings, and great rejoicing.

The national festivals thus far spoken of were all connected with religious observances. The derivation given of the term *feast* implies the association. It is to be noted that no nation has fewer holidays than our own. This is due, in part, to the fact that the Union is not yet a hundred years old, but also to the fact that the U. S. government has no connection with religion. An attempt has been made to institute a national yearly Thanksgiving, but the President, who has on several occasions recommended the observance, cannot appoint as one authorized to do so. Another reason is that the majority of the citizens of the U. S. have discarded the religious system on which are based the feasts observed in Christian lands during many centuries. The natural promptings which found expression under that system are gratified by the ceremonies connected with secret societies akin to Masonry, and by vereins which result from the tie of race, not of citizenship.

Under the New Testament there are no festivals of Divine appointment, save as the Church rules in God's name—none enforced as were those commanded to Moses. But from the first, Christians observed the Lord's Day and Easter, the weekly and yearly memorials of the fact which confirms the Christian faith. They also observed Pentecost, in commemoration of the descent of the Spirit and the founding of the Church. Additions were gradually made to these feasts, until each prominent event in the life of our Blessed Lord had its special day of observance. Some of these are, as near as may be, anniversaries; others are assumed to be such. Some are fixed, recurring always on the same day of the month; others, dependent upon Easter, are movable. The cycle of the Church's teaching, marked by her appointed days, is, in the eyes of those accustomed to its observance, very beautiful, as tending to ensure due consideration of all Christian doctrine. The year begins with Advent, when we are told of the second coming of the Lord in glory, and are also prepared to celebrate His first coming in humility at Christmas—the Nativity. Eight days after is the Circumcision, which marks His obedience to the law for man and our need of the true circumcision of the Spirit. Then follows the season of Epiphany, which includes His manifestation to the Gentiles and His baptism. Next we are bid to dwell upon the facts which in the Litany we plead before God: His fasting and temptation: His agony and bloody sweat; His cross and passion; His precious death and burial; His glorious resurrection and ascension; and, finally, that which was purchased by His death and which followed His ascension—the coming of the Holy Ghost on the day of Pentecost, or Whitsun Day. The first Sunday after this is Trinity Sunday, from which, in the English Church, the remaining Sundays of the year are named. "Thus every year the whole gospel story is, as it were, enacted before our eyes; and then follow the exhortations to practise, to fulfil in daily life, the duties of the Christian religion." Besides these feasts of the Lord, embracing the whole year, there are many others commemorating His Blessed Mother, His apostles and saints. Every day is a saint's day, many of them being dedicated to more than one saint, and in different churches to different saints. Some of these minor holy days are of doubtful origin, but many of them date back to early persecutions. We have seen in our day repeated the very mode by which many saints' days came to be observed—viz. the yearly assembling of admiring friends at the grave of a holy man on the anniversary of his death or burial for the purpose of religious service. All Christian bodies who keep stated festivals agree in their general observances while differing in respect to the minor feasts. The Church of England, when the Book of Common Prayer was set forth, provided special services (with two exceptions) only for the days of saints connected directly with the history of our Lord, while yet, from whatever reason, other names were retained on her calendar. The Protestant Episcopal Church has omitted all days for which there is no prescribed service.

As the term "holy day," a day of sacred rest, has been changed to "holiday," a mere season of leisure and enjoyment, so the word "feast" has naturally come to express in a lower sense feasting, banqueting. For, as sorrow is marked by a setting aside of luxuries, so joy that is shared with others generally finds expression in indulgence of appetite, in eating and drinking. The plea, "For good fellowship," which has led to so much intemperance, has its warrant in nature, if the habits of all ages result from the teaching of nature. The word *festum*, whence comes our "feast," has been derived from ἑστιάω, to "receive on one's own hearth," to "feast;" however true this may be, festivals were always accompanied by sacrificial banquetings. The habits of the Jews on glad days holy to the Lord was to "eat the fat, drink the sweet, and send portions." And in the Christian Church, while spiritual joy is not connected with indulgence of the senses, feasts are contrasted with fasts. The most ascetic rule is modified by the occurrence of a feast-day. And we cannot but note that the partaking in common of bread and wine is made by the Lord the sacrament of closest communion, while his apostle, to mark entire separation, has written, "With such an one, no not to eat." Wm. F. Brand.

Feath'erfoil, Water-feather, or **Water-violet,** the *Hottonia inflata* of the U. S. and *Hottonia palustris* of Europe, curious primulaceous plants which grow submerged in water, and thrust up long scapes into the air to produce the blossoms, which in the European species are very beautiful. Other species are known. The name commemorates Peter Hotton, a Dutch botanist who d. in 1709.

Feath'er-Grass [so called from the long feathery awns or beard attached to the seed], a name applied to several long-awned grasses, especially to those of the genus *Stipa*, several of which grow in the U. S. From the hygroscopic twisting and untwisting of these awns the name "weather-grass" is also used. It is stated that this hygroscopic twist causes the awn to act like the vanes of a windmill, so as to screw the seed down into soft earth, where it takes root.

Feath'er Riv'er, in California, is formed by the union of its N., S., and Middle forks, which rise in Plumas co., in the Sierra Nevada. Its waters reach the Sacramento in Sutter co. It is a beautiful stream, whose lower waters are navigated by steamboats as far as Yuba City.

Feath'ers are a modification of the epidermic system peculiar to birds, of which they form the covering and means of flight. Every feather is composed of a quill or barrel (Fig. 1, *a*), a shaft (*b*, *b*), and a vane or beard (*c*), consisting of barbs (Fig. 2, *c*) and barbules (*f*, *f*). The quill is horny, semi-transparent, and nearly cylindrical.

Its lower extremity is pierced by an orifice called the lower umbilicus (Fig. 1, *e*), and at its upper extremity, where the shaft begins, is a second orifice, termed the upper umbilicus (*f*). The shaft, always longer than the quill, tapers from its base to its apex, is nearly four-sided, and is more or less curved towards the bird's body. Its inner surface (Fig. 5, *c*) is divided by a fine longitudinal groove, while its outer surface (*b*) is smooth and slightly convex. It is composed of a white elastic substance called the pith (*a*), covered by a horny material similar to that of the quill. The barbs (*c*, *c*), formed of a like horny substance, are laminæ, branching from each side of the shaft near its outer surface, with an oblique direction towards its apex. Their broad sides are towards each other, and in some feathers these are so shaped that every barb fits exactly into the one next it. The barbules grow from both sides of the upper margin of the barbs, and are sometimes barbed in turn. They are commonly short, close set, and constructed so as to hook the barbs one to another (*f*, *f*). Those growing from that side of the barb nearest the tip of the feather are curved downward, while those of the opposite side are curved upward; thus, two adjoining rows of barbules interlock. This mechanism is subject to many variations. Sometimes—for instance, as in the plumes of the ostrich—the barbules are long and loose. The feathers of the owl have the barbs covered with silky down; hence the slow and silent flight of that bird. The secondary quills of the waxwing (*Bombycilla*) have the tips of their shafts widened into little horny disks resembling sealing-wax. In the down of all birds the barbs are separate and the barbules long and floating. At the point where the quill and shaft unite, there frequently grows from the feather an appendage called the plumule or secondary plume (Fig. 1, *d*). This is often a small downy tuft, but it varies in different species and in different parts of the same bird's plumage. In the emu it rivals in size and structure the feather from which it springs. In the cassowary there are two plumules to a feather, so that one quill supports three shafts and vanes. The ostrich has no accessory plumes.

FIG. 1.

Parts of the Feather.

From OWEN'S *Comparative Anatomy and Physiology of Vertebrates*, vol. ii., London, 1866.

Plumage may be generally divided into quill-feathers and clothing-feathers. These are classified by ornithologists, and have special names according to their position and uses. The wing-quills are called *remiges*, or rowing feathers, and are classified as primaries, secondaries, and tertiaries. Upon the development and shape of the primaries depends the mode of flight pursued by the bird. The tail-quills are called *rectrices*, or steering feathers. Their insertion is hidden above and beneath by feathers termed the upper and under tail-coverts. In some birds these grow very long. The upper tail-coverts of the peacock form the gorgeous "train," which is supported by the short and stiff tail-quills. The under tail-coverts of the marabout stork are developed into beautiful plumes much used as ornaments. A newly-hatched bird is scantily covered by *fasciculi* of down, each growing from a small quill and enclosed in a thin sheath, which soon crumbles away when exposed to the atmosphere. These fasciculi fall off, and are succeeded by feathers, which first appear in clumps upon those parts of the body least liable to friction. To these clumps special names have been given by naturalists. (See *Anatomy of Vertebrates*, Owen, vol. ii. p. 237.) Each feather is produced by the matrix (Fig. 2), a cylindrical cone-shaped organ attached by filaments to a papilla of the skin, and consisting of a capsule (*a*, *a*), a bulb (*e*), and two intermediate membranes. The capsule is composed of several layers, the outermost of which is of the nature of epiderm. The sides of the capsule corresponding to the outer and inner sides of the enclosed feather are marked each by a white longitudinal line. The capsule infolds a *medulla*, or bulb, of cylindrical shape and soft fibrous texture, which adheres by its base to the parts beneath, and there receives various blood-vessels and a nerve. The two membranes (*b*, *d*) lie between the medulla and the capsule. From the external membrane (*b*) proceed several close set parallel laminæ, which branch obliquely and in an upward direction from both sides of the outer white line of the capsule, curve round the cylinder, and meet at the inner white line on its opposite side. In the narrow spaces between these laminæ the matter of the vane (*c*, *c*) is deposited and formed into barbs and barbules. The outer white line receives and moulds upon the inner side of the capsule the horny back of the shaft; while on the opposite surface of the internal membrane (*d*) are formed the pith of the shaft and the horny covering of its inner surface. The inner white line serves as a barrier between the meeting extremities of the barbs. The shaft and barbs (Fig. 3, *d*) at the apex of the cylinder are the first parts formed. As the medulla increases at its base, these are pushed through the tip of the capsule, the bulb (Fig. 3, *a*, *a*, *b*; Fig. 4, *a*) supplying the necessary secretions, which are moulded between the two membranes until the feather is completed. The membrane enclosing the bulb is connected with a series of membranous cones (Fig. 4, *b*, *c*, *d*, *e*) ranged one upon another along the bulb, and joined by a tube running through its centre. The interspaces of these cones are filled with a pulpy matter, which, as the feather develops, becomes absorbed, leaving the dry conical caps. These are the light pith found inside quills. When the grooves in which the shaft and barbs are moulded are filled with horny matter, and the barbed part of the feather is finished, the horny matter spreads about the medulla and forms the quill. The quill having become firm, the internal bulb dries up: its last remnant is the ligament which passes from the pith through the quill and attaches it to the skin.

FIG. 2.

Matrix of a Growing Feather, with the capsule laid open.

From Owen.

FIG. 3.

Growing Feather.

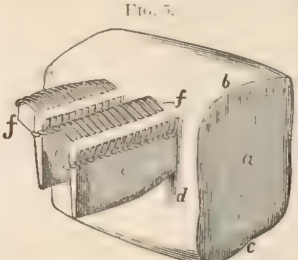
From Owen.

FIG. 4.

Structure of the Bulb.

From Owen.

FIG. 5.



Diagrammatic Section of the Shaft and Vane, enlarged.

From Owen.

The growth of feathers is very rapid, any torn out or dropped being generally replaced in a few days. The plumage is wholly or partially renewed once, and in some species twice, every year by a process called *moulting*. The nestling may be said to moult for the first time when its downy covering is exchanged for feathers. In a few months these drop out and are replaced. Some birds require four or five years to attain their perfect plumage; thus, an adult, a half-grown, and a young specimen of the same class are occasionally mistaken for birds of different species. When the male bird's plumage differs from that of the female, as is the case with blackbirds, the young birds of both sexes resemble their mother in their first plumage; but when the adult male and female are of the same color, the young birds have a plumage peculiar to themselves. Thus, swans, both the black and white species, have gray cygnets.

Under the body-feathers, especially on the breast, there is a growth of down. In aquatic birds this down is very thick and elastic, and the warm air which it keeps in increases their buoyancy in the water. Most birds dress their feathers with an oily fluid secreted by a gland at the base of the tail; this oil renders the plumage almost impervious to wet, and is most abundantly secreted by aquatic birds. The care which a bird bestows on its feathers, the connection of these feathers with the skin, from which they continually derive nourishment, and their regular renewal by moulting, account for their fresh gloss and color, and also for the diminution of these qualities after their separation from the bird's body.

Feathers are used chiefly for ornament, for the stuffing of beds and cushions, and for writing-implements. A great variety of feathers are used for ladies' head dresses and military plumes, the principal kinds being those of the ostrich, brought from the northern shores of Africa, Sahara, Madagascar, Senegal, and the Cape of Good Hope; the bird of paradise, from New Guinea and the Moluccas; the marabout stork, from India and tropical Africa; the ibis, from the Nile Valley and from South America; the rhea, from South America; the grebe, from North America; the peacock, the pheasant, the domestic cock, the seagull, the jay. Of all these, ostrich feathers are most important in commerce. Those growing above the wings are most esteemed; in the male they are generally pure white—in the female they are always tinged with gray. Next in value are the wing and tail feathers. The body-feathers, varying in length from four to fourteen inches, are called down, and are black in the male, gray in the female. In preparing the feathers for use the first process is to sort them, and tie those of equal quality in bundles of twenty-five. These bundles are washed in a lather of soap and tepid water to free them from grease, and afterwards rinsed several times in very hot water. They are next steeped for a quarter of an hour in boiling water holding in solution Spanish white, then rinsed three times, and passed very quickly through a bath of cold water deeply colored with indigo. Finally, they are exposed for a short time to sulphur vapor and carefully dried. Very discolored feathers undergo a preparatory bleaching: their stems having been pointed, they are planted upright in a grass plot and exposed for a fortnight to the sun and dew; they are then bleached in the ordinary way. The tools of the *plumassier*, or feather-dresser, are scissors for trimming the barbs; a knife or piece of sharp edged glass for scraping and paring the under part of the stem, in order to render the feather pliant; a blunt curling-knife, its handle made so as to keep it from turning in the hand; and flattened needles for sewing feathers together, two or more being often joined to form one plume. The breast of the grebe and seagull are used for muffs and trimmings. Very elegant trimmings are also made of swans' down and of ostrich, peacock, and vulture feathers. In former times the plumassiers ranked high among French artisans. Henry IV., of the celebrated white plume, gave them statutes, and a charter which was confirmed in 1612 by Louis XIII., and in 1644 by Louis XIV. The number of master-plumassiers was limited to twenty-five, and they alone were allowed to prepare feathers and enrich them with real or imitation gold and silver. (CELNART, *Art du Plumassier.*)

The Romans used feathers for stuffing beds and cushions. "The geese that come from Germany," says Pliny, "are most esteemed. They are white, of a small size, and are called *ganta*. The price paid for their feathers is ten denarii the pound. Hence, we have repeated charges brought against the commanders of our auxiliaries, who detach whole cohorts from their posts in pursuit of these birds." Here we have, perhaps, the origin of our common expression, "A wild-goose chase." Pliny further complains: "We have reached such a pitch of effeminacy, that now-a-days not even men can lie down without the aid of goose feathers as pillows." (*Nat. Hist.*, x. 27.) Down was also used. Martial, in his 161st Epigram, says, "When fatigued, you may recline on Amyclaean feathers, which the swan's inner down provides for you."

The date when feather beds were first used in England is unknown. An old chronicle tells us that the duke of Gloucester, uncle to Richard II., was smothered with "a feder-bedde." (STRUTT, *Manners and Customs of the English*, ii. 88.) By a statute of Henry VII. it was forbidden to make beds of mixed down and feathers: "The mixture of such being conceived contagious for man's body to lie on." (*Stat.* xi., ch. 59.) From this period "fether beddes" are included in most inventories of household furniture.

Goose feathers are brought from Germany, Russia, and Poland. In the fenny part of Lincolnshire, called Holland, flocks of geese are kept for the sake of their feathers, which are plucked four or five times a year. New feathers are dried by the sun's heat or in ovens, and then beaten to clean them. Those that have been used are purified by a short exposure to steam, and are dried in the air. Eider down, so much prized for lining quilts, skirts, etc., is found most commonly on small rocky islands from 45° N. to the highest Arctic regions yet explored.

The oldest authentic mention of writing quills is in a passage of Isidorus, who died in 636. (*Origines*, lib. vi. 13, p. 132, cited in BECKMANN'S *History of Inventions.*) A short poem on a writing pen is found in the works of Aldhelmus, who died in 709. The Dutch invented the art of preparing quills so as to free them from a fatty humor which prevented the ink from flowing. They used hot ashes, and for a long time kept the process a secret, but it was discovered and improved. A bath of fine sand is kept at a temperature of 140°; into this the quill end of the feather is put and left a few instants. It is then rubbed with flannel, and becomes white and clear. The yellow tint of age is given by dipping the quills into diluted muriatic acid and then drying them. Each goose-wing produces five good quills, which are classified according to their order in the wing, the first being the best. A portion of the barb is stripped off for packing. A pen-cutter will make about 800 pens in a day. Besides goose quills, those of the swan, turkey, and crow are used, the last-named chiefly for drawing. Since the introduction of steel pens the use of quills for writing has diminished in a great degree. JANET TUCKEY.

Feath'er Star, a popular name for certain echinodermatous radiate organisms of the genus *Comatula*, which in their younger stages are fixed, like the true crinoids, by a stem, but in adult life they become detached, whence they are sometimes called free crinoids. The feather star has five pinnate rays, with a chalky shell in many movable pieces. The *Comatula rosacea*, the best known species, is graceful and active in its motions, and, though a deep-sea species, can move readily upon the land.

Feath'erstone, tp. of Goodhue co., Minn. Pop. 850.

Featherstone (W. S.), Confederate brigadier-general, b. in Tennessee, emigrated to Mississippi, and represented that State in Congress (1847–51).

Feath'erstonehaugh (GEORGE WILLIAM), F. R. S., traveller and author, published a translation of the *Republic* of Cicero in 1828; in 1834 made a *Geological Report of the Elevated Country between the Missouri and Red Rivers*, *Excursion through the Slave States* (1844), *Geology of Green Bay and Wisconsin* (1836), *Observations on the Ashburton Treaty* (1842), *Canoe Voyage to the Minnesota* (2 vols., 1847), and *Geological Reconnaissance in 1835 to Côteau de Prairie* (1836). He was commissioner for Great Britain to settle the northern boundary of the U. S. under the Ashburton treaty, and afterward British consul for Calvados and Seine, France. D. at Havre, France, Sept. 28, 1866.

Feb'iger (CHRISTIAN), American soldier, b. in Denmark 1747, enlisted Apr. 28, 1775, and served honorably at Bunker's Hill. He was made prisoner at Quebec in Arnold's attack on that citadel; was conspicuous also at the capture of Stony Point and at Yorktown, Va., where he commanded the Second Virginia regiment. He was treasurer of Pennsylvania from 1789 to his death, at Philadelphia, Sept. 20, 1796.

Febiger (JOHN C.), U. S. N., b. Feb. 14, 1821, in Pennsylvania, entered the navy as a midshipman Sept. 14, 1838, became a passed midshipman in 1844, a lieutenant in 1853, a commander in 1862, a captain in 1868. From 1861 to 1863 commanded various vessels of the Western Gulf and Mississippi squadrons, and in 1864–65 commanded the Mattabeset (North Atlantic blockading squadron), in which vessel he participated in the desperate fight between the little squadron of wooden vessels under the command of Captain Melancthon Smith and the ram Albemarle, which took place in Albemarle Sound, N. C., on May 5, 1864, and resulted in the defeat of the ram and the capture of her tender, the Bombshell. For his "gallantry and skill" on this occasion Febiger was warmly commended by Captain Smith and Rear-Admiral Samuel Phillips Lee.

FOXHALL A. PARKER.

Febric'ula [a diminutive of the Lat. *febris*, "fever"], or **Ephemeral Fever,** a short feverish attack lasting from one day to a week, marked by a rapid pulse, a furred tongue, and often by a very considerable increase of heat and by headache. Persons suffering from febricula are said to be "threatened with a fever," and are too often improperly dosed. A warm bath, warm or cold water to drink as best suits the patient, the use of enemata if called for, and other simple treatment is sufficient, for the disease will pass away of itself if allowed to do so. It is often followed by an eruption or a stage of profuse sweating. There would appear to be no constant factor in the causes of febricula, which may be associated with a severe cold, a profound emotional disturbance, or with some excess on the patient's part. It is especially common during epidemics of typhoid and typhus fevers.

REVISED BY WILLARD PARKER.

Feb'rifuge [from the Lat. *febris*, "fever," and *fugo*, to "put to flight"], a medicine capable of banishing or diminishing fever. The term is much less used than formerly, it being now recognized that the specific fevers are as a rule self-limited diseases, with a somewhat definite course to run; consequently, it is not considered desirable or possible to "break up" fevers of this class. Still, much may be done by the use of cold water, the cinchona alkaloids, and the arterial sedatives, such as veratrum and aconite,

to diminish the severity of fevers. Such medicines as quinia and arsenic may, however, have a really specific febrifugal action in many malarial fevers. Hence, it is to them that the name more strictly belongs.

Febro'nianism [so called from *Justinus Febronius*, the pseudonym of its founder], a name applied to the views taught in the writings of J. N. von Hontheim (1701–90), suffragan bishop of the Roman Catholic diocese of Treves. He taught that the primacy of the pope is of human origin, and opposed with great success the Ultramontane view. He had many followers, but in his old age was so annoyed by the persecutions visited upon himself and his family that he recanted twice, and finally abandoned his bishopric; but Febronianism long survived, and the "Old Catholic" movement of recent years is its development. (See HONTHEIM, VON.)

Feb'ruary [so named from *Februus*, an old Etruscan and Roman divinity, identified in later times with the Pluto of the Greeks], the second month of the Gregorian year, having twenty-eight days, except in leap-years, when it has twenty-nine.

Fécamp [Lat. *Fiscannum*], a manufacturing town and seaport of France, in the department of Seine-Inférieure. Its port, though small, is one of the best on the English Channel, and is much frequented by colliers from Newcastle and Sunderland, and by timber-ships and fishing-vessels from the Baltic. Lat. of Fécamp light, 49° 46′ N., lon. 22′ E. It is a favorite resort for sea-bathing, and has some manufacturing interests. Pop. 12,243.

Fech'ner (GUSTAV THEODOR), b. at Gross-Särchen Apr. 19, 1801, after a brilliant course of study at Sorau and Dresden studied medicine at Leipsic, where he became professor of physics in 1834; has written much and ably upon chemistry, physics, anthropology, medical science, philosophy, and antiquities; besides poetry, criticism, and humorous literature. Among his more important works are *Ueber das höchste Gut*, 1846; *Elemente der Psychophysik*, 1860; *Zur Geschichte der Holbein'schen Madonna*, 1866.

Fech'ter (CHARLES ALBERT), actor, b. in London Oct. 23, 1824. His father was a German, his mother a Frenchwoman, and he was educated in England and France. For some time he devoted himself to sculpture, but having an inclination for the stage, he made his *début* at the Salle Molière in *Le Mari de la Veuve*; after passing some weeks at the Conservatory he joined a company and made the tour of Italy; on his return he resumed his occupation of sculptor. His first success on the French stage was as Duval in *La Dame aux Camélias*. In 1860 he appeared on the English stage as Hamlet, and in 1861 as Othello; and in 1863 he leased the Lyceum Theatre and produced *The Duke's Motto, Bel Demonio*, etc., assuming the principal characters himself. In 1870 he played successful engagements in the principal cities of the U. S., and managed the Globe Theatre in Boston for a season. D. Aug. 4, 1879.

Fecula. See STARCH.

Fecundation. See EMBRYOLOGY, by PROF. J. C. DALTON, M. D., M. N. A. S.; also FERTILIZATION OF PLANTS.

Fed'eralist, written also **Fœderalist** [from the Lat. *fœdus*, meaning a "league," and akin to *fides*, "faith"].

I. A collection of essays written in favor of the new (present) Constitution of the U. S., and, with the exception of the concluding nine of the eighty-six numbers, originally published in *The Independent Journal*, a semi-weekly newspaper printed in the city of New York, between the 27th of Oct., 1787, and the 2d of Apr., 1788. Its authors were Alexander Hamilton, James Madison, and John Jay, who addressed themselves over the common signature of "Publius," in a series of letters, "To the People of the State of New York," with the avowed purpose of securing the accession of that State to the Constitution as proposed by the Federal convention of Sept. 17, 1787.

The immediate cause, or, so to say, provocation of the work, was the appearance, almost simultaneously with the recommendation of the convention, of two series of able articles so severely criticising the proposed Constitution that its adoption was more than endangered. Mr. Hamilton resolved to counteract these attacks through the same means, the public press—to answer the arguments advanced, and, in reply to a charge that the supporters of the Constitution designed to supplant the Union of the States by their fusion under a centralized (if not monarchical) government, to retort upon its opponents with an implied accusation of favoring the division of the States into separate confederacies. For this purpose he drew up a syllabus of essays, to be written by himself and associates, which should perspicuously exhibit the advantages of the Union, expose the insufficiency of the subsisting Confederation, with the necessity of a more energetic government, and advocate the plan under consideration by showing that it was the least objectionable of any feasible scheme, and that it conformed to republican principles and approved institutions.

It is beyond reasonable doubt that Mr. Jay, then secretary for foreign affairs, discussed the foreign relations of the States in the second, third, fourth, and fifth numbers, and the lodgment with the Senate of the treaty-making power in the sixty-fourth. Concerning the respective shares of Hamilton and Madison in the authorship a dispute early arose between the admirers of those gentlemen. The curious reader may consult the introduction to Mr. Dawson's edition for a summary account of this not unembittered controversy, which was never of much moment save, mayhap, as to No. 49 and those immediately succeeding, relating to the independence of the several departments of the government. It is a noteworthy indication of the importance attached by Mr. Hamilton to the posthumous fame of his connection with the work that he was at pains to leave a significant memorandum concerning it in the office of a friend the day before his fatal duel with Aaron Burr.

In estimating its merits the *Federalist* is to be judged as a collection of fugitive pieces intended to vindicate a specific Constitution, rather than as an elaborate treatise on the science of government. For the end aimed at it was admirably adapted. The basis of the argument wellnigh throughout is utility, or, as has been somewhat harshly said, "interest and fear." From this point of view it would have been difficult to adduce more convincing reasons for the preservation of the Union; many of them, in the light of more recent events, savor of prescience. The method is mainly empirical, rarely speculative. The style is elevated, yet designedly popular. The whole is replete with more or less familiar illustrations, particularly from history. It may be true, as was the opinion of Mr. Stuart Mill, that a more philosophical work upon modern democracy has been founded upon American institutions, but it was also said by a no less eminent foreigner, M. Guizot, that "in the application of the elementary principles of government it is the greatest work known."

If the Constitution is to be interpreted according to the intention of its framers and the understanding of those who ratified it, an acquaintance with the *Federalist* is nearly indispensable. It also affords a valuable view of many of the cardinal differences of the parties which, under various names, have contended in American politics.

The first collected edition appeared in 1788 in two 12mo volumes from the press of J. & A. M'Lean, the proprietors of *The Independent Journal*. It has since been issued, in this country and abroad, in over twenty editions, of which one by Mr. Dawson is the most attractive and complete. The references in this article, however, are made to the numbers of the first and more familiar edition.

II. The name of a political party prominent in the early history of the U. S.

Various circumstances have been assigned as its origin. But, whatever its proximate cause, its real basis must be sought in divergent connections and interests of long and gradual growth. During the struggle for independence the Revolutionary government was supported by a devotion frequently cited by observant foreigners as a marvellous example (*e. g.* CONSTANT, *Cours de politique*, i. p. 101, ed. 1872). Upon the accomplishment of the Revolution and relaxation of the motives to the self-denial which alone had made it possible, the necessity of a more vigorous authority for the unimpassioned purposes of peace became irresistibly apparent. What change would be most expedient was the question to be decided.

Experience of the shortcomings of the existing system had peculiarly impressed its defects upon the leading citizens, who had had the most to do with administering it. A majority of these were imbued with British constitutional traditions, and not unaffected by the exercise of peremptory powers during the war. They distrusted the capacity of the masses to manage their own concerns, and feared in the common people a disrespect for the rights of persons and of property. They believed it necessary to consolidate the country under a general national government powerful enough to permeate the whole. Though by no means harmonious as to the powers to be conferred, they were unanimously in favor of a "strong government." With these the commercial classes generally sided, as did also the greater number of those distinguished by wealth and social position.

On the other hand, the very self-sacrifice so long practised had increased the attachment of the masses for independent local institutions, and quickened their jealousy of an overshadowing authority beyond the reach of "a swift responsibility." They had dearly learned the worth of the Union, but, imputing to the more aristocratic party a design to subvert their liberties, and believing a limited alliance of free States sufficient for their purposes, they desired

to retain the federal league (under the Articles of Confederation), somewhat modified to suit unforeseen needs.

Out of this conflict came the Constitution, "extorted," in the words of John Quincy Adams, "from the grinding necessity of a reluctant nation." By one of those freaks of nomenclature not uncommon in religion and politics, those who favored the consolidation of the States into one nation received the name of "Federalists," while the misnomer of "Anti Federalists" was bestowed upon their opponents, who least of all deserved it.

With the administration of Gen. Washington the Federalists came into ascendency. Having only accepted the compromise Constitution in default of something more to their liking, they, under the accomplished leadership of Hamilton, set about finding in that instrument a warrant for the government they desired through the doctrines of "implied and constructive" constitutional power, of the exercise of which the establishment of a national bank and the assumption of the State debts may serve as examples. This perversion of the organic law of the land caused the defeat of the Federalists and the accession of their opponents (under the name of Republicans) in the election of Mr. Jefferson, who announced as the new policy "the support of the State governments in all their rights as the most competent administrations for our domestic concerns and the surest bulwark against anti-republican tendencies—the preservation of the general government in its whole constitutional vigor as the sheet anchor of our peace at home and safety abroad." The power of the Federalists was irretrievably lost by their action in the famous Hartford Convention, which was called to protest against alleged neglect of New England during the last war with Great Britain, but which fastened upon them the imputation of condemning the war itself. The party, as such, expired six years later on the election of Mr. Monroe and the commencement of the "era of good feeling." Long after its public overthrow the seeds sown by this powerful organization continued to bear fruit, particularly in the judiciary, its last stronghold. Despite that its prestige was broken even here by the resistance of Mr. Secretary Madison to a mandamus of the Supreme Court in the case of Marbury, one of the so-called "midnight appointees" of Mr. Adams, the decisions of that tribunal long continued under the influence of Federalist doctrines, of which a striking instance is to be found in the Dred Scott case, wherein the leading opinion was delivered by Mr. Chief-Justice Taney, himself an old Federalist.

III. The generic name of divers political parties in Spain opposed to monarchical government, but favoring very different systems, ranging from a socialism resembling that set up by the Parisian Commune of 1871 to a republic patterned after the U. S. of America. Upon the abdication of King Amadeus (Feb. 11, 1873) the government of the country fell to a national assembly elected during the late reign, and mainly made up of the mild royalists called "radicals." Dissensions amongst the monarchists enabled the republican members, although in the minority, to bring about a declaration of the Republic with a republican ministry, under the supervision of a permanent committee, which should represent the legislature until the convening of a constituent assembly. After the lapse of a couple of months preparations were made, with the assistance of the permanent committee, for seizing the government by a military *coup d'état* in the interest of Marshal Serrano. This was frustrated by the adroit boldness of the civil governor of Madrid, Señor Estevanez, who, on the day elected for the Serrano movement, disarmed the guards by which it was to have been effected, and enabled President Pi y Margall and his associates to dismiss the permanent committee and take full possession of the government by what is known as the Federalist *coup d'état* of Apr. 23, 1873. The ensuing elections were favorable to the republicans, but, through disagreements amongst themselves, their administration lasted but one year, when they gave place to Serrano, who, after having been practically dictator, at the end of 1874 in turn yielded to the monarchy of Alphonso XII.

The term *Federalist* has also been used at other periods to designate other less prominent partisans, particularly in Spain and Spanish America. CHARLES F. MACLEAN.

Federal Point, tp. of New Hanover co., N. C., named from the point at the entrance to New Inlet and Cape Fear River, which has a lighthouse on iron piles; lat. 33° 57' 31" N., lon. 77° 55' 11" W. Pop. 410.

Fed'eralsburg, post-v. and tp. of Caroline co., Md., on Nanticoke River and the Dorchester and Delaware R. R., near the centre of the great Peach Peninsula. It has 3 churches, a weekly newspaper, 2 hotels, 3 public schools, is well supplied with stores, and largely engaged in the manufacture of fruit-baskets. It is being rapidly settled by Northerners. Principal occupation of its people, fruit raising. Pop. of tp. 1466.

GEO. BAKER, ED. "MARYLAND COURIER."

Federa'tion [from the Lat. *fœdus*, a "league"], a union of states under a compact by which the general or common government is supreme in its own sphere. As distinguished from a confederation, with which it is often confounded, a federation is a composite sovereignty under a supreme government formed from attributes of sovereignty relinquished by the constituent states or component parts of the new body politic. It follows, as to domestic economy, that a federal government within its proper sphere can act directly upon the individual citizens of the several states, instead of mediately through the state governments; as to international relations, it follows, further, that the supreme central power alone can hold intercourse with foreign governments, which recognize only independent sovereignties. Contrariwise, the several states forming a confederation retain their autonomy and sovereignty, and can maintain all international relations not conflicting with the conditions of the union, while the individual subject is answerable only to his own state government. In short, a confederation differs little from an ordinary alliance except in the permanency and intimacy of the association. The distinction between the two forms of government is aptly suggested by the German names *Bundesstaat* ("Union-State") and *Staatenbund* ("Union of States"), as also in the phraseology of English writers on constitutional law by the terms "composite state" and "system of confederated states."

An important consequence of the relations of the aggregate body and the constituent states of a federation is the competency of the judiciary of each to examine the acts of the other, in that the states can obviously no longer exercise the powers which they have relinquished to the general government, and that the latter has no powers not expressly conferred upon it.

The principal existing examples of this form of government are the American republics and the federation of the Swiss cantons. In all of these the superintendence of the foreign relations of the states is vested in general congresses, which also have more or less direct and controlling relations to the individual subjects. The U. S. of America furnish the most complete and thorough model of a federation (see CONSTITUTION OF THE U. S.)—a model after which the other American federations have been more or less directly fashioned. The latter are, the "United States of Mexico" (twenty-seven states, a federal district, and a territory), the "United States of Colombia" (Antioquia, Bolivar, Boyacá, Cauca, Cundinamarca, Magdalena, Panama, Santander, Tolima), and the "United States of Rio de la Plata" (fourteen provinces, commonly called the "Argentine Republic").

The Swiss or Helvetian federation is composed of twenty-two political cantons, of which the supreme authority is vested in a federal diet composed of a national council (a deputy for every 1000 inhabitants) and a state council (two delegates from each canton). Seven members are chosen by the two branches of the diet, on a joint ballot, to form the federal council, which exercises the executive authority under a president, who holds office but one year, and is ineligible for the next ensuing term. The diet is responsible for the internal and external security of the federation. It alone can declare war or conclude treaties of peace, commerce, or alliance with foreign powers. The several cantons can, however, conclude conventions respecting matters of revenue and police with subordinate departments of foreign governments, subject to the approval of the federal authority. CHARLES F. MACLEAN.

Fee [Sax. *feh*, *feoh*, a "stipend or reward"; L. Lat. *feodum*, *feudum*; Scot. *feu*; Fr. *fief*]. In its original signification under the feudal-law system of tenure the term "fee" or "feud" was employed to denote the allotment of land which a vassal received from his superior lord on condition of the performance of various services in his lord's behalf, especially of military service in time of war. (See FEUDAL SYSTEM.) It was used in contradistinction to *allodium*, which applied to land which a man owned in his own right, without any obligation to render service to another. But in the [illegible] of the law appertaining to the tenure of real property the word "fee," while still retained, has undergone a change of signification, being used to designate the estate which a land owner possesses. [illegible] tion is meant not the property itself—though such an application of the term is common in popular parlance—but the interest which one has in the land as regards the nature and duration of his [illegible]. A fee, therefore, signifies an estate of inheritance [illegible] an interest in land which, at the death of the [illegible] a will, passes immediately to his heirs. [illegible] without any word of [illegible] it has the [illegible] of the phrase "fee simple" [illegible] "fee simple absolute." These words of designation appear to have employed to indicate more [illegible]

cifically that the estate is to be enjoyed without any qualifications or restrictions limiting or tending to limit the indefinite duration and absoluteness of the tenure, and that it is indefeasible, in contradistinction to the terms "qualified fee," "determinable fee," etc., to be hereafter explained. A fee or fee-simple is the highest estate known to the law. Its mode of creation by deed at common law still exhibits the application of arbitrary rules derived from the feudal system, which derive their justification only from the circumstance that they are the result of the historic growth of the system of tenure, a factitious importance being given to them which seems, to a great degree, unreasonable when they are considered without reference to their origin. Thus, it is absolutely essential that the word "heir" or "heirs" be employed in a deed in connection with the name of the grantee, or the only interest created will be a life estate. The purely arbitrary nature of this requirement has caused its abrogation in a few of the American States by statute. In wills, moreover, and in estates created under the doctrines of Uses (see USES and TRUSTS), it has never been obligatory, since in these cases the object of legal interpretation has been to arrive at the true intent of the devisor or grantor, and to effectuate his real purposes without such precise regard to the forms in which they are couched. When a fee is conveyed to a corporation aggregate the word "heirs" is unnecessary, even in a deed, since it is not properly applicable; if the conveyance be to a corporation sole, the word "successors" should be substituted. The most important right which the owner of a fee-simple possesses is that of free and unrestricted enjoyment of the property, and an unlimited power to dispose of it at his own pleasure. Even if any language be inserted in the conveyance through which he received his title restricting his power of alienation, it is void and may be disregarded. This is not true, however, as to restrictions upon the mode of occupation, for there may be prohibitions against erecting buildings of a certain character or the use of the land for certain specified purposes which cannot be transgressed. An owner in fee may transfer his entire estate to another, or he may carve out of it any inferior estate, such as a life estate or an estate for years, retaining in himself a reversion or creating a remainder in a third person, or he may make any other transfer he may think desirable. His interest may be seized and sold for the payment of his debts, either in his own lifetime or after his death, in exclusion of the claims of his heirs.

Estates in fee inferior to a fee-simple are termed "base" or "qualified" or "determinable" fees—*i. e.* estates of inheritance which are granted with qualifications or restrictions which may cause their defeasance. These assume various forms. Thus, there may be a *fee upon limitation*, as an estate given to A until B goes to Boston. In such a case, if B ever goes to Boston the estate is at once defeated; if he never goes, the fee becomes absolute. A fee may be granted upon *condition*, as an estate to A on condition that he builds a market upon the land within three years. If the grantee fails to comply with the stipulation, the grantor or his heirs may re-enter after the condition is broken and recover the estate. Limitations are created by words of time; conditions, by terms in the nature of a proviso. There are also what are styled estates upon *conditional limitation*, as an estate to A until B goes to Boston, when the estate is to pass to C, some third person. No entry is required in such a case by the grantor to defeat the estate, as in the case of a condition, but on the occurrence of the event specified the estate is at once, *ipso facto*, vested in C, the grantee in the alternative. There was, moreover, a fee conditional at common law, which was afterwards modified by statute into a peculiar estate termed a *fee tail*. This was created when an estate was given to a man and the "heirs of his body." In this case the grantee had a fee, but could not make disposition of it so as to defeat the right of the heirs designated. This particular restriction at common law was, in course of time, in England avoided by a resort to ingenious legal fictions, as by fines and recoveries; and in the American States there has been very generally an entire abolition of this form of estate, or so fundamental a change in it that this mode of limitation is made equivalent to a conveyance in fee-simple. (See ENTAIL.) (On this general topic consult WASHBURN on *Real Property;* WILLIAMS on the same subject; CRUISE'S *Digest;* KENT'S *Commentaries*, etc.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fee'jee (Fidji, Fiji, or **Viti) Islands** is a group in the South Pacific Ocean, between lat. 15° 30' and 20° 30' S., and lon. 177° and 178° W., numbering about 200 islands, of which about 80 are inhabited. They were discovered in 1643 by the Dutch navigator Tasman, but not fully explored until 1840, when they were visited by the American navigator Wilkes. The two largest islands are Viti Levu, having an area of 90 miles by 50, and an estimated population of 50,000; and Vanua Levu, with about 30,000; the others are small. The Feejee Islands are of volcanic origin; earthquakes are common and hurricanes periodical. The soil, which consists of a deep yellow loam, and is well watered, is exceedingly fertile, and the moist and hot climate, the temperature ranging from 60° to 120°, calls forth a most luxuriant vegetation, consisting of bread-fruit trees, bananas, cocoanuts, sugar-canes, and tea-plants; cotton grows wild. The inhabitants were a most fierce and savage race, middle-sized, strong-limbed, short-necked, with a complexion between copper-color and black. They live in tribes, each tribe being governed by its own chief, who rules absolutely. Lately, however, the efforts of Christian missionaries have been followed with success, and in 1861 the king and chiefs of Viti Levu formally offered the island to Great Britain; which offer, after many hesitations, was accepted in 1874, when the British flag was first hoisted on Feejee soil. The population of the islands is probably 200,000, some of the smaller islands being exceedingly populous. It was formerly true to call the islanders cannibals, but it is not true now. This was the case when the Wesleyan missionaries went there in 1835, but now 100,000, or half the whole native population, regularly attend church on the Sabbath. There are 22,223 church-members. There are 663 native preachers of the gospel. There are 1524 day schools, attended by 57,057 children, and the barbarities, crimes, and vices of their former state have within a few years greatly lessened.

Feel'ing has a double definition. In its narrower meaning it refers simply to the sense of feeling, and denotes the sensation produced by an object on the sensory nerve, as hearing denotes the sensation produced by an object on the auditory nerve, sight the sensation produced by an object on the visual nerve, and so on. In its wider sense it comprises all the impressions we receive through the senses, as they all arise from the same general sensibility, which is merely particularized in the special sensory organs; but it refers to them not as far as they are sensations in the organs of sense, but as far as they are modifications of consciousness. Thus, feeling is nearly synonymous with emotion, and the two expressions are often used synonymously, though emotion is more properly applied to the separate states of the feeling, and feeling to the general capacity for emotions. Emotion refers to the shifting, changing surface of the feeling—feeling, to the steadily recurring sentiments rooting in the depths of our organization.

In this, its wider sense, feeling is one of the three forms under which the mind becomes conscious of itself, thought and will being the two others. The mind is conscious of itself only as far as it feels or thinks or wills, and it is never conscious of itself as performing more than one of these operations at a time, the two others being either dormant or absorbed. But although intellect, volition, and feeling thus form three very different manifestations of the mind, the distinction between them is nevertheless only an abstraction; in actual life no line of separation can be drawn. Thus, feeling involves thought, and thought feeling. An impression on our sensibility remains a sensation in the organ of sense until an idea is sent out to meet it, to introduce it into consciousness, and to transform it into a feeling. All feelings—anger, pity, sorrow, love, joy, etc. —are charged with ideas. They express themselves not only through laughter and tears, but in winged words, and when they are strong they make men eloquent. Feelings which are untouched by intellect we refuse to call feelings; we call them instincts, cravings, appetites, desires, and so on. On the other hand, ideas are nothing but feelings which have been fixed in the memory, and by comparison, analysis, abstraction, and other processes of thinking, wrought into thoughts. A man has so many original ideas as he has living feelings, and no more; the rest are unoriginal, often borrowed, sometimes stolen. Our ideas correspond to our feelings, not only with respect to their number, but also with respect to their quality—nay, even with respect to their most delicate coloring. A man who feels hatred can rise in morals to the idea of justice, but never to that of love. With Seneca, all his ideas were tinged by a cold, vain pride; with Voltaire, by a malicious, cowardly joy; with Hegel, by a broad, benign sympathy; with Stuart Mill, by a machine-like exactness and delicate subtleness. To draw a broad and unwavering line of demarcation between thought and feeling, or, generally, between the three different manifestations of the human mind, and to assign to each of them its own thoroughly encircled sphere, as the old psychology tried to do, is impossible, and leads to grave errors. To discover and describe the delicate transitions or transfusions of thought, feeling, and will, as modern psychology tries to do, is of paramount importance for the right understanding of the human mind, and has proved less difficult than it seemed at first sight.

CLEMENS PETERSEN.

Fees'burg, post-v., Clark tp., Brown co., O. Pop. 201.

Fehm'ic (or **Vehm'ic**) **Court** [Ger. *Femgericht;* Old Ger. *Fehm*, "punishment"], of Germany. It is claimed by some that Charlemagne first organized these courts, and by others that they came down from the ante-historic Germans; but whether either of these statements is correct or not, they first appear in history during the anarchical days which followed the expulsion of Henry the Lion from his estates by the Diet of Würzburg in 1180. This court was composed of "initiated" members (*Wissende*), who were sworn to secrecy by a tremendous oath. The archbishop of Cologne (as lord of Westphalia) and the emperor were at least nominal members. The courts were presided over by a *Freigraf*, or free count. Their tribunals were either open—held by day in the open air—or secret, the latter being held for the trial of the more serious offences. The Fehmic courts came to have a most extensive and dreadful authority. Not only feudal barons, but at least in one instance the emperor himself was cited before this irresponsible tribunal. In the Pact of Westphalia (1371) they were recognized as lawful. In 1438 the emperor Albert II. attempted to suppress them. In 1461, so dreadful was their influence that many nobles, prelates, and cities of Germany and Switzerland combined to resist their power. In 1495, Maximilian I. gave them a new code, which greatly reduced their authority. In 1568 their last open court was held near Celle in Hanover, but in Westphalia, their true home, these courts nominally existed until 1811, holding secret meetings, but were suppressed in the latter year by Jerome Bonaparte. Born of a stern necessity, the Fehmic courts came in time to be a serious evil, and are now chiefly remembered for the excessive cruelty of their punishments.

Feia, a large lake of Brazil, 130 miles N. E. of Rio Janeiro, near the Atlantic, with which it has been connected by a canal. It is shallow, but abounds in fish.

Feild (Rt. Rev. Edward), D. D., b. in England in 1801, was educated at Rugby and at Queen's College, Oxford, where he graduated with honors, and in 1827 became a public examiner. He held the living of English Bicknor, Gloucestershire, and in 1844 was consecrated Anglican bishop of Newfoundland, receiving the appointment from the queen. His diocese includes the Bermudas, and he is *ex officio* a member of the government of the latter colony.

Felanich'e, or **Felanitx,** an old town of the Spanish island of Majorca. It has considerable trade in wine, brandy, and fruit. On a neighboring mountain is the old castle, with its subterranean vaults constructed by the Moors. Pop. 5918.

Felch (Alpheus), b. in Limerick, Me., Sept. 28, 1806; graduated at Bowdoin College 1827, and became a lawyer of Michigan; was in the State legislature 1836–37; bank commissioner 1838–39; auditor general of Michigan; was a judge of the State supreme court 1842–45; governor of Michigan 1846–47; U. S. Senator 1847–53; was a commissioner of California land claims 1853–56.

Felch'ville, post-v. of Reading tp., Windsor co., Vt. It has manufactures of furniture and other goods. It is 59 miles S. of Montpelier.

Feld'kirch, thriving manufacturing town of Austria, in the Vorarlberg, is the seat of a bishop, suffragan to the bishop of Brixen, and vicar general of the Vorarlberg. It has an important Jesuit educational institution (Stella Matutina) and a Capuchin cloister, and is the seat of important courts, etc. It is 20 miles S. W. of Bregenz. Its manufactures are varied and important. Pop. 2350.

Feld'spar, or **Felspar,** a term in mineralogy derived from the German *Feldspath* ("field spar"), or, according to some, from *fels*, a "rock," and applied to a family of minerals embracing many species, which crystallize in several systems. In chemical composition they all agree in being silicates of alumina, with silicates of other bases, either soda, potash, or lime. By some authors the term is restricted to one species, the common potash feldspar, or orthoclase. Popularly, the term is also applied to albite, a soda feldspar, and to labradorite and oligoclase, soda-lime feldspars, etc. Feldspars enter largely into the composition of all granitic and of many metamorphic rocks, and form the chief element of porphyries and volcanic rocks. In their decomposition they are the source of clay. Moonstone and lapis-lazuli are members of this family valued in the arts, and feldspar is also used as a glaze for porcelain. Edward C. H. Day.

Felegyha'za, town of Hungary, on the road between Pesth and Temesvar. It has great cattle-markets, and an extensive trade in corn, wine, and fruit. Pop. 19,390.

Feli'ce, de (Fortunato Bartolommeo), b. at Rome Aug. 24, 1723; studied at Rome and Naples; eloped with a nun to Switzerland, and became a Protestant printer, editor, and teacher of Yverdun; published Italian and other translations of the leading philosophical works of that period; wrote some original works upon natural, national, and civil law; and was the principal editor of an *Encyclopédie* in 58 vols., 1770–80, based upon the great French *Encyclopédie*. Died at Yverdun Feb. 7, 1789.

Felicis'simus, a deacon of Carthage, ordained by the enemies of the bishop Cyprian while he was absent in time of persecution, between Feb. 250, A. D., and April, 251 A. D. He was a man of wealth, of talents, of energy, and of influence. As soon as he returned to Carthage, Cyprian summoned a council which excommunicated Felicissimus and the presbyters who sympathized with him. Refusing to submit, the party chose one of their own number (Fortunatus) in place of Cyprian as bishop. Felicissimus was deputed to represent their cause at Rome and to sustain charges against Cyprian. This project failed, and the schism soon came to an end. (See *Cyprian's Epistles*, 38 and 55, for the character of Felicissimus, drawn in the darkest colors.)

Another Felicissimus was a friend of Cyprian, and first to suffer in the Decian persecution. It is uncertain whether he is the Saint Felicissimus named in the martyrologies. R. D. Hitchcock.

Felic'itas, Saint, a mother and a martyr put to death, with her seven sons, at Rome under Marcus Aurelius Antoninus (161–180 A. D.). All were arraigned together before the tribunal of Publius the prefect. To the question whether they would sacrifice to idols, they replied by a firm refusal, fearlessly confessing their Christian faith. The officer informed the emperor of their refusal, and by him they were left to the sentence of the judges, who ordered the sons to be put to death by diverse punishments, but the mother to be beheaded.

Another of the same name suffered death for the Christian faith, in company with Saint Perpetua, under Caracalla (211–217 A. D.). The two, who alike remained firm in their refusal to offer sacrifice as they were required, were first exposed to wild beasts, and after having been torn by them, were put to death. R. D. Hitchcock.

Felic'ity, post-v. of Franklin tp., Clermont co., O., 42 miles S. E. from Cincinnati. Pop. 955.

Fel'idæ [from *Felis*, the typical genus of the family], a family of the order Feræ and group Æluroidea, distinguished by the dentition (M. $\frac{1}{1}$, P. M. $\frac{3}{2}$ or $\frac{2}{2}$, C. $\frac{1}{1}$, I. $\frac{3}{3}$ × 2 = 28 or 30), form of body (cat-like), digitigrade feet, and the absence of an alisphenoid canal. Most of the forms have retractile claws, but the hunting leopard (*Guepardа*) has non-retractile ones. The family contains the cats, lions, tigers, panthers, leopards, lynxes, etc.

Felix, tp. of Grundy co., Ill. Pop. 616.

Fe'lix, tp. of Grundy co., Ia. Pop. 656.

Fe'lix [Gr. Φῆλιξ] Antonius, a freedman of the emperor Claudius, whence he was also, according to Suidas, called Claudius, and a brother of the powerful freedman Pallas, through whose influence with the emperor and the empress Agrippina, Felix was appointed procurator of Judæa about 53 A. D. He found his province filled with disorders and tumults, caused by the robbers and assassins (*sicarii*) who then abounded, and he exercised great severity in repressing them, but he also was guilty of great rapacity. Married Drusilla (youngest daughter of Herodes Agrippa I.), whom he induced to leave her former husband. It was this Felix to whom Lysias sent the apostle Paul, and before whom he "reasoned of righteousness, temperance, and judgment to come." In A. D. 60 (probably, but the year is uncertain) he was succeeded by Festus, and on his return to Rome the Jews preferred complaints against him, but he was saved from punishment by the influence of his brother Pallas. H. Drisler.

Felix (Célestin Joseph), Jesuit preacher, b. at Neuville sur l'Escaut June 28, 1810, began preaching in Paris in 1851 with great success, entered the Society of Jesus in 1837, and has contributed largely to [illegible], and is the author of several works, "conférences," sermons, etc.

Felix (Marcus Minucius), commonly called Minucius Felix, an eloquent Roman advocate and Christian, who probably lived about 230 A. D., but the period when he lived is not at all certain. Wrote the dialogue *Octavius*, designed as a popular defence of Christianity, and remarkable for its choice diction. The edition of Gronovius (Leyden, 1707) is one of the best.

Felix I., Saint, succeeded Pope Dionysius Dec. 29, 269 A. D. In the persecution under the Roman emperor Aurelian he was condemned to die, but expired in prison Dec. 22, 274. Felix II., Pope, chosen by the Arians or by the emperor Constantius in 355, during Liberius's

exile, upon whose return he was expelled. D. Nov. 22, 365, and was canonized by the Romish Church.—FELIX III., pope in 483 A. D., was a native of Rome and great-grandfather of Gregory the Great. His condemnation of Acsius, patriarch of Constantinople, accused of heresy in 484, occasioned the first schism between the Eastern and the Western churches. D. Feb. 24 or 25, 492.—FELIX IV., pope in July, 526, appointed by Theodoric, king of the Goths. D. Oct., 530.—FELIX V., POPE OR ANTIPOPE, was elected by the Council of Bâle Nov. 5, 1439, and consecrated July 24, 1440, but renounced the pontificate Apr. 9, 1449.—FELIX, bishop of Urgel, in Catalonia, in the eighth century, promulgated the "Adoptian heresy"—*i. e.* that Christ, as man, was merely the adopted son of God. He was deposed and banished about 800, and d. about 818.

Fell, tp. of Luzerne co., Pa. Pop. 343.

Fel'lah, plu. **Fellahin'** [Arab. "peasant"], a term designating the laboring class in Egypt. They are mostly Mohammedans, but a few of them are Copts. Except the slaves, they are the lowest class of the population. Politically and socially, they are in a deplorable condition. They are far more numerous than any other body of the Egyptian people. They are of mixed Coptic, Arabian, and Nubian stock. They are licentious, idle, and obstinate from the effects of many ages of grievous oppression. The name *Fellahin* is also given to the laboring classes of other Mohammedan countries.

Fellat'ahs, Fou'lahs, or **Fella'ni,** an interesting Mohammedan people of the Western Soudan in Africa, remarkable for their enterprise, intelligence, and religious zeal. They are a race, and not a nation—have many tribes, several shades of color and varieties of form, probably from the fact that they have blended with various subject-races. They cultivate Mohammedan learning with much enthusiasm. Their history is quite obscure. Saccatoo is their principal state, but they are the predominant people of many countries in the Soudan.

Fel'lenberg, von (PHILIPP EMMANUEL), b. in Berne, Switzerland, June 27, 1771, was a descendant on the mother's side of Admiral Van Tromp. In youth he imbibed in some measure the philanthropic views of Pestalozzi, his father's friend. Fellenberg studied at Colmar and Tübingen, and a visit to Paris just after Robespierre's death convinced him that a better public education was necessary to the safety of society. He opposed the French in their occupation of Switzerland, for which cause he was banished, but after his return was employed in important diplomatic, political, and military offices. Failing to secure government aid in his educational plans, he founded in 1799 his famous educational and manual-labor establishment at Hofwyl, near Schönbühl, in the canton of Berne. In this school Fellenberg invested all his large fortune. In 1804, Pestalozzi removed his Burgdorf school to the old monastery of München-Buchsee, adjoining Hofwyl, and admitted Fellenberg to a share in the management of the school; but in 1805, on account of differing views in regard to methods of management, Pestalozzi removed to Yverdun. In 1807, Fellenberg established a scientific department, and in 1808 a normal school and an agricultural institution, where scientific agriculture was taught and practised and farming-implements manufactured. The Hofwyl institution flourished, and before Fellenberg's death there were in it ten distinct departments of instruction. Children of all ages, the rich and poor alike, were received. The wife and nine children of Fellenberg assisted him in his work. He d. at Berne Nov. 21, 1844. A few years after his death his establishment was abandoned, but many similar ones have been founded in various parts of Europe. Of these, the most extensive are the pauper-colonies of Fredericksoord, Wilhelminesoord, Willemsoord, Wateren, Veenhuizen, and Ommerschans in the Netherlands, which contain nearly 11,000 inmates in the aggregate.

Feller (HENRIETTA), b. in Switzerland about 1780 of a wealthy family, came, after her husband's death in 1835, to Canada, where she established the Grande Ligne mission for French Canadians. There she endured much persecution, but finally triumphed by her gentleness, courage, and benevolence, and became widely known and beloved by Roman Catholics as well as Protestants. Madame Feller was a Baptist. She expended her own fortune in her work, and was afterwards supported by the benevolent of various denominations. D. at Grande Ligne, province of Quebec, Canada, Mar. 27, 1868.

Feller, de (FRANÇOIS XAVIER), a Jesuit, b. at Brussels Aug. 18, 1735, held professorships in various Jesuit colleges. His principal works are *Catéchisme philosophique* (1773) and a *Dictionnaire historique* (1781), often revised and reprinted. D. at Ratisbon May 21, 1802.

Fel'lowes (ROBERT), b. in Norfolk, England, in 1770; graduated at St. Mary's Hall, Oxford; entered the Anglican priesthood, which he afterwards abandoned, having embraced new religious views. He was a man of exalted moral character and great benevolence, and was one of the founders of the London University. His peculiar views are set forth in a series of works, culminating in his *Religion of the Universe* (1836). D. in 1847. Was for a time editor of the *London Critical Review*.

Fel'lows (Sir CHARLES), b. at Nottingham, England, in 1799; made four expeditions into Asia Minor; collected the Lycian Marbles, now in the British Museum; was knighted in 1845, and d. Nov. 8, 1860. Author of *Journal of an Excursion into Asia Minor* (1839), a *Journal* (1841) of his second expedition, *Xanthian Marbles* (1843), *Account of an Ionic Trophy Monument* (1848), *Coins of Ancient Lycia* (1855), etc. The rich archæological remains of Lycia were quite unknown until announced by him.

Fellows (JOHN), American general in the war of the Revolution, b. at Pomfret, Conn., 1733, served in the French war, was in the provincial congress in 1775, led a regiment to Boston after the battle of Lexington, commanded a brigade at Long Island, at White Plains, and at Bemis' Heights, N. Y. His commission as brigadier-general dated June 25, 1776. D. at Sheffield, Mass., Aug. 1, 1808.

Fellows (JOHN), b. at Sheffield, Mass., 1760, graduated at Yale College 1783, and d. in New York City Jan. 3, 1844. He wrote upon the authorship of Junius, *Life of General Putnam* (12mo, 1843), *Exposition of the Mysteries or Religious Dogmas and Customs of the Ancient Egyptians, Pythagoreans, and Druids*, and *Inquiry into Freemasonry*.

Fel'lowship, in the universities of Oxford, Cambridge, Durham, and Dublin, a position held by the fellows (*socii*) of a particular college. The fellows were originally poor students (chiefly of divinity) who received the income of the fellowship as a means of support, but when they obtained a sufficient benefice, or became owners of property beyond a certain amount, or by marriage signified their abandonment of the Church, they lost the fellowship. The same causes, with some modifications and exceptions, will vacate a fellowship at present. Now, however, the fellowships are rewards for eminent scholarship, yielding in some cases a very handsome income, besides other valuable perquisites. Recent legislation has much simplified the ancient system of fellowships. The fellows of certain American colleges are simply members of a board of trustees who manage the business-affairs of their college.

Fe'lo de Se [Lat., "a felon of himself"], a self-murderer, one who commits suicide. Under the English law this offence is, as the name indicates, regarded as a peculiar kind of felony. The act causing death may either be deliberate and intentional, with a view to self-destruction, or a felonious attack upon another which results unexpectedly in the death of the assailant, as where one shoots at another, but the gun bursts and kills himself. The person committing the act must be of years of discretion, and possessed of sufficient soundness of mind to be able to appreciate its wrongful nature. It follows, therefore, that even a lunatic may be guilty of this crime if he kill himself in a lucid interval. The consequences of suicide under the English law from very early times, as regards the forfeiture of property, were the same as attended the commission of other kinds of felony, with this important exception, however—that only chattels were forfeited, and not lands of inheritance, and that no corruption of blood resulted. In order to vest the chattels in the Crown the fact of suicide must be determined by a coroner's inquisition. Formerly, in order to show the detestation of law for the crime, the body of the suicide was required to be buried in the highway with a stake driven through it. This barbarous mode of burial was abolished by statute in the reign of George IV. (1824), but the law still affixes the stigma of peculiar enormity to the offence by providing that interment shall take place by night, in privacy, and without the performance of the rites of Christian burial. The offence has never been punishable in the U. S., and of course the peculiar English modes of burial have never been practised.

The questions of greatest importance which arise at the present day in relation to suicide occur in connection with the subject of life insurance. Life policies usually contain a clause exempting the company from liability in case the insured "shall die by his own hands" or "take his own life." When suicide is committed by a person in the full possession of his mental faculties no difficulty can evidently arise as to the company's responsibility; but when the act is claimed to be the consequence of insanity, especially when this is only temporary in its character, or is nothing more than monomania or morbid impulse, considerable diversity of opinion has arisen in the courts as to

the effect of the exemption in the policy. The prevalent view seems to be that if the self murderer, though his mind was disordered, had still "power to distinguish right from wrong, and the power to adhere to the right and avoid the wrong," the claim under the policy is invalidated. The application of this general principle must, however, give rise to many perplexing questions. If the death of the insured be caused "by his own hand," but is purely accidental, as if he should take poison by mistake or shoot himself by some unfortunate mischance, there is general agreement among the legal authorities that the company remains liable. If the insured, being in the possession of his ordinary reasoning faculties, from anger, pride, jealousy, or a desire to escape from the ills of life, intentionally takes his own life, there can be no recovery. On the other hand, if the death is caused by his voluntary act, and he knows and intends that his death shall be the result, but his reasoning faculties are so far impaired that he does not understand the general nature and consequences of the act, or is impelled thereto by an insane impulse which he has not the power to resist, the insurer is liable. (*Life Insurance Co.* vs. *Terry*, 15 Wallace, U. S. Reports, 580.) This proposition, however, has been criticised in the very recent case of *Van Zandt* vs. *Life Insurance Co.*, 55 N. Y. 178, and the whole subject is still open for discussion. If there be no exemption clause in the policy, and suicide be committed in a fit of temporary insanity, the insurer is liable. Whether the insurer would be responsible in the same way under such a policy if the insured were sane at the time of committing the act, is not yet definitely settled. The presumption is, that this would be regarded as a fraud upon the company which would make the policy null and void. (See May on *Insurance*.)

George Chase. Revised by T. W. Dwight.

Felon. See Whitlow, by E. Darwin Hudson, Jr., M. D.

Fel'ony [perhaps from the Saxon word *feh*, "fee" or "feud," and the German word *lon*, "price" or "value," thus meaning, originally, "the price or cost of one's fee." Others refer it to the Saxon verb *fælen* or *felen*, to "fail" or "fall," because the criminal's property *fell* to his superior lord or to the Crown]. Under the English common law all grades of criminal offences have, from an early period, been divided into two great classes, felonies and misdemeanors. The principle of classification in accordance with which this distinction was made did not depend upon any definite inherent peculiarity by which the offences in one category were separated from those in the other, but merely upon the difference in the modes of punishment adopted. The commission of offences of greater criminality was attended with a forfeiture of the wrongdoer's lands, goods, or both, and all crimes thus punished were included under the comprehensive designation *felony*. Death was in a large number of instances superadded to forfeiture, but was not a distinguishing characteristic of this grade of offence. The common belief, that in order for a crime to be felonious it must be one for which capital punishment is inflicted, is entirely erroneous. In the English law at the present day there have been some important changes made in the laws concerning forfeiture, but the term "felony" retains its previously established signification, and no offence comes under this designation to which forfeiture is not annexed as a penalty. Goods and chattels are forfeited upon conviction for any felony, but in the case of lands conviction alone is not sufficient, but sentence of attainder must be pronounced. (See Attainder.) By attainder for felony the offender forfeits the profits of all freehold estates during life; if the offence be *murder*, he also forfeits, after his death, all lands held in fee simple to the Crown for a year and a day. (See Forfeiture.) In the U. S., where the nature and punishment of crimes are generally determined by statutory provisions, there is no universally recognized meaning given to the word "felony." Some States which have still retained it in use give to it a specific definition, employing it to designate crimes involving a certain kind of penalty, but making the penalty of a different character from that by which its meaning was originally determined. Thus, in New York any offence punishable by death or by imprisonment in a State prison is a felony. In a few States the use of the term is entirely discarded, and if it be employed at all in legal proceedings, it is without definiteness and precision of meaning. (See Crime.)

George Chase. Revised by T. W. Dwight.

Fel'sing (Jakob), German engraver, born at Darmstadt 1802, wrought in Italy ten years, and then, in 1832, obtained at Darmstadt the title of engraver to the court. *The Marriage of Saint Catharine*, after Correggio, *Holy Family*, after Overbeck, and *Violin-Player*, after Raphael, are among his best works.

Felsö-Bánya, town of Hungary, county of Szathmár, in the neighborhood of rich gold, silver, copper, and lead mines. Pop. 5500.

Felspar. See Feldspar.

Fel'stone, a name given by some writers to such rocks as consist largely of feldspar, such as pitch-stone, the trachytes, phonolite, etc.

Felt [kindred to the Gr. πῖλος, "felt"], a stuff composed of wool, fur, or hair, of which the fibres are so entangled and interlaced that they cannot readily be separated. Felt is an article which has long been known. Homer and Hesiod distinctly mention it. It was a common material for caps, hosiery, floor-cloths, tents, and cloaks. It has long been known in the East, and the nomads of the desert largely occupy tents of felt. There is, however, a tradition that Saint Clement discovered felt while on a pilgrimage. Having put a bat of carded wool into each shoe to save his feet from blistering, he found at his journey's end that moisture and friction had converted the wool into felt.

Waste wool is largely employed for felting. It is first deprived of its oil, then carded and placed in a machine, where it is kept wet with hot water and subjected to a process of beating, by which the fibres are made to move upon each other until the interlocking of their serrations and the curling of the fibre itself unite the whole into a compact sheet of felt. The *fulling* of cloth is but a partial felting of wool already woven. Felted wool is used for carpets (often beautifully printed), carpet-covers, coarse hats, carriage-linings, and even for cloaks and other garments. The cheapest woollen rags, etc. are worked into felt for covering steam-boilers. This is an excellent non-conductor, and greatly diminishes the waste of heat. Roofing felt is a coarse kind, usually coated and filled with coal-tar, and sometimes with tar and powdered slate. Felt is also used for sheathing walls, and is useful as a non-conductor of heat. Felt for hats is made of the fur of nutria, raccoons, beavers, conies (rabbits), etc., and is generally mixed with some Saxony or other felting wool. The heap of fur is struck with a bowstring until it falls into an even layer, and it is felted by working it with the hands in a soapy liquid. Machinery is also sometimes used in this process. The U. S. census of 1870 reports the manufacture for that year of 586,000 yards of felt carpeting, made in Connecticut, New York, and Pennsylvania, but there are no separate returns for the manufacture of felt hats or clothing, or of boiler, roofing, and wall felts. Felt stiffened with dextrine, etc. is used for making surgeons' splints.

Felt (Rev. Joseph Barlow), LL.D., American scholar and author, b. at Salem, Mass., Dec. 22, 1789, graduated at Dartmouth College 1813, and d. in Salem Sept. 8, 1869. He was pastor at Sharon and at Hamilton, Mass., from 1821 to 1824, and from 1824 to 1834, respectively. In 1846 he completed the classification and binding of the archives of the State of Massachusetts. He was president of the New England Historical and Genealogical Society 1850–53, besides holding other offices in kindred institutions. *Annals of Salem* (1827), *History of Massachusetts Currency* (1839), *Ecclesiastical History of New England* (2 vols., 1855–62), etc., were among his publications.

Fel'ton, post-v. of S. Murderkill hundred, Kent co., Del., on the Delaware R. R., 10 miles S. of Dover. It is the seat of an institute and classical seminary. Pop. 437.

Fel'ton (Cornelius Conway), LL.D., American scholar and author, b. at West Newbury, Mass., Nov. 6, 1807, graduated at Harvard University 1827, and taught in Northampton, Mass., and at Geneseo, N. Y. In 1829 he was Latin tutor at Harvard University, in 1830 Greek tutor at the same institution. In 1832 he became Eliot professor of Greek there, and July 19, 1860, was inaugurated its president. D. at Chester, Pa., Feb. 26, 1862. President Felton's publications were numerous. *Homer, with English Notes and Flaxman's* [illegible] appeared in 18[illegible]; Menzel's *German Literature* translated [illegible] in 1840; in 1841 the *Clouds* of Aristophanes. In 1843, with Sears and Edwards, he published *Ancient Literature and Art;* in 1845 assisted Prof. Longfellow [illegible] *Poets and Poetry of Europe;* in 1849 edited [illegible] of Isocrates, the *Agamemnon* of Æschylus, [illegible] edited Guyot's *Earth and Man.* In 1852 he [illegible] *Birds* of Aristophanes; in 1853 [illegible] he made a [illegible] in 18[illegible] revised for publication Smith's [illegible], with an edition of Lord Carlisle's [illegible] *and Greek Waters.* A selection from modern Greek writers was published by him in 1856. Other [illegible] were a [illegible] in Sparks's [illegible], occasional addresses, and contributions to the [illegible], etc. He contributed to the [illegible] *Cyclopædia*, wrote upon Spiritualism [illegible] in 18[illegible], was a member of the Massachusetts board of education, regent of the Smithsonian Institution, and member of the American

Academy of Arts and Sciences. *Familiar Letters from Europe* was published in 1865.

Felt's Mills, post-v. of Rutland tp., Jefferson co., N. Y., on the Black River and the Utica and Black River R. R., 8 miles E. by N. of Watertown, has important manufactures of leather. Pop. 230.

Feluc'ca [from the Arabic], a vessel used in the Mediterranean Sea, having a small tonnage, light draught, and great speed with a light wind. These vessels have from ten to eighteen sweeps or large oars, carry lateen sails, and have frequently a rudder at each end, so that they may be used as "double-enders" and may reverse their course without tacking or veering.

Feme Coverte. See MARRIED WOMEN.

Fem'ern, or **Feh'marn,** a very low, perfectly level, marshy, but fertile island in the Baltic, belonging to Prussia, and separated from Holstein by a narrow and shallow sound. It has two towns, Burg and Petersdorf. Pop. 9600.

Femme Osage, post-tp. of St. Charles co., Mo. Pop. 2383.

Fe'mur [Lat. the "thigh"], in the vertebrate skeleton the proximal bone of the posterior extremity, interposed between the innominate bone and the tibia and fibula, the bones of the leg. It has (1) a globular *head*, rotating within the acetabulum or socket of the hip, and joined by a (2) *neck* to the main femur or (3) *shaft;* also (4, 5) a *greater* and a *lesser trochanter*, prominences for attaching the rotating muscles and giving them leverage; (6) a *linea aspera*, or "rough line," running lengthwise for the attachment of muscles; and (7, 8) *outer* and *inner condyles*, at the lower end, affording articulating surfaces for union with the bones of the leg. The femur in man is popularly called the thigh-bone.

Fences, Law of. At common law, land-owners were under no obligation to build and maintain fences between their premises and those of adjacent owners. Trespasses by cattle and other animals were to be prevented, not by means of fences, but by a duty imposed upon each owner of animals to keep them within the precincts of his own estate, and to take precautions against their entering upon a neighbor's premises. If cattle should escape and do injury to another's land, their owner would be liable in an action for damages. The obligation to build fences might, however, be assumed by contract or imposed by prescription, as if a land-owner should keep up fences upon his property for twenty years to the benefit of his neighbor. In such cases, if damage should be done by cattle trespassing in consequence of a defect in the fences, the fence-builder would be responsible, and not, as customarily, the cattle-owner. At the present day the matter of fence-building is generally regulated to some extent by statute, both in England and in this country. The duties imposed upon railroad companies to maintain fences along the line of their routes are particularly minute and exacting. (The statutes of each State should be specially consulted.) GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fen'cing [formerly called "the *fence*," a contraction of *defence*]. Combat with the sword is as old as the history of the human race. The Roman soldier was a carefully instructed swordsman, but aided by the shield. Fencing, the art of handling the small-sword with skill in attack and to the greatest advantage, relying upon it as a means of defence, came into use after armor and the shield ceased to be worn. It was in Italy during the religious wars of Charles V., under a condition of society which rendered life particularly insecure, that the small-sword or rapier was adopted and habitually worn by military and state officers, and generally by all men whose position in society or whose occupation permitted it. Then and there its skilful use was found essential, and fencing at that period and long subsequently was considered a necessary art. The Italians, who were expert fencers, were the instructors of the art, first in Spain and afterwards in France, where, during the last century, fencing was brought to the highest perfection.

The small-sword, when once it came into use, was adopted as the fairest weapon for duelling; and though to the custom of wearing it may be charged the disposition to indulge in violence, many desperate encounters in which innocent persons sometimes suffered, and the loss of valuable lives, it must be said that the practice of duelling, which had previously been so conducted that every unfair advantage was taken and allowed, and with a revolting display of ferocious passions, was greatly humanized by the refinement introduced by the rules and art of fencing. Skill with the sword is practically of advantage to those upon whom falls the duty of the national defence, to enable them to use loyally the weapon they alone are required to wear. But as the sword is no longer generally worn, and is not, among English-speaking peoples, used in duelling, adroitness in its use may no longer be feared as likely to create a fondness for contention; and fencing may be and is now resorted to as an enjoyable and healthful recreation and as a certain means of physical development. As an exercise it is void of danger, gives no occasion for rudeness, calls for no over-exertion, yet brings into active and graceful play every muscle of the body, and demands the eager and unremitting attention of every faculty.

A distinguished French authority on the art of fencing declares that a swordsman, on crossing blades with an antagonist and before closing in combat, must take in at a glance the intellectual and physical powers of his adversary, so as to judge of the employment he will likely make of them, and decide by the first few movements of his weapon if he is a man of nerve or one that may be intimidated or confused; observe on the instant if his guard is faulty, and what advantage may be taken of it; discover by feints his natural parry, and by his attitude and aspect whether his *forte* is the attack or defence; if he will probably rush in, trusting all to strength and audacity; and of whose attack signal advantage may be taken if anticipated, or contend warily with the skill of one accustomed to fencing, and must therefore be attacked with caution. This, so true in mortal combat, must be borne in mind by fencers to secure the best advantages from the use of foils as an exercise.

The Foil.—The foil or small-sword consists of two parts, the hilt and blade; and the hilt of three pieces, the pommel, the gripe, and the guard. The part of the blade nearest the guard is the fort. The two-thirds nearest the point are the feeble. The side of the gripe on which the thumb rests should be broad, flat, and convex, the opposite side slightly concave.

To hold the foil or sword in the most advantageous manner, the thumb must be extended along the convex side of the handle, and at least half an inch from the guard. The fore finger is partially extended on the under side, the middle portion opposite the thumb. The remaining fingers embrace lightly the side of the handle. At the moment of making a blow or parry the handle is firmly grasped, but to hold it so constantly would soon fatigue and paralyze the hand.

The *guard* is the attitude a swordsman assumes, best calculated for attack and defence. It is the position men take naturally when they meet in combat. The right foot is twice its length in front of the left, the knees bent equally, the right being vertically over the instep. The body should be erect, and its weight resting a little more on the left than the right leg. The right foot should point directly to the front, and the knees be flared apart. The weapon is at the same time raised to the height of the waist and turned near the left side, bringing the point to the front; the right arm is extended till it is half bent, the elbow about six inches in front of the side and turned in towards the body, the hand at the height of and opposite the right nipple, the nails turned up, the thumb horizontal, the back to the right. The point of the blade should be at the height and in front of the eyes. The left hand is extended to the rear and a few inches higher than the head, the elbow is slightly bent, the hand open, palm to the front. The arm from the shoulder to the end of the fingers forms a curve. The reverse of this position is true for left-handed men. The guard here described is the "middle guard," because in it the weapon occupies a middle position in reference to those it assumes in the defence. When on guard it is essential to be *covered* on the side towards which the adversary's blade points.

If the hand is carried to the right till it is so nearly in front of the right shoulder that the adversary's point, if extended on that side, would not touch, one is covered and the guard of tierce is formed; if to the left till the hand is sufficiently in front of the left breast to divert the point on that side, the guard of quarte is formed. The moment blades are crossed one or the other of these guards is formed, and is called the *engagement*.

Men of small stature should form the guard with the hand nearly as high as the neck; those of medium size, with the hand as high as the breast; tall men, with the hand a little below the breast. Although the guard should be habitually taken according to stature, still it must be varied, for it is dangerous not to make the height of the guard correspond with that of one's adversary.

The *engagement* is the act of crossing weapons and bringing them into contact. When the right of the blades is in contact, the engagement is in tierce; if the left, the engagement is in quarte. When the hand is turned so as to bring the back up and obliquely to the left, and the points lowered and brought in contact on the right, and at the height of the groin, the engagement is in seconde.

These are the only three engagements, and from these

all blows are made: the last is rarely offered, unless from a feeling of superiority and to provoke an attack.

The *opposition* is a slight movement of the sword to bear the point of the antagonist's weapon out of the line of the person while delivering a blow to prevent falling upon it, and to avoid receiving a blow in return when in the act of recovering the position of guard. It must be insisted upon from the first blow a beginner makes till it becomes a confirmed habit.

To *change the engagement*, make a very small quick movement of the point, passing it under and as near as possible to the blade of the antagonist to the opposite side; this movement must be abrupt, and executed with the fingers only, without lowering the hand. *Cover* at the instant the point of the opposing blade is felt.

Feeling the blade consists in supporting and keeping the weapon in contact with the adversary's, without pressing upon it. This requires a delicate sensibility of the hand most essential to acquire. It indicates, in connection with the eye, when the opponent's blade has commenced an attack, and enables the weapon to be so managed in the parries as to deflect a blow without violence.

Fingering the sword is to conduct the point of the sword by the action of the fingers alone, without the aid of the wrist. To do this, the grasp, particularly of the two middle fingers, must be alternately relaxed and tightened. It is only by cultivating this that disengagements can be abruptly and closely made, and the point moved with quickness, dexterity, and precision either in making a feint or avoiding the adversary's disengagement in order to deliver a blow.

The *blow* is the act of directing the point towards the antagonist. It may be delivered in two ways—by means of the *thrust*, or with the thrust combined with the extension of the body called the *development*.

To *thrust*, extend the arm to the front fully and vigorously, raising the hand to the height of the mouth, and lower the point slightly by bending the wrist, but without loosening the grasp. At the same time throw the weight of the body forward on the right leg by straightening quickly and stiffly the left, and bring down the left arm by the side, rigidly extended, the hand about three inches above the left leg, fingers extended and joined, the palm to the left.

The *elevation* is raising the sword-hand when delivering the blow. This movement of the hand increases the probabilities of making a successful blow, while it acts as an important protection from a return blow.

The *development* is executed by, in addition to the action prescribed for the *thrust*, advancing the right foot close to the ground about twice its length, the left foot remaining firm in its position; the body is slightly thrown forward in an easy attitude, the head erect; the right knee vertical over the instep.

To *recover the guard*, raise the toe of the right foot, and exert strongly the muscles of the right leg, throwing up rapidly the left arm to the rear at the same moment, and take the position of guard. The right hand should be brought instantly to its position, never falling *below* it.

The left arm is an important auxiliary in all these movements in maintaining the equilibrium, and in materially assisting in the development and recovery of the guard.

To *advance*, move the right foot quickly forward its own length, raising it but slightly from the ground, and follow it at once with the left, moving it the same distance, and resume the position of guard. In advancing to make a blow at an antagonist who is out of distance, it is necessary to bring up the left foot near the right, keeping the legs well bent.

To *retreat*, move the left foot its length to the rear, and follow it quickly with the right, moving it the same distance, and resume the position of guard. The hand and point must neither rise nor fall in these movements. The point must remain steadily presented in a menacing attitude at the adversary.

Points of Attack.—There are three general points where an antagonist may be attacked when on guard. As the breast is nearest and most vulnerable, it is to be aimed at whenever exposed. But the point cannot, in a desperate encounter, be directed with absolute certainty, and cannot but be damaging wherever it touches. The blow at the face and right side, on the right of the weapon, is the attack on the "right;" at the face and left side, on the left of the weapon, the attack on the "left;" and under the sword arm, the attack "below." Two of these points are always exposed, as the weapon can guard but one at any one moment.

The *direct blow* is the result of the effort which carries the point to the front, in the most direct line, to the point of attack. It is the quickest of all the blows, and of course should be executed whenever the opportunity offers—that is, whenever the antagonist is *uncovered*. For instance, if engaged in tierce, to deliver a direct blow the point would be moved to the front on the same side (the right) as the engagement, should the antagonist momentarily uncover himself.

To *disengage* is to change the direction of the point and deliver a blow at the antagonist where he is not protected by his weapon; the movement of the point must precede the development. But these acts must be as nearly simultaneous as possible.

The *measure* is the distance the point attains when the person is fully developed.

The *appel* is striking the right foot on the ground, and generally twice in rapid succession, by raising it about an inch and striking it back with force. It is resorted to in making a feint to discompose the antagonist, or is done by the fencer to reassure himself in his position after a retreat, and deter his adversary from advancing too rapidly.

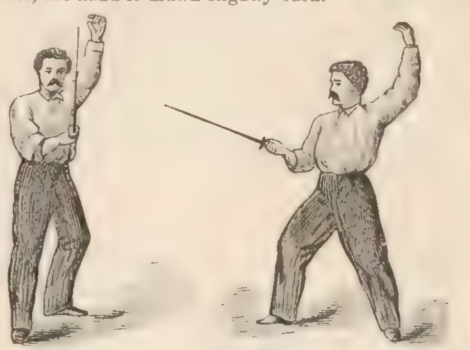
A *parry* is the action of turning aside the antagonist's blade from the point at which it is aimed. This is done with the fort of the blade. Ten parries have been decided upon as affording protection to the person from all blows that can be directed at it. They are designated by the (old) French ordinal numbers, and are thus known in all languages—viz. prime, seconde, tierce, quarte, quinte, six, sept, octave, counter-tierce, and counter-quarte. Tierce, quarte, quinte, and six are called simple parries, as the weapon is but slightly moved from the position of guard. Prime, seconde, sept, and octave are called half-counters, as the point describes a half circle in effecting the parry. The remaining two are called counters, as the point is made to describe a complete curve, returning to its original position. To parry correctly, the weapon must take a position which will protect the person, while at the same time the point is retained in front of the antagonist. The advantage of having a number of parries is to add to the security of the defence by embarrassing the antagonist in deciding which will be resorted to.

Prime is the position that would be involuntarily taken by one if attacked when in the act of drawing his blade from the scabbard. From the position of guard it is formed by turning the hand until the back is towards the left, keeping the point stationary to the front, then raise the hand diagonally to the left until the fore arm is in front of the forehead, describing with the point, in descending, a curve from right to left, arresting it on a line with the left side at the height of the waist. It is necessary to describe a curve with the point, so that the blade will cut the line of approach of the opposite weapon. Executed properly, it is most effective, as it may be used to turn aside every blow that can be made from the position of guard, which cannot be said of any other parry. It is particularly advantageous to men of small stature.

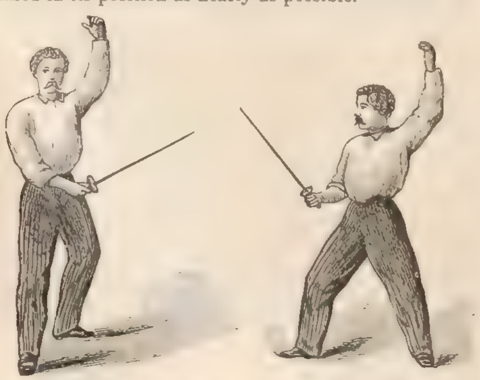
Seconde naturally follows prime in case that parry is avoided. From guard it is formed by turning the hand to pronation, both lowering it and moving it slightly to the right, describing with the point a curve, the convexity to

the left, arresting the point on a line with the right side and at the height of the groin.

Tierce.—When seconde has been avoided by the antagonist's point, tierce would be resorted to involuntarily: it is nearly the same as the guard of tierce. From the middle guard it is formed by moving the hand to the right till it is opposite the right side, keeping it in supination—that is, with the back down: the point moves as little as possible, the hand is drawn slightly back.



Quarte would naturally follow to parry a high disengagement from tierce. It is formed from the middle guard by moving the hand to the left as far as the left side, inclining the nails slightly to the left. The point is maintained in its position as nearly as possible.

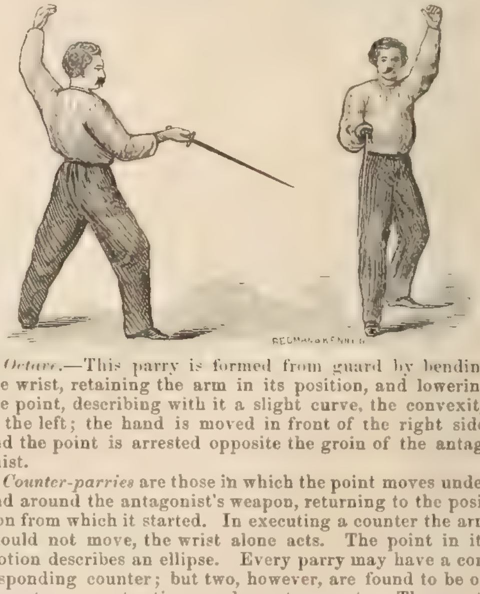


Quinte.—Quinte is naturally resorted to in order to parry

a low disengagement from tierce. It is formed by lowering the hand diagonally, placing it in front of the left side at the height of the groin, the nails to the left; the point is arrested as nearly as possible on a line with the right shoulder of the antagonist.

Six was formerly tierce parry, and constituted among early masters the guard of tierce; it is yet too frequently confounded with the true tierce. It is formed from middle guard by turning the hand in pronation and moving it opposite the right side; the point is in front of the antagonist and at the height of the crown of the head.

Sept.—This parry is also called demi-circle. It is formed from middle guard by bending the wrist and lowering the point, describing with it a slight curve, the convexity to the right; the hand is raised slightly and moved to the left, opposite the left side, and the point is arrested in front of the groin of the antagonist. Sept is used to parry blows delivered at the waist, but it is less effective than quinte.



Octave.—This parry is formed from guard by bending the wrist, retaining the arm in its position, and lowering the point, describing with it a slight curve, the convexity to the left; the hand is moved in front of the right side, and the point is arrested opposite the groin of the antagonist.

Counter-parries are those in which the point moves under and around the antagonist's weapon, returning to the position from which it started. In executing a counter the arm should not move, the wrist alone acts. The point in its motion describes an ellipse. Every parry may have a corresponding counter; but two, however, are found to be of advantage, counter-tierce and counter-quarte. The counters have two advantages: they cut all the lines of attack, and throw off the weapon of the antagonist to the side on which he is prepared to take the opposition, and consequently may leave him uncovered and exposed to a direct return blow.

Counter-tierce.—Being engaged in tierce, when the antagonist disengages at the "left" lower the point with a quick bend of the wrist, passing it under the approaching weapon, and throw it off to the right.

Counter-quarte is executed after the same manner from the engagement of quarte; the blow is thrown off to the left. The point in both these parries must be arrested opposite the antagonist's face.

Double Counters.—The execution of the counters twice in quick succession is called a *double counter.* It is a parry that should be much practised, as it gives great command of the weapon.

Disengagements.—The disengagement from tierce to quarte, or from quarte to tierce, is made by pressing on the gripe with the thumb and middle fingers, changing the point from one side to the other with an abrupt and rapid

motion, at the same time that it is moved in a spiral direction to the front. The point should be directed at the right nipple. The curve which the point makes around the blade should be as small as possible. To disengage "below" from tierce or quarte, the point is lowered by bending the wrist, and moved to the front at the same time just under the blade of the antagonist. The disengagement from tierce at the "left" may be parried with quarte, a simple parry, prime, seconde, and octave, half counter, and with counter-tierce. The disengagement from quarte at the "right" may be parried with tierce and six, with prime and sept, and with counter-quarte. The disengagement "below" from tierce may be parried with quinte, prime, and with seconde and octave; from quarte, with prime and sept.

Feints.—A feint is a quick movement of the point towards an exposed "point of attack," as if a blow was intended, the object being to disquiet the antagonist and induce him to move his blade, and thus expose himself. To execute a feint, the point must be moved smoothly and quickly to the front, nearly to the full extent of the arm, and as close as possible to the antagonist's weapon. The hand should be raised to the height of the mouth; neither the body nor the legs should move. The feint may be accompanied with an appel. In feinting "below," lower the point in a vertical line, and move it to the front just under the antagonist's guard, being careful to raise the hand well. To execute a feint at the "left," supposing the engagement to be in tierce, change the point and advance it nearly to the full length of the arm, describing with it the smallest possible circle around the antagonist's weapon. A feint is followed by a disengagement or by a direct blow. If the opponent moves his weapon to oppose the feint, disengage; if he does not move it, deliver a direct blow, being careful to take in either case the opposition.

Counter-disengagements.—To avoid the counter-tierce and counter-quarte parries, it is necessary to move the point entirely around the adverse blade, describing a very small circle near the shoulder of the foil. This, if followed by delivering a blow, is called a counter-disengagement.

The *riposte* is the blow that immediately follows a successful parry. It may be delivered with the thrust or development, direct or with a disengagement. If delivered direct, it should be with such rapidity as to touch the opponent before he recovers his guard. It may be made also by first menacing a direct thrust, and as soon as the opponent recovers his guard and covers the point of attack menaced, then disengaging.

To *menace* is to advance the point quickly by a partial extension of the arm on the side of the engagement, as if about to make a direct blow. In menacing after a parry the opposition must be maintained. If the adversary moves his blade towards the point menaced, disengage; if he does not, deliver a direct blow.

Ripostes are usually attempted after quarte, quinte, six, and tierce, counter-quarte, and counter-tierce parries. The riposte, after six, from the favorable position of the hand, can be delivered with more certainty and fatal effect and with more rapidity than any other. These ripostes are all executed by the thrust or development, raising the hand and lowering the point, directing it at the face and neck, or by first menacing and then disengaging at whichever point of attack may be uncovered.

Riposte after Prime Parry.—Keep the hand in the position of prime, and by a rapid extension of the arm, and making a strong effort with the thumb and wrist, direct the point "below."

To Riposte after Seconde Parry.—Lower the hand, keeping it in pronation; raise the point and deliver the blow at the flank, or menace "below" and turn the hand as in tierce, and deliver the blow at the "right."

To Riposte after Six.—Raise the hand as high as the head, turning the thumb directly down; lower the point over the guard of your antagonist, and deliver the blow at the "right," or disengage "below."

To Riposte after Sept Parry.—Lower the hand and deliver the blow at the flank; or menace, and as the antagonist covers himself and recovers his guard, disengage.

To Riposte after Octave Parry.—Lower the hand very slightly, raise the point, and deliver the blow at the flank. This is also called *flanconade.*

Disengagements by cutting over the point are made by raising the blade over the point of the antagonist's weapon and as close as possible to it. The cut, as a simple blow, is always preceded by a feint, or an attack upon the weapon, by exerting some force upon it, pressing or striking it aside. For instance, whether on guard in quarte or tierce, turn the hand, the thumb up, and with a sudden energetic pressure move the antagonist's point out of the line of the body; then leave his blade abruptly and extend the point to the front; as soon as your antagonist covers, raise the blade over his point and develop. The cut is most successfully made at the "right," first compelling the antagonist to parry quarte.

Rule.—Force in fencing accomplishes little, quickness much, but ability and skill to deceive the antagonist, everything.

On Commencing the Attack.—The disengagement, simple feint, and menace have been explained. The other modes of commencing an attack are as follows:

Gliding the weapon is executed by moving it smoothly along, and in slight contact with the adversary's, till the arm is nearly extended, then terminating the movement with the greatest celerity, executing a direct blow. The opportunity for making this blow can only occur when the opponent is not covered, and, as the point approaches him, does not take the opposition. If the opponent protects himself, taking the opposition, a disengagement may be made.

Pressing.—Without quitting the adversary's blade, move the weapon forward quickly, bearing upon his, commencing at the feeble, and develop, or if the opposition is taken, disengage. This blow is employed with advantage against one who extends his blade too much.

Beating.—Raise the point slightly and strike the opponent's weapon at an acute angle, the fort against his "feeble." It is employed against an extended guard to displace the point of an adversary upon whom a feint has no effect, in order to afford an opportunity for a disengagement.

False beating or *tapping* is to strike the adversary's weapon with the "feeble" on the side of the engagement a slight quick tap, by the action of the wrist alone, for the purpose of disquieting him, and causing him to grasp nervously his weapon and make some movement of which advantage may be taken. It is often done several times in rapid succession. The same effect may be produced by rapidly changing the guard.

Removing the Point.—When an adversary has a hard hand and bears upon the weapon, remove the point suddenly, but only a short distance. Finding the support to his blade removed, he will involuntarily seek it, and will almost certainly afford an opportunity for making a direct blow or disengagement; or he may attack, of which, being anticipated, advantage may be taken.

Crossing is employed against an antagonist who, without replying to a feint, extends his blade, presenting it at the breast. It is executed by holding the hand high and turning the blade over that of the adversary, and forming the parry of seconde or sept (demi-circle), thus securing command of his weapon and an opportunity of attacking "below." Crossing, if done with force and skill, will disarm. To disarm, however, in fencing as an exercise, is a discourtesy.

Binding is employed the instant after a successful parry, when the feeble of the adversary's blade is controlled. For instance, if the antagonist disengages from quarte "below," and the blow is parried with sept, then an opportunity occurs to bind his weapon by turning the blade under his, and with a quick motion of the wrist raise it and throw it off to the right. If done at the nick of time, as the antagonist is recovering his guard, an opportunity is given to deliver a blow at the "right," where he will be uncovered, his weapon still retaining its opposition in quarte with which he delivered his blow. Binding after the parry, if octave, may be effected after the same manner. The weapon in this case is thrown off to the left, and a blow may be de[illegible] the "left." In either case, if the antagonist [illegible] after his weapon has been bound to close the line of the direct blow, a disengagement should follow.

Flanconade.—The blow delivered at the flank of the antagonist when he menaces at the "left" is called flanconade, and is executed as follows: If [illegible] in quarte, the antagonist menaces or extends h[illegible] to the front and low, or if he feints at the "left" from the engagement of tierce, execute the parry of octave and deliver a blow at the flank, raising well the hand. This blow is parried with octave or seconde.

Time thrusts are made at an [illegible] who, in delivering his blow, is uncovered [illegible] disengagement. Such blows m[illegible] by attacking in return, by a quick exten[illegible] arm, taking a strong opposition.

Time blows [illegible] at an antagonist who advances within [illegible], or who makes his feints too slow or w[illegible] such blows depend upon the readiness with which advantage is taken of the moment[illegible] antagonist, they are regarded as the m[illegible]

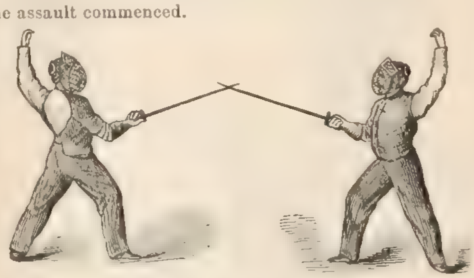
F[illegible] by raising the hand after parry [illegible] six, [illegible] the forte the feeble of the adversary's blade, then [illegible] the latter rises and tries to [illegible]

the riposte) turning or sliding the blade around it without quitting it, and riposting "below" or by a cut over the point at the "left."

Combinations.—A feint followed by a disengagement is called "feint *one, two.*" For instance, if engaged in tierce, feint one, two would be made by showing the point at the "left," and when the opponent covers the "left," disengaging at the "right." If, instead of this disengagement, a feint be made at the "right," and when the opponent covers the blow be delivered "below" or at the "left," the combination would be feint *one, two, three.* Two feints and a disengagement or counter-disengagement, or cut over the point, or a feint and a double counter-disengagement, is as much of a combination as can be attempted in an assault.

Wall practice, or tierce and quarte, is an exercise for the purpose of acquiring a fine development and great precision in making the simple disengagement at the "right" and "left."

The *salute* is a preparatory exercise in the fencing-hall in which fencers indulge as a compliment to spectators and to each other, and to assure themselves before engaging in an assault. The masks are laid aside. The fencers, on first taking the position of guard, rise, salute with their weapons each other and the spectators on the right and left. On resuming guard in tierce, one disengages first at the "left," then at the "right," the blows being delivered with a loose hand, so that the weapon, on being parried, will be turned and the point thrown to the rear, the parrier at the same time lowering his point out of line. After a few repetitions of these disengagements the first fencer will discontinue, and will so indicate by an appel, both rising. The guard of tierce is then again resumed, and the other fencer will make the same disengagements. On appelling and both rising, the salute with the weapon will terminate the exercise, when masks will be resumed and the assault commenced.



The Assault.

The Sabre.—The attack and defence with the foil is the basis for that of the sabre.

The guards with the sabre are essentially the same as with the foil—in tierce, quarte, and seconde; the left hand, however, is placed on the hip, to avoid cutting the arm. The edges of the sabres are in contact. The ordinary guard is tierce. The points of attack are the same—at the "right," "left," and "below." Blows, both points and cuts, are delivered with the thrust and development, direct or by disengagement. The attack is begun by feints or by attacks upon the weapon. In delivering the point at the "right" from the engagement of tierce, the sabre is turned, the edge up, the back of the hand to the left. The parries are prime, seconde, tierce, quarte, and demi-circle, and against points are executed in the same manner as with the foil. Against

Prime against Cut. Tierce against Cut. Quarte against Cut.

cuts at the head, the hand, in parrying prime, tierce, and quarte, is raised, so that the sabre affords the required protection. Cuts are made with the point of the sabre and by a motion of the wrist alone, raising the sabre as little as possible. With a keen edge slight force will inflict a fatal cut. From the ordinary engagement of tierce the first cut would be made at the face or right of the head, and parried with tierce. Or the cut may be at the left of the head by raising the hand, turning the edge of the sabre to the left as it is launched beyond the antagonist, making the cut in drawing the hand back. The parry against this cut is prime. The cut "below" at the right flank would be parried by seconde. From the engagement of quarte the first cut would be at the face or left of the head, and parried by quarte, or at the right of the head, by raising the hand, turning the edge to the right as it is launched beyond the antagonist, making the cut in drawing the hand back.

The cut "below" at the left flank would be parried by demi-circle. The cut at the leg is best avoided by with-

Slipping the Leg.

drawing the leg, at the same time extending the point. The most effective parries are prime and seconde. The most

Riposte with point after Tierce parry.

Cut after Prime parry.

effective ripostes are with the point after tierce parry, with the cut after prime. J. C. KELTON.

Fen'dall (JOSIAS), governor of Maryland from 1656 to 1660, received appointment from the commissioners of Parliament in 1658, his previous appointment, in 1656, having been made by the Proprietors. Was superseded in 1660 for intrigues and sedition. In 1681 was heavily fined and banished for their continuance.

Fendall (PHILIP R.), b. at Alexandria, Va., in 1794, graduated in 1815 at Princeton, and became an eminent lawyer of Alexandria and Washington, D. C., where he was district attorney (1841–45 and 1849–53). Was an able writer. D. at Washington Feb. 16, 1868.

Fénelon (FRANÇOIS SALIGNAC DE LA MOTTE), French archbishop and author, b. at the château de Fénelon, Périgord, Aug. 6, 1651, went to the University of Cahors in 1663, and thence to the College of Plessis. He preached his first sermon in 1666, went thence to the Seminary of Sulpice, and received holy orders about 1675. In 1678 was superior of the order of Nouvelles Catholiques, for the instruction of new converts. In 1686, after the Revocation of the Edict of Nantes, was sent by Louis XIV. to Poitou to convert Protestants. Was preceptor to the duke of Burgundy in 1689, tutor to the duke of Anjou in 1690, and to the duke of Berri in 1693. In the same year he became a

member of the French Academy. Was appointed archbishop of Cambray Feb., 1695, and during that year, as afterwards, became the friend and defender of Madame Guyon. Bossuet denounced him as a heretic in 1697, and in 1699, Fénelon, having in vain appealed to the pope, signed his renunciation of Mme. Guyon's doctrines, and d. at Cambray Jan. 7, 1715. Among Fénelon's earliest works was *Traité du Ministère des Pasteurs*, an argument against Protestantism. While tutor to the duke of Burgundy he wrote *Dialogues of the Dead*, etc. His *Explication des Maximes des Saints*, regarded as an indirect apology for Guyonism, appeared in 1697, *Les Aventures de Télémaque* in 1699. Other works of Fénelon's were *Dialogues on the Eloquence of the Pulpit, Demonstration of the Existence of God, On the Temporal Power of the Mediæval Popes*, a *Treatise on the Education of Girls*, etc. (The following works may be consulted: RAMSAY, *Vie de Fénelon*, 1725; CARDINAL DE BAUSSET, *Histoire de Fénelon*, 4 vols., 1808; GOSSELIN, *Histoire littéraire de Fénelon*, 1843; CHARLES BUTLER, *Life of Fénelon*, 1810; ALPHONSE DE LAMARTINE, *Fénelon*, Paris, 1854; HENRI LEMAIRE, *Vie de Fénelon*, 1826; J. F. DE LAHARPE, *Éloge de F. Salignac de la Motte Fénelon*, 1771; MAURY, *Éloge de Fénelon*, 1771; ROY, *Histoire de Fénelon*, 1842; WERFER, *Leben des F. Fénelon*, etc., 1852; E. GANDAR, *Fénelon et son Temps*, 1864.)

Fen'elon Falls, post v. of Fenelon tp., Victoria co., Ontario, Canada, between Cameron and Sturgeon lakes, 16 miles N. of Lindsay, with which it is connected by steamboat. It has large lumber mills, and a waterfall 20 feet high and 300 feet wide. Pop. about 700.

Fenestel'la, a genus of fossil bryozoans, of which many species have been obtained from the palæozoic rocks. They usually have the form of a calcareous network, of which the meshes are often quadrangular, resembling little windows, whence the name. The threads of the network are poriferous. The corallum of *Fenestella* frequently grows in the form of a broad, ribbon-like frond, spirally wound round and radiating from a central axis. J. S. NEWBERRY.

Fenestella, a Latin historian who flourished under Augustus, and continued to live into the reign of Tiberius, since, according to the statement of Jerome, he d. in the seventieth year of his age, A. D. 21. Nothing further is known positively of his life. Wrote a work entitled *Annales*, of which the twenty-second book is cited by Nonius, and which supplied to Plutarch materials for some of the statements in his *Lives* of distinguished Romans. It probably extended from the period of the kings down to and including the later history of the republic, which portion seems to have been more fully treated than the earlier. (See J. POTH, *De Fenestella hist. script. et carm.*, Bonn, 1849. The fragments are collected in HAVERCAMP'S *Sallust*, vol. ii. pp. 385-387; reprinted in Frotscher's ed., Leipsic, 1825-30.) H. DRISLER.

Fe'nian, a name first applied in the early history of Scotland and Ireland to a tribe of warriors noted for their prowess. Finn MacCumhail was their most famous chief. According to Irish annals, he died about 285 A. D. So great was his renown that these Gaelic warriors were henceforth called Feinne, Fiann, or Fenians. Their deeds form the theme of many poems and legendary tales in Celtic literature, and are also commemorated by various names in Scotch and Irish topography. In early Irish histories they are represented as an established militia, whose duty it was "to defend the country against foreign or domestic enemies, to support the right and succession of their kings, and to be ready, upon the shortest notice, for any surprise or emergency of state." With the rise of monasticism the ancient order disappeared, but Finn and his Fenians, and especially his two sons, Fergus and Oisin (the Scottish Ossian), long remained to the Gaelic imagination what Arthur and his knights were to the Cymric.

In 1859 the name was applied to an organization of Irishmen that was formed in America and Great Britain to secure the independence of Ireland. The organization was constituted on republican principles, having its social, district, and State circles, and its congress, in which was vested the supreme legislative authority and the choice of the chief executive officer. The first Fenian congress met in Chicago in 1863; the order, however, did not attract much attention until its second congress, in Cincinnati in 1865. It then became very popular among the Irish; 80,000, it was said, belonging to it in the U. S. In 1866 several attempts were made by the Fenians in this country to invade the British provinces, but all, except two, were frustrated by the U. S. authorities. The two companies of Fenians who succeeded in crossing the Canadian frontier were speedily driven back, and most of those who returned were taken prisoners by U. S. authorities and sent on parole to their homes. During the following year there was a number of Fenian riots in Great Britain, but all were soon quelled, and some of the rioters executed. From that period the Fenian excitement rapidly subsided. Divisions occurred in the organization, the masses lost confidence in their leaders, and many of the wrongs of Ireland which they sought to redress were abolished by legislation.

L. CLARK SEELYE.

Fen'nec, Cer'do, or **Zer'da,** a small fox-like animal of Northern and Central Africa, considered by some as a dog (*Canis Cerda*), by others a fox (*Vulpes Zaarensis*), and by others as quite different from either, and assigned to a genus *Megalotis*, so called from its large ears. Its habits accord generally with those of the true foxes. Its fur is highly prized by the Africans.

Fen'nel [Lat. *fœniculum*, dim. of *fœnum*, "hay," from its finely divided leaves], a genus (*Fœniculum*) of Old World umbelliferous herbs, closely allied, and by many assigned, to *Anethum*, the dill genus. The *Fœniculum vulgare* (common fennel), *Fœniculum dulce* (sweet fennel), and *Fœniculum officinale* of Europe (the first cultivated in the U. S. also) are raised extensively for their seeds, a very pleasant, warm aromatic much employed in pharmacy. These seeds abound in volatile oil of fennel. The leaves and blanched shoots are used as salad and potherbs in Europe. The *Fœniculum Capense* of South Africa has an edible root. The *Fœniculum Panmorium* of India is much cultivated for its aromatic seeds. Among the popular superstitions there is a belief that he who sows fennel-seed sows sorrow. Fennel-leaves were once emblematic of grief. The giant fennel, in whose stalk Prometheus concealed the fire which he stole from heaven, was the *Ferula Tingitana* of the Mediterranean coasts, whose pith is still used as a port-fire and as tinder. This coarse plant is also umbelliferous. "Small fennel" is the *Nigella sativa* of Europe and Asia, the "love-in-a-mist" of our gardens, a small ranunculaceous herb with quaint flowers and aromatic seeds, sometimes used in cookery and medicine.

Fen'ner, post-tp. of Madison co., N. Y., has marl-beds and manufactures of lime. Pop. 1381.

Fenner (ARTHUR), governor of Rhode Island from 1789 to 1805, was b. at Providence, R. I., in 1745, and d. there Oct. 15, 1805. Before his election as governor he was for a long time clerk of the superior court.

Fenner (JAMES), LL.D., son of the preceding, was b. at Providence, R. I., in 1771, graduated at Brown University in 1789, was U. S. Senator from 1805 to 1807, then governor of Rhode Island from 1807 to 1811, as also from 1824 to 1831, and in 1844-45. D. at Providence Apr. 17, 1846.

Fen'nimore, post-tp. of Grant co., Wis. Pop. 1794.

Fenouillet, de (EMILE), journalist in Canada, was b. at Hyères, France, studied law and wrote for the Paris press, edited the *Journal de Québec* after Oct., 1854, besides teaching history and literature at the Laval normal school and writing for the *Journal de l'Instruction Publique*. D. at Quebec June 30, 1859.

Fen'ter, tp. of Grant co., Ark. Pop. 173.

Fenter, tp. of Hot Springs co., Ark. Pop. 1057.

Fen'ton, tp. of Whitesides co., Ill., on the Chicago Burlington and Quincy R. R. Pop. 758.

Fenton, a v. and tp. of Genesee co., Mich., is situated in an agricultural district about 50 miles N. W. of Detroit, on the Detroit and Milwaukee R. R. It has an extensive flouring mill, 4 hotels, 2 weekly newspapers, 3 dry goods houses, an extensive cooperage, an iron-foundry, a woollen-factory, a Baptist seminary, an Episcopal high school, a union school, etc. Pop. of v. 2353; of tp. [illegible]. (P. O. name, FENTONVILLE.) W. H. H. SMITH, ED. "GAZETTE."

Fenton, tp. of Broome co., N. Y. Pop. [illegible].

Fenton (ELIJAH), English poet, b. in Staffordshire in 1683, had M. A. from Cambridge University in 1726. He assisted Pope in the translation of the *Odyssey*, having as his portion the first, fourth, nineteenth, and twentieth books, and, according to the earl of Orrery, to whom he was secretary, double that number of books. His *Mariamne* (1723), tragedy, was successful. He wrote also *Life of Milton* (1727), etc., and d. in Berkshire July, 1730.

Fenton (REUBEN E.), American legislator, was b. at Carroll, Chautauqua co., N. Y., July 11, 1819, educated at Pleasant Hill and Fredonia academies, studied law, and became a merchant. He was supervisor of Carroll in 1843, representative in the U. S. Congress from the thirty-third district of New York from Dec., 1857, to Mar., 1865, governor of New York from 1865 to 1869, and then U. S. Senator from New York, being elected in 1869.

Fen'tonville, Mich. See FENTON.

Fentonville, post-v. of Carroll tp., Chautauqua co., N. Y., on the Dunkirk Allegheny Valley and Pittsburg R. R. Pop. 82.

Fen'tress, county of Tennessee, bordering on Kentucky. Area, 570 square miles. It is a part of the Cumberland Mountain plateau, and has abundance of coal and iron ore, not yet worked. It has a great extent of fine pasture-lands. Grain is the staple agricultural product. Cap. Jamestown. Pop. 4717.

Fen'triss, post-tp. of Guilford co., N. C. Pop. 866.

Fen'ugreek [Lat. *fœnum Græcum*, "Greek hay," because it is used in the Levant and in Asia as a forage-plant], a name given to the *Trigonella Fœnum Græcum* and other species of the genus, leguminous annual herbs of Asia and Europe, resembling clover. The above species is cultivated in France and Germany for its seeds, which are ground into an oily, mucilaginous meal, much used in farriery as a vehicle for drugs. They were once valued in medicine, but are now only employed in poultices, etc.

Fen'wick, a v. of Old Saybrook tp., Middlesex co., Conn., near the mouth of the Connecticut River, is the S. terminus of the Connecticut Valley R. R.

Fenwick (Benedict J.), b. in St. Mary's co., Md., Sept. 3, 1782, joined the Jesuits; was president of Georgetown College, D. C. In 1825 became Roman Catholic bishop of Boston, Mass., and displayed remarkable administrative talent in that position. D. at Boston Aug. 11, 1846.

Fenwick (Edward), D. D., first Roman Catholic bishop of Cincinnati, was b. in Maryland in 1768; became bishop in 1822, and d. in Wayne co., O., Oct. 6, 1832. Was succeeded by Archbishop Purcell.

Fenwick (George), English proprietor of a plantation near Saybrook, Conn., came to America in 1636, and was governor of Saybrook until Dec. 5, 1644. Selling out to the Connecticut colony, he returned to England, and was one of the judges at the trial of Charles I. D. in 1657.

Fenwick (Sir John), English Roman Catholic conspirator in the reign of William III., b. near the middle of the seventeenth century, was committed to the Tower for his part in the assassination plot June 11, 1696, and, a bill of attainder against him being passed Jan. 11, 1697, was executed on the 28th of January in the same year. This was the last execution in consequence of attainder in Great Britain.

Fenwick (John), English Quaker and founder of a colony in New Jersey, was b. in England in 1618. His grant of land in West Jersey was obtained in 1673, and he settled at Salem in 1675. In 1678, Governor Andros, disputing his claim to the governorship, confined him in prison two years. He d. poor in 1683, having transferred his claim to William Penn.

Fenwick (John R.), b. at Charleston, S. C., 1780, educated in England, and entered the service of the U. S. as lieutenant of marines Nov., 1799; promoted to be captain in that corps 1809. In Dec., 1811, he accepted the commission in the army of lieutenant-colonel of artillery; as such served with distinction in the war with Great Britain 1812–15, particularly at the assault on Queenstown Heights, Oct. 13, 1812, where he was three times wounded, and made prisoner. Brevetted colonel Mar. 18, 1813, for gallant conduct on the Niagara frontier, was on same date appointed adjutant-general of the army, with the rank of colonel, and disbanded as such June 1, 1815, but retained in the army as lieutenant-colonel of light artillery; commissioned colonel Fourth Artillery May 8, 1822; brevet brigadier-general Mar. 18, 1823. D. at Marseilles, France, Mar. 19, 1842.

G. C. Simmons.

Fenwick's Island, on the E. coast of Worcester co., Md., 20 miles S. of Cape Henlopen, has a lighthouse 86 feet high, with a flashing light; lat. 38° 27′ 1″ N., lon. 75° 2′ 59″ W.

Feoff'ment, a mode of conveyance of landed property, formerly in use in the English law, by which land or other corporeal hereditaments were transferred by one person called a *feoffor* to another called a *feoffee*. Feoffment meant originally, under the feudal system, the giving of a feud or fee (see Fee), but in the modification of the system of land tenure which afterwards ensued it was employed to denote the grant of an estate in fee-simple, and was then extended to any transfer of freehold estates in hereditaments purely corporeal. An actual delivery of the land was made by a peculiar ceremony known as *livery of seizin*—*i. e.* a delivery of the possession of the land by taking the feoffee upon or near it and directly investing him with the ownership and occupation. When the parties entered upon the land the livery was said to be *in deed*, and in the presence of witnesses the feoffor handed to the feoffee a clod or turf or a twig or bough as a symbol of actual investiture, at the same time uttering certain words of transfer. When the delivery was made in sight only of the land, the livery was said to be *in law*; and in order to make the transfer effectual the feoffee had to make an actual entry during the feoffor's life. The words of donation which accompanied the livery were at first oral, but at an early period they were reduced to writing in the form of a deed of transfer, though no written instrument was imperatively required until the enactment of the Statute of Frauds (which see). Conveyance by feoffment was for a long period in English history the only ordinary method of transfer of land in possession. It has been entirely superseded by more convenient methods. It was only to be tolerated at a time when the means of communication between different sections of country were imperfect, and transfers of property were generally made between residents in the same immediate neighborhood. As a part of the common law it was in use in this country until abolished. It was frequently resorted to as a means of "disseising" a claimant of land, and thus setting in motion the statute of limitations. In this way, after the lapse of a certain number of years (say twenty-one), a party would gain a title by force of his uninterrupted possession and claim of ownership. For an instance of this see *McGregor vs. Comstock*, 17 New York Reports, 162. The mode of conveyance now in use is by deed. (See Deed.)

George Chase. Revised by T. W. Dwight.

Fe'ræ Natu'ræ [Lat., "of a wild nature"], a legal term used to designate such animals as are naturally of a wild disposition, as bears, foxes, deer, pigeons, wild-geese, etc. The separation of such animals as a class from those which are domestic is of importance in law, on account of the difference in the right of property which an owner is said to have in the two instances. Property in domestic animals is absolute, or indefeasible, while in animals *feræ naturæ* it is only qualified—*i. e.* the right of property only continues to exist as long as the animals are reclaimed from their savage or wild condition, and ceases when they return to it. When animals are of such a kind that if once restored to their freedom they would never return of themselves to their owner, his ownership of them can continue only so long as he keeps them confined. Wild beasts in a menagerie would be of this character. But if animals naturally wild have become so tamed that if suffered to escape or roam at large they have a habit or disposition of returning (*animum revertendi*), a qualified property in them continues so long as this habit is found to have a controlling influence. But if they stray and remain absent, it is lawful for any stranger to take them as his own property. Pigeons, bees, deer are familiar examples of this kind of wild animals. A property in bees is obtained by hiving them. But if they swarm and fly away, the owner retains his property as long as he keeps them in sight while pursuing them, so that he may distinguish them as from his own hive. A qualified property may also exist in certain cases by reason of the inability of the animals to depart from a person's property, as in the case of the young of wild birds who have built their nests in trees. While a qualified property continues, the owner's right is as much under legal protection as is his interest in property of any kind, and any interference with it is punished in the same manner. The owner of such animals will in some instances be liable for their acts. A distinction is to be taken between animals that are and are not naturally inclined to do mischief. In cases of the first class the owner is not in general responsible for injuries done by his animals, unless he is shown to have special knowledge of some vicious propensity. This knowledge is technically called *scienter*, and must be alleged in an action, and proved. This proof would not be necessary if the animals were trespassing on the land of another. The owner in that case is liable for acts done in the course of the trespass. When the animal belongs to the second class, and is naturally inclined to do mischief, no proof of knowledge is requisite, as the owner is presumed to have knowledge of its vicious propensities.

In regard to the right in wild animals killed upon any person's property, certain peculiar rules have been established. If such animals, while upon or flying over a person's land, are killed either by himself or by a trespasser, they become the land-owner's property. If he starts animals upon his own grounds, follows them into another's, and there kills them, the property remains in himself. If a trespasser chases game from one man's land into another's, and there kills it, he has a claim superior to that of the owner of either of the contiguous estates. This last rule has, however, been questioned. A number of statutes in regard to the preservation of game and the protection of wild animals of various kinds have been passed both in England and in the States of the Union, which should be consulted. George Chase. Revised by T. W. Dwight.

Fer de Lance [Fr., "lance-iron"—*i. e.* the head of a lance], the *Craspedocephalus lanceolatus*, a much-dreaded

venomous serpent of the West Indies and South America, especially abundant in St. Lucia and Martinique. This

Fer de Lance.

serpent is extremely prolific, and is from five to eight feet long. It gives no warning of its attack. The bite is very often fatal, and when its present effects are warded off by stimulants it usually ruins the health of the sufferer, who is for years afflicted with boils and ulcers, and often with paralysis and other distressing symptoms.

Fer'dinand, post-tp. of Dubois co., Ind. Pop. 1732.

Ferdinand, tp. of Essex co., Vt., traversed by the Grand Trunk R. R. Pop. 33.

Ferdinand the Just, king of Aragon, was co-regent of Castile and Leon near the close of Dec., 1406, became king June 24, 1412, and d. Apr. 2, 1416. In 1413 he defeated and imprisoned the count of Urgel.

Ferdinand I., ex-emperor of Austria, eldest son of Francis I., emperor of Germany, b. Apr. 19, 1793, married Maria Anna Carolina Pia, daughter of Victor Emmanuel I., king of Sardinia, in 1831. Took the throne Mar. 2, 1835, but was under the direction of Prince Metternich, his prime minister. On Dec. 2, 1848, he abdicated in favor of Francis Joseph, the present emperor, after having repeatedly fled from Vienna during the revolutionary agitations of that year. D. June 29, 1875.

Ferdinand I., king of Bohemia and Hungary and emperor of the Romans, was b. at Alcalá, Spain, Mar. 10, 1503, married Anne Jagellon May 5, 1521, and was made king of Bohemia Feb. 24, 1527, of Hungary, Oct. 28, 1527, and of the Romans, Jan. 15, 1531. Took the title of emperor when his brother, Charles V., abdicated, near the end of Sept., 1556. Recognized as emperor by the electors at Frankfort Mar. 12, 1558, was forbidden to take the title by Pope Paul IV. In 1562 he sent ambassadors to the Council of Trent, and d. at Vienna July 25, 1564.

Ferdinand II., king of Bohemia and Hungary and emperor of the Romans, b. July 9, 1578, was crowned king of Bohemia July 29, 1617. Failed to protect his Protestant subjects against the persecutions of the Roman Catholics, and the Bohemian states deposed him Aug. 19, 1619, and offered the crown to Frederick, elector-palatine. Had been crowned king of Hungary at Presburg July 1, 1618, and was elected Roman emperor Aug. 28, 1619. Frederick, having accepted the Bohemian crown, was defeated by Ferdinand's army, under Maximilian of Bavaria, at Prague, Nov. 8, 1620, and in 1623 the Bavarian duke received the Palatinate. In 1624 the imperial general, Wallenstein, defeated the armies of another Protestant league which had been formed against Ferdinand, with the king of Denmark at its head. Dec., 1625, and Nov., 1627, respectively, Ferdinand resigned the crowns of Hungary and Bohemia to his son, Ferdinand III. In 1630–32, Gustavus Adolphus of Sweden, with France and Venice in a new league against the emperor, invaded Germany, and gained important successes over Ferdinand, although at the battle of Lützen in Nov., 1632, the Swedish monarch was slain. The battle of Leipsic was fought in Sept., 1631, that of the Lech in Apr., 1632. Chancellor Oxenstiern directing the league after the death of Gustavus Adolphus, Ferdinand was more fortunate, made peace with some of the allies, and procured the election of his son Ferdinand as king of the Romans. D. at Vienna Feb. 15, 1637.

Ferdinand III., king of Bohemia and Hungary and emperor of the Romans, was b. July 20, 1608, and became king of Hungary and Bohemia Dec. 8, 1625, and Nov. 25, 1627. In 1631 he married Mary Anne of Spain, who d. in 1646. Gained the battle of Nördlingen in the contest of his father (Ferdinand II.) against the Swedes and their allies, Sept. 6, 1634, was made king of the Romans Dec. 22, 1636, and became emperor in 1637. The Thirty Years' war continuing, the battles of Thionville, of Fribourg, and of Sommershausen were fought in June, 1639, in 1644, and in 1648. In this latter year Ferdinand married Maria Leopoldina, who d. in 1649. In 1648 he also signed the peace of Westphalia, guaranteeing religious liberty to his Protestant subjects. In 1651 he married Eleanor of Mantua, and d. at Vienna Apr. 2, 1657.

Ferdinand I. THE GREAT, king of Castile and Leon, married Doña Sancha of Leon, and was named king of Castile in 1033, succeeding to the throne in 1035, and being crowned king of Leon June 22, 1038. Invaded Portugal, and acquired Coimbra in 1044 and 1045. In 1046–49 he warred against the Moors. On Sept. 3, 1054, he defeated Garcia III., king of Navarre, near Burgos; in 1063 conquered Mohammed ben Abad, dividing his kingdom between his three sons in 1064. Forced the kings of Saragossa and Toledo to become his tributaries in 1065, and d. at Leon Dec. 27 of that year.

Ferdinand III., THE SAINT, king of Castile and Leon, was son of Alfonso IX., king of Leon, and Berengaria, queen of Castile, succeeding in Castile, on his mother's abdication, Aug. 31, 1217, and in Leon in 1230. In his Moorish wars he conquered the kingdom of Baeza, took Cordova and Seville, and made the kings of Granada and Murcia his tributaries. D. May 30, 1252, and was canonized by Pope Clement X. in 1671.

Ferdinand V., king of Castile and Aragon, THE CATHOLIC, b. at Sos, Spain, Mar. 10, 1452, married Isabella of Castile Oct. 18, 1469. At this time Spain was divided into the kingdoms of Castile, Aragon, Navarre, and Granada, the last held by the Moors. On the death of Isabella's brother, Henry IV., Ferdinand was proclaimed king, with her as queen, at Segova, Dec. 13, 1474. Isabella's title being disputed by the princess Joanna, Henry IV.'s acknowledged daughter, Ferdinand defeated Affonso, king of Portugal, who supported her claims, at Toro in 1476. In 1479, Isabella secured undisputed possession of the kingdom by a peace with France, signed Nov. 9, 1478. In Jan., 1479, Ferdinand succeeded his father, John II., in Aragon; and immediately afterwards in both kingdoms, but especially in Castile, the two sovereigns commenced salutary reforms in the administration of justice, restraining the excesses of the nobility, and checking their power as feudal lords. In 1480, Ferdinand established the Inquisition at Seville, and subsequently permitted its establishment in Aragon. Began his wars with the Moors for the possession of Granada in 1482, the Moors having in 1481 captured the fortress of Zahara in Andalusia, and on Jan. 6, 1492, with Isabella his queen, he entered Granada in triumph. The same year he issued an edict for the expulsion of all Jews from his dominions. This year also Isabella furnished to Christopher Columbus two vessels in his fleet of three, with which he discovered San Salvador. Columbus returned in Mar., 1493, and during that year Ferdinand and Isabella obtained a bull from Pope Alexander VII. confirming their title to all the territories which they should discover in the Western hemisphere. In 1493, Ferdinand reacquired Roussillon and Cerdagne from Charles VIII. of France, and in 1495 opposed Charles in Italy, the Spanish troops being commanded by Gonsalvo de Cordova. In 1497 he promoted the expedition of Amerigo Vespucci. By 1500 the Spanish conquest of Naples was complete; by 1501 every Moor had been expelled from the kingdom or was compelled to be baptized. Isabella d. Nov. 26, 1504, and Ferdinand married Germanie de Foix, niece of Louis XII. of France, Mar. 14 or 18, 1506. On the death of Philip, his son-in-law, he became regent of Castile in Sept., 1506. By the treaty of Cambray (Dec., 1508) he received several Venetian cities, which were incorporated with the kingdom of Naples. In Oct., 1511, he joined the "Holy League" against France, and Jean d'Albret, king of Navarre, having leagued himself with the French monarch, Ferdinand invaded his dominions, drove him from the throne, and in 1512 subjugated that kingdom, thus finally uniting Aragon, Castile, Granada, and Navarre under one sway. Ferdinand d. Jan. 23, 1516.

Ferdinand I., king of Naples, b. in 1425, married Isabella de Clermont in 1434, was legitimized by Pope Eugene IV., and crowned king in June, 1458. In a short time his subjects invited John of Anjou to take the throne, and having done so, John sustained himself for a time, but Ferdinand defeated him at Troia Aug. 18, 1462, and became master of the kingdom in [illegible] married Joanna of Aragon. In 1486 the barons of Naples revolted. Ferdinand having made peace with them on Aug. 11, treacherously arrested and massacred them at the palace on Aug. 13. For this he was excommunicated by Pope Innocent VIII. June 29, 14[illegible] peace with the pope in May, 1492, and d. Jan. 25, 1494.

Ferdinand IV., [illegible] of Naples, and **I.** of the Two Sicilies, was b. [illegible] Jan. 12, 1751, and succeeded, on the accession of his father, Don Carlos, to the throne of Spain, Oct. 5, 1759. In 1767 he expelled the Jesuits; Apr. 7, 1768, married Maria Carolina of Austria by proxy,

and in person on May 22. In 1777 dismissed his prime minister, Tanucci; in 1792 joined the first coalition against France, but in 1796 purchased peace from the Directory. In Nov., 1798, a secret alliance having been formed with Russia, Austria, and England against France, the Neapolitan army marched to Rome, but was defeated by the French, who made conquest of Naples Jan. 23, 1799. The king and queen fled to Sicily, but during the same year were restored to power by the successes of the allies, and then took a bloody revenge on the republican citizens of Naples. Mar. 28, 1801, by the treaty of Florence, Ferdinand made peace with France, but in Sept., 1805, joined a third coalition against her. In the end of that year he was deprived of Naples by Napoleon I., and retired to Sicily under English protection. In Jan., 1812, he resigned his authority in favor of his son Francis, but on Napoleon's fall he was restored, entering the capital Aug. 14, 1815. In Dec., 1816 or 1817, he took the title of king of the Two Sicilies (Naples and Sicily), but in the latter part of his reign (1820–21) was threatened with a fresh revolt of his subjects, annulled their constitution, and entered Naples, supported by the Austrian army, May 15, 1821. D. Jan. 3, 1825.

Ferdinand I., king of Portugal, b. at Coimbra Feb. 27, 1340, succeeded to the throne Jan. 18, 1367. In 1369 claimed Castile, but was defeated by Henry II. of that kingdom, and compelled to make peace in 1371. The war being renewed, a like issue ensued in 1373. Again warred with Castile, assisted by Edmund, duke of Cambridge, in 1381, and d. Oct. 20, 1383.

Ferdinand VI., king of Spain (THE WISE), b. at Madrid Sept. 23, 1713, or Apr. 10, 1712, married the princess Magdalene Theresa of Portugal in Jan., 1729, and succeeded his father, Philip V., Aug. 10, 1746. Acceded to the treaty of Aix-la-Chapelle June 28, 1748. His queen d. Aug. 27, 1758, and he d. Aug. 10, 1759.

Ferdinand VII., king of Spain, was b. at St. Ildefonso Oct. 13, 1784, and was proclaimed prince of Asturias and heir to the crown in 1790; Oct. 6, 1801, he married Maria Antoinetta Theresa of Naples, who d. May 21, 1806. On the abdication of his father (Mar. 19, 1808) he succeeded to the kingdom, but meeting Napoleon at Bayonne (Apr. 28), was compelled to resign, which he did on May 1, and was sent with his brother and uncle to the château of Valençay. In Mar., 1814, was liberated, and in May annulled the Spanish constitution and dissolved the Cortes; Sept. 29, 1816, married Isabella Maria, infanta of Portugal, who d. Dec. 26, 1818; Oct. 2, 1819, married Maria Josephine of Saxony. The French having invaded Spain under the duke of Angoulême in Apr., 1823, Ferdinand was declared incapable by the Cortes, and a regency was appointed on June 11, but he was restored on Sept. 28, and proclaimed an amnesty, with promise of good government, on Sept. 30. Married the daughter of Maximilian of Saxony in 1824, and she d. in 1829. The same year he married Maria Christina of Naples. Mar. 29, 1830, re-established the Pragmatic Sanction of 1789, and d. Sept. 27, 1833.

Ferdinand II. of the Two Sicilies, known as KING BOMBA, b. Jan. 12, 1810, succeeded his father, Francis I., in 1830; by false promises and liberal measures at first excited great hopes among the friends of liberty, which his subsequent course cruelly disappointed. The history of his reign is a catalogue of conspiracies, rebellions, executions. His reckless bombardment of Messina Sept. 2–7, 1848, won him his shameful title. D. at Naples May 22, 1859.

Fère, La, town of France, in the department of Aisne, on an island in the Oise. It is a fortress of the fourth rank, and has a school of artillery. Pop. 4945.

Ferenti'no, town of Central Italy, 6 miles N. W. of Frosinone. Portions of the old cyclopean wall still exist. Pop. 9096.

Fer'gus, post-v. of Nichol tp., Wellington co., Ontario, Canada, on the Guelph branch of the Great Western Railway, 17 miles N. N. W. of Guelph. It has varied and important manufactures, and one weekly newspaper. Pop. 1666.

Fergus Falls, post-v., cap. of Otter Tail co., Minn., 225 miles N. W. of Minneapolis, on Otter Tail River, in a lumber region. It has fine water-power, a number of saw and planing mills, two weekly newspapers, and a national bank.

Fer'guson, tp. of Drew co., Ark. Pop. 400.

Ferguson, tp. of Centre co., Pa. Pop. 2111.

Ferguson, tp. of Clearfield co., Pa. Pop. 585.

Ferguson (ADAM), LL.D., b. at Logierait, Perthshire, Scotland, June 20, 1723; studied at St. Andrew's; read divinity in Edinburgh; was ordained in 1745; became Gaelic chaplain in the Forty-second regiment; was professor of natural philosophy at Edinburgh 1759–64, professor of moral philosophy 1764–84; was one of the commissioners sent in 1778 to the U. S. to effect a peace. D. at St. Andrew's Feb. 22, 1816. Author of a *History of Civil Society*, 1767; *History of the Roman Republic*, 1783; *Institutes of Moral Philosophy*, 1769; *Moral and Political Science*, 1792.

Ferguson (ELIZABETH GRÆME), b. in 1739, was the daughter of Dr. Thomas Græme of Philadelphia and Anne, granddaughter of Gov. Keith. She translated Fénelon's *Telemachus* into English heroic verse, and wrote minor poems, letters, etc. The latter were printed; the MSS. of the former are in the Philadelphia Library. The American estate of her husband, Hugh Henry Ferguson, having been confiscated for his adherence to the British government in the Revolutionary war, a part of it was restored to Mrs. Ferguson, from whom he had separated, by the legislature in 1781. D. Feb. 23, 1801, in Montgomery co., Pa.

Ferguson (JAMES), F. R. S., astronomer and mechanician, was b. in Banffshire, Scotland, in 1710. His mechanical genius was developed at a very early age by investigation into the wheel and axle and the construction of a wooden clock and watch which were good timekeepers. He spent several years in Edinburgh, and in 1743 went to London. In 1747 he published a *Dissertation on the Phenomena of the Harvest Moon*, and in 1748 commenced lecturing upon astronomy and mechanics. Elected a fellow of the Royal Society in 1763, he was chosen a member of the American Philosophical Society in 1770, and d. Nov. 16, 1776. *Astronomy Explained* (1756) and *Lectures on Subjects in Mechanics, Hydrostatics, Pneumatics, Optics, etc.* were among his *Works*, which were edited in 5 vols. 8vo by Sir David Brewster. The *Encyclopædia Britannica* is authority for the assertion that "in his whole life he had not received above half a year's instruction at school."

Ferguson (JAMES), PROF., was b. in Perthshire, Scotland, Aug. 31, 1797, arrived in New York Sept., 1800, was assistant civil engineer on the Erie Canal 1817–19; assistant surveyor on the boundary commission under the treaty of Ghent 1819–22; astronomical surveyor on the same commission 1822–27; civil engineer for the State of Pennsylvania 1827–32; first assistant of the U. S. Coast Survey 1833–47; and assistant astronomer of the U. S. Naval Observatory 1847–67. He discovered during this latter service the following asteroids: Euphrosyne in Sept., 1854; Virginia in 1857; Echo in 1860, for which he was awarded the astronomical prize medal by the Academy of Sciences of France in 1854, and again, by the same institution, in 1860. Prof. Ferguson was a valued contributor to Dr. Gould's *Astronomical Journal* and to the *Astronomische Nachrichten;* also to the Episcopal *Church Review*, to the Albany *Argus*, the *Merchants' Magazine* of New York, and to other standard papers. The records of the navy department alone show a career of most useful and distinguished service on the part of Prof. Ferguson, extending over twenty years, and ending only at his death, which seems to have been occasioned by extraordinary devotion to, and exposure in the line of, duty. His character as a man of varied learning and accomplishments was adorned by manly modesty, sincerity, and the principles of practical Christianity. D. Sept. 26, 1867.

Ferguson (PATRICK), MAJOR, English officer, was killed at the battle of King's Mountain, S. C., Oct. 7, 1780. Had served at the battle of Brandywine and on the Hudson in 1779, and so distinguished himself at the siege of Charleston in 1780 that he was made major of the Seventy-first regiment.

Ferguson (ROBERT), English poet and prose-writer, b. at Carlisle 1820, published *The Shadow of the Pyramid*, poem, in 1847, and *The Pipe of Repose, or Recollections of Eastern Travel*, in 1848.

Ferguson (Sir WILLIAM), BART., F. R. S., F. R. S. E., was b. at Prestonpans, East Lothian, Mar. 20, 1808, studied under Drs. Knox and Turner in the Royal College of Surgeons at Edinburgh at the age of eighteen, and became a licentiate of that institution in 1828, a fellow of the corporation in 1829, and began to lecture on the principles and practice of surgery in 1831. In 1836 he was assistant surgeon to the Royal Infirmary, and in 1839 a fellow of the Royal Society of Edinburgh. He settled in London in 1840, having been appointed professor of surgery in King's College and surgeon to King's College Hospital. He is now professor of clinical surgery in King's College, having also been elected president of the Royal College of Surgeons of England July 4, 1870, and having been for some time professor of surgery and human anatomy in that institution. These are but a few of the active and honorary positions to which he has been called. His *Progress of Anatomy and Surgery in the Nineteenth Century* was the substance of two courses of his lectures. His *System of Practical Surgery*

has reached its fifth edition; he is the inventor of numerous surgical instruments, and in 1866 was made a baronet. D. at London, England, Feb. 11, 1877.

Fer'gusonville, post v. of Davenport tp., Delaware co., N. Y., has considerable manufacturing interests.

Fer'gusson (James), D. C. L., F. R. S., architect, b. at Ayr, Scotland, in 1808, journeyed through the East, and in 1845 published *Illustrations of the Rock-cut Temples of India*. *Picturesque Illustrations of Ancient Architecture in Hindostan* appeared in 1847; *Handbook of Architecture*, in 1855; *Essay on a Proposed New System of Fortification by Earthworks*, in 1849; *The Palaces of Nineveh and Persepolis Restored*, in 1851. He was the architect of the Nineveh Court in the Crystal Palace at Sydenham. On Apr. 17, 1871, he received the royal gold medal at a meeting of the Royal Institute of British Architects.

Fergusson (Right Hon. Sir James), Bart., b. at Edinburgh Mar. 18, 1832, succeeded to the title on his father's death in 1849, was educated at Rugby school, after which he entered the Grenadier Guards, in which he became captain 1854; retired from the army in 1855; represented the county of Ayr in Parliament 1854–57 and 1859–68; under secretary for India 1866–67, and under secretary for the home department July, 1867–Aug., 1868; governor of South Australia 1868–72. In 1873, governor of New Zealand.

Fe'riæ [Lat., plu. of *feria*; probably (through *fesia*) connected with *festus*], in ancient Rome, were those holidays whereon business could not lawfully be done and when slaves might rest from their labors. These public festivals were of many kinds and were very numerous. Marcus Antoninus fixed them at 135 in the year, though before his time they had been much more frequent. The way in which they were kept varied extremely, but in general their celebration resembled that of the Christian Sabbath, there being a religious element in their observation.

A feria in the Ordo of the Roman Catholic Church is a week-day having no feast. The feriæ of Ash Wednesday, Holy Week, Whitsun Eve, and the Octaves of Easter and Whitsuntide have the offices of Sundays of the first class. The feriæ of Advent, of Lent, the Ember Days, and the Tuesday of Rogation Week are called greater feriæ.

Ferish'ta (Mohammed Kasim), Persian historian, b. at Astrabad 1550 or 1570, wrote a *History of India*, commencing about the close of the tenth century. In the introduction he gives an account of Indian history prior to the invasion of the Mussulmans. His history was translated by A. Dow (2 vols., 1768), and by Gen. Briggs (4 vols. 8vo, 1829). D. about 1612.

Ferland (Jean Baptiste Antoine), L'Abbé, author, was b. at Montreal, Canada, Dec. 25, 1805, and admitted to orders in the Roman Catholic Church in 1823. Was priest and professor in Canada for several years, then superior of the College of Nicollet in 1847, afterwards professor at Laval University June 10, 1855. *Observations on the History of Canada* was published in 1854; then *Notes on the Registers of Notre Dame de Quebec*, *A Voyage to Labrador*, *Courses of History of Canada from 1534 to 1663*, *Journal of a Voyage to the Coast of Gaspé*, and *Life of Bishop Plessis*, the last in 1863. D. at Quebec Jan. 8, 1864.

Ferman'agh, inland county of the province of Ulster, Ireland. It has an area of 714 square miles and a pop. of 92,688. Its surface varies from the richest vales to the wildest uplands. Its rocks are mountain limestone, millstone grit, and old red sandstone, with some coal, iron, and marble. In the low grounds the soil is a deep and rich loam, which grows thin and cold in the uplands. Fermanagh returns two members to Parliament. Cap. Enniskillen.

Fermanagh, tp. of Juniata co., Pa. Pop. 993.

Fermat, de (Pierre), French mathematician, was b. at Toulouse in 1601, and d. there Jan. 12, 1665. French savants claim for him a great part of the honor of the discovery of the differential calculus. He made important discoveries in the theory of numbers, and invented a theory of finding maxima and minima. La Place thought Fermat ought to share with Pascal in the fame of the invention of the calculus of probabilities. His *Works* (*Varia opera*) were published by his son in 1679. He was a councillor of the Parliament of Toulouse, and cultivated mathematics as a recreation, and is known as the first to propose two celebrated theorems called by his name.

Fermenta'tion [Fr. *fermentation*; Ger. *Gährung*], a spontaneous change or decomposition which takes place in most vegetable and animal substances when exposed at ordinary temperatures to air and moisture. When the process is accompanied by the liberation of fetid gases, as in the decomposition of urine, blood, or flesh, it is termed *putrefaction*. When it occurs with free access of air, and without excess of water, it is termed *decay* or *eremacausis*, as when a fallen tree moulders into brown pulverulent humus. The term *fermentation* is limited in common language to the process as conducted for the production of inoffensive and useful products, as when grape-juice and malt-wort are fermented into wine and beer. While these processes differ widely in their products, they are all similar in their general character. The substances most liable to undergo putrefaction are compounds rich in nitrogen, such as albumen, fibrin, caseine, gluten, gelatine, etc. These bodies require only the presence of water, and access of air for a short time, to bring them into a state of putrefactive fermentation, which is very offensive, owing to the liberation of sulphuretted hydrogen, ammonia, and a variety of volatile bodies, whose exact nature has not been definitely determined. These bodies, which ferment spontaneously, are composed of carbon, hydrogen, nitrogen, oxygen, and sulphur. Many non-nitrogenous substances, consisting of carbon, hydrogen, and oxygen only, which are incapable of fermenting or putrefying spontaneously, readily undergo this change when brought in contact with albuminous or gelatinous compounds, either in a fresh state or in a condition of incipient putrefaction. These latter bodies, which are capable of exciting fermentation, are called *ferments*, and bodies which are made to ferment by them are said to be *fermentable*. One of the most active of all ferments is yeast, a plant which develops in liquids undergoing vinous or alcoholic fermentation. Bodies composed wholly of carbon and hydrogen do not appear to be capable of undergoing fermentation under any circumstances. Bodies may be brought into different states of fermentation by the same ferment, according to the particular stage of decomposition which it may have attained. Thus, in the raising of bread by the aid of leaven, vinous fermentation may occur, with the production of alcohol and carbon-dioxide gas (CO_2), which makes the bread light and porous, or lactous fermentation may occur, with the formation of lactic acid, which makes the bread sour and heavy. Temperature influences both the development and the character of fermentation. It cannot occur at a temperature much below 40° F., nor much above 140°.

Fermentation is generally indicated by a sensible internal motion, the development of heat, and the liberation of bubbles of gas; and when it occurs in a clear liquid, always results in turbidity and the formation of a scum and a sediment. During the process complex organic bodies are resolved into simpler organic bodies, as when milk-sugar is changed to lactic acid; or into simpler organic bodies and inorganic compounds, as when glucose is changed to alcohol and carbon dioxide; or the decomposition may result in the liberation of elementary bodies, as hydrogen and nitrogen. The elements of water are often assimilated during fermentation, and enter into the composition of the new bodies. The process is always complex, and while it often results in the formation of some well-characterized predominating product, as alcohol, acetic acid, lactic acid, butyric acid, etc., there is always produced a variety of bodies in smaller quantities the exact nature of which has not been fully determined, although many of these secondary bodies have been identified. Fermenting substances generally have a tendency to abstract oxygen from the air and other bodies. When fermentation occurs with free access of air, it is accompanied by oxidation (*eremacausis*) on the surface. Putrefying bodies reduce ferrous sulphate to sulphide of iron by withdrawing oxygen.

Fermentation has long been resorted to in raising bread with leaven or yeast, in preparing alcoholic beverages, and in preparing certain vegetables, as sour beans and sauerkraut. It is the process, too, by which all vegetable and animal substances ultimately undergo destruction, and finally return to the inorganic world in the form of carbon-dioxide (CO_2), water (H_2O), ammonia (NH_3), nitrogen (N), etc., to become again the food of plants, and under the influence of the solar rays again to generate complex organic bodies. It is the process by which milk and vegetables sour, meats putrefy, and fats become rancid, and by which timber and textile fabrics decay. It is, moreover, intimately associated with the development of contagious diseases, and its study leads to the discovery of methods for preserving food and timber and for preventing the occurrence and spread of such diseases.

There is an endless variety of processes to which the term fermentation may be applied with more or less propriety; the following are a few of the most important: (1) Vinous, alcoholic, or spirituous fermentation; [illegible] and (11) [illegible].

I. Vinous or Alcoholic Fermentation is the process by which grape-juice is converted into wine and the wort,

malt into beer. A solution of pure sugar in water will remain unaltered for a long time, but finally mould appears upon it, and it becomes sour and dark-colored. If, however, a suitable ferment is added to it, such as yeast, putrid blood, or partially decomposed flour-paste, albumen, caseine, fibrin, or any similar body, it rapidly passes into a state of active fermentation, by which the sugar is converted into alcohol, carbon-dioxide, etc. The sweet juices of plants contain, in addition to sugar, small quantities of albumen, gluten, and legumen, and when they are exposed to the air and maintained at a temperature of about 80° F., they undergo fermentation spontaneously, the process continuing from forty-eight hours to several weeks, according to the temperature, the amount of sugar present, and the nature and quantity of the nitrogenous bodies which act as ferments. The most striking phenomena of this fermentation are—(1) the liquid becomes turbid, (2) bubbles of gas rise to the surface, (3) the temperature rises, (4) the sugar disappears, (5) alcohol makes its appearance, (6) by and by the liquid becomes clear and quiet again, and a light scum and a light-colored deposit are formed. This deposit consists of yeast, which is capable of exciting vinous fermentation in other solutions of sugar. The conditions essential to vinous fermentation are—(1) an aqueous solution of sugar, which may be either glucose, cane-sugar, or milk-sugar. The two latter are, however, invariably changed to glucose before they undergo vinous fermentation. (See *Saccharous Fermentation.*)

$$\underset{\text{Cane-sugar.}}{C_{12}H_{22}O_{11}} + \underset{\text{Water}}{H_2O} = \underset{\text{Glucose.}}{2C_6H_{12}O_6}.$$

(2) The presence of yeast or of a nitrogenous ferment; (3) access of air, at least at the outset; (4) a certain temperature, the limits of which are 41° and 86° F. The lower the temperature the slower the process, while at the temperature of 86° the vinous fermentation is liable to pass into butyrous fermentation. The chief products of the fermentation are alcohol and carbon-dioxide, which are produced from the glucose by the following decomposition:

$$\underset{\text{Glucose}}{C_6H_{12}O_6} = \underset{\text{Alcohol}}{2C_2H_6O} + \underset{\text{Carbon-dioxide.}}{2CO_2}.$$

Were these the only products, 100 parts of glucose would yield 51.11 of alcohol and 48.89 of carbon-dioxide; but only about 95 per cent. of the sugar is accounted for by these products. Most of the missing 5 per cent. is converted into succinic acid (discovered by C. Schmidt in 1847) and glycerine (discovered by Pasteur). In addition to these bodies, there is a host of others in minute quantities, derived partly from the glucose, partly from the ferment, and partly from the other bodies always present in vegetable solutions. The following scheme gives approximately the products from 100 parts of glucose:

Alcohol	48.5 per cent.
Carbon-dioxide	46.5 "
Glycerine	3.6 "
Succinic acid	0.7 "
Acetic acid	
Cellulose	
Fatty substances	
Hydrogen	
Nitrogen	
Hydrocarbon (methane?)	0.7
Propylic alcohol	
Butylic alcohol	
Amylic alcohol*	
Acetate, butyrate, valerianate, and œnanthate of ethyl, amyl, etc.*	
	100.0 per cent.

The last-mentioned bodies, indicated by a *, constitute, when separated by distillation, what is called the *fusel oil.* Béchamp reports leucin and tyrosin as constant products of vinous fermentation (*Comptes rendus*, lxxiv.), and T. Oser finds an alkaloid, $C_{16}H_{20}N_4$ (*Acad. z. Wien*, 1867, p. 209). The formation of succinic acid and glycerine is explained thus:

$$\underset{\text{Glucose}}{49C_6H_{12}O_6} + \underset{\text{Water}}{30H_2O} = \underset{\text{Succinic acid.}}{12C_4H_6O_4} + \underset{\text{Glycerine}}{72C_3H_8O_3} + \underset{\text{Carbon-dioxide.}}{30CO_2}.$$

H. T. Brown (*J. Chem. Soc.*, 1872, p. 570) suggests

$$C_6H_{12}O_6 + H_4 = 2C_3H_8O_3.$$

As Brown finds that water is always decomposed during vinous fermentation, the following seems probable:

$$4C_6H_{12}O_6 + 2H_2O + H_2 = C_4H_6O_4 + 6C_3H_8O_3 + 2CO_2.$$

Brown also finds that if the water used contains nitrates, a small quantity of nitric oxide (N_2O_2) will be found among the gases evolved. The yeast increases from 0.8 to 1.5 per cent. of the sugar.

The infusion of malt and sugar solutions to which gluten, caseine, albumen, or substances of like nature are added, do not generally undergo a purely vinous fermentation; lactous, butyrous, acetous, and putrefactive fermentation also occurs, and offensive products result. This can be prevented by the addition at the outset of a proper quantity of yeast, which at once determines the vinous fermentation; and if a temperature below 86° F. is maintained, and the air is properly excluded, the products of this kind of fermentation alone result. In the making of wine and the brewing of beer the complete destruction of the sugar is not desirable, and rarely, if ever, occurs, but in the manufacture of spirits the change to alcohol is made as complete as possible. (See WINE and BEER.) When vinous fermentation is resorted to in making bread, the object is not to produce alcohol, but carbon-dioxide, which shall make the bread light. Many substitutes for fermentation are in use by which the carbon-dioxide is produced without the alcohol. (See BREAD.)

Theories of Fermentation.—The discovery of fermentation and the preparation of wine date back beyond historic times. According to the Egyptians, Osiris, and according to the Greeks, Bacchus, taught the art to men. The Israelites attribute the discovery to Noah. The alchemists often employed the terms *fermentation* and *putrefaction*, but in a sense quite different from that in which the words are now used; the gradual solution of an inorganic body was called putrefaction, while fermentation was used as equivalent to our word *digestion*—*i. e.* the digestion of a mineral with an acid. The term *ferment* was applied to every active chemical agent. Valentine supposed the alcohol to pre-exist in the wort, and to be simply set free during fermentation. Libavius believed fermentation and putrefaction to be similar processes, differing merely in their products. Van Helmont (1648) attributed to fermentation the formation of gases during digestion, also the formation of the blood and of the sap. He considered fermentation to be the cause of the formation of living organisms, and of their reproduction and development. Mayow (1669) noticed the importance of air to fermentation. Sylvius de le Boë (1659) claimed that fermentation differed entirely from the action of acids upon alkalies (carbonates). He says the latter results in combination, while fermentation results in decomposition. Lemery (1775) recognized a similar distinction. Becher (1669) considered fermentation as similar to combustion (separation of phlogiston from calx), and as resulting in a splitting up of the fermenting body. Willis (1659) and Stahl (1697) considered fermentation and putrefaction similar processes, and attributed them to the action of a ferment—a body possessed of internal motion, which motion it communicated to the fermentable bodies.

The modern theories of fermentation have been developed as our knowledge of the conditions and products of the process has become more accurate. The production of alcohol attracted attention very many centuries ago. Van Helmont (1648) noticed the gas liberated during vinous fermentation, and called it "gas vinosum," to distinguish it from "gas carbonum," produced by coal. He recognized the fact that during fermentation something disappears or evaporates (sugar), which could otherwise be changed to coal (charcoal). He says *fermentum volatilizat quod alias in carbonem mutatur.* McBride (1764) showed that fermentation and putrefaction yielded the gas called "fixed air" by Black, and Cavendish (1776) showed that sugar yielded 57 per cent. (correctly, 48.89) of the same gas which is obtained from marble. After the discovery of oxygen, hydrogen, and nitrogen, of the composition of water and of the atmosphere, and the elementary composition of vegetable and animal bodies, and the recognition of the true character of combustion, Lavoisier (1789), in his *Traité élémentaire de Chymie*, exhibited the quantitative relations of cane-sugar to its products on fermentation, in the following table:

	Carbon	Hydrogen	Oxygen.
95.9 lbs. cane-sugar	26.8	7.7	61.4
and yield			
57.7 lbs. alcohol	16.7	9.6	28.4
35.3 " carbonic acid	9.9	....	25.4
2.5 " acetic acid	0.6	0.2	1.7
95.5, total products.			

These numbers are not correct, the actual products being as already stated. He claimed that the products contained all the carbon, hydrogen, and oxygen of the sugar, and that it was not necessary to suppose that water was decomposed during fermentation. He assumed that sugar, an oxide, was split into two products, the gas and the alcohol, which, if they could reunite, would regenerate the sugar. Berthollet (1803) believed that the alcohol had no isolated existence in the wine, but that, excluding the argol and the acids, the wine was a homogeneous body, in which alcohol was produced by heat. Brande (1811) and Gay-Lussac (1813) proved the pre-existence of alcohol in wine. The further investigation of the nitrogenous ferments, and finally the study of the yeast-plant, have given us the following definite theories of fermentation: (1) *acid theory;* (2) *contact theory;* (3) *influence theory;* (4) *chemical theory;* (5) *galvanic theory;* (6) *germ theory.*

1. *The Acid Theory.*—Pliny considered the action of leaven in raising bread to be due to an acid. Fabbroni, in his prize essay on fermentation, published at Florence in 1787, claims that fermentation depends on the action of a vegetable acid on sugar. He afterwards advanced the theory that the ferment is a vegeto-animal body, like gluten, and that the products result both from the sugar and from the ferment—the carbon of the ferment and oxygen of the sugar forming the carbonic acid, while the deoxidized sugar forms alcohol with the hydrogen and nitrogen of the ferment. The acid theory was long since disproved by the fact that fermentation occurs in the presence of calcic as well as of alkaline carbonates, and of metallic oxides.

2. *Contact Theory.* Berzelius supposed that fermentation is due to the contact or *catalytic* action of the ferment, in the same way that platinum sponge was supposed to effect the union of alcohol and the oxygen of the air, and sulphuric acid was formerly supposed to change alcohol to ethylic ether. As these reactions have already received more rational explanations, the idea of catalysis has been generally abandoned.

3. *Influence, Contagious, Mechanical, or Physical Theory.*—This theory originated with Stahl, and was re-established by Liebig in 1839, and was held by Pelouze, Frémy, Gerhardt, etc. It attributes fermentation to the mechanical action of certain nitrogenous matters (ferments), which are themselves in a state of decomposition, which is imparted to the sugar as soon as it comes in contact with the decomposing ferments under favorable circumstances. The more changeable body, by its own inherent instability, initiates molecular movements in a more permanent compound. The action is compared to several inorganic reactions, as the solution in nitric acid of platinum when alloyed with silver, platinum alone being insoluble; the decomposition of hypochlorous acid, chloride of nitrogen, peroxide of hydrogen; action of pyroracemic acid on argentic carbonate; the kindling of combustible bodies; crystallization from supersaturated solutions by rubbing the side of the vessel with a rod or introducing angular particles. The yeast-plant is supposed by the advocates of this theory to be only an incidental product of some varieties of fermentation, and to be active in inducing fermentation only in that it contains decomposing albuminous substances. The access of air is by them supposed to be necessary only to initiate by oxidation the activity of the ferment.

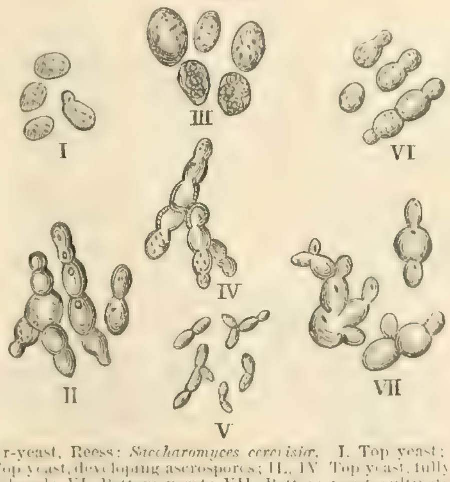
4. *The Chemical Theory* supposes a purely chemical action of the ferment or yeast on the sugar. It was founded by Trommsdorff and Meissner, but has at present few if any adherents.

5. *The Galvanic Theory* assumes that the decomposition is called forth by the dualism of the exciting body in a conducting fluid. Its adherents are Schweigger, Colin, and Kölle.

6. *The Germ, Vital, or Physiological Theory.*—This theory, which is the one which is now generally accepted, attributes the decomposition of the fermentable body to the vital action of living organisms, the vegetable cells of the yeast-fungus. These plants are formed from the nitrogenous substances present in the grape-juice, beer-wort, or other fermenting material, and involve the consumption and consequent destruction of the sugar, and the production of a variety of products of which in vinous fermentation, alcohol, carbon-dioxide, glycerine, and succinic acid are, as already stated, the most abundant. "It is now fully established that (1) the growth and reproduction of the yeast-fungus takes place only in fermentable liquids; (2) that the saccharine liquid will only ferment when the yeast plant is present in a state of active development." (*Dalton.*) This view is now so well established that any process which is proved to proceed without the development of living organisms must be excluded from the class of decompositions known as fermentation.

The Yeast Plant. In 1680, Anthony Leeuwenhoeck, with his newly-invented microscope, discovered the fact that yeast consisted of "little globules collected into groups of three or four together." Fabbroni (1787), as already stated, considered the yeast to be a "vegeto-animal" body, like gluten. Fourcroy entertained the same idea. In 1803, Thénard stated that yeast contains a nitrogenous "animal" substance common to all ferments. Mulder (1844) endeavored to show that a peculiar nitrogenous body, which he called *proteine*, was essentially characteristic of living matter, and was nearly allied in chemical composition to albumen, caseine, fibrin, and gluten. Payen in 1846 recorded the opinion that all vegetable cells contain materials similar in composition to animal organisms; and in the same year Von Mohl, a German botanist, invented for the active compound in living cells the term "protoplasm." The relation of the yeast-cells to fermentation was recognized by Thénard in 1803. He then first enunciated the "germ theory," by assuming that the yeast assimilates a little of the sugar, while the rest breaks up into alcohol and carbon-dioxide. The same idea was maintained by Erxlebens in 1818, and in 1825 Desmazières examined the yeast of beer and of wine, and called them animals. These investigations attracted little attention, even after Cagniard de la Tour in 1837 rediscovered the yeast-plant, made some most important observations upon it, and "declared that by some effect of their vegetation the equilibrium of the sugar was destroyed." He measured the yeast-cells and found them to be about [illegible] of an inch in diameter; and he also noticed that by a process of budding they multiplied during fermentation, and increased six or seven fold. Schwann made similar observations in the same year; Kützig investigated the subject; and Turpin, in 1838, made an elaborate study of beer-yeast. All of these writers considered yeast organisms to be alone capable of initiating fermentation. Mitscherlich adopted this view, and referred fermentation to vegetable organisms, and putrefaction to minute animals. Helmholz, in 1843, made a remarkable experiment: he placed a quantity of yeast on one side of a film of bladder, and a solution of sugar on the other, and although the liquids circulated freely through the membrane, the yeast could not pass, and fermentation took place only on the side of the yeast. Nevertheless, the "influence" theory of Liebig was generally accepted till about fifteen years ago, when Pasteur made the most elaborate and conclusive investigation, which has finally established the germ-theory. He says: "Albuminous bodies are never the ferments, but the aliment of the ferments;" "the true ferments are living organisms."

Fig. A.

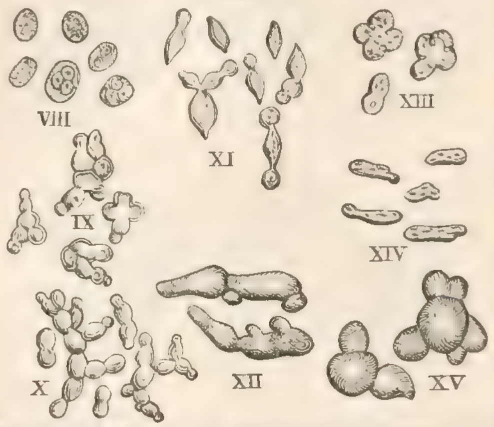


Beer-yeast, Reess: *Saccharomyces cerevisiæ.* I. Top yeast; III. Top yeast, developing ascrospores; II., IV. Top yeast, fully developed; VI. Bottom yeast; VII. Bottom yeast, cultivated at 61° to 66° F. *Saccharomyces exiguus;* V. The yeast of the after-fermentation.

The study of this subject has expanded far beyond its original limits, and has involved the questions of spontaneous generation and the germ-theory of disease, which are now engrossing the attention of the most acute observers on both sides of the Atlantic. This arose from the necessity of accounting for the presence of the living yeast-cells in fermenting and putrefying liquids, which decompose spontaneously without the addition of yeast. Appert, who studied early in this century the preservation of vegetable and animal food, found that by boiling such perishable articles, and sealing them up so as to exclude the air, they could be preserved indefinitely. This was explained by many by supposing that the oxygen of the air, which is necessary to initiate decomposition, was excluded. It was long supposed that a large number of animals were produced spontaneously. Aristotle supposed that shellfish, sponges, maggots, worms, moths, eels, etc., were produced without parents, and the idea that putrefaction is peculiarly favorable to the production of life was entertained by him, repeated by Pliny four centuries later, by Fabricius in 1600, Harvey in 1650, and is now held by the advocates of spontaneous generation. In the year 1668, Francis Redi, an Italian, showed that maggots were the progeny of the flies. His experiments were important, as they demonstrated the fact that insects were produced from eggs. As investigations continued, the idea of spontaneous generation was narrowed down to include only the microscopic organisms, the Infusoria. Needham, in 1748, wrote that he had seen them produced from decaying organic matter. He boiled solutions containing animal matter, corked them hot to exclude air, and found after a few days that they were full of living organisms, whose origin he attributed to

"vegetative force" residing in the solutions. Spallanzani, in 1776, repeated these experiments in glass flasks, with more care, and satisfied himself that the germs of life entered the solutions from the air. Schultze, in 1836, repeated the experiments, renewing the air, but subjecting it on its way to the flasks to the action of sulphuric acid or caustic potassa, to destroy the vitality of any germs it might contain. Schwann, in the following year, repeated these experiments, passing the air into the flasks through tubes heated to 600° F. They showed that the Infusoria were not produced spontaneously, but from spores or germs floating in the air. Schroeder and Dusch in 1854, and Schroeder alone in 1859, repeated these experiments, and found that if the air admitted to the flasks was filtered through cotton plugs, it failed to induce decomposition and develop animal or vegetable organisms. Pasteur even detected germs on the cotton plugs by the microscope, and found that when the plugs were placed in suitable solutions they at once gave rise to numerous animals and fungi. Dr. Lamaire, in 1864, collected germs by condensing the moisture of the air in glass tubes cooled by ice, and Tyndall showed the floating particles in the air by a beam of light. It was thus established that the germs of the yeast-fungus and of Infusoria float in the air, fall into organic solutions, and give rise to fermentation and putrefaction, and, as many think, to infectious diseases. There are still, however, many advocates for the theory of spontaneous generation, who base their belief on the experiments of Wyman, Bastian, Cantoni, and others, who claim to have seen living organisms develop in sealed flasks which had been exposed, after sealing, to temperatures varying from 140° F. to 300° F.

Fig. B.



Wine-yeast, Reess. VIII., IX., X. *Saccharomyces ellipsoideus*; XI. *S. apiculatus*; XII. *S. Pastorianus*; XIII. *S. conglomeratus*; XIV. *S. Reessii*; XV. *Mucor racemosus*, bullet-yeast.

The yeast-fungus consists of little cells composed of cellulose, containing a fluid, in which may be seen granules or germinal cells; it multiplies by budding (gemmation). The name *Torula* or *Torvula cerevisiæ* was first applied to it; it was subsequently called *Mycoderma vini*, *Cryptococcus*, *Hormiscium*, etc. Dr. Max Reess, who has made the most elaborate study of the subject (*Botanische Untersuchungen über die Alkoholgährungspilze*, Leipsic, 1870), found that there is a variety of yeast-fungi, and proposed for the genus the name *Saccharomyces*, which has been generally adopted. Beer-yeast is *S. cerevisiæ*, which develops in two different ways, according to the temperature. At about 72° F., as in the brewing of ale, the fermentation is rapid, and the yeast is carried to the surface of the liquid by the bubbles of carbon-dioxide; this is *top yeast*. When the fermentation proceeds at a temperature between 40° and 50° F., in brewing lager beer, it proceeds much slower, and the yeast appears as a sediment: *bottom yeast*. (See Beer.) These two varieties have a tendency to reproduce the kind of fermentation by which they were developed; and if the bottom yeast is placed in wort at a temperature of 72° F., it does not develop into top yeast, although its mode of growth is considerably modified. The after-fermentation of beer is caused by the development of another species, *S. exiguus*, the smallest of all yeast-fungi.

There is a greater number of species noticed in the fermentation of wine; *S. ellipsoideus* is the most common, and often the only form seen. Next in order of frequency occurs *S. apiculatus*. Engel insists that this form belongs to a different genus, and calls it *Carpozyma apiculatus*. During the after-fermentation of wines, especially of sweet wines and of other wines than the grape, *S. Pastorianus* appears. *S. conglomeratus* is often noticed at the beginning of the fermentation. *S. Reessii* occurs in some red wines. One or two familiar mould-fungi, *Mucor Mucedo*, and especially *M. racemosus*, have the property, in the total exclusion of the air, of developing their mycelium in sugar solutions in more or less globular forms, producing true alcoholic fermentation. This gives some confirmation to the suggestion made by certain observers, that the yeast-fungus is developed from the spores of common mould-fungi, like *Penicillium glaucum*, etc. Fitz noticed that when the quantity of alcohol reached $3\frac{1}{2}$ per cent., the development of the *Mucor* ceased.

The chemical composition of yeast has not been very fully determined. It consists chiefly, as do all plants, of cellulose, albuminoids, fat, and metallic salts. It contains no chlorophyll. An elementary analysis gives about the following percentages: carbon, 48.9; hydrogen, 6.8; nitrogen, 10.8; oxygen, 29.9; sulphur, 0.6; ash, 3. Some analyses make the ash in dry yeast as high as 7 or 8 per cent. The ash consists chiefly of potassic phosphate, with small quantities of sodic, calcic, magnesic, and ferric phosphates.

II. *Acetous Fermentation.*—While it is true that alcohol and other organic bodies may be readily oxidized to acetic acid without the aid of fungi, as when platinum-black, containing condensed oxygen, chromic acid, nitric acid, hypochlorous acid, etc., is employed, it is nevertheless true that in the ordinary process of vinegar-making we have a true fermentation, caused by a peculiar fungus, the *Mycoderma aceti*, which acts as a carrier of oxygen. Pure diluted alcohol does not undergo oxidation to acetic acid when exposed to the air. Like all other fungoid plants, the *M. aceti* requires food in the form of nitrogenous bodies and mineral salts, which are always present in wine, beer, and other fermented vegetable juices. The formation of vinegar is always preceded in such cases by the development of the plant, either from small additions from a previous fermentation or from germs from the air. The plant acts as a carrier of oxygen from the air to the alcohol, and the oxidation occurs in two successive stages; alcohol becomes aldehyde by the loss of hydrogen (withdrawal by oxygen), and then passes into acetic acid by a gain of oxygen.

$$\underset{\text{Alcohol}}{C_2H_6O} + O = \underset{\text{Aldehyde}}{C_2H_4O} + H_2O.$$

$$\underset{\text{Aldehyde.}}{C_2H_4O} + O = \underset{\text{Acetic acid.}}{C_2H_4O_2}.$$

In the quick vinegar process considerable losses occurred at first from the evaporation of the very volatile aldehyde, which escaped conversion into acetic acid from a deficient supply of air. The conditions most favorable to the formation of acetic acid by fermentation are—(1) a sufficient dilution; the fluid should not contain more than 10 per cent. of alcohol, nor should it be much below 4 or 5 per cent.; (2) the presence of nitrogenous and saline bodies; (3) the presence of the *M. aceti* added from a previous operation; (4) a suitable temperature, not above 36° C. (96.8° F.), nor below 10° C. (50° F.); below 7° C. (44.6° F.) the formation of vinegar no longer takes place. Above 40° C. (104° F.) it takes place very rapidly, but there is a considerable loss of alcohol and acid by evaporation; (5) a plentiful supply of air, with an extended surface of liquid for its ready contact. The progress of the fermentation is indicated by the development of the fungus, a rise of temperature, an increase of the specific gravity, the disappearance of alcohol, and the sour taste of the acetic acid. The plant acts best when it simply spreads over the surface. If it becomes diffused through the liquid, its action proceeds too far, and the acetic acid is in turn oxidized and destroyed. This second fermentation or putrefaction is most liable to occur in vinegar made from malt or stale beer, and is attributed to the presence of large quantities of nitrogenous bodies. Vinegar-makers believed that this putrefaction could be prevented by an addition of sulphuric acid, and in England they were allowed by law to add $\frac{1}{1000}$ by weight. Although it is now known that this practice is unnecessary, it is still continued. In practice acetic acid is made chiefly from wood by distillation, but large quantities of vinegar are still made by acetous fermentation. The materials employed are wine, malt, sour beer, cider, sugar, molasses, and spirits. Dr. Stenhouse has shown that when sea-weeds are subjected to fermentation at 96° F. in the presence of lime, acetate of lime is found in large quantities, from which acetic acid can be readily extracted. (See Vinegar.)

III. *Lactous fermentation* occurs in milk which has been allowed to stand, the milk-sugar changing to lactic acid.

$$\underset{\text{Milk-sugar.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Lactic acid.}}{4HC_3H_5O_3}.$$

The milk is at the same time coagulated by the lactic acid formed, which neutralizes the alkali by which the caseine is held in solution. By the addition of carbonate of lime, oxide of zinc, etc. the lactous fermentation is not prevented,

but the lactic acid being neutralized as soon as it is formed, the coagulation of the milk is prevented. Glucose and cane sugar are also capable of undergoing lactous fermentation.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} = \underset{\text{Lactic acid}}{2HC_3H_5O_3}.$$

$$\underset{\text{Cane-sugar}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Lactic acid}}{4HC_3H_5O_3}.$$

Albuminous substances, which at an advanced stage of putrefaction act as alcoholic ferments, often induce lactous fermentation at a certain period of decomposition. The azotized matters of malt, when suffered to putrefy in water for a few days, induce lactous fermentation, while in a more advanced state of putrefaction they cause vinous fermentation. The gluten of wheat flour, which is the active agent in leaven, behaves in the same manner. When wheat flour is made into a paste with water, and left for four or five days in a warm place, it becomes a lactous ferment; if left a few days longer, it acts as an alcoholic ferment. This accounts for the uncertainty which attends the use of leaven for raising bread: when it acts as a vinous ferment the bread is light, porous, and spongy; when it causes lactous fermentation, the bread is heavy and sour. See BREAD. Cheese, glue, urine, and many other substances containing more or less nitrogenous matter, induce lactous fermentation under certain conditions. The same property is possessed by many animal membranes in a certain state of decomposition. The most active of these is the inner coat of the stomach of the sucking calf, called rennet. This is the agent employed to coagulate milk in the manufacture of cheese. The stomach, bladder, etc. of the dog possess the same property. Lactous fermentation occurs between 58° and 104° F.; a temperature of from 75° to 90° F. is probably the most favorable. Lactous fermentation is often accompanied by vinous fermentation, the product exhibiting the products of both, with an evolution of carbonic acid (CO_2). Butyrous fermentation often occurs at the same time, with an evolution of hydrogen and carbonic acid and the formation of butyric acid. Mannite, a product of mucous fermentation, is said to occur among the products of lactous fermentation, but it is not clear whether this is also a product of this fermentation or is an evidence of mucous fermentation.

According to Pasteur (*Ann. Chim. Phys.* [3], li. 298; lii. 404) lactous fermentation is caused by the common mould fungus (*Penicillium glaucum*) which develops in solutions containing milk-sugar, cane-sugar, or glucose, and the necessary nitrogenous matters and mineral salts, just as the vinous fermentation is caused by the yeast-fungus. Pasteur collected this plant as a gray sediment formed during lactous fermentation, and introduced it into a cooled filtered decoction of beer-yeast, with from 15 to 20 pints of water, together with chalk, and sugar equal to from $\frac{1}{20}$th to $\frac{1}{10}$th of the liquid. On keeping this mixture at from 86° to [illegible]° F. for some days, a brisk effervescence of carbonic acid and hydrogen took place, the chalk dissolved in the lactic acid formed, while the liquid became turbid and deposited a sediment. This sediment, a purer form of the fungus, produced lactous fermentation within an hour in a solution of sugar containing chalk. When air is excluded from solutions which otherwise undergo lactous fermentation, or is supplied through heated tubes, fermentation does not occur, because the germs of the *P. glaucum* do not gain admission. The lactous ferment resembles in mass ordinary beer-yeast. It is gray, somewhat glutinous, and appears under the microscope to consist of minute spherules [illegible]th to [illegible]th inch in diameter—some isolated, others in groups. It increases at first by the formation of new round cells, but afterwards by the formation of elongated and branched groups, which ultimately cover the surface like a white mould. A small quantity of lactous ferment is capable of decomposing a large quantity of sugar, provided the liquid is kept neutral by chalk, which forms calcium lactate; otherwise its action on the sugar is retarded by the presence of the free acid. If no other ferment is present, the lactous fermentation goes on regularly, and often more quickly than vinous fermentation. According to Blondeau (*J. Pharm.* [3], xii. 257), the liquid becomes viscous previous to lactous fermentation, in consequence of the development of the *P. glaucum*, whose ramifications fill the liquid.

The name *Oidium lactis* has been given to the fungus found in sour milk. Karsten, in his *Chemismus der Pflanzenzelle*, calls it milk-yeast (*Milchhefe*), and considers it a mere form of development of the beer and wine yeast. De Bary, in his *[illegible] Schimmel und Hefe*, asserts that the *O. lactis* is a distinct plant, not to be confounded with *P. glaucum*. Reess (*Botan. [illegible] Untersuchungen über die Alkoholgährungspilze*, p. 2[illegible]) and Mayer (*Lehrbuch der Gährungs-chemie*, p. 162) insist that the true lactous ferment is a minute *bacterium*, which the latter figures, and that the mould fungus, called *P. glaucum* and *O. lactis*, is merely an incidental growth. Bechamp claimed to have shown that the germs of the real ferment were contained in the chalk used in lactous fermentation. He called the fungi *Micro[illegible]*. His conclusions are disproved by the fact that oxide of zinc, chemically prepared, may be substituted for the chalk without modifying the character of the fermentation; and also by the experiment of O. Loew, of heating the chalk red hot previous to introducing it into the liquid. (*American Chemist*, i. 244.)

Lactous fermentation is conducted in the following manner for the production of lactic acid: To 2 gals. milk are added 6 lbs. raw sugar, 8 oz. putrid cheese, and 4 lbs. chalk. The mixture is placed in a loosely-covered jar, and maintained at a temperature of about 86° F. with occasional stirring. After two or three weeks the process is complete, and a semi-solid mass of calcium-lactate is the result, from which lactic acid is readily prepared. By substituting oxide of zinc for the chalk, zinc-lactate is obtained. A certain quantity of mannite is found at the same time. The spontaneously developed fermentation of saccharine juices is sometimes lactous, sometimes vinous, more frequently both together. Lactous fermentation is the process by which articles of food are so often spoiled when they are said to become sour; it is also the process by which the German *Sauerkraut* and *Sauerbrunn* are prepared.

IV. *Butyrous Fermentation* sets in when lactous fermentation is allowed to proceed beyond the point indicated by the formation of calcium-lactate. The calcium-lactate redissolves, carbonic acid and hydrogen are evolved, and calcium-butyrate is found in the solution.

$$\underset{\text{Lactic acid}}{2HC_3H_5O_3} = \underset{\text{Butyric acid}}{HC_4H_7O_2} + 2CO_2 + 2H_2.$$

A temperature of 100° F. or more seems to favor this fermentation. By adding to calcium lactate a certain quantity of cheese, and maintaining an elevated temperature, butyrous fermentation is induced, and the lactate is converted into calcium-butyrate, with some valerianate and acetate. (WILLIAMSON, *Chem. News*, xxii. 256.) Blondeau refers butyrous fermentation to *Penicillium glaucum*, but Pasteur (*Compt. rend.*, lii. 344; liv. 416) refers it to minute bacteria or vibrios. They appear as small cylindrical stems, rounded at the ends, usually straight, and occurring singly or in chains of two, three, or more, [illegible]th of an inch in thickness, a single stem varying from [illegible]th to [illegible]th of an inch in length. They increase by division, and may be sown and cultivated in a suitable medium like beer-yeast. Sugar or lactates, with ammonia salts and phosphates, constitute the necessary food of the plant. (*Bull. Soc. Chim.*, 1862, p. 52.) As soon as the lactate is all converted, the vibrios die. (*American Chemist*, ii. 371.)

V. *Mucous* or *Viscous Fermentation* occurs in solutions of cane-sugar under the influence of nitrogenous bodies, and in contact with the air, under circumstances not fully investigated. Carbonic acid gas and hydrogen are evolved, and the cane-sugar is converted into mannite, a peculiar gum, and a mucilaginous substance. The ferment is composed of spherules about $\frac{1}{20000}$th of an inch in diameter. When these are added to 100 parts of cane-sugar in water, with some albumen, 51.09 parts of mannite and 45.5 parts of gum are obtained, which corresponds to

$$\underset{\text{Cane-sugar}}{25C_{12}H_{22}O_{11}} + 13H_2O = \underset{\text{Mannite}}{24C_6H_{14}O_6} + \underset{\text{Gum}}{12C_{12}H_{20}O_{10}} + 12CO_2.$$

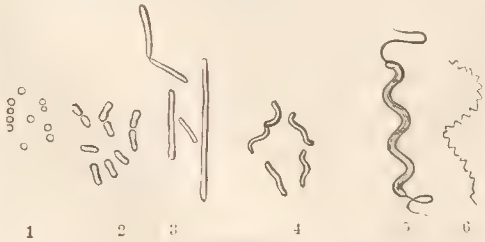
Although often accompanied by vinous and lactous fermentation, mucous fermentation may occur without the formation of either alcohol or acid. It occurs at temperatures ranging from 68° to 104° F. The juice of the sugar-cane, sugar-beet, mangold wurzel, carrot, dandelion, etc. are liable to undergo this form of fermentation spontaneously when exposed to the air. Effervescing lemonade made from sugar, citric acid, oil of lemon, and carbonic acid, loses its fluidity on long keeping from this kind of fermentation.

When yeast is washed with cold water, then boiled with water, and $\frac{1}{20}$th part of sugar added to the filtrate, the liquid undergoes fermentation for a week or two, evolving hydrogen, carbonic acid, and [illegible], and becoming turbid and tenacious like a [illegible]. Water boiled with gluten produces a similar change in solutions of cane-sugar. When the fermentation is completed, the liquid is still sweet, but is so thick that it runs out in threads when the vessel is inverted. The gum produced resembles gum arabic, [illegible] in water, makes a thicker mucilage, but yields scarcely any mucic acid when treated with nitric acid. (PASTEUR, *Bull. Soc. Chim.*, 1861, p. [illegible]; [illegible], *J. [illegible]*, xxx. [illegible]; PLANCHE, *J. Pharm.*, xxvi. [illegible]; KIRCHHOFF, [illegible] *Pharm.*, xxx. [illegible]; DESFOSSES, *J. Pharm.*, xv. 602; VAUQUELIN, *Ann. Chim. Phys.*, xx. [illegible].)

VI. *Putrefaction*, or putrefactive fermentation, is the

process by which azotized animal and vegetable substances undergo decomposition spontaneously, with the production of offensive gases. The essential conditions are the presence of moisture, a temperature between 32° and 140° F., and exposure to the air during or previous to the process. The process is very complicated, resulting in the formation of carbonic acid, sulphuretted hydrogen, phosphuretted hydrogen, marsh-gas, ammonia, nitrogen, hydrogen, acetic, lactic, butyric, and valerianic acids, and many offensive bodies which have not yet been identified. Resins, if present, are but little changed, and fats often resist all decomposition save saponification, remaining as free fatty acids for years. (See ADIPOCERE.) The process varies considerably with the quantity of water present and the extent to which air has access. Two theories have been advanced to account for putrefaction. Liebig claimed that "when the life-power or vital force has ceased to control the organic combinations, the nitrogen in the albuminous bodies, by its affinity for hydrogen, decomposes water, with the formation of ammonia." "The molecule set in motion by this affinity imparts its motion to other molecules with which it is in contact." Many investigators still hold that the true putrefactive ferment is an albuminoid substance not endowed with vitality. (PANUM in *Virchow's Archiv für path. Anat.*, 1874.) The theory generally accepted, however, is that of Schwann, Pasteur, and Cohn, which describes putrefaction as a chemical process induced by bacteria. The bacteria bear the same relation to putrefaction that the yeast-plants bear to alcoholic fermentation; the *Bacterium termo* (Fig. C, 2) being the most common species. If we expose a clear solution of any nitrogenous animal or vegetable matter, such as an infusion of hay, to the air at ordinary temperatures, it will soon become turbid, and exhibit the usual signs of decomposition, evolving offensive gases. The microscope shows the turbidity to be caused by innumerable bacteria, which move in every direction and multiply by division. After a time putrefaction ceases, the liquid becomes clear, and a sediment of bacteria is found to have separated. The smallest portion of this sediment will excite putrefaction in another albuminous liquid, just as yeast causes fermentation. Any process by which the access of bacteria germs to the albuminous solutions can be prevented is found to protect them from putrefaction. Dr. Burdon-Sanderson has shown (*13th Rep. Med. Officer of the Privy Council*) that contamination by germs of bacteria usually occurs from contact with water and moist surfaces, not directly from the air, while the germs of the mould-fungi enter directly from the atmosphere. Substances, protected from bacteria germs, mould, but do not putrefy. A piece of muscle, cut out of a recently killed animal with a knife which had just been heated, was hung under a bell-jar, and after 31 days, although overgrown with mould-fungi, *Penicillium*, etc., it showed no signs of bacteria or putrefaction. In the ordinary process of decay the putrefaction occasioned by bacteria is accompanied by the action of the mould-fungi, the organisms themselves being subsequently destroyed by similar agencies, other bacteria, and fungi, till nothing remains save brown humus (see HUMUS) and the mineral salts, the carbon, hydrogen, nitrogen, sulphur, and oxygen passing into the atmosphere or washed into the soil as carbonic acid, ammonia, water, etc.

FIG. C.



1 2 3 4 5 6

Bacteria.

Bacteria, Vibriones, Microzymas, Microzoaires, Mycoderma, etc. were first recognized by Leeuwenhoeck in 1684. O. F. Müller in the last century recognized and described the most important forms, and Ehrenberg in 1830 established for them the family of Vibrionidæ, which Dujardin in 1841 placed as the first and lowest form of Infusoria. They were first supposed to be animals—at least those which are endowed with motion—but all are now recognized as plants. Ferdinand Cohn first established their vegetable character and structural relations. (*Nova Acta Ac. Car. Leop. nat. cur.*, xxiv. 1, 1853.) He has since added much to our knowledge of their classification and general physiology. (*Beiträge zur Biologie der Pflanzen*, heft. ii. p. 127, 1872.) The bacteria consist of cells composed of cellulose or a body similar to it, containing protoplasmic matter, but no chlorophyll. They are spherical, oblong, cylindrical, curved or twisted, isolated or connected in chains. They are extremely minute, taxing the highest powers of the best immersion lenses. The *Bacterium termo* is $\frac{1}{500}$th mm., or $\frac{1}{12000}$th inch, in length, and $\frac{1}{1000}$th mm., or $\frac{1}{24000}$th inch, in diameter; 41,000,000,000 weigh one grain. They multiply by division or scission, neither buds nor spores having been detected. Cohn, believing that they divide once every hour, finds that one bacterium will by doubling every hour produce in 24 hours $16\frac{1}{3}$ millions bacteria; in 2 days, 281 billions; in 3 days, 47 trillions; and in a week a number expressed by 51 figures. Billroth has recently announced that the spores noticed by Cohn among the bacteria (*Dauersporen*) form micrococci (spherical bacteria) in their interior, which are set free by the bursting of the envelope, and multiply by scission or lengthen into rod bacteria. They are formed in the interior of bacteria, and sink to the bottom of the liquids. The bacteria are killed by an exposure to 140° F. for several hours, to 212° for 10 or 15 minutes, to 215 for 4 or 5 minutes. Near the freezing-point the movements stop, but are resumed again on warming to 40° or 45° F. Billroth finds that the spores described by him retain their vitality after freezing, boiling, and drying. He has some which were kept eight years without losing their power of producing bacteria. To kill them he employs a temperature of 392° F. Bacteria live upon albuminous ammonia or urea and carbonaceous matters, organic acids, sugar, etc., and require mineral salts. They absorb oxygen and exhale carbonic acid.

Cohn subdivided the bacteria into six genera, distributed among four families:

I. Family, Sphærobacteria (spherical bacteria).
 1. Genus, *Micrococcus* (Fig. C, 1).
II. Family, Microbacteria (short rods).
 2. Genus, *Bacterium proper* (Fig. C, 2).
III. Family, Desmobacteria (thread-like).
 3. Genus, *Bacillus* (Fig. C, 3).
 4. Genus, *Vibrio* (Fig. C, 4).
IV. Family, Spirobacteria (corkscrew-like).
 5. Genus, *Spirillum* (short, stiff screws, Fig. C, 5).
 6. Genus, *Spirochæte* (flexible spirals, Fig. C, 6).

(For a description of the species see *Beit. z. Biol. d. Pflanzen*, ii. p. 146.)

Recent investigations have shown that bacteria may be developed in the interior of living animals, that they exist in the body during various diseases, and that healthy animals may be inoculated with the virus. This has led to the germ-theory of disease (see GERM-THEORY), now accepted by many of the most prominent investigators. This theory assumes that such diseases as smallpox, diphtheria, malignant pustule, septicæmia, cholera, typhus and typhoid fever, etc., are caused by bacteria, and that they belong to the same class of processes as fermentation and putrefaction. The discovery that the potato-rot is caused by a fungoid plant, the muscardine of silkworms by a mould-fungus, and the pébrine of the same animal by a minute plant, and the study of the trichinæ and of several skin diseases caused by mould-fungi, have furnished a very solid foundation for this theory. As the *Micrococci*, the smallest of the bacteria, are concerned in these diseases, the difficulty of actually determining their relation to the disease is most serious, and renders direct proof very inaccessible.

VII. *Saccharous Fermentation* is the process by which starch is changed to dextrine and glucose. This change is effected by the diastase of germinating barley and other seeds, saliva, blood-serum, pancreatic juice, etc. The starch first changes to dextrine and glucose, the former in turn changing to glucose.

$$\underset{\text{Starch.}}{2C_6H_{10}O_5} + \underset{\text{Water}}{H_2O} = \underset{\text{Dextrin}}{C_6H_{10}O_5} + \underset{\text{Glucose.}}{C_6H_{12}O_6}.$$

$$\underset{\text{Dextrine}}{C_6H_{10}O_5} + \underset{\text{Water}}{H_2O} = \underset{\text{Glucose.}}{C_6H_{12}O_6}.$$

This is one of the most important processes of nature; by it the store of starch laid up in seeds, tubers, bulbs, and in the bark of some trees, is made available for assimilation and conversion into vegetable tissue. No observations have shown it to be connected in any way with living organisms corresponding to yeast. (See DIASTASE, GLUCOSE, DEXTRINE, BEER, GERMINATION, etc.)

VIII. *Glucosic Fermentation* takes place when cane-sugar is subjected to vinous fermentation.

$$\underset{\text{Cane sugar}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Lævoglucose.}}{C_6H_{12}O_6} + \underset{\text{Dextroglucose.}}{C_6H_{12}O_6}.$$

Although acids produce a similar change, it is produced by yeast, or a watery solution from yeast, in the presence of carbonate of soda. Berthollet attributes it to a nitrogenous ferment analogous to diastase or pancreatin. Béchamp (*Comp. rend.*, lviii. 601, 723; lix. 496) finds a soluble ferment in the mould of sugar solutions, which he calls *zymase*, which converts cane-sugar into glucose. (See SUGAR.)

IX. *Pectous Fermentation.*—Many unripe fruits and fleshy roots contain an insoluble substance called *pectose*, which is converted by a ferment called *pectase* into the soluble gelatinous bodies pectin, parapectin, pectic acid, and metapectic acid. (See PECTIN.)

X. *Gallous Fermentation* (*Tannic Fermentation*).—When powdered nut-galls are exposed to moisture, the tannic acid they contain is changed to gallic acid, with the formation of sugar; hence tannic acid has been classed with the glucosides. (See GLUCOSIDES.)

$$\underset{\text{Tannic acid}}{C_{27}H_{22}O_{17}} + 4H_2O = \underset{\text{Gallic acid}}{3C_7H_6O_5} + \underset{\text{Glucose}}{C_6H_{12}O_6}.$$

(STAS, *Ann. Ch. Pharm.*, xxx. 209; STRECKER, *ibid.*, xc. 328.) This change is said by Van Tieghem (*Compt. rend.*, lxv. 1091) to be due to the growth of the two common mould fungi *Penicillium glaucum* and *Aspergillus niger*. (See TANNIC ACID.)

XI. *Amygdalous Fermentation* results from the action of the emulsin of bitter almonds upon the amygdalin, by which hydride of benzoyl, hydrocyanic acid, and glucose are produced. (See ALMONDS, OIL OF.)

XII. *Sinapous Fermentation*, the formation of the volatile oil of mustard by the action of myrosin on myronic acid. (See MUSTARD, OIL OF.)

XIII. *Ureous Fermentation* occurs when urine becomes putrid. The urea is changed to carbonate of ammonia by the influence of the mucus and other nitrogenous bodies present.

$$\underset{\text{Urea.}}{CH_4N_2O} + 2H_2O = \underset{\text{Carbonate of ammonium.}}{(NH_4)_2CO_3}.$$

In the presence of yeast the change takes place very rapidly. (C. SCHMIDT, *Ann. Ch. Pharm.*, lxi. 168.) This action has been referred to bacteria. (PASTEUR, *Ann. Chim. Phys.*, 1862, lxiv; VAN TIEGHEM, *Compt. rend.*, lviii. 210, 1864.)

XIV. *Peptous Fermentation* is a name given to the action of pepsin of the gastric juice on the albuminoids of the food. The exact nature of the process is not known. (See PEPSIN.)

XV. *Prevention of Fermentation and Putrefaction.*—As moisture and the development of vegetable germs are necessary to induce these processes, they may be prevented by (1) drying thoroughly; (2) cooling to prevent the development of the germs; (3) sealing hermetically in jars or tin cans, and subjecting to a temperature sufficient to destroy the vitality of all the germs present; (4) employing antiseptic substances, such as alcohol, common salt, saltpetre, sugar syrup, tannic acid, creosote, smoke, phenol, [illegible] acid, salts of iron, zinc, lead, mercury, and copper, borax, sulphurous acid, sulphites, etc. (See PRESERVATION OF FOOD, PRESERVATION OF TIMBER, and EMBALMING.)

For further information on fermentation, etc. consult, in addition to the works already mentioned, *The Germ Theory of Disease*, by PRES. F. A. P. BARNARD, *Am. Chemist*, v. 1; *The Origin and Propagation of Disease*, by DR. J. C. DALTON, *Am. Chemist*, iv. [illegible]; *Spontaneous Generation*, by DR. J. C. DALTON, *New York Med. J.*, Feb., 1872; *Four Lectures on Fermentation*, by A. W. WILLIAMSON, *Chem. News*, xxv. 231, xxvii. 9; Paper, by DR. J. WYMAN, *Am. J. Sci.*, [illegible] Sept., 1867; *Inaug. Address*, by T. H. HUXLEY, *Chem. News*, xxii. 133; *A Lecture on Yeast*, by T. H. HUXLEY, *Pop. Sci. Monthly*, 1872, i. p. [illegible]; Paper, by BURDON SANDERSON, *12th Rep. Med. Officer Privy Council*; *The Antiseptic System*, by A. E. SANSOM; *The Germ-Theory of Fermentation*, by A. E. SANSOM, *Chem. News*, xxii. 241, 2[illegible]; *Disease Germs*, by L. S. BEALE; *The Beginnings of Life*, by H. C. BASTIAN; *Mémoire sur la fermentation alcoolique*, by PASTEUR, *Ann. Chim. Phys.*, lviii. 1860, 323; *Animalcules infusoires vivant sans oxygène libre et déterminant des fermentations*, by PASTEUR, *Compt. rend.*, 1861; *Mémoire sur les corpuscules organisés qui existent dans l'atmosphère*, by PASTEUR, *Ann. Chim. Phys.*, 1862, p. [illegible]; *Les ferments alcooliques*, by L. ENGEL, Paris, 1872; Paper on Yeast, by L. ENGEL, *Compt. rend.*, 1871, 168; *Fermentation*, *[illegible]*, by KOPP, *Geschichte der Chem.*, iv. [illegible]; *Lehrbuch der Gährungschemie*, by A. MAYER, Heidelberg, 1874; *Die pflanzlichen Parasiten*, by DR. F. A. ZÜRN, Weimar, 1874; *[illegible] Fermente*, by G. HÜFNER, *J. f. pr. Ch.*, 1872, N. S. [illegible] 1 9; *Die Gährung*, by WEISBERG, *[illegible]*, Nov., 1870; SCHWANN, *Pogg. Ann.*, xli. 184; HELMHOLTZ, *J. f. pr. Ch.*, xxxi. 429; LIEBIG, *Handw. d. Chem.*, iii. 217. C. F. CHANDLER.

Fermented Liquors. See BEER and WINE, by C. F. CHANDLER, PH. D., M. D., LL.D.

Fermeuse, one of the oldest towns of Newfoundland, in Ferryland district, 51 miles by land S. of St. John's, has a good harbor and cod and salmon fisheries, and a Roman Catholic church. It is 7 miles from Ferryland. Pop. [illegible].

Fer'mo, town of Central Italy, province of Ascoli, 30 miles S. E. of Ancona and 4 miles from the Adriatic. It is fortified, is the see of an archbishop, and has some trade. Pop. 8011.

Fermoy', town of the province of Munster, Ireland, in the county of Cork, on the right bank of the Blackwater, over which a splendid bridge of thirteen arches was built in 1689; is the seat of St. Colman's College (Roman Catholic). Pop. [illegible].

Fer'mont, small v. of Champlain co., Quebec, Canada, 14 miles N. of Three Rivers, is important only for its iron mines and forges, producing excellent pig iron and castings. Pop. about 150.

Fern (FANNY). See PARTON.

Fernan'dez de Ta'os, post-v., county-seat of Taos co., N. M.

Fernandi'na, city and port of entry of Nassau co., Fla., on the W. side of Amelia Island, between Nassau and Prince William sounds, and separated from the mainland by a channel called Amelia River, which affords a deep, safe, and spacious anchorage. The harbor-entrance is marked by a lighthouse; lat. [illegible] 30° 2[illegible]′ N., lon. 81° 26′ 20″ W. Vessels drawing 20 feet can enter at high tide. The manufacture and export of lumber and the foreign and coastwise trade in cotton and naval stores are important. The Florida R. R. extends from this point 154 miles to Cedar Keys. Fernandina is the seat of the Protestant Episcopal bishop of Florida, has a ladies' seminary, ten churches, a weekly newspaper, three hotels, cotton-ginning works, and manufactures of cotton-seed oil. The entrance is protected by Fort Clinch, a strong defensive work. Pop. 1722. FRED. W. HOYT, ED. "FERNANDINA OBSERVER."

Fernan'do de Noron'ha, a small but mountainous, woody, and rugged island in the S. Atlantic Ocean, 125 miles from the E. extremity of Brazil, to which the island belongs, and which uses it as a place of banishment. It has several harbors defended by forts. It is surrounded by smaller islets. Lat. 3° 53′ S., lon. 32° 25′ W.

Fernando Po, an island, 44 miles long and 20 miles broad, on the W. coast of Africa, in the Bight of Biafra, 20 miles from the nearest point of the shore, between lat. 3° 12′ and 3° 47′ N., and lon. 8° 26′ and 8° 57′ E. It is a beautiful island, traversed by a lofty range of mountains terminating in a magnificent cone (Clarence Peak) 10,650 feet high. A most luxuriant vegetation, sugar-canes and yams, and dense forests of palms, *Bombax*, etc., cover the island, but the climate is so hot, and, along the coast, so unhealthy, that all attempts made by the English and Spaniards at forming settlements on the island hitherto have been in vain. The native inhabitants, whose number is estimated at from 4000 to 20,000, consist of two tribes, so different from each other that members of one tribe cannot even understand those of the other. And, still more singular, both these tribes are entirely different from the inhabitants of Guinea, from whom they are distinguished by the athletic but perfectly proportionate shape of their limbs, the light yellow color and beautiful angle of their faces. They are pagans, but slavery is unknown.

Fer'nan Nu'ñez, town of the province of Cordova, Spain. It has woollen and linen manufactures. Pop. [illegible].

Ferney, a small town of France, in the department of Ain, with only 1100 inhabitants, but famous as the residence of Voltaire during the last twenty years of his life. Ferney was a miserable hamlet when Voltaire arrived; it was a prosperous town when he left. The château in which he lived has undergone many alterations since his death, yet it retains many relics of him, and is annually visited by many thousand tourists.

Ferns (Lat. *Filices*; Fr. *Fougères*; Ger. *Farnkräuter*) is the name of a large family of flowerless plants, [illegible] the largest natural order of the class [illegible] of this class being Equisetaceæ, Lycopodiaceæ, Marsiliaceæ, Salviniaceæ, and Isoeteæ. Ferns are characterized by having a woody root-stock, which is [illegible] afterwards erect, and even developed into an arboreous trunk, and bears along the sides or at the end green leaves (*fronds*), which are either simple and entire, or variously lobed or decompound, often [illegible] feathery patterns. These leaves [illegible] the back, but sometimes [illegible] collections of capsules [illegible] properly [illegible] which is commonly [illegible] dual. In the [illegible] analogous to the [illegible] flowering plant, nor [illegible] to the fertilization of the pistil [illegible] but when the spore germinates it produces [illegible] which bears on its lower surface [illegible] the latter containing [illegible] which, when fertilized by the

ciliated threads of the former, develops in the manner of a bud into a proper frond-bearing fern. A prominent characteristic of ferns, which fails only in the doubtful suborder Ophioglosseæ, is that the fronds are coiled up spirally in the bud, and when half-grown bear a very beautiful resemblance to a crosier, the tip of the frond being at the centre of the coil, and of course the last to straighten. In respect to size, ferns vary from the smallest *Hymenophyllum*, consisting of a few little leaves not half an inch long, growing from a thread-like, creeping stem, up to the gigantic tree-ferns of the tropics, which have an erect trunk sometimes 50 or 60 feet high, bearing at the top a magnificent crown of feather-branched fronds, often 8 to 10, or even 15 to 20, feet long, and gracefully curving outward on every side. The whole number of known ferns cannot be exactly stated, owing to the very different views of specific distinctions taken by the various writers. A most moderate estimate, however, places the number of well-known species at 2500, and with a fair allowance for little-known and undiscovered species all the ferns of the world probably do not exceed 3000 species. With regard to their geographical distribution, it should first be noticed that in regions of extreme cold ferns are scanty in number and small in size; in the warmer temperate regions they are larger and more numerous; and in the torrid zone, especially in its more humid districts, they become very abundant and reach their grandest proportions. Europe and temperate North America are much less abundant in ferns than the temperate parts of Asia, there being in the U. S. and British America only about 128 ferns, in Europe 67, and in temperate Asia 415. In the arctic regions the species of ferns are 26, and, according to Mr. J. G. Baker of Kew, the entire fern-flora of the N. temperate zone consists of 514 species, of which only 34 are common to all three continents. The same author assigns to the S. temperate zone 423 species, and to the torrid zone 1901 species, of which 946 are American, 863 Asiatic and Polynesian, the remainder being natives of Africa and the African islands, the greater proportion being insular rather than continental.

The warm and moist forests and mountain-sides of equatorial America are the richest fern-region of the world, and this richness extends in a less marked degree to the neighboring regions of Mexico, the West Indies, Southern Brazil, and Chili. The S. temperate zone affords, again, a diminished number of species, 423 in all, while beyond the Antarctic Circle no fern has been discovered.

Many systems of classification for the ferns have been proposed, the earliest ones being based principally upon the shape of the frond. Such was the system—if it may be called a system—in which Plumier in 1705 arranged the ferns of the Antilles. Linnæus recognized 12 genera, based on the position and grouping of the sporangia, and in 1790 Sir James Edward Smith published an essay in the memoirs of the Turin Academy in which he increased the number to 22. Bernhardi added several genera in 1800, and about the same time Swartz, in *Schrader's Journal*, reduced the known ferns to order and arranged them in 30 genera, all but two of which are still held to be good genera. In 1806 the same botanist published his *Synopsis Filicum*, and now arranged the genera, by this time 38, in three tribes, the first tribe, "Gyratæ," being the ferns in which the sporangium is provided with an articulate elastic ring, which at length straightens and breaks open the sporangium, thus liberating the spores; the second tribe, "Spuriæ Gyratæ," comprised the ferns with a rudimentary ring; and the third, "Agyratæ," those with no vestige of ring. In this work 609 species are recognized, and many others, of various authors, are referred to as dubious and not understood. Swartz's work remained for many years the standard treatise on ferns, and though many species and a few genera were from time to time proposed or established, it was not until 1836 that a serious attempt was made to establish an entirely new system. In that year Presl, of the University of Prague, published his *Tentamen*, in which he took the ground that differences in the arrangement of the veins of the frond should be considered of generic importance. Accordingly, he adopted or proposed 112 genera. Mr. John Smith, curator of the Kew Gardens, arrived independently at much the same views, and published them in Hooker's *Journal of Botany* in 1841. Dr. Fée of Strasburg not only followed out the same theory, but took characters also from the number of articulations in the rings of the sporangium and from the form of the spores, and in his various writings has admitted no less than 212 genera. Later writers have rejected as untenable many of these genera, and in two of the more recent systems of fern-genera, that of the late Dr. Mettenius of Leipsic and of the celebrated Sir W. J. Hooker of Kew, the admitted genera are, respectively, 68 and 75. From the studies of these and other systematists there now seem to be satisfactorily established eight well-marked tribes, mainly distinguished by the nature of the sporangium and of the elastic ring in the tribes where that exists. These tribes, with their essential characters and the names of their principal genera, are given below:

TRIBE I.—POLYPODIACEÆ.—Sporangia pedicelled, the pedicel running into a vertical, narrow, incomplete many-jointed ring. Seldom tree-ferns; fronds simple, or variously lobed or decompound. This tribe, by far the largest of all, is divided into about ten groups of genera.

Principal Genera.—1, Acrostichum, Platycerium; 2, Polypodium; 3, Monogramma, Vittaria, Tænitis, Antrophyum; 4, Selliguæa, Hemionitis, Gymnogramme, Meniscium, Brainea, Notholæna; 5, Pellæa, Adiantum, Cheilanthes, Pteris, Ceratopteris; 6, Blechnum, Lomaria, Sadleria, Woodwardia; 7, Scolopendrium, Asplenium; 8, Hypolepis, Phegopteris, Aspidium, Oleandra, Nephrolepis, Onoclea, Cystopteris, Woodsia; 9, Lindsæa, Davallia, Dennstædtia; 10, Sphæropteris, Deparia, Dicksonia, Cibotium, Thyrsopteris.

TRIBE II.—CYATHEACEÆ.—Elastic ring completely encircling the sporangium, and usually oblique, not connected with the pedicel. Mainly tree-ferns.

Genera.—Alsophila, Hemitelia, Cyathea, Matonia.

TRIBE III.—HYMENOPHYLLEÆ.—Elastic ring complete, oblique or horizontal. Sporangia sub-globose, sessile on a bristle-like receptacle. Small ferns of a very delicate texture.

Genera.—Hymenophyllum, Trichomanes (Loxsoma?).

TRIBE IV.—GLEICHENIEÆ.—Sporangia large, solitary or few together, globose; elastic ring broad, transverse to the sporangium's point of attachment. Fronds rigid, usually forking and with axillary buds.

Genera.—Platyzoma, Gleichenia.

TRIBE V.—SCHIZÆACEÆ.—Sporangia ovate or sub-globose, sessile, the ring forming a radiated cap at the end opposite the point of attachment.

Genera.—Schizæa, Aneimia, Lygodium, Mohria.

TRIBE VI.—OSMUNDEÆ.—Sporangia globose, short pedicelled, reticulated, the ring reduced to a few cells forming a short band opposite and transverse to the line by which the sporangium opens into two nearly equal valves.

Genera.—Osmunda, Todea.

TRIBE VII.—MARATTIEÆ.—Sporangia without any ring, arranged in a circle or in a double row, or combined in a many-celled compound sporangium, each cell or sporangium opening by a longitudinal cleft. Root-stock often fleshy or tuberous.

Genera.—Kaulfussia, Angiopteris, Marattia, Danæa.

TRIBE VIII.—OPHIOGLOSSEÆ.—Sporangia large, coriaceous, globose, without ring, opening into two equal valves, disposed in spikes or panicles, or else grouped in clusters alternately on both sides of an elongated axis. Fronds erect in the bud, never rolled into a crosier, as in all other ferns.

Genera.—Ophioglossum, Botrychium, Helminthostachys.

It should be observed that the genera *Ceratopteris* and *Loxsoma*, each of a single species, are made the types of separate tribes by many authors, and that the Ophioglosseæ differ so much from all other ferns that they ought perhaps to be considered a separate natural order, having nearly as close a relationship to lycopods as to ferns proper.

The economical uses of ferns are few. The Hawaiian species of *Cibotium* have the young fronds enveloped in a fine and dense woolly covering, which is gathered by the natives, and under the name of *pulu* is extensively used to stuff pillows and cushions, and for some years past has been exported to America and other countries in great quantities. In New Zealand the root-stocks of *Pteris aquilina* are used for food after a process of washing, scraping, macerating, and baking, and the experiment of preparing and eating it has been tried in England with fair success. The ashes of the same species, the common brake, are made into balls and used for making lye by the English peasantry. The root-stocks of *Aspidium filix-mas* have long been used in medicine as an anthelmintic, and *Aspidium athamanticum* in Southern Africa is there used in the same way. The moonwort (*Botrychium lunaria*) was formerly supposed to have wonderful powers in healing and in magical craft, and the belief that the fortunate possessor of fern-seed could walk invisible was anciently common, and is referred to in the play of *King Henry IV.*

Ferns of some sort existed as long ago as in the later Devonian age, and became very abundant in the Carboniferous, from which time they have continued, though in diminished numbers, to the present day. As the fructification is rarely preserved in fossil ferns, very little besides the shape and size of the frond, and the venation, exists on which to base genera, and so the common genera of most fossil ferns, *Pecopteris*, *Sphenopteris*, *Neuropteris*, etc., are purely arbitrary. But specimens with the fruit do oc-

casionally occur, and some very good genera have been described closely related to those now existing. Thus, *Sphenopteris* and *Anomopteris* are considered to have been related to *Marattia*, and *Senftenbergia* was not far from *Aneimia*; and even some existing genera have been pretty fairly identified among ancient ferns. For the later geological ages this is quite probable, but the greater part of the ferns of the Devonian and Carboniferous were most likely utterly unlike those we now see.

(For a good general essay on ferns the reader is referred to BERKELEY'S *Introduction to Cryptogamic Botany*, and for the study of genera and species to the various writings of HOOKER, METTENIUS, FÉE, BAKER, etc.)

DANIEL C. EATON.

Fero'nia, an Italian goddess concerning whose cultus and myth little is known. She has been variously regarded by commentators as goddess of the earth, of the inferior world, of commerce, and of liberty. She appears to have been especially honored among the Sabines; and the chief seat of her worship was the town of Feronia, at the foot of Mount Soracte.

Fe'rox (URSEIUS), a Roman jurist, the author of legal works now known only through the citations in other writers. He probably lived in the latter part of the first century.

Ferozepoor, or **Ferozapore,** town in the district of Sirhind, British India, on the E. bank of the Sutlej. The extensive ruins surrounding the town indicate that at one time it must have been a place of great importance, but in 1835, when it came into the possession of the English, it was utterly poor and insignificant. It is now rising once more, and aspiring to the rank of a great commercial centre. Pop. about 10,000.

Feroze Shah, Canal of, a great canal of India, serving chiefly for irrigation, was begun in 1356 by Feroze Shah, king of Delhi, but was not finished until some 250 years later. It flows from the W. side of the Jumna more than 100 miles above Delhi, and with its branches is 240 miles long. It rejoins the Jumna at Delhi. The British authorities have cleaned the canal out during the present century, and also constructed a similar canal on the E. side, running from Fyzabad (a little below the origin of the old canal) to Delhi. These canals are of importance to the agriculture of that region. (See FYROUZ SHAH.)

Ferrandi'na, town in the province of Basilicata, in the S. of Italy, on the right bank of the Basento. It produces excellent wine. Pop. 6420.

Ferra'ra, province of Italy, bounded N. by the main branch of the Po, E. by the Adriatic, S. and W. by the provinces of Ravenna, Bologna, and Modena. It has an area of 1111 square miles and a population of 209,767. The ground is low, in many parts below the level of the Po, marshy, and, on account of the vast swamps, unhealthy, but the soil is rich, and produces, besides extensive pastures, grain, flax, and hemp. In the Middle Ages it formed a dukedom belonging to the House of Este. In 1598, Clement VIII. united it to the Papal States. In 1860 it became a part of the kingdom of Italy.

Ferrara, old and celebrated city of Northern Italy, capital of the province of the same name. While this province belonged to the House of Este, Ferrara was the ducal residence and a city of great splendor and importance. It was a commercial centre in Northern Italy; it developed a school of art of its own; Tasso, Ariosto, and Guarino lived here. Under the papal rule it went into decay, and it has now a deserted and melancholy appearance. Still, many of its monuments—as the cathedral, the ducal palace, etc., with their collections of pictures—are of great interest, and several branches of manufacture and trade are carried on with success. It is an archbishop's see. Pop. 72,447.

Ferrara, Council of, was convened by Pope Eugenius IV. in opposition to the Council of Bâle, in 1438. It was soon joined by the Byzantine emperor, John Palæologus, with 700 followers, including the patriarchs of the Greek Church, the emperor hoping, by obtaining a union of the Eastern and Latin churches, to gain the aid of the West against the Turks. The council discussed principally the points of difference between the Eastern and Western churches. In 1439, the plague prevailing at Ferrara, the council was transferred to Florence. (See FLORENCE, COUNCIL OF.)

Ferra'ri (GAUDENZIO), an Italian painter, b. at Valduggia 1484, d. in 1550. Studied in Rome under Raffaelle, whom he assisted in some of his works. His style of painting was impressive and grand. He studied the highest models, and entered into competition with the highest eminences—with no less a master than Titian. His best works are in Milan.

O. B. FROTHINGHAM.

Fer'ret, the *Putorius furo*, a carnivorous mammal of the weasel family, so closely allied to the European polecat (*Putorius fœtidus*) that many regard it as merely a delicate albino variety of the latter. It breeds freely with the polecat, has red eyes, a white or yellowish fur, and is so tender that the winters of England are too severe for it unless well housed. It is half domesticated in Europe, but is probably of African origin. It is much employed in hunting rabbits and rats, but often has to be muzzled, otherwise it will suck its victim's blood and leave the body in the burrow. It is fierce and treacherous, sometimes severely biting the hand of its master.

Fer'ric Ox'ide, called also **Sesquioxide** (or **Peroxide**) **of Iron** (Fe_2O_3), a feebly basic oxide of iron, found abundantly in nature as the principal constituent of the valuable ores known as hæmatite. It also abounds in the ochres and in most of the so-called mineral paints. It forms astringent salts with strong acids. With some bases, such as potash and barium, it gives rise to salts called ferrates. Magnetic iron ore (Fe_3O_4) is sometimes called a ferrate of iron, but it is generally held that the ferrates are compounds of FeO_3—an oxide which has not yet been isolated.

Ferricy'anides, a class of chemical compounds formed by the action of oxidizing agents upon ferrocyanides, from which an atom of the metal is extracted. For example, the potassium ferrocyanide (yellow prussiate of potash, $K_4Fe''Cy_6$) is changed by the action of chlorine into potassium ferricyanide (red prussiate of potash, $K_3Fe'''Cy_6$, or $6KCy.F'''_2Cy_6$). The most important of these salts are the potassio-ferrous ferricyanide (soluble prussian blue) and Turnbull's blue (ferrous ferricyanide). Potassium ferricyanide is a delicate test for ferrous salts, and is invaluable in the laboratory. The ferricyanides may be regarded as compounds of ferric cyanide (Fe_2Cy_6) with some other cyanide.

Fer'rier (JAMES FREDERICK), a Scottish moral philosopher, b. in Edinburgh 1808, and son-in-law of Prof. John Wilson, became professor of history at Edinburgh University in 1842, and of moral philosophy and political economy at St. Andrew's in 1845. *Institutes of Metaphysic, the Theory of Knowing and Being*, was his chief work, though he edited the *Works* of his father-in-law in 12 vols. Ferrier d. at St. Andrew's June 11, 1864.

Fer'ries, Law Concerning. A ferry, according to the legal definition of the term, is a franchise or privilege created by governmental grant or by prescription, which authorizes the transportation of passengers and goods across streams and other bodies of water, giving a right to demand compensation by way of toll in return. In England the grant is by the king's license—in the U. S., by statutory enactments in the several States. The right may, however, be derived from the supreme power indirectly through authority delegated to courts, commissioners, or municipalities to create such franchises. Without a grant, no one, not even the owner of both sides of a stream, is authorized in maintaining a public ferry. The conferring of the privilege constitutes a contract between the state and the individual or corporation, and the ferry thus becomes a species of property, and reciprocal duties are imposed upon the contracting parties. If the ferry-proprietor abuse his franchise or fail to provide and maintain suitable accommodations for the public, government may withdraw the grant. On the other hand, he must, if guilty of no default, be protected in his property, and if it be taken from him in the exercise of the public right of eminent domain, suitable compensation must be made. Thus, ferry-premises may be taken for the construction of a bridge, but only on condition that remuneration be given. As, however, ferries are principally established for the benefit of the public, they may be controlled by the legislature, and their value may be diminished or entirely destroyed by the lawful creation of new ferries in their immediate proximity. As this would be but a legitimate exercise of governmental prerogative, no right to demand compensation would exist. If, however, the grant was plainly of an exclusive right, the legislature could not properly establish another ferry which would interfere with the existing one, as such a course would trench upon that provision of the U. S. Constitution which forbids the impairment of the obligation of contracts. If an unauthorized ferry should be established in the neighborhood of a former one, so as materially to diminish public travel by it, this would constitute a nuisance, on account of which an injunction might be sought in equity or a civil action for damages be maintained. (See FRANCHISE.)

Ferry-proprietors are common carriers, invested with the same rights and subject to the same duties as other carriers. They must afford accommodation to the entire public, must exercise the same high degree of care as is

obligatory upon all who engage in the business of transportation, and are responsible for damage to property entrusted to them unless it be attributable to the act of God or the public enemy. This responsibility may be modified, or, according to some authorities, in the absence of fraud or misfeasance, entirely cast off, by lawful agreement with the owner, and in some instances by notice. (See CARRIERS.) Safe means of access to the ferry-boats must be provided, and every reasonable precaution taken to prevent injury. The responsibility of ferrymen commences when passengers or teams are upon the drops or slips of the flat which affords a way of access to the boats. Even though property be under the care of an owner or driver during the transit, the ferry company will be liable for any injury which it sustains, unless the owner himself occasion the disaster by his own wrongful act or default.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fer'ris, post-tp. of Montcalm co., Mich. Pop. 494.

Ferris (ISAAC), D. D., LL.D., was b. in New York Oct. 9, 1798; graduated at Columbia College in 1816, having served for a time during his college course in a military company during the war of 1812; taught in the Albany Academy for one year; studied theology under Dr. J. M. Mason two years, and in the Rutgers Seminary at New Brunswick, N. J., one year; was licensed to preach in 1820; held Reformed Dutch pastorates at New Brunswick, N. J., 1821–24; at Albany, N. Y., 1824–36; in the Market Street church, New York, 1836–53; was commissioner to Holland on behalf of American missionaries in the Netherlands India in 1842; chancellor of the University of New York City 1852–70. Found the university in a depressed state, and largely by his own personal efforts brought it to a condition of prosperity. He was professor of moral science and Christian evidences 1853–70, and acting professor of constitutional and international law 1855–69. Was also prominent in Sunday-school and mission work. Previous to his chancellorship he was for a time principal of the Rutgers Institute for young women. Was author of *Home Made Happy*, *Characteristics of the Reformed Dutch Church*, *Memorial of the First Fifty Years of the American Bible Society*, *Memorial of Dr. Bethune*, etc. D. at Roselle, N. J., June 16, 1873.

Fer'risburg, post-tp. of Addison co., Vt., 3 miles N. of Vergennes, on the Rutland and Burlington R. R. and on the E. side of Lake Champlain. It has manufactures of leather and woollen goods. Pop. 1768.

Fer'ro, the smallest and least fertile of the Canary Islands, situated in lat. 27° 45′ N. and lon. 18° 7′ W., with an area of 100 square miles and a pop. of 4337. As it is the most westerly isle of the archipelago, it was by ancient geographers considered the most westerly point of the world, and they drew through it the first meridian. German geographers still adhere to this manner of reckoning longitudes, while the English have adopted the meridian of Greenwich as the first meridian, but the meridian of Ferro is the conventional line between the hemispheres.

Ferrocy'anides, a class of chemical compounds formed by uniting ferrous cyanide with some other cyanide. Thus, ferrous cyanide ($FeCy_2$), added to four equivalents of potassium cyanide (KCy), gives $K_4Fe''Cy_6 = 4KCy.Fe''Cy_2$ = the ferrocyanide of potassium (yellow prussiate of potash), an extremely valuable chemical reagent; useful also in pharmacy, and especially in dyeing and calico-printing. Refuse animal matters, iron-filings, and commercial potash are melted together, and the mass is poured into hot water, filtered, evaporated, and repeatedly crystallized, yielding a very pure salt; but several other processes have been invented. Ferric ferrocyanide is commercial prussian blue.

Fer'rol, strongly fortified seaport and the chief naval arsenal of Spain, in the province of Galicia. Its harbor, surrounded by splendid dockyards where fifteen ships-of-the-line can be built at a time, is formed by an inlet of the Bay of Betanzos, so narrow as to admit only one ship-of-the-line at a time, and defended by the castles of San Felipe and Palma. Pop. 17,404.

Fer'rotype, a photograph taken on japanned sheet iron by a collodion process. (See PHOTOGRAPH.)

Fer'ry, post-tp. of Oceana co., Mich. Pop. 366.

Ferry (JULES), French advocate, journalist, and politician, b. at Saint Dié, in the Vosges, Apr. 5, 1832, joined the Paris bar in 1851, and became connected with the *Gazette des Tribunaux*. In 1865 he contributed to the *Temps*, obtaining notoriety in 1868 by his attacks on Baron Hausmann's administration of the city of Paris. In 1869 he was returned to the Corps-Législatif by the sixth circonscription of Paris, and in Sept., 1870, became a member of the government of the National Defence.

Ferry (ORRIS SANFORD), U. S. Senator, b. in Bethel, Conn., Aug. 15, 1823, graduated at Yale College in 1844, and was admitted to the bar in 1846. In 1847 was lieutenant-colonel of the first division of Connecticut militia; in 1849 judge of probate for the district of Norwalk, Conn.; State senator in 1855 and 1856; in 1856–59 State attorney for the county of Fairfield; in 1859 was chosen representative to Congress from Connecticut. Served as colonel and brigadier-general in the U. S. volunteers in the war of 1860–65, and was then chosen U. S. Senator from Connecticut for 1867–73. In 1872 he was re-elected to the same office for a second term. D. at Norwalk, Conn., Nov. 21, 1875.

Ferry (PAUL), a French Protestant divine, noted in ecclesiastical history for his irenic proclivities, was b. at Metz Feb. 24, 1591. His parents were related to the first of the Huguenot families; his mother was sister to Attorney-General Jolly. Paul was destined for the ministry, and educated at the Huguenot seminary in Montauban, where, while yet a student, he issued a volume of poems of considerable merit. In 1612 took holy orders, and returned to his native place to become pastor of a congregation which he served until his death July 28, 1669. Ferry was distinguished for his eloquence, and ranked second only to Calmet in all Lorraine. But he was more noted still for his generous sentiments and unbounded religious toleration. Was not only the pride of Protestants, but was beloved also by Romanists, and gave himself so largely to efforts not only for a union of all Protestants, but of all Christians, that he was surnamed THE PACIFICATOR. He corresponded for this purpose with the great Scotch irenic John Duræus and with the noted French ecclesiastic Bossuet. (See *Œuvres de Bossuet*, Versailles ed., vol. xxv.) The correspondence with Bossuet was provoked by Ferry's *Catéchisme Général de la Réformation* (Sedan, 1654), which, holding that the corruption of the Church had called for the Reformation, was replied to by Bossuet, and thus opened the way for an exchange of opinions on many topics, until the irenical subject became uppermost. Ferry is charged with having received a pension of 500 crowns from the government, under Richelieu, for agitating the reunion of Romanists and Protestants in France. His receipt for the amount is said to exist in the National Library at Paris. Ferry wrote much, but published little. His most important works are *Scholastici Orthodoxi Specimen* (Geneva, 1616, 8vo, and since), *Le dernier Desespoir de la tradition contre l'écriture* (Sedan, 1618, 8vo; defended against attacks in 1624), *Vindiciæ pro Scholastico orthodoxo adversus Leon. Perinium Jesuit.* (Leyden, 1630, 8vo). (See HAAG, *La France Protestante*; BAYLE, *Histor. Dict.*; *London Review*, July, 1856, p. 409 *seq.*)

JAMES H. WORMAN.

Ferry (THOMAS W.), b. at Mackinaw, Mich., June 1, 1827; entered early upon a business life; removed to Grand Haven; sent to the State legislature in 1850, to the State senate in 1856; long an active member of the State Republican committee; a vice-president of the Chicago convention of 1860; member of Congress 1864–71; U. S. Senator 1871–77; chosen president *pro tem.* of the Senate, and became acting Vice-President of the U. S. on the death of Henry Wilson, Nov. 22, 1875.

Ferry (WILLIAM M.), father of U. S. Senator T. W. Ferry, b. in Granby, Mass., Sept. 8, 1796, and d. at Grand Haven, Mich., Dec. 30, 1867. He graduated at Union College in 1817; was a Presbyterian missionary at Mackinaw from 1821 to 1832, conducting successfully a school for white and Indian children. His health failing, he purchased land in the Grand River Valley, near Lake Michigan, founded a prosperous settlement there, which became the city of Grand Haven, engaged largely in the lumber manufacture, and became wealthy. W. S. GEORGE.

Fer'ryland, port of entry of Newfoundland, the capital of Ferryland district, has a good harbor, 44 miles S. of St. John's. It was settled by Lord Baltimore in 1623, and called Avalon; was deserted in consequence of disturbances by the French. Ruins of the old batteries remain. It has a court-house and jail and a lighthouse. Pop. 680.

Fer'rysburg, post-v. of Ottawa co., Mich., on Grand River and Spring Lake, and on the Michigan Lake Shore and the Detroit and Milwaukee R. Rs.

Ferté-sous-Jouarre, La, town of France, in the department of Seine-et-Marne, on the Marne. About 1200 pairs of burr millstones are annually quarried in its vicinity and shipped to England and America. Pop. 4482.

Fer'tile, post-tp. of Worth co., Ia. Pop. 164.

Fertiliza'tion of Plants, the process by which the contents of two sexual cells are blended to form the starting-point in a new development. In flowering as well as flowerless plants the mechanism of reproduction is so complicated that some knowledge of vegetable physiology is necessary to its comprehension. (See PHYSIOLOGY, VEGETABLE.)

Fer'tilizers [Lat. *fertilis*, "productive," from *fero*, to "produce"]. The name *fertilizer* is applied to substances which enrich the soil with nutriment of plants. Agriculturists distinguish usually between home-made and artificial mineral or commercial fertilizers. The former consist mainly of the various refuse matters, animal and vegetable, incidental to the particular farm operations carried on. The latter include a large number of articles which are obtained elsewhere than from the farm. The use of animal secretions of every description, and of all kinds of vegetable refuse matter in the form of barnyard manure and farm composts, has been known in agriculture from time immemorial, whilst the application of the commercial fertilizers can scarcely be dated farther back than to the close of the past or the beginning of the present century. Lime, salt, saltpetre, oyster-shells, gypsum, and ground bones are among the first more prominently mentioned commercial fertilizing substances. The consumption, however, of these and similar articles remained quite limited until some thirty years ago, when their demand at once began to increase rapidly in consequence of Prof. Justus von Liebig's famous exposition of the relations which exist between the constituents of the soil and the growth of plants.

The extensive use of commercial or artificial fertilizers is one of the most important features in the present management of farms. Their merits are so generally recognized that a rational and thorough system of agriculture is thought impracticable without their assistance, particularly when it is proposed to apply them for the purpose of rendering the stable manure a complete fertilizer for the various crops under cultivation. The successful introduction of these fertilizers furnishes one of the most striking illustrations of the influence and the value which exact modes of inquiry with well defined questions have over mere experimenting without a previous correct appreciation of the agencies and the principles involved in the operation.

Agriculture, although one of the oldest industries, was, comparatively speaking, until of late in an unusual degree deficient in rational explanations of many of its modes of operation. Stable manure, ashes of plants, and various other means, as fallow and rotation of crops, irrigation, and drainage, etc., had been employed for ages in the interest of a successful fertilization of cultivated lands, yet no satisfactory explanation regarding their respective action was offered until quite recently—a fact which readily accounts for their repeated failures in former ages. The state of the natural and the physical sciences previous to the beginning of the present century rendered in many instances a correct exposition of the processes involved impossible. To enter with any reasonable prospect of success upon the discussion of so intricate questions as the relation of animal secretions to plant-life required not only a familiarity with the composition of the air, the water, and the soil, and the various reactions of these agencies upon each other and on plant-life under the influence of light and heat, but also a thorough knowledge of the various constituents of plants and animals, their respective organizations, and the functions of their assimilative, respiratory, and excretory organs. Without any knowledge of the nature of the previously mentioned important physiological processes peculiar to animal and vegetable life, not even an approximately correct appreciation could be entertained regarding the mutual dependency of plants and animals in the economy of farming. Modern agriculture rests its claim of real progress, as compared with previous centuries, less on the introduction of new means for the maintenance of an increased production of cultivated lands than on a more efficient because more rational use of the best features of well-known modes of cultivation. It ascribes the present advanced position, and its claims of being a scientific art, to the accumulated results of the scientific researches of many of the most illustrious scientists of the past century in every branch of the natural and physical sciences, and recognizes in Lavoisier, Sir Humphry Davy, and Liebig the foremost and most influential minds during its various stages of progress. One of the most important services which the experimental sciences have rendered of late to practical agriculture consists in the elucidation of the fact that it is essential to a successful cultivation of the various crops to restore without delay to the soil those of its constituents which the crops have abstracted.

It is scarcely more than some thirty years since the mineral constituents of plants were looked upon as being merely of incidental occurrence, and without any essential bearing upon their development: these views have been entirely changed in consequence of recent careful analytical investigations. In comparing the ash constituents of different plants it was noticed soon that certain mineral elements were present in a more or less conspicuous proportion in every plant. The general occurrence of these substances led ultimately to the quite natural assumption that their presence might be necessary for the performance of some physiological process of vegetable life. These important relations were in their general outlines for the first time pointed out in the year 1840 by Justus von Liebig in his memorable work on *Organic Chemistry in its Application to Agriculture and Physiology*. Subsequent additional actual experiments, instituted under well-defined circumstances for testing his views, have not only confirmed their correctness in their main features, but furnished much additional information in regard to the requirements for a successful cultivation of plants. We have learned since that of all the substances which enter into the composition of plants, only potassium, calcium, magnesium, iron, sulphuric acid, phosphoric acid, and carbonic acid, besides some nitrogenous compounds, as ammonia or nitric acid, and water, are indispensable for their growth; whilst the functions of a few other elements quite frequently noticed in plants, as sodium, silicium, chlorine, etc., remain still less explained. As soil and air were thus proved to be equally important contributors of the essential articles of plant-food—the former furnishing the mineral constituents of plants, the latter mainly their organic portion—it became evident that the atmospheric resource of plant-food could only serve its purpose in the same degree as the soil-constituents present would be able to support them in the production of vegetable matter. To store the farm-lands with the largest possible amount of available essential mineral constituents of plants in particular has thus become the most important point of consideration in practical agriculture. The intelligent farmer of to-day recognizes this principle in the selection of his modes of operation. An early experience has taught him that the soil he cultivates, as a general rule, differs more or less in its physical condition and its chemical composition. Chemists have subsequently proved to him that any improvement in the former direction tends to render the natural and original resources of the soil treated sooner and in a larger degree available, and thus hastens on its final sterility in consequence of the production of larger crops. Superior mechanical treatment of the soil before seeding—rotation of crops, fallow, irrigation, and drainage—is for this reason at present resorted to mainly for the purpose of turning the natural resources of the soil to better account, either in consequence of a more uniform distribution of its plant-food or at the expense of time; whilst a continued unimpaired production is secured by returning in the form of some suitable fertilizer the soil constituents which the removed crops have abstracted. The selection of a fertilizer is for economical reasons always made with reference to the nature and the amount of available plant-food in the soil under cultivation, and to the special requirements of the crops to be raised. Most of our home-made fertilizers are of a compound nature, whilst the commercial or artificial fertilizers supply usually but one or two articles; they are for this reason frequently called "special fertilizers." Stable manure, although the most complex of home-made fertilizers, cannot be considered a complete one as long as farmers sell a part of their produce. The commercial fertilizers furnish excellent means to correct the composition of the stable manure obtained under any system of agricultural industry, and to make it a complete fertilizer for the crops under cultivation. Although the stable manure represents still by far the largest bulk of the fertilizers used in general mixed farm-management, the demand for commercial fertilizers is already so great that their manufacture ranks among the most extensive branches of chemical industry of the present day. Their importance cannot be over-estimated in regard to the maintenance of the fertility of our farm-lands as long as farmers still allow a fair portion of their home fertilizing material to waste, and as long as the sewage question of our centres of social life remains practically unsolved. Bones, mineral phosphates, and superphosphates—the latter frequently mixed with nitrogenous animal matter, as fish, blood, meat, etc., or ammonia compounds—have been for years the main portion of commercial fertilizers. Phosphoric acid, lime, sulphuric acid, and nitrogen have thus for years past been duly represented in the market, while potassa and magnesia were hardly attended to until of late years. The source of potassa for fertilizing purposes consisted formerly largely of nitre and wood-ash; the former proved too expensive, and the latter insufficient in quantity, to encourage a more general application for agricultural use. The recent discovery of large mineral deposits at Stassfurt and elsewhere, containing both potassa and magnesia in soluble form, has given a powerful interest to extensive and systematic agricultural experiments, by which their great value has been abundantly demonstrated. Many of the artificial fertilizers have acquired also an additional value on account of their special character, and thus their special

action on the quality of various important crops for industrial purposes, as tobacco, sugar-beets, etc. The study of the peculiar influence of each article of plant-food in reference to the production of vegetable substances, such as starch, sugar, oil, etc., has more recently engaged the particular attention of agricultural chemists.

CHARLES A. GOESSMANN.

Fe′sa, town of Persia, in the province of Fars, with an estimated population of 18,000. Its silk fabrics are famous.

Fes′cennine Verse (*carmen Fescenninum, versus Fescenninus*), in ancient Italy, a rude and generally extemporaneous kind of poetry, often roughly satirical and licentious, sung at first in rustic communities at harvest-homes and weddings, and afterwards introduced into Rome, where it was long popular. The *fascinum* or *phallus*, the symbol of fertility, is supposed by some to have given it a name, which others derive from Fescennium, a town near Falerii. This verse was originally in form a dialogue.

Fesch (JOSEPH), CARDINAL, a half-brother of the mother of the first Napoleon, b. at Ajaccio Jan. 3, 1763, was a commissioner attached to the French army of Italy (1795–99), archbishop of Lyons (Apr., 1802), ambassador to Rome and cardinal (1803), grand almoner and senator (1805), president of the Council of Paris (1811), then exiled to Lyons for opposing Napoleon (1811–14), and d. at Rome May 13, 1839.

Fes′cue, a name applied to the numerous species of grass of the genus *Festuca*, which abound in most temperate regions of the globe. The sheep's fescue and the field fescue (*Festuca ovina* and *elatior*) are excellent pasture and forage grasses. Peru has the *Festuca quadridentata*, which is reputed poisonous to stock, perhaps from the growth of ergot in place of its seeds. The European fescues are more numerous and important than the American. The celebrated tussock-grass of the Falkland Islands is a fescue—*Festuca flabellata*.

Fes′senden (FRANCIS) was b. at Portland, Me., Mar. 18, 1839, graduated at Bowdoin College 1858, studied law, but was appointed captain 19th U. S. Infantry May 14, 1861; wounded at Shiloh; colonel of the 25th Me. Vols. Oct., 1862, to Jan., 1863; in command of brigade in the battle of Chantilly, Va.; colonel of the 30th Me. Vols. in the battle of Sabine Cross-roads; commanded a brigade in battles of Pleasant Hill and Monett's Bluff, La., and lost a leg; brigadier-general of volunteers May, 1864; brevet major-general of volunteers, and brevet major, lieutenant-colonel, colonel, and brigadier and major-general U. S. army; lieutenant-colonel 28th U. S. Infantry; retired Nov. 1, 1866.

Fessenden (SAMUEL), LL.D., American lawyer, b. at Fryeburg, Me., July 16, 1784, graduated at Dartmouth College in 1806. Admitted to the bar in 1809, he practised at New Gloucester, Me.; was a member of the Massachusetts general court (1814–16), and of the senate (1818–19); major-general of militia (1818–32). Removed to Portland, Me., in 1822, and was its representative in the Maine legislature (1825–26), as also grand master of the grand lodge of Masons in Maine. He was the father of Hon. W. P. Fessenden. D. near Portland, Me., Mar. 13, 1869.

Fessenden (SAMUEL C.), American Congressman, b. in New Gloucester, Me., Mar. 7, 1815, graduated at Bowdoin College 1834, and at the Bangor (Me.) Theological Seminary in 1837. In 1838 became pastor of the Second Congregational church at Thomaston (now Rockland), Me. In 1856 he left that place and established the *Maine Evangelist*. In 1858 studied law, soon became judge of the municipal court of Rockland, and was then elected a representative from Maine to the Thirty-seventh Congress. In 1861 was appointed a member of the board of examiners of the U. S. Patent Office at Washington, D. C.

Fessenden (T. A. D.), American Congressman, b. at Portland, Me., Jan. 23, 1826, graduated at Bowdoin College, Me., 1845, was aide-de-camp to the governor of Maine in 1858, and in 1860 was a member of the Maine legislature; in 1861 was attorney for the county of Androscoggin. In 1862 was chosen representative from Maine to the U. S. Congress for the unexpired term of C. W. Walton. D. at Lewiston, Me., Sept. 28, 1868.

Fessenden (THOMAS GREEN), American poet and agricultural writer, b. at Walpole, N. H., Apr. 22, 1771, graduated at Dartmouth College 1796, and studied law, but the success of a poem, *Jonathan's Courtship*, led him to literature. In 1803 he wrote in London *A Terrible Tractoration*, a satirical poem; in 1804 settled in Boston, publishing there, in 1806, *Democracy Unveiled*, a political poem, etc. Afterwards edited the *Weekly Inspector* at New York City two years. In 1812 practised law at Bellows Falls, Vt., removing to Brattleboro', Vt., in 1815, where he published *The Reporter*. From 1816 to 1822 he edited the *Intelligencer* at Bellows Falls, Vt. From that time until his death, at Boston Nov. 11, 1837, he published *The New England Farmer* at Boston, Mass., and edited *The Horticultural Register*. *Original Poems*, *The Ladies' Monitor* (1818), *American Clerk's Companion* (1815), *Laws of Patents for New Inventions*, etc., were also published by Mr. Fessenden.

Fessenden (WILLIAM PITT), LL.D., an American statesman, b. at Boscawen, N. H., Oct. 16, 1806; graduated at Bowdoin College 1823; admitted to the bar 1827; began the practice of his profession at Bridgeton, Me., removing two years later to Portland, Me., where he continued to reside, and with whose interest and progress he was ever identified. Chosen as a Whig to the State legislature in 1832, although the youngest member of that body, he attained distinction as a legislator and debater; refusing further political preferment, he devoted himself (1832–39) to his profession, rising to the highest rank as counsellor and advocate. He was, however, returned to the legislature in 1840, and in 1841–43 represented his district in the Congress of the U. S., where he made a brilliant record as an eloquent and forcible debater. During the year 1843 he received the Whig vote for U. S. Senator, but was defeated; was returned to the State legislature in 1845 and 1846, and again in 1853, when he was elected to the U. S. Senate as a Whig, though the legislature was Democratic; but the Kansas-Nebraska question, which now began to assume importance, obliterated strict party lines, and by a union of the Free-Soil Democrats with the Whigs he was elected. Taking his seat Feb., 1854, he was placed upon the finance committee, and the following month made one of the most eloquent and effective speeches delivered against the Nebraska bill, establishing him at once as a leading member of the Senate. Re-elected in 1859, he was made chairman of the finance committee, and throughout the civil war rendered valuable service, as such, by aiding the secretary of the treasury to maintain the national credit, as well as by his eloquence and counsel in the Senate chamber. In 1864, on the retirement of Mr. Chase from the secretaryship of the treasury, he accepted that portfolio, and discharged the duties of the office during a most critical period of the nation's finances until Mar., 1865, when, owing to his delicate health and the overwhelming duties of the office, he resigned and resumed his seat in the Senate, to which he had been re-elected. On the conclusion of the impeachment-trial of President Johnson, he cast his vote for acquittal, in accordance with his opinions, which he set forth fully in an able and logical speech. For this act he was severely censured by his party, which was strong for conviction, but no taint of suspicion could be attached to the integrity of his vote, and he regained its confidence upon the subsidence of momentary excitement, and retained his place in the Senate as a leading debater and member of the party. As a politician he began his career as an ardent Whig; was member of the convention which nominated Harrison for the Presidency in 1840; of that which nominated Taylor in 1848, though in the latter he advocated the claims of Mr. Webster; but in the convention of 1852 he opposed Webster and favored Scott. He was one of the founders of the Republican party, in which he became a recognized leader. As a lawyer he ranked among the first in his State, and in the Supreme Court of the U. S. made himself a national reputation; as a debater he had few if any superiors in the Senate; and as a man his character was irreproachable. He was for a number of years an invalid, and suffered from a chronic complaint that finally hastened his death, which occurred at Portland, Me., Sept. 8, 1869.

G. C. SIMMONS.

Fess′ler (IGNAZ AURELIUS), b. at Czörendorf, in Hungary, in July, 1756; was at first a Capuchin, but in 1791 became a Protestant; was 1785–87 professor of Oriental languages at Lemberg, and in 1809 received the same chair at St. Petersburg, and afterwards was a prominent Lutheran official in Russia. Besides novels, Masonic treatises, etc., he wrote *Marc-Aurel* (a romance, 1790–92); *Matthias Corvinus* (1793); *Aristides und Themistokles* (1792); *Attila* (1794); a history of Hungary (1812–25); and an autobiography (1826). D. at St. Petersburg Dec. 15, 1839.

Festival. See FEAST, by REV. W. F. BRAND, A. M.

Fes′tus [Gr. Φῆστος], PORCIUS, procurator of Judæa, succeeded Antonius Felix about A. D. 60, while Nero was emperor. On his arrival in his province he found the apostle Paul a prisoner, examined his case, refused to gratify the vindictive feelings of the Jews against him, and would have set him at liberty, but as the apostle had appealed to Cæsar (*i. e.* Nero), he sent him to Rome to lay his case before the emperor. The disturbances caused by the robbers, assassins, and magicians which had prevailed in the time of Felix still continued under the government of Festus, and he was obliged to use vigorous measures to

subdue them. D. about two years after his appointment, and was succeeded by Albinus. H. DRISLER.

Festus (SEXTUS POMPEIUS), a Latin grammarian and lexicographer of uncertain date, but after Martial (A. D. 100), from whom he quotes, and before Charisius and Macrobius (400 A. D.), who quote from him. No particulars of his life have come down to us apart from his connection with the great work of FLACCUS, VERRIUS (which see), *De Significatu Verborum*. Festus prepared an abridgment of this work, which he arranged under the letters of the alphabet into twenty books, following the order and authority of Flaccus, introducing additional matter from his other writings, but rejecting certain points, which he intended to treat of in his *Priscorum Verborum cum exemplis*. This abridgment, entitled *De Significatione Verborum*, caused no doubt the loss of the original work of Flaccus, but it would have been, even in its reduced form, an exceedingly valuable treasure-house of the forms of Latin words and of Roman antiquities and mythology. In the eighth century, however, PAULUS DIACONUS (which see) made a meagre abridgment of Festus's work, adapted to the wants of his own time, and thus no doubt caused the discontinuance, and finally the disappearance, of the latter. One manuscript only of the eleventh century, now preserved at Naples, survived, but in a very imperfect condition, as it began with the letter *M*, and part of the remainder was defaced by fire. The labors of many scholars have been bestowed on the restoration of this important work, from some slight fragments of the original treatise of Flaccus, from the surviving MS. of Festus, and the compend of Paulus. The results are presented in their best and most complete form by K. O. Müller, Leipsic, 1839, who has printed the several works in separate columns. H. DRISLER.

Fe′tials, or **Fe′cials** [Lat. *fetiales*; etymology uncertain], a body of ancient Roman priests who had charge of certain international affairs, acting as heralds in the announcement of war to a foreign state and presiding over the solemnities attending the return of peace. They were probably twenty in number, were anciently citizens of high birth, were chosen for life, and were called *patres patrati*. Their duties were performed with much ceremony. Their rites and regulations constituted a code known as the *Jus fetiale*.

Fe′tich [root in the Lat. *factum*, but derived directly from the Portuguese *feitiço*, meaning a "charm," "witchcraft," "magic"], a name given by the Portuguese discoverers to the objects worshipped by the degraded tribes of Senegal and Congo. A fetich is not an idol, and is not properly a symbol, but is looked upon as the actual and visible dwelling-place of a preternatural power. It may be thus some fixed object of nature, as some lofty mountain, a grove, or a tree; it may be an animal, as a snake, a snail, a crocodile, and often a sheep or a goat; or it may be any object on which the whim or the fancy has fixed, as the beak of a bird, the fin of a fish, the hoof of a quadruped, a stone, a block, a feather, a stick, a nail, or almost anything else that can be named. One thing will do about as well as another for a fetich, provided the worshipper can believe that his god resides therein; and this he is easily led to do in reference to anything which pleases or is useful to him. A fetich is often worn about the person or hung up in the hut as a talisman, and is employed in the most disgusting rites of superstition and witchcraft. Fetichism shows the religious instinct degraded into its lowest forms. J. H. SEELYE.

Fet′id Gums, in pharmacy and medicine, are certain gum-resins which are the concrete natural juices of umbelliferous plants. They have a strong, unpleasant alliaceous odor, whence the name. They are antispasmodics and expectorants. Assafœtida, ammoniac, galbanum, and sagapenum are the best known.

Fétis (FRANÇOIS JOSEPH), Belgian writer on music and biographer, b. at Mons Mar. 25, 1784, studied at the Conservatory of Paris in 1800, was organist and professor of singing at Douai in 1813, director of the conservatory at Brussels in 1833, member of the Academy of Belgium in 1845, musical executor of Meyerbeer, producing his *L'Africaine* in 1864, officer of the Legion of Honor in 1864, grand officer of the Order of Leopold 1869, dying at Brussels Mar. 27, 1871. Published treatises on music, a *Universal Biography of Musicians* (8 vols., 1834–44; 2d ed. 1865–70), and a *General History of Music from the Earliest Times down to the Present*, 8 vols. Founded and edited the *Revue Musicale*.

Fet′lock, originally, it would appear, a name for a horse's fetter; also called **Fetter-lock**, both words occurring in heraldry as names of the rude figure of a fetter. At present it is the name of the point on a horse's leg behind the pastern joint. The fetlock is covered by a tuft of long hair.

Fet′terman, post tp. of Taylor co., W. Va., on the Baltimore and Ohio R. R., 1 mile N. W. of Grafton. P. [illegible]

Feu′dal Sys′tem. In the Roman empire, as in all compact states where the central power has its due degree of strength, the individual was placed directly under the supreme magistrate, and all authority of subordinate officers was exercised in his name. This dependence of the freeman in the direct way on the head of the state continued in the Germanic kingdoms, after they superseded the Roman power, for a length of time. In the tenth century, however, a new set of institutions are at work, rooting out and breaking up the institutions of the state proper. We give to them the name of *feudalism*, *feudality*, or *the feudal system*. They developed themselves, without absolutely destroying all earlier institutions, in France, England, Germany, Spain, Italy, and in the neighboring lands of Hungary, Poland, and Denmark. They appear also in other parts of Europe, and out of Europe in the Christian kingdom of Jerusalem. If traced back, they must be brought into connection with the Germanic element which diffused itself by invasion over a large part of Europe, while yet there was, properly speaking, no feudalism among the invaders. The notion common some time since that the invading armies consisted of bands under chieftains to whom the conquering kings gave lands for their services, and who in turn gave lands to their *comitatus* or retainers, is beginning to be exploded. Feudalism was a German growth, but had no such antique and tangible shape. It grew up, by little and little, out of institutions which were ripened in the Carolingian period, no one of which is enough of itself to explain feudalism, and which in combination could not have brought it about but for concurrent historical causes.

Feudalism controlled society and government for several centuries, and began to grow weak at the same time that the countries of Europe began to be nationalized; that is, at about the end of the fourteenth century. It was, however, not the sole, but only the controlling, power of society. The Church, the suzerains, the towns, were at heart its foes, although they put on some of its forms.

The word *feudum* in mediæval Latin, from which *feudal* is derived, did not come into use until about the ninth century, when it began to take the place of *beneficium*, which denoted a property given for use on certain conditions, the ownership of which did not go over with the usufruct. *Feudum* and *allodium* included the two tenures by which property was held in independent right (in fee simple, as we say—and by which it was held on condition of performing a service to the former owner. *Alod* is from *al*, "all," and *od*, "property," entire or genuine property, freehold estate; and *feud*, *fief*, is from a root (Gothic, *faihu*; Old High Ger. *fihu*; Old Sax. *fehu*, etc.) denoting "cattle," "property;" then "money," "rent," "interest." *Fe-od*, then, would be property for which rent is paid. The German expression is *lehen*, "loan;" thus, *lehen*, or *lehngut*, is originally a property lent, which may be recalled; *lehnrecht* is feudal tenure.

But what was the feudal system? It may be defined as that political form in which there was a chain of persons holding land of one another on condition of performing certain services, beginning with the serfs and lowest freemen, and ascending through *milites* or knights to the arrière-vassals and immediate vassals of the suzerain. Every member in the chain, from the milites upward, was bound to his immediate superior, held land from him, took the oath of allegiance to him, and became his man. The suzerain, then, had, when the system was pure, no direct connection with any but the great vassals, and they, with others, it might be, under them, were lords in their districts. The legal fiction was that the land was originally in the hands of the suzerain (that is, all the land which was not allodial, of which there was much in Germany, but in France very little); that allegiance and certain services fixed by custom were due to him; and that for neglect to perform these services the lands and all rights going with them could be forfeited. With the lands, down to the [illegible] of knights' fees, jurisdiction was connected, as well as [illegible] within certain limits, military command over the fief-holders of the barony, and, to a considerable extent, the right of coining money, together with that of giving charters. In short, nearly all sovereign powers passed over from the old sovereign—who now must be called a suzerain, to show his altered position—to his vassals; so that society was disintegrated, as much as it would be [illegible] in one of the U. S. had the rights of holding courts of itself and of passing laws. [illegible] all uniform development, all national existence, all unity. In [illegible] every feudal [illegible] on its own [illegible]

ject to compact between the suzerain and the vassal, a lord and an inferior. For instance, down to the first part of the twelfth century, females, if a baron died and left no son, could not inherit, but then they began to gain this right in Eastern France, England, Castile, Aragon, and the kingdom of Jerusalem. By this change it was brought about that females could inherit the throne, this being viewed in the light of a fief. And thus the law of succession in some monarchies took more or less definitely a new shape. This is one of many instances which will justify us in saying that in European feudalism public or political relations were confounded with private relations—political rights were blended with private rights.

The origin of the system has been traced by some writers to the Roman custom in the empire, from the time of Alexander Severus, of protecting the borders towards Germany by military colonies, in which the soldiers received land and were bound, they and their descendants, to military service. This, which was by no means confined to the Roman empire, but is seen in other parts of the world, was perhaps suggested by a Germanic usage. As Waitz says (*Deutsch. Verfassungsgesch.*, i. 376), "the way in which, among various Germanic tribes, Scandinavian as well as Teutonic, military service was united with possession of land, gives a probability to the opinion that even in the earliest times a certain connection between them subsisted." But this is the least characteristic element of the feudal system. It does not account for subinfeudation, or for the political powers which the fief-holder had, which was the striking characteristic of feudalism.

Neither can the *comitatus*, or relation of the *comites* or companions to the *princeps* or chief, as existing among the Germans of the time of Tacitus, account for feudal institutions. That was a relation of any chieftain to his companions, and not of a German king only to his followers. And that relation conveyed no political authority.

The true account of the matter seems to be this. Under the first race of Merovingian kings the kingdom was modelled much after the plan of the Roman empire. The county was assigned to a man (a *comes* or "count") who was both civil and military ruler, who commanded the forces of the county, administered justice, had no hereditary right to jurisdiction, but who might have grants of land for his lifetime, or on some other condition, from the king.

During the reigns of the later Merovingians, and after the East-Frank or Carolingian dynasty got possession of the throne, there were growing up several institutions in some respects new, in some respects analogous to older Germanic ones. These were vassalage and commendation, the beneficiary system, and immunity or exemption. To give a complete exposition of these elements of new social and political forms, and indeed to exhibit full-grown feudalism in its details, would require far more space than can be here afforded. We will try to give an explanation of what is necessary in the fewest words possible.

1. *Beneficia and the Beneficiary System.*—This was a relation of *property*, and long before the feudal system proper grew up *beneficium* denoted a gift of property, especially of landed property, in usufruct only, with reversibility to the donor or his heirs. The early meaning still appears in our word "benefice," in its sense of an ecclesiastical property, the use of which is given to a clergyman as officiating in a certain parish. The donor or grantor of the *beneficium* might be a king, any lay person, any ecclesiastical corporation; while the grantee might be any man, even the king himself, or a female, or a corporation, as before. *Beneficia* given for a short term of years or revocable at pleasure were called *precaria*—that is, obtained by the prayers or requests of the beneficiary; and the short, uncertain tenure of such holdings illustrates the modern word "precarious." But the distinction between *beneficia* and *precaria* is by no means a perfectly exact one. Such precaria were given, for instance, where a donor of land to a monastery in full ownership received it back in usufruct, with perhaps some of the older Church property besides.

Beneficia are distinguished in the course of time from leased lands transferred for use to dependent persons, such as serfs. Thus, a monastery might have serfs on its lands or free tenants. The lands so cultivated by them were not regarded as *beneficia*, but a man who received from such a foundation tracts of land to be cultivated by his own people, or lands with laborers on them, would be called a "beneficiary."

The terms and conditions on which such benefices were held were very various. Some were for short terms, some were renewable every five years, while others were expressly excepted from this condition. *Beneficia* of the king usually terminated with the life of the grantor or of the grantee, but sometimes they passed on to the grantee's heirs. Under the grandsons of Charlemagne they came to have more and more of an hereditary character, and in the kingdom of the West Franks (or France) a sort of acknowledgment of the hereditary principle was made in 877 A. D. by Charles the Bald at the convention or diet of Quiercy-sur-Oise (*conventus Carisiæus*). Yet diplomas of Charles the Bald show that this rule of inheritance was not absolutely fixed by the celebrated capitulary referred to. And this provision had no necessary authority in other parts of the kingdom of Charlemagne. On the renewal of grants of benefices sometimes money was demanded, reminding one of the subsequent fine or relief, but this was not thought to be becoming. The obligation for holding a benefice might be something like a rent, real or nominal, or no requital of any outward sort might be called for. But a certain kind of tie grew out of the giving and receiving of benefices—something expressed by the Latin word *obsequium* in the formulas of gifts—that is, a readiness to comply with the wishes of the benefactor; if he were the king, a personal feeling of gratitude apart from the sense of duty as a subject. This is expressed in a form of which the following is a translation: "Let him know that he ought to show such (*obsequium*) dutiful compliance towards his senior on the ground of that gift, as other men, on the ground of similar beneficence, are wont to show towards their seniors." Here we see the reception of benefices becoming connected with

2. *Vassality* or *commendation*, which was a merely *personal tie.* The latter of these words has the more extensive meaning, and several relations were described by it besides that which was called "vassality." The essence of these relations lay in formally putting one's self under the protection of another. The king was regarded as the protector of certain helpless classes, such as widows and orphans. They were *in his peace*, as also were the whole people and the Church. So, too, pilgrims and travellers were for the time under his care—under the tutelage or the defence of the king—although *commendation* is not the term specially used in such cases. Again, young men brought to the court to be trained for some service or court office are said to be commended, although no formal taking of them into his protection or guardianship (*mundium*) may have found place. Nor was the king alone in giving his protection. The *major-domus*, or mayor of the palace, sometimes gave his protection with or instead of the king, and Pepin made his son Charles (Charlemagne) joint protector with himself. The property of a diocese might be in the tutelage of a count—that of a convent under a count's or bishop's protection. Free men put themselves under the guardianship of a convent. Thus, originally there were manifold relations, differing, yet having resemblances to one another, which were described by the same words.

A person who made commendation of himself was called *vassus* or *vassallus*, a word probably of Celtic origin, and at first denoting a servant, then in time confined to the relation above spoken of. (See WAITZ, *Deutsch. Verfassungsgesch.*, iv. 205, for examples of the use of the words as applied to inferior proprietors.) Another equivalent term was *gasindus*, of Germanic origin (comp. modern German *gesinde*), and another still was *homo*, of Latin origin, whence *homage* comes. The person who received another into his protection was especially called *senior* (whence *seignior*), and also *dominus*. In later documents the seignior's relation or standing is called *senioratus* (as if seigniorship). The entrance into the relation of a vassal was denoted by the form of folding the hands together and laying them in the hands of the *senior* or protector. This was accompanied by an oath containing a promise of fidelity. The oath and the form in general were used as well when a count or other important person took an inferior under his protection as when the king received a vassal into his service. The oath and obligation were contemporaneous with the general oath of allegiance on the part of the subjects, as required by Charlemagne and other Carolings. And yet the oath to the king's or emperor's subject certainly tended at length to weaken the tie between the head of the state and those members of it who were bound to others than the sovereign or suzerain.

The vassal sometimes remained with his senior, especially if the king was the senior, and served in his court; sometimes he lived remote from the king on lands which had been given to him for his use. If an inmate of his senior's dwelling, he was bound to services, such as military duty, going on messages, presence at his courts (*placita*), following in his train. In a capitulary of A. D. 811 it is said of such vassals of the king that if they have benefices, and vassals on them, they shall not keep these subordinate vassals with them, but "shall allow them to go with the count to whose district they belong." From this it appears that already vassals had vassals; that some vassals had no benefices; and apparently, also, that the old-received jurisdiction and military power of the count in his county (*pagus*) was beginning to be weakened, for it was necessary to give

orders that such vassals should follow the count to his county and upon military expeditions.

At first the tie between a person other than the sovereign and his man was probably weaker than that between the magnates and the king. In the disorders after Charlemagne's death, and in the time of his grandsons, the great people seduced each other's vassals away, so that this had to be expressly prohibited. The vassal also could not leave his senior or lord except for reasons which involved a crime on the senior's part, unless, indeed, the latter freely dismissed him. Such crimes, as mentioned in a capitulary of Aix la-Chapelle (A. D. 816), are attempts on the senior's part to enslave the vassal, seduction of his wife by the senior, plots against his life, running upon him with a drawn sword, neglecting to protect him if this were in the senior's power. With this may be compared the feudal crime of felony, which is generally committed by the vassal against his lord, but may also be committed by the lord himself against his vassal.

It came to pass in the course of time that vassals held benefices and beneficiaries became vassals—that is, that no person could stand in the one relation without its involving the other. Waitz says (*Deutsch. Verfassungsgesch.*, iv. 216) that "no one could get a benefice without binding himself by commendation more closely to the grantor of the land—more closely than would take place by the fact of having another's land put for use into his hands." Roth, in his *Beneficialwesen*, says more safely that this union of the two relations was usage only for some time, and not universal custom. When the custom was becoming universal a class of landholders was growing up who held estates by a tie of personal obligation to a superior; and this class, owing to the vast tracts of land which the Frank kings could dispose of, embraced a large part of the leading persons, especially in the West Frank kingdom.

3. *Immunity* (*emunity*) or *exemption*, a *political* privilege, was the third constituent element of the feudal system. The first form under which this element appears is immunity from taxes or burdens on the land. When the king gave benefices he transferred that which before belonged to the *fisc*, and which was exempt from taxes. It was a great thing for a person to obtain this exemption. The first exemptions that are known are all granted to convents or to other ecclesiastical foundations, the property of which was entirely derived at first from gifts of lands. Originally, this grant of immunity could only proceed from the king, yet documents issued to such corporations by nobles who were vassals of kings confer it, in the expectation, perhaps, that a confirmation of the step would be obtained from the supreme authority. There seems also to have been a special anxiety on the part of convents that a public officer should not enter within their premises and disturb their sacred quiet. However little or much this cause may have affected, the immunity naturally took the shape under Pepin and the next sovereigns that no public officer should enter the court or lands of the foundation, either to levy peace-money (*freda*), or to demand quarters and lodging, or to take securities, or to hold the people of the foundation to justice, or to set up judicial proceedings there. These dispensations from what was due to the state were not granted all at once, but one at a time; and, on the other hand, there were cases where the public officer might enter the religious precincts. We may well imagine that these privileges would be eagerly coveted, and in regard to nothing in the mediæval times do so many forged documents exist as in regard to these grants of immunities. They were protected by fines very considerable in amount. But as free men commended themselves to the Church corporations to get rid of public service in war, an edict of 829 gives the counts the right to distrain on them, "notwithstanding the immunity." In some cases this privilege was given for hedged or enclosed lands only, not for plough, pasture, or wood lands, at least so far that breaches of it should not have the same penalty outside of the court and buildings as within.

This privilege evidently could amount, if bestowed on all holders of benefices (or fiefs, as we now may call them), to an overthrow of direct public power, and was evidently worth the efforts of the secular proprietors to secure for themselves. When and by what steps they obtained it does not so clearly appear as in the case of convents and other Church foundations. But such a privilege could not be confined to ecclesiastics, and in the unquiet times under the grandsons of Charlemagne, and afterwards, public power became weak, while at an equal pace the power of the landholding grantees became great. The smaller free proprietors could not stand alone in those times, but found it necessary, in order to protect themselves, to join some society where they could find protection, and so gave up their lands to a count or other great person, to receive them back as his men owing allegiance and securing support. The counts would naturally be large landholders within the county, and if their functions, at their death, passed out of the family, the son would naturally want to have the same authority in his estates which his father had in the county or district. These are some of the reasons which brought it about that multitudes of men, ecclesiastical and civil, in process of time got exemptions from public authority—that is, as far as justice, police, military headship were concerned—broke up society into fragments, and denationalized a great part of Europe.

These three causes, then, working together, produced the feudal system. Public property, by the distribution of lands in the way of beneficiary gifts, which were finally held by hereditary right, created great proprietors. Vassalage connected these proprietors by a personal tie with one another, and at length *only* with one another, the high vassals alone having immediate relations to the sovereign. Finally, immunity distributed in process of time the principal powers of the state to the vassals of the suzerain or to their vassals also. In this course of things different parts of Europe moved forward independently. In France, where there was very little allodial property, the maxim of feudalism was "Nulle terre sans seigneur." In Germany there were many small free proprietors who stood their ground, as in Ditmarsch, and many large proprietors whose allods alone, without their fiefs, were very wide territories. When Henry the Lion was deprived of both his Saxon and Bavarian dukedoms, in 1180, for his want of fidelity to Frederick Barbarossa, he had still in his hands the extensive Brunswick territories, which, when divided up, made several important German principalities.

In another particular, which was of no inconsiderable moment, the countries differed. In France, if we mistake not, all the feudal holdings became hereditary at an early day. It was otherwise in Germany and in Italy. In Germany there had been no acknowledgment of the right of the great vassals to transmit their imperial fiefs to their children until the emperor Henry II. silently acknowledged it in every known instance but one (1002–24). But still, the princes retained the right to dispose of the fiefs on the death of arrière-vassals as they pleased, until Conrad II. (1024–39) gave it to be understood—without any positive law, as it would appear—that the same usage must prevail towards them also, and thus raised up a class of friends to the imperial power among the smaller nobility. In Italy things were even worse for the arrière-vassals—the *valvassors* as they were called—until the same emperor by his constitution, given out before Milan, granted to the valvassors the right of inheritance in their fiefs, of trials by their peers, of appeal to the emperor or his deputies the counts palatine, and of security against the conversion of fiefs into leasehold or copyhold properties—a measure by which he made friends of the smaller nobles, and took away arbitrary power from the larger.

Feudalism grew up and spread in the different parts of Europe amid so many different influences, favorable or counteracting, that its minor diversities in the several countries were countless. Thus, in France the North was especially the home of customary law (*coutumes*), while the South retained influences from the Roman times. In England a duke of Normandy, a vassal of the French Capets for his French possessions, is supreme ruler under no superior, brings the land and land-tenures into the forms of feudalism, but endeavors to mitigate the disintegrating tendencies of that system and to uphold the royal power by modifications more or less drawn from the Saxon institutions. In Germany an elected emperor, an intimate connection with the papacy, a necessity during a long time for a vigorous head to protect the land from Eastern neighbors, with various other causes, gave a peculiar turn to many of the institutions. Here we see the old Teutonic ideas standing their ground, while foreign law and institutions are creeping in from Italy. So also if we look at the internal affairs of each part of Europe, we find opposing elements at work and a most vigorous, unquiet life; the kings, at war with their principal feudatories, leaning for support on the towns or the lawyers; the Church feudalized, but in contest with the unruly nobles, and falling back upon the ecclesiastical unity represented by the pope. And, to mention but one thing more, we discover new institutions like the towns arising, capital other than land becoming important, unions of the citizens of various communities against the nobles.

The theory of feudalism, not true in matter of fact, has been already stated to be that all the land belonged originally to the king, and was given over on certain conditions to his principal vassals, and by them to theirs. Long after the fiefs became hereditary their original lapse into the hands of the superior was indicated by the fine or payment called *relief* which the heir paid on entering into possession of his father's or next relative's possession. As the tenure was personal, the holder of a fief could not sell it without his

lord's consent, who had on such occasions the right of prior purchase, called *rachat*. The necessity of defending the kingdom or fief led for a time to the exclusion of females from succession, and, especially in France, to the indivisibility of a fief where a deceased person had left more than one son; but to these rules there were extensive exceptions. Where more than one fief pertained to a family, a subordinate one might be given to a younger son. In Germany subdivision among the male children of the fief-holder was the general rule. It was natural that if an unmarried daughter succeeded to the fief, the superior's consent should be necessary before she could marry the man of her choice. Again, when an heir was a minor there was a propriety that the superior should be his or her guardian—a very gainful thing for the higher vassal or for the suzerain.

As for the termination of the feudal relation, it could cease by extinction of the line; by the vassal's felony towards his lord, which comprehended a number of the grossest and most dishonorable actions in violation of his feudal oath; by the felonious conduct of the superior against his vassal (of which we have spoken already); or by the vassal's voluntary relinquishment of his fief where this was permissible. When a vassal's crime subjected him to loss of his fiefs, a judgment of a court of peers was necessary; the superior could not generally, by his own act, without such consent, declare him to have forfeited his estate. The most remarkable cases of such trial were that by which John of England, on sentence of his French peers, was stripped of the lands he held in France by homage as a vassal of Philip Augustus (A. D. 1203), and that by which Henry the Lion in 1180 lost the dukedom of Saxony, as has been already mentioned.

As feudalism grew up, not only laymen but ecclesiastics and corporations were invested with fiefs, and in fact the great bishops and abbots ranked in some countries among the most important feudatories. The kings were quite willing to have such vassals, for the lay barons gave them trouble by active resistance more frequently, and there was an opportunity, on the death of a feudal ecclesiastic, of influencing the appointment of a successor, as well as of deriving advantages from the introduction of a new ecclesiastical person into the feudal relation. But as the ecclesiastics holding fiefs had two characters—that of feudatories and that of churchmen under the pope—it was natural that just at this point there should be a conflict of secular and religious authority. The most important struggles of the Middle Ages grew out of the two characters of the ecclesiastical princes, the sovereigns being unwilling to give up their feudal rights over Church lands held as fiefs, and the popes claiming the independent relation of the great ecclesiastics toward the sovereign, as well as the inalienability and sacredness of lands once consecrated to religious purposes. As the bishops and abbots could not sit in capital trials according to the canons, and could not without irregularity take part in traffic, they needed lay vicars, who often managed to enrich themselves and grow into power at the expense of the foundations.

The complexity in the feudal system was increased by the fact that not only land, but everything that could be held as property, could take the form of fiefs. So also certain offices at the suzerain's court, as those of the high chamberlain, butler, seneschal, constable, pertained to certain families; and the counts palatine, who were originally assistants of their suzerain in the administration of justice, transmitted their title and the lands connected with their office to their sons.

The principal obligations of the fief-holders or vassals were the following:

1. Service in war (*service d'hoste*). The customary obligation in France, when the superior was involved in war or followed his own superior in war, was a military service of forty days with his men or with a fixed number, after the expiration of which the vassal could go home, although the war was not at an end. If certain specific reasons prevented his appearing at all, a fine (in Old France an *écuage*) could be demanded from him. Such a limited time of service of course broke up many expeditions. Hence, in France—which we select as especially the feudal country—toward the end of the eleventh century fiefs were granted on the condition that the vassal should serve until the end of the war. The vassal under these obligations was especially a liege-man (*homo ligius—ligius* being derived from the Latin *ligo*, to "bind," most probably), while the vassal bound to definite service was his lord's man simply, and his relation was called ordinary homage (*hommage ordinaire*). Still another kind of service, called *hommagium planum*, bound the vassal neither to service at his lord's court nor to service in war, but simply to fidelity and neutrality. Others, still, were bound to defend only a castle of their superior, and were maintained at his expense.

2. Another general obligation was that called *justitia*, or that the vassal must appear, when summoned, at his lord's courts, either to act the part of a judge, together with his fellow-vassals or peers (*pares curiæ*), or to submit to trial before them as judges. The rule was trial by peers, and the power of administering justice was vested in all the gradations of the feudal persons down to the knights (*milites*), who themselves, if there were free persons on their estates, were their natural judges. The great lords did their office by deputies for the most part, and in process of time their vassals came into the habit of having their representatives also. Besides other proof, wager of battle or trial by combat was a common method of deciding cases in these courts, being a kind of feudal ordeal.

3. *Aids or Auxilia.*—These were money payments, determined according to feudal usage. They were due in France and in England when the lord was to be redeemed from captivity, when his son (or eldest son) was made a knight, and when his daughter (or eldest daughter) was married. (Comp. *Magna Charta*, § 14.) At one time aids were demanded and given when the lord went on a crusade.

Besides these, the specific duty of fealty implied general respect and obedience, honesty in not altering the condition of the fiefs, and similar duties.

The feudal system not only broke up countries into almost independent parts, encouraged private feuds, and made the leaders of society a law unto themselves in great measure, but it rested on a system of serfage, which appears as well among the Germans before the emigrations as in the later Roman empire. Under it there could be no unity except that of the Church. Its evils were immense, but amid the evils, by the help of Christian ideas, there grew up the sentiments of honor and of fidelity, the spirit of courage and of personal independence, the sense of obligation to protect the weak, a new respect for woman unknown to the classical nations. Among its good principles of a political kind, those of trial by peers and of taxation only by consent of the taxpaying inferior were the most important.

At length the feudal system began to fall; new political ideas and forms, new powers in society, began to take its place; nations arose out of separate fiefs, and suzerains again became kings. What broke up feudalism? The most prominent immediate causes were the substitution of a better law in the place of feudal law, the growth of the cities, and new methods of warfare. These causes added strength to the central power, created an opulent class outside of the feudal nobility, gave birth to new political institutions, helped somewhat the lower classes, and brought in new knowledge, a new civilization. In the first place, as the feudal law was found inapplicable to the new circumstances which the growth of cities and of industry had introduced, the Roman law was called in the twelfth century out of the obscurity where it had long lain in the north of Italy; and the University of Bologna owed its origin or its first prosperity to this study. Hither multitudes resorted for the purpose of learning the new science. From this starting-point it was propagated through Europe. The courts of the suzerains made use of it, and with the more effect owing to the fact that the appeals to their courts, which had in France at least been long disused, were revived. In this way a code which was favorable to the growth of a central power began to prevail over one unsuited to the times, and the kings began anew to be regarded as centres of justice. In the next place, the growth of towns all over Europe in and after the Crusades was a source of changes in the political system. The towns acquired privileges by especial charters granted by their feudal lords, whose resources might in this way be increased. As they grew they became a new power, which, like the suzerain's, was naturally opposed to the feudal power. The kings aided them because both were enemies of the feudal nobility, and they in turn helped the kings. Their self-government, capital, and common interests made the towns, though isolated, aware of their strength; they were able to send deputies to the estates-general, parliaments, or cortes through which nations expressed their national feeling; they could give assistance to the kings in struggles against the feudal element by their men and money. Louis IX., who died in 1270, the best sovereign in the Middle Ages, in his testament exhorted his son to be mindful of the interests of the "good towns," as if there were a natural alliance between them and the sovereign.

Again, the new modes of warfare had advantages over the feudal military system, which was heavy in its movements and unreliable. Its great strength lay in its mail-clad horsemen. The use of cross-bowmen, gunpowder, guns, and cannon, and of a population in the towns or of freemen in the country who could serve as hired soldiers, changed the face of war. The battle of Crécy, gained by Edward III. of England in 1346, was due to two causes—that a yeomanry had grown up in England earlier than in France, and that these intrepid freemen were skilled at

the cross-bow. The battle of Agincourt (1415) was won by bill and bow, the French chivalry literally sticking fast in the mud, to be shot down by English archers. The victories of Granson and Murten or Morat (1476) were won by free Switzerland over the troops of the most feudal of princes, Charles the Bold. What is remarkable here is that the superiority as it respects arms lay on the duke of Burgundy's side, so that guns alone were not the cause of the fall of the feudal military system. But there is no doubt that the use of weapons capable of producing an effect at a distance gave to foot troops, and to those who were cheaply equipped, a great advantage over the heavy-moving horsemen and the undisciplined infantry of feudalism, and thus helped the sovereigns and others who soonest availed themselves of the new instruments of war.

Underlying and acting with the other causes of the downfall of feudalism were the more general ones which indicated the progress of society. Intelligence was spreading in the middle class, but not so much in the higher. There were men in many towns who had travelled into the East and seen the institutions of the nations in remote parts; there were professional men who were cultivated in law or in medicine at the universities; there were great merchants whose views were enlarged by the intercourse which they kept up with the world; the arts were beginning to refine the dwellers in the towns; church architecture was already in its glory. It was impossible that capital, intelligence, the means of closer intercourse, should not have an effect in modifying political forms which had given power to soldiers and landowners less intelligent and with less available capital. The feudal lords themselves in many places entered the towns and became burghers, thus confessing that the centre of social life was altered.

The feudal period, one of the most remarkable in the history of the world, passed away, leaving a multitude of influences which will never die out of our civilization. We must not despise it; we ought to deal justly with it—to blame and to admire on good grounds. But it is becoming in the rapid progress of society more and more strange to us. Many of our institutions which sprang up in that institutional era need to be explained, as we explain Roman and Greek usages. The study of an age now ancient alone can make the origins of many customs and laws that are still vigorous, intelligible. T. D. WOOLSEY.

Feuer'bach (LUDWIG ANDREAS), a German philosopher of great notoriety, b. at Landshut, Silesia, July 28, 1804; in 1822 went to Heidelberg to study theology, but removed in 1824 to Berlin, where, under Hegel's auspices, he devoted himself exclusively to the study of philosophy. In 1828 he gave a course of lectures at the University of Erlangen, and in 1844 another at the University of Heidelberg. Meanwhile he developed a great activity in literature, and wrote, besides numerous minor essays in periodicals, *Thoughts on Death and Immortality* (1830), *History of Modern Philosophy from Bacon to Spinoza* (1833), *Criticism of the Philosophy of Leibnitz* (1837), *Pierre Bayle* (1838), *Philosophy and Christianity* (1839), *Das Wesen des Christenthums* (1841), *Principles of the Philosophy of the Future* (1843), and *Das Wesen der Religion* (1845). After 1844 he retired to a small village in Franconia, where he lived, very poor and mostly occupied by practical employments, till his death, Sept. 12, 1872. A national subscription was raised for him shortly before he died.

Ludwig Feuerbach is the representative of the modern atheism in its German form. His polemics is often boisterous and uncouth, but his positive views are entirely free from that coarse or supercilious materialism which characterizes the English and French atheism. He dissolves the idea of God into that of nature; construes religion as the product of a merely psychological process—natural, perhaps necessary, at one stage of human development, ridiculous and injurious at another. His views on this last point contain many deep and striking psychological ideas, and it is not until he approaches Christianity, and begins to construe its doctrines too as resulting from the weakness and confusion of the human spirit, that he becomes crude, and sometimes even puerile. CLEMENS PETERSEN.

Feuillant Club, The, of the French Revolution, took its name from the cloister of the Feuillants, where its meetings were held. It was founded in 1790, and known at first as "the Company of 1789." We first hear of a Feuillant club in the summer of 1791, and by November of that year the club was suppressed. Its members were of the moderate party, and were consequently objects of popular violence. La Fayette was the most distinguished of its members.

Feuillants [from *Feuillans*, a village near Toulouse, where their first abbey was situated], a name applied to certain congregations of reformed Cistercian monks and nuns. Jean de la Barrière, abbot of Feuillans, began the reform in 1567. The reform was approved by the pope in 1586 and 1587. Their first house in Paris was instituted in 1588. Their severe rule was mitigated in 1595. The congregation was divided in 1630 into that of Notre Dame de Feuillans and the reformed Bernardines (the latter Italian). Nuns were admitted to receive the rule of the Feuillants in 1588. The nuns (Feuillantines) were first organized as a congregation in 1583 by Marguerite de Polastron. The Feuillants were one of the numerous remote branches of the Benedictine order.

The original abbey at Feuillans (*Folium, Fulium*), in Haute-Garonne, Languedoc, was founded in 1162.

Feuillet (OCTAVE), dramatist, b. at St. Lô (Manche), Aug. 11, 1812; was educated at the College of Louis le Grand at Paris, where he distinguished himself; entered upon his literary career in 1844 under the name of DÉSIRÉ HAZARD, and since that time has been a constant contributor to various newspapers and periodicals, and has written many comedies, dramas, and farces, most of which have been received with much favor. Among his remarkable productions are *La Nuit terrible*, *La Crise*, *La Tentation*, *Rédemption*, *The Sphinx*, etc., and of his works of fiction *Bellah*, *Le Roman d'un jeune Homme pauvre*. In 1862 he was elected to fill the chair in the French Academy left vacant by the death of Eugène Scribe.

Feuilleton [Fr., a "small leaf"], in recent French journalism, the name of that part of the sheet which contains the literary intelligence, criticism, and other similar matter. The feuilleton often contains tales, either complete or serial. Hence, a light romance written for a journal is often called a feuilleton.

Féval (PAUL HENRI CORENTIN), French novelist, b. at Rennes Sept. 27, 1817, was admitted to the bar at his native place, but soon became an author. Among his many novels the following have been translated into English: *The Lover of Paris* (1846), *The Duke's Motto* (1863), *The Woman of Mystery* (1864), and *Thrice Dead* (1869). Was made an officer of the Legion of Honor in 1869.

Fe'ver [Lat. *febris*, allied to *ferveo*, to "glow," to "be hot"]. In distinction from other diseases, which, however grave or extended, are confined to certain organs or systems of the body, fever may be said to be a departure of the *whole body* from its normal condition—a perversion of all the physiological functions. Not enough is known of the nature of the febrile process to make a definition of it possible. Even a description of it is difficult to give, considering the great variety of its forms and the difference of its degrees.

Symptomatology.—This difference will best be understood by selecting for description a febrile attack of average degree and duration. After a sensation of general *malaise*, of bodily as well as mental languor, with more or less headache, with pains in the back and in the limbs, loss of appetite, an accelerated and rather small pulse, and great sensitiveness of the skin to the temperature of the surrounding atmosphere, a *chill* sets in, causing involuntary shaking of all parts of the body, with paleness of the surface and a bluish tinge of the nails and lips. This stage, after having lasted a certain length of time, gives way to a sensation of *heat*, not merely felt by the patient himself, but also by others. The skin becomes turgid and congested, feels hot and dry, the pulse remains quick, but is fuller, the respiration is more hurried and irregular, the general restlessness becomes very great, the thirst intense, the appetite is wholly lost, the tongue is coated with a whitish film, the mucous membrane of the mouth and throat is dry, the urine is scanty, of a deeper color but clear, and of a greater specific gravity; the patient, who during the cold stage could hardly get on clothing enough, wants to free himself from every covering. After this stage of dry heat the skin breaks out in a profuse *sweat*, the dryness of the mouth and the thirst diminish, the respiration becomes deeper, more regular, and less frequent, the pulse, still accelerated, is full and bounding, the patient gets calmer, and often falls into a sleep, out of which he awakes with a pleasant sensation of well being, although more or less debilitated.

Not all the symptoms just described must necessarily be present to pronounce a certain condition of the system as febrile in character. It is not always that fever is ushered in with a chill. Very often only slight horripilations and insignificant rigors precede the development of intense heat, which may pass off, scarcely moistening the skin by sweat. Instead of the great muscular pain and the torturing sensation of restlessness, there may be not more than a rather voluptuous feeling of laziness, and, in place of a distressing confusion of ideas, a not unpleasant play of the fancy may exist. The appetite is not always wholly lost, nor is the thirst necessarily great. The pulse, never as slow as in health, either from individual peculiarities, or from being in a debilitated condition antedating the fever, or from

long duration of the fever, may show great frequency, and yet not denote a very grave febrile state, provided other symptoms are moderate. The symptoms may vary too, in consequence of the coexistence, intrinsic or accidental, of local diseases, or according to the duration of the febrile process. With all these variations, producing the most different types of fever, it is surprising that the totality of symptoms so strikingly impresses the mind of even non-professional observers that hardly ever a mistake is made in pronouncing a patient "feverish."

But there is one symptom which is never wanting in fever, which can be measured with mathematical exactitude, which always keeps in true relation to the degree of the fever: it is the *increase of the temperature* of the body as determined by the thermometer. It varies from 98.5° F. (normal temperature of the body) to 108° F., or a little more (37.5° to 42° C.). There is no more certain and trustworthy guide to a correct judgment of the dangers threatening health and life from fever than the thermometer, and it is now universally adopted by the medical profession as a means of diagnosis and prognosis in fevers.

It is interesting in this respect to find with what unerring grasp popular instinct has seized on the leading symptom of fever, and made it the name-giver of this most complex morbid action in the different languages, at least of Indo-Germanic origin. Fever in Greek is πυρετος, from πῦρ, "fire;" in Latin, *febris*, Old Latin, *ferbis*, from *ferveo*, "I grow hot;" in German, *Fieber*, from the Old German, *Fiur*, "fire." All these words, it is believed, are from the Indo-European root, *pû*, to "purify."

The classification of fevers is based partly on scientific, partly on practical, partly on purely arbitrary grounds. The principal and really scientific distinction is between *idiopathic* (primary) and *symptomatic* (secondary) fevers. The first class comprises those varieties in which the fever is the only, or at least the first (primary), morbid action, so that local diseases occurring in the course of the fever must be considered as depending upon it, or as acceding to it, without cogent inner cause. These fevers are also called *essential* fevers, because they make up the essence of the disease. All zymotic fevers, be they contagious or miasmatic, belong to this class. Symptomatic fevers require a local disease as a preceding condition, by which the fever is started. All the fevers belong to this class whose names are derived from the *morbid process* which lies at their root; for example, inflammatory, catarrhal, rheumatic, hectic fevers; also all fevers named after the organs whose diseased condition causes them—brain, lung, gastric, enteric fever. Another principle of distinction is, whether fevers occur in solitary instances (*sporadic*), or whether they attack a larger number of individuals. In this latter respect, if they are circumscribed by certain limits beyond which they cannot be discriminated, they are called *endemic;* if migrating over extended spaces, ignoring varying climatic and other differences, *epidemic.*

The name of some fevers is derived from some predominating symptom—*e. g.* typhus (τῦφος, "stupor"), eruptive fevers, broken-bone fever, spotted, scarlet, yellow fever. Sometimes the real or supposed *cause* is made use of to give the name—*e. g.* malarial, septic, hay, jail, ship fever.

The name *bilious* fever is often given to cases of ill-defined type and varied character, very commonly with no special propriety; and the term is happily obsolescent.

A very important principle of distinction is what is called the *type* of the fever. It is characteristic of the febrile process that, while having, like most acute diseases, its stages of rise, height, and decline, yet it does not run through them with an even tenor, but that certain oscillations will be noticeable, the febrile symptoms showing an exacerbation and remission every twenty-four hours, or even in shorter intervals. The exacerbation in the greatest number of cases will set in in the evening and rise until about midnight, when the remission commences, so that in the morning hours all the symptoms are mildest. Yet, the symptoms never wholly disappearing, the fever is called a *continued* or *continuous* one. This peculiarity of the febrile process may be so marked that it nearly ceases in the morning—*remittent;* or the febrile symptoms may disappear altogether, to return on another day at about the same time—*intermittent.* This intermission may occur daily—*quotidian;* or every other day—*tertian;* or every three days—*quartan.* Or the fever may last with certain well-marked symptoms for several days, then disappear, returning after a couple of days' intermission, to react the former scene—*relapsing* fever.

A prominent feature of the fever is the one which refers to a condition of apparent augmentation or depression of the vital process as a whole. This constitutes the *character* of the fever, which is wholly distinct from its type, although carelessly this expression is used rather indiscriminately. If the essential symptoms of fever are average in degree and proportion, none preponderating unduly, the fever is called *erethic.* If the circulation is very much increased in force, the respiration is deep, the skin turgid and very hot, the eyes are glistening, it is a *synochal* fever. If, on the contrary, the stamp of exhaustion or suppression of vital forces is marked on the whole process, we speak of it as an *adynamic* fever. And if the disturbance of the depressed vital functions is coming on insidiously, or is such as to threaten almost at any moment their annihilation, we call it *malignant.*

From what has been said it is plain that the febrile process in the same individual and at the same time may belong to different varieties, according to the principle of classification applied. For example: typhus fever is always an idiopathic, zymotic, contagious, eruptive fever of a continuous type. It may be or not sporadic, malignant, ship, or jail fever.

Pathology.—To understand fully what occurs in fever, conditions would have to be fulfilled which to our present anatomical, physiological, and chemical knowledge are either totally hidden or obscure, or the realization of which is surrounded by such difficulties that they have become only partially solved. Granted a thorough knowledge of the anatomical structure of the organs and the systems of the body in perfect health; of their chemical composition; their relative and total weight; of the quantity and quality of secretions and excretions; and testing the same individual just emerging from a fever in all these respects,—the *ultimate* changes wrought by fever would be apparent.

To understand how these changes have been produced it would be necessary to know the quantity and chemical constitution of solid and liquid food consumed during the fever; the alteration of the circulation; the air inspired and expired; the quantity of force expended by voluntary and involuntary motion; the quantity and chemical composition of all secretions and excretions; and finally, the amount of animal heat generated during the fever. Moreover, to guard against any error vitiating the value of these facts, it would be necessary to eliminate all the influences of local diseases, producing the fever or being produced by it. Moreover, all the above occurrences would have to be gathered, not as a whole, but in parts, in regular intervals, some of them if not hourly at least twice a day, as it is known that periodical fluctuations do take place in the physiological state during the night and day. Of all these matters only a very small part has been studied with such frequency and thoroughness that results have been gained which are beyond doubt.

At present, instead of philosophical speculations and the coining of a more or less ingenious hypothesis, a true scientific method of observation and experiment rules the science of pathology; and if no great advances have been made in clearing up the pathology of fever, it is not altogether because the ways are unknown, but because the means and time to unravel the complex maze of the febrile process are not furnished even to scientific institutions, not to speak of single individuals.

What is known with certainty is this: that the waste of organic material is not merely owing to a diminished supply of food or to an imperfect assimilation, but that of all organic substances the albumen of the body is disproportionately consumed. This is shown by the fact that more than double the quantity of urea is eliminated than is normal. The quantity of urea cannot be increased unless a corresponding decomposition of nitrogenous substances by oxidation takes place. Further, more carbonic acid gas is given off, partly by breathing, partly by insensible loss, than under the same conditions in a state of health. The same is true of water. But neither of these substances is lost in so great a proportion as urea. Consequently, it is not improbable that the body does not become poorer in fat-generating substances. This at first sight somewhat paradoxical assertion finds its corroboration in the fact that at the close of very wasting febrile diseases—for example, typhoid fever—a marked fatty degeneration of the muscles is found. The coloring-matter of the urine is increased in quantity, which demonstrates disintegration of the red blood-corpuscles and of the muscles. The urine, too, contains a much greater proportion of salts of potash—another argument for the waste of red blood-corpuscles and muscles. Not much is known of the changes in the other non-organic acids and salts, nor of the quantitative and qualitative changes in the other secretions. But the known changes which have been alluded to cannot occur except by increased oxidation. And as oxidation is the source of heat, during fever more heat is necessarily produced. This increase of heat in the body is found even during the cold stage; and although the outer parts are colder than they are normally, yet within the cavities of the body the thermometer detects an increase of heat. This increase is somewhat moderated by the body giving off more heat by

conduction, radiation, and evaporation, or by all three combined. Nevertheless, the body retains a surplus, which keeps it hotter while the fever lasts than under the same conditions in the normal state. That wonderful regulation by which the body in the physiological state keeps its inner temperature at 98.5 F°., contracting the blood-vessels of the skin if the surrounding medium is cold, or causing evaporation by sweat if the surrounding medium is hot, although not entirely lost, is materially perverted in fever.

Pathogeny.—Limited and fragmentary as is the knowledge of pathology of fever, even less is known of its origin. One hypothesis has certainly been shown to be untenable—namely this, that an irritation of the peripheral nerves can produce an alteration in the nervous centres, in consequence of which fever is originated. That fever can be produced experimentally by injecting septic substances into the blood—that contagious and infectious fevers are the result of peculiar substances, which get into the circulation either because they float in the air we breathe or because they are contained in what we eat and drink—is beyond doubt. The inference, then, is strong that secondary fevers also are generated in a similar manner, the local diseases producing some substance which if absorbed contaminates the blood in such a way that fever must follow.

In what manner this is done is unknown. Some pathologists of the humoral school would have it that the organic and chemical changes in the blood alone are sufficient so to alter the whole process of nutrition and assimilation that a general disease, called fever, must be the result. According to their views, the nervous system would be degraded to, as it were, a mere registering apparatus for the changes which occur, without originating or influencing them. Another party, although recognizing that the blood is the first bodily constituent on which the fever-exciting cause acts, maintain that no fever could arise if the blood, having undergone certain changes, did not act in a manner on the nervous centres—that the functions of nutrition, assimilation, secretion, and particularly the regulation of animal heat, cannot be kept any longer in physiological harmony by the nerves leading from the nervous centres to the peripheral parts. This latter hypothesis, although it has hardly reached yet the dignity of a theory, seems the more probable one, and is held by far the larger number of pathologists. (The more important varieties of fever are described under their alphabetical heads.)

ERNST KRACKOWIZER.

Fever Bush, the *Lindera Benzoin*, a handsome shrub of the order Lauraceæ, common in the Northern States. Decoctions of its bark and leaves have been used for aromatic and stimulant drinks in low fevers. Its red spicy berries have afforded a poor substitute for allspice. It is also called spice bush and benjamin tree.

Fe'verfew (*i. e.* a "febrifuge"), the *Pyrethrum Parthenium*, a large perennial herb of the order Compositæ, resembling chamomile, and a native of Europe, sparingly naturalized in the U. S. There are some fine cultivated varieties, which are prized in the flower-garden. It was formerly much used as a deobstruent, tonic, and febrifuge. It is not much used, but it has valuable medicinal powers.

Fe'verwort, Wild Ipecac, Horse Gentian, or **Tinker's Weed,** a coarse perennial herb of the U. S., the *Triosteum perfoliatum* of the order Caprifoliaceæ. Its root is used as a cathartic and emetic. It is mild and usually safe. A smaller species, *Triosteum angustifolium*, grows in the Southern States.

Few (IGNATIUS A.), D. D., LL.D., an eminent minister of the Methodist Episcopal Church, South. He was b. in Augusta, Ga., Apr. 11, 1789, and d. in Athens, Ga., Nov. 28, 1845. He was educated at Princeton and New York, and his legal studies were directed by Gen. Flournoy of Augusta. In 1812 he obtained a colonel's commission in the army, which he honorably held till the close of the war, when he returned to his legal practice. He was at this time tinctured with infidelity, but, becoming a Christian, he shortly after (in 1828) entered the ministry of the Methodist Episcopal Church, in which he soon rose to great eminence. He was the founder and first president of Emory College, Oxford, Ga. He was distinguished in the highest councils of the Church, and was an able defender of the South in the General Conference of 1844, when measures were adopted which led to the organization of the Methodist Episcopal Church, South. He suffered for years from hæmorrhages of the lungs, which occasioned his death. He was highly esteemed for his encyclopædic attainments and abundant labors, and as much beloved for his catholicity of spirit and childlike simplicity. T. O. SUMMERS.

Few (WILLIAM), b. in Baltimore co., Md., June 8, 1748, removed in 1758 to Orange co., N. C., and to Georgia in 1776. He was chosen to the State convention to form a constitution, as also to the assembly, and made one of the council. With the rank of colonel he served in the war of the Revolution; in 1778 he became surveyor-general, and also presiding judge of the Richmond co. court. From Jan., 1780, to 1783, he was delegate to the old Congress, and also in 1786; a member of the national constitutional convention in 1787, and of those of the State of Georgia in 1796 and 1798; U. S. Senator from Georgia 1789–93, and then three years on the bench. He removed to New York in 1799, and was afterwards in the State legislature, commissioner of loans, and mayor of the city. D. at Fishkill, N. Y., July 16, 1828.

Fez, province of the empire of Morocco, by which it was conquered in 1548. It is bounded N. by the Mediterranean, E. by Algeria, S. by the mountains of Atlas, and W. by the Atlantic. It is a rich champaign country, productive of wheat, honey, tobacco, olives, and wine. Its population is estimated at 3,200,000.

Fez, Fes, or Fas, the capital of Morocco, numbers 100,000 inhabitants, and is situated, according to the statement of the Spanish general Badia (Ali Bey el Abassi), in lat. 34° 6′ 3″ N. and lon. 5° 1′ 11″ W., in a valley on the north-western slope of the Atlas, surrounded by mountains on all sides except towards the S. Two rivers run through the city, changing their names whenever they change their course. Thus, the river which rises about 20 kilomètres S. W. from Fez is first called Ras-el-ma, and then, on entering the city, Ued-Fes; in the city it unites with a larger river coming from the S. E., and after the conjunction it is first called Ued-Fes, and then Ued Tebu, which latter name belonged to the larger river before it entered the city. Fez consists of Old Fez (Fes-el-bali) and New Fez (Fes-el-djedid), and these two parts of the city are two kilomètres distant from each other, connected with one street only, which, however, is densely set with houses. Old Fez lies to the N., and its eastern part rises with the slope; New Fez lies to the S., wholly in the valley. Old Fez numbers sixteen quarters and has seven gates; New Fez, only two quarters and three gates. The above-mentioned rivers unite between the two parts of the city, and run then through Old Fez, dividing it into an eastern and a smaller western part, which are connected with each other by six stone bridges. Both Old Fez and New Fez are surrounded with walls from 30 to 40 feet high, from 6 to 7 feet broad at the base, about 3 feet at the top, and built of a mixture of clay, lime, and cement; only the gates are framed with stone. At each 350 mètres rises a quadrangular tower constructed to hold cannon, and the upper passage of the wall has loopholes adapted for defence. But the walls are in very bad repair; only those of New Fez are a little better preserved, and some of their towers rise to a height of 80 feet. Yet, although two detached forts of stone are added to these fortifications, one to the E. and one to the W., they would afford no real power of resistance except against a native enemy. Fez makes, generally, a gloomy impression, as the streets are very narrow, the public squares very small, and the houses two or three stories high, without presenting any windows to the street. Pavement does not exist, whence an immense dust in the summer and deep mud in the winter. The interiors of the houses, however, are often very handsome, the yards being paved with marble and the walls and ceilings of the rooms covered with light colors. Each house has a spring or fountain to wash away offal and dirt. The palace of the sultan of Morocco comprises the whole south-western part of New Fez. This gigantic palace consists of many large yards provided with arcades and surrounded with buildings. The harem, situated separately in the S. E. corner, affords room for more than 1000 women. The garden is beautiful, and yields the finest European vegetables. Besides this, the sultan has another but smaller palace called Bu Djelud, situated between Old and New Fez, and built—probably by European renegades—in the style of the Renaissance, blended with Moorish ideas. A couple of miles S. of New Fez he has a summer palace, and here is laid out a camping ground (Mhalla) for the army, which is always stationed near the person of the sultan, the soldiers encamping in tents. Among the remarkable buildings are also the mosques of Karubin and El Mulei Edris. The former is of immense dimensions, and rests on about 800 columns. It is situated in the middle of Old Fez, and is very rich. Its architecture is without harmony, heavy but durable. A library consisting of manuscripts is connected with the mosque, and even science is taught here. The mosque of El Mulei Edris, named after the founder of the city, lies close by the Karuben, is very old, and of an architecture which evidently imitates the Christian temple. It has no court. The main building consists of one single quadrangular nave without columns, and contains the tomb of Mulei Edris. This mosque is a refuge for fugitive criminals. Fez has eleven mosques of importance, besides a

great number of smaller ones. Although the natives are hospitable in the highest degree, yet the great conflux of foreigners has made inns and hotels necessary. The best ones, which are built to lodge both men and animals, are called *tenaduk;* they are large and substantial buildings, but entirely without furniture. The city has a considerable trade with Marseilles, Gibraltar, Cadiz, and Lisbon. Raw and manufactured silk, cotton, cloth, paper, arms, tea, sugar, and spices are imported from Europe. Tanning, weaving, and pottery are the principal manufactures of the country, and form the exports. Fez is unsurpassed in the manufacture of silk scarfs. The inhabitants are a mixed race of Arabs and Berbers, ugly, very uncleanly, and fanatical in religion. From 8000 to 10,000 Jews live here.

Fez was founded at the end of the eighth century; as to the exact date, authorities disagree. Edris, a relative of Haroun-al-Raschid, was its founder, and he was very fortunate in selecting the location of the city. From several points in the surroundings of Fez it seems evident that there must have been earlier Roman settlements in these localities. The etymology of the name of Fez is uncertain. At the time of the Crusades it was one of the most magnificent cities in the Mohammedan world, but since the middle of the sixteenth century it has declined.

A. Niemann.

Fezzan' [the ancient *Phasania*], a kingdom of Northern Africa, between lat. 24° and 31° N. and lon. 12° and 17° E., bounded N. by Tripoli, and on the other sides by the Sahara. The northern part of the country is covered with bare hills of black quartz sandstone, without rivers and almost without vegetation. The southern part is level land, often consisting of dry sand. Only one-tenth of the soil is cultivable. The climate is in summer extremely hot, and at all seasons very dry. Wheat and barley are cultivated; dates, figs, and lentils are the principal articles of food. Horses and camels are reared, but cattle, and even sheep, are rare. Lions, tiger-cats, and jackals are abundant; also gazelles and ostriches. The inhabitants, whose number is estimated at about 50,000, are a mixed race of Berbers, Tuaricks, Arabs, and negroes. They are governed by a sultan, who pays a tribute to the viceroy or *valy* of Tripoli. Moorzook is the capital and the rendezvous for the caravans coming from Cairo, Tripoli, and Timbuctoo, which occasion a considerable trade.

Fibre. See Nerve-Fibre, by E. C. Seguin, M. D.

Fi'bre [Lat. *fibra*, a "filament"]. Man has for ages availed himself of the filamentous character of various parts of plants to make clothing, domestic utensils, parts of instruments of the chase, and shelter for himself and his possessions. The animal kingdom has also been laid under contribution from the earliest times, and even the mineral kingdom contributes, in the substance known as asbestos, a fibre—in the general sense of the word—which has various uses in the arts. The history of the employment of these different materials, their uses, and the details of those processes of manufacture by which they are converted into fabrics for the use of man, belong properly to the different articles in this work in which they are severally described. (See Silk, Wool, etc.) But the minute characteristics of the principal vegetable fibres, and the points on which their value for particular purposes depends, are most conveniently studied by grouping them under one subject. Anatomically considered, vegetable fibres may be referred to three different sources: viz. (1) plant-hairs, (2) fibro-vascular bundles, or (3) the separate constituents of the latter. (1) The important plant-hairs employed for textile purposes are the long, single cells which are attached to the seeds of certain species of *Gossypium* (cotton). (2) Fibro-vascular bundles are obtained from the stems of endogenous plants, and consist chiefly of long bast-cells, with an admixture of spiral ducts (*e. g.* Manila hemp). (3) The principal elements of fibro-vascular bundles of exogens—namely, bast-cells and woody tissue—are used separately as fibres for spinning or for papermaking (*e. g.* flax and poplar-wood). These structures are cells of different shapes, sizes, and thickness of wall. Although they are derived from sources so different, they possess in common certain chemical and physical properties which must be considered before an examination of individual fibres is undertaken.

Chemical Characters.—The principal material of vegetable tissues consists of cellulose ($C_6H_{10}O_5$, or some higher multiple, $C_{18}H_{30}O_{15}$). This is generally accompanied by an incrusting substance which greatly reduces the flexibility of the fibre. Fibres are freed from this incrusting matter by the careful use of acids, alkalies, and bleaching agents. Cellulose dissolves in an ammoniacal solution of cupric oxide. (For an account of other changes produced by chemical agents, see Gun-cotton, Parchment-paper.)

Physical Properties.—Fibres vary in color, from the snow-white of china-grass (*Böhmeria nivea*) to the grayish-black of *Tillandsia*. All vegetable fibres are doubly refringent in polarized light. The conductive power of vegetable fibres for heat appears to be greater in the direction of the length of the fibre than perpendicular to it. The hygroscopic power of fibres is shown in the following table by Wiesner (*Rohstoffe*, § 293):

Fibre.	Percentage of water when air dry	Greatest amount of water.
Esparto	6.95	13.32
Belgian flax	5.70	13.90
Cotton	6.66	20.99
Fresh jute	6.00	23.30
Manila hemp	12.50	about 40.00

Cotton.—Cotton fibres are the hairs which grow upon the seeds of species of *Gossypium*, plants belonging to the mallow family. Five species, now much mixed up, produce most of the cotton of commerce—*G. arboreum, barbadense, herbaceum, hirsutum, religiosum.* In India and China *G. arboreum* and *religiosum* are extensively cultivated; *G. hirsutum* is common in the West Indies; *G. barbadense* and *herbaceum* are those best known in the U. S. The seeds are numerous in the capsule (boll), which splits from the top into three or five parts as the fruit ripens. Each seed is clothed with delicate cells of variable length. Very short hairs are mixed thickly with the longer cells, which are used as fibres. The longer cells vary in length within certain limits in different species; the following measurements by Wiesner are averages:

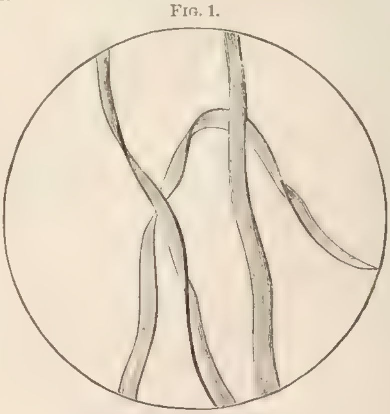
Gossypium barbadense	3.89–4.05 cm.
" *arboreum*	2.50
" *herbaceum*	1.03–1.82 cm.

The cells are slender cylinders, with a slight enlargement a little above the base, after which they taper to the summit. The thin walls collapse and twist as the seed ripens, so that the slender, tapering tubes become spiral bands. The breadth of the flattened cells varies in different species. The measurements (from Wiesner) are given in fractions of a millimètre:

G. barbadense,	0.0192–0.0279,	most	common	0.0252
G. arboreum,	0.0200–0.0378,	"	"	0.0299
G. herbaceum,	0.0119–0.0220,	"	"	0.0189
G. religiosum,	0.0255–0.0400,	"	"	0.0333

The spiral is irregular, sometimes turning to the right, and then abruptly turning in the opposite direction; occasionally, there is simply a folding of one edge of the band over the other. These spirals adapt the cells for spinning. Contiguous fibres cling together slightly by interlocking their spirals as they are drawn out, and this slight grasp is strengthened by torsion of the thread at the spindle. Length of fibre is known in the cotton trade as length of "staple."

Fig. 1.



Cell of cotton (170 diam.).

Under a magnifying power of 200 diameters, the flattened cell, if ripe, exhibits plainly the cell-walls and the space between them, which is filled with air. In exceptional cases the walls are thick, and then the air-space is reduced to a slender dark line. The surface of the wall has a cuticular layer, which may appear unevenly striated, somewhat granular, or nearly smooth. When a cotton fibre is placed in an ammoniacal solution of cupric oxide, the cell-wall dissolves, and leaves the cuticular layer somewhat altered in shape. The same phenomenon is observed in the case of other plant-hairs—for instance, vegetable silk—but never in bast-cells. This use of the solvent serves for the positive discrimination of the textile plant-hairs. The cotton fibre is usually white, but may be tinged yellow (*G. religiosum*). The finer short fibres are frequently colored green (*G. hirsutum*). This becomes rose-red on the addition of dilute acid, but the green color is restored by

ammonia. The removal of the cotton fibre from the epidermis of the seed is effected without material injury to the hairs of black-seed cotton by means of the saw gin. In green-seed cotton the fibres are more closely adherent. The shorter hairs which remain after the ginning are utilized in papermaking. The characters which determine the commercial grade of cotton are length of staple, fineness, and whiteness. In sea-island cotton, always black-seeded (*G. barbadense*), the latter qualities are found combined with great length of staple. The cotton of Louisiana is short-stapled, fine, and white; that from *G. religiosum* (and *G. flavidum*) is short-stapled, fine, and yellow.

Bombax Wool. The mature seeds of many Bombaceæ are packed in their capsules in a mass of silky hairs which have become detached during ripening. These hairs are single cells of brilliant lustre and a yellowish-brown color. It cannot be spun except when mixed with cotton or other fibres, which it can in no way improve.

Vegetable Silk.—Under this name are grouped the fibres which grow on the seeds of many milkweeds (Asclepiadaceæ and the like). The remarkable fineness and lustre of these fibres have led to many futile attempts to employ them, either alone or with cotton. The fibre is so weak and brittle that it would be useless for weaving even if it could be spun. A species of *Beaumontia* in India yields a vegetable silk of greater strength and almost pure whiteness. It is used in the manufacture of artificial flowers.

Fibro-vascular Bundles of Endogenous Plants. New Zealand Flax.—This fibre is obtained from *Phormium tenax*, now extensively cultivated in New South Wales. The leaves yield 22 per cent. of merchantable fibre. The fibre is yellowish, and composed of bast-cells mixed with ducts and cambium cells. The bast-cells are 0.008–0.0189 millimètre broad, and 2.7–5.65 millimètres long. These form the raw fibre, which often exceeds a mètre in length. New Zealand flax is fitted for cordage by its strength and resistance to the action of water and the atmosphere. According to Labillardière, the absolute strength of New Zealand flax, hemp, and flax are in the ratio of 60 : 48 : 34.5 ; silk : 100.

Aloë Fibre.—This is obtained from tropical species of *Aloë.* The fibre is white, of brilliant lustre, and of nearly the same thickness throughout its great length of 20–50 centimètres. It is made up chiefly of bast-cells 1.3–3.72 millimètres long, which do not readily separate from the bundle. The fibres are used in the rough state for cordage. The finest aloë fibres are spun and woven for fine muslins.

Manila Hemp.—This fibre, known also in commerce under the names plantain fibre, Siam hemp, Menado hemp, and white rope, is obtained from the clasping leaf-stalks of *Musa textilis* of the Philippine Islands. The fibres of other species of *Musa* have been employed, notably the plantain and banana. The outer parts yield coarse fibres seven mètres long—the inner, finer, about two mètres. The fibre consists chiefly of bast-cells 2.7 millimètres long and .029 millimètre thick. Manila hemp is used for cordage.

Agave Fibre, from *Agave Americana,* now cultivated in many warm climates, is less tough and flexible than Manila hemp. It is extremely light, and is capable of extensive use in rigging, but it has of late been more employed as an addition to bristles in the manufacture of brushes.

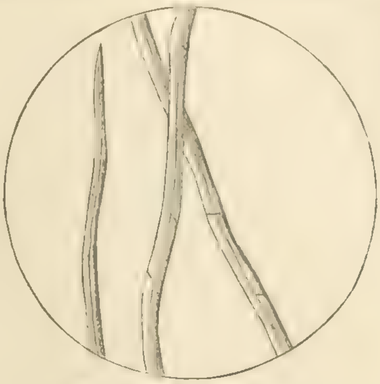
Cocoanut Fibre, from species of *Cocos,* a tropical palm, is known in commerce under the name coir. It consists of the fibro-vascular bundles of the husk of the fruit. It is reddish-brown in color, very strong, and withstands the action of water for a long time. It is regarded by Grothe as the lightest of all fibres which can be used for making cordage. The raw fibre is 15–33 centimètres thick, and consists of many structural elements. The bast-cells are the most important. These are from half a millimètre to one millimetre in length, and 0.016 m. broad. The walls are unequally thickened. Coir is one of the most important vegetable fibres of the tropics. It is now used for twine, cordage, tapestry, brushes, coarse paint-brushes, and even machine-belting.

Pineapple Fibre.—The fibres of the leaves of several species of *Bromelia* are employed for textile purposes. *Bromelia Karatas,* of South America, yields a whitish, glistening fibre which resembles Manila hemp, but is coarser, weaker, and less flexible. The fibres are cylindrical and about a mètre in length, seldom exceeding 1.2 millimètres in thickness. Its constituents are chiefly thin-walled bast-cells, with a few spiral vessels. When carefully prepared the finest fibres can be used for delicate fabrics.

Bast Fibres from Exogenous Plants.—These are the inner layer of the bark. They are long, flexible cells, with thick walls, aggregated with parenchyma in bundles or bands which are separated by very narrow (or in some cases wide) medullary rays.

Flax.—This is the bast fibre of species of *Linum,* chiefly *L. usitatissimum,* of which there are several varieties. The separation of the bast-fibres of flax, hemp, etc. from their contiguous tissues involves mechanical and chemical manipulations which are elsewhere described in detail. The stems are first subjected in mass to the action of water, either cold or warm. A kind of fermentation ensues, after which the bast-fibres can be separated from the surrounding tissues by mechanical means. The processes are known as "retting" and "scutching." The best results have been reached by what is known as warm-water rotting, followed by the use of a heckling machine, from which, according to the quality of the flax-plant, 15–20 per cent. of pure flax has been obtained. The length of flax fibres thus separated varies from a fifth of a mètre to a mètre and two-fifths; their width varies from 0.015–0.620 millimètre. The fibres are made up of regular cylindrical cells which taper towards the ends. The calibre of the cells is very minute, and is often reduced so that it appears a mere dark line. The cells are 2–4 centimètres long and from 0.015–0.017 millimètre broad. Here and there minute canals are to be detected in the walls, and by crushing the cell-wall exhibits spiral markings. The microscopic appearance of fresh flax bast-cells differs from that presented by manufactured flax. The thickening layers of

Fig. 2.



Bast-cell of flax (170 diam.).

the cell-wall are more or less broken, and the cells are covered with dark lines which are nearly parallel to each other, and generally run in the direction of the length of the cell. This appearance is seen under a magnifying power of 200–300 diameters. The best flax fibre is whitish, and this absence of color is secured by the best methods of preparation. Much of the Belgian flax is steel-gray, and that of Egypt is grayish-yellow. Flax has a delicate silky lustre. The total absence of any lustre is an indication that the bast-cells have not been wholly freed from surrounding tissues. Irish, Belgian, and, of late years, Italian flax is regarded finest. The Irish fibre is very fine, soft to the touch, and strong. Many Belgian varieties are nearly as fine as the Irish, and exceed it in length. The longest fibre comes from Egypt. It is coarse and hard to bleach, but very strong. The use of flax in the manufacture of linen thread and linen fabrics can be traced farther back than that of any other textile vegetable fibre. It is spun before bleaching.

Hemp.—This fibre consists of the bast-cells of *Cannabis sativa,* a plant of the nettle family. Hemp fibre is generally longer than flax fibre, sometimes reaching a length

Fig. 3.

Bast-cell of hemp (170 diam.).

of one or two mètres, or even more. Whitish and grayish fibres are best, the greenish come next, and lastly come the yellowish. Hemp fibre, even when finest, contains a max-

ture of parenchyma with the bast-cells. The latter are not so regular as those of flax. The walls are not always equally thick, but they are in general strongly thickened, and exhibit the canals which have been described under *Flax.* The air-space in the cells equals one-third of the whole breadth of the cell. Wiesner has shown that an ammoniacal solution of cupric oxide serves for the discrimination of hemp from flax. Under the influence of this agent the inner layer separates and becomes much crumpled, while the outer portion of the cell-wall becomes swollen and exhibits a fine parallel marking. Flax and cotton become blue by the action of iodine solution and sulphuric acid, but hemp turns somewhat greenish. The finest hemp is Bolognese, but by far the largest amount comes from Russia. It is not so fine as the hemp from Prussia or Austria. The hemp produced near Strasbourg is used for spinning. Hemp is chiefly used for fine and coarse cordage.

Mallow Hemp.—Several plants of the mallow family yield fibres which may be treated of in this place.

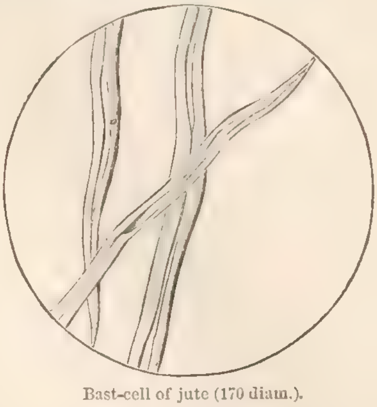
Hibiscus cannabinus of India, now cultivated in the West Indies, where it is called *ambaree*, has fibres of unequal length and differing greatly in their thickness. The bast-cells are 4–6 millimètres long and .020–.041 millimètre thick.

Sida retusa and other species of *Sida* are much used in India as sources of fibres, which are coarse or fine according to the mode of preparation. The bast is without lustre and of remarkable strength. The fibres consist almost wholly of flattened irregular cells, which in other characters much resemble the bast-cells of flax. Sunn hemp is produced from stems of *Crotolaria,* a plant of the pulse family. It is a fine and very strong fibre, only slightly hygroscopic. It is known in India also as Madras hemp. The flattened fibres are striated, and vary in width from 0.02–0.35 millimètre. Tercum fibre and Jetee fibre are from the stems of plants of the milkweed family.

China-Grass and Ramie.—These are from plants of the nettle family—the first from *Böhmeria nivea,* and the second from *B. tenacissima.* China-grass is cultivated in India and Southern China. The bast is very tough, and can be finely divided into minute fibres, which are known as cottonized fibre. It is whiter and more lustrous than ramie fibre, but in other respects does not differ widely from it. *Ramie* is cultivated in China and Japan and in some parts of America. By the "cottonizing" process the fibres are broken up into the bast-cells, which are themselves sometimes broken. It is frequently possible to detect under the microscope traces of the mechanical injuries which they have received in the process. From the coarser fibres cordage is made, but from the finer the so-called *grass-cloth* or *grass-linen* is woven. The manufacture was formerly confined to India and China, but of late it has been undertaken in Germany.

Jute is the fibre of several Indian species of *Corchorus,* a plant of the linden family. *Corchorus capsularis* is the species most commonly employed in cultivation. In warm countries the culture of jute presents few difficulties. The seed is sown in April or May; in June or July the plant is in flower; in September or October the fruit is ripe. The strength and flexibility of this fibre, like those of flax, hemp, and ramie, diminish at the time the fruit matures. The bast-cells at that time become woody and more brittle, so that it is always desirable to cut the stems before the ripening of the fruit. The yield of jute is said to be from two

Fig. 4.



Bast-cell of jute (170 diam.).

to five times as great as that of hemp or flax. The stalk is three to four mètres high. The fibre of jute is very silky, slightly colored, and composed almost wholly of bast-cells, which are cylindrical, somewhat flattened, or prismatic. The cells are 0.8–4.1 mm. long, and 0.016 mm. thick. The most striking peculiarity of its microscopic structure is the total lack of parallelism between the inner and outer surfaces of the wall. At many points the cell-wall is much thickened, while in others it is as thin as in vegetable silk. The same unevenness is seen in a few other fibres, but not in flax or hemp. Jute in its finest state has such a brilliancy of lustre, and takes colors so well, that it has been much used to mix with silk. Much has been employed as a substitute for human hair in the manufacture of chignons, etc. Of late it has found an extensive use in papermaking. Jute was formerly imported from Calcutta, and was used chiefly in the manufacture of bagging. The term gunny bagging (*goni,* a Madras word) was applied not only to this, but to coarse fabrics made out of sunn, *Crotolaria juncea.* Much jute is brought into the market in the form of jute butts, in which state it is taken by the papermakers. A fibre much like jute, and frequently mixed with it, is obtained from *Abelmoschus* (*Hibiscus*) *tetraphyllos,* a plant of the mallow family from India. The bast-cells are 1–1.6 mm. long and about 0.016 thick.

Esparto Fibre.—This is obtained from the stems and leaves of *Macrochloa tenacissima,* a grass of South-western Europe. The fibre has been employed in the manufacture of coarse twine, but is now used wholly for papermaking.

Any of the fibres which have been spoken of can be used in the manufacture of paper, but only a few of them can be economically employed for this purpose at first hand. The fibres first serve in cordage or in woven fabrics, and then are turned over in the form of rags to the papermaker. Fibres for paper must be waste products or very cheap raw material (for instance, wood-tissue) which can be economically worked. *Zizania* (wild rice), *Phragmites* (reed), and the straw of cereals are used in the manufacture of different grades of paper.

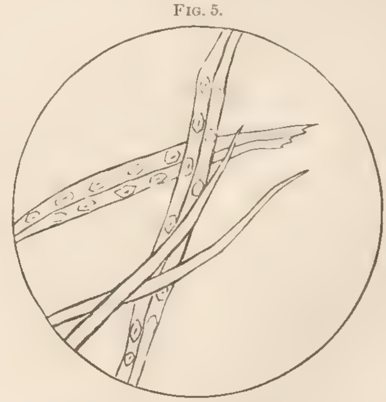
Paper Mulberry.—This plant, which belongs to the fig family, furnishes the fibres of which the tapa cloth of Polynesia and the common paper of Japan are made. The inner bark is beaten to a pulp and spread out in thin layers. Much of the Japanese paper contains some vegetable mucilage by which the texture is rendered firmer, but in general the tissues cohere without the addition of any *size.*

Bast Tissue.—The bast of the linden and some other exogenous plants may be separated from the stem in broad and thick bands, which can be split up into thin ribbons. From these thin bands the coarse Russia matting is made.

Bast of the Linden (*Tilia parvifolia* and *T. grandifolia*).—Stems thirty to forty centimètres high are best for the purpose. From these stems strips six to seven centimètres broad can be taken. Their ultimate bast-cells are very thick-walled, and sometimes much widened in the middle. Cuba bast, used for tying up packages of cigars, is from *Paritium tiliaceum* and *elatum,* plants which may be referred to the genus *Hibiscus,* of the mallow family. *Lagetta lintearia,* the lace-bark tree, yields a delicate but strong white bast which has open meshes like coarse lace. *Daphne cannabina,* another plant of the same order (Thymelaceæ), has a tough, fibrous bast, which is employed in India for the manufacture of cordage and paper.

Woody Fibres.—These are not used for spinning, but they are finding extensive application in papermaking, and their characters should now receive attention. Two important woods are selected, poplar and spruce, both of which are disintegrated either by mechanical means or by chemicals. In some mills the wood is boiled under pressure, with or without the presence of alkalies, after which

Fig. 5.

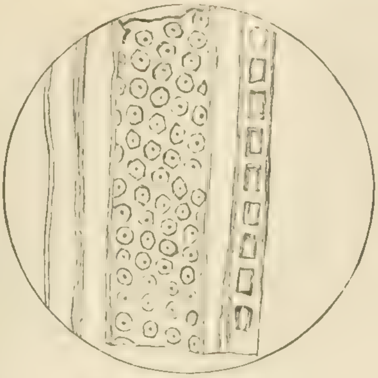


Spruce fibre (170 diam.).

it is easily broken down into its cells. In the Voelter process the wood is simply ground upon a rough surface, and

the fibres are sufficiently fine for papermaking. The processes will be found described under the title PAPERMAKING.

Fig. 6.



Poplar fibre (170 diam.).

Chemical Tests for Vegetable Fibres. A. Iodine in solution, followed by sulphuric acid. 1. Blue color: cotton; raw flax; cottonized china grass and ramie (sometimes reddish to blue); raw hemp, greenish blue to pure blue. 2. Yellow to brown: raw jute; raw esparto; bromelia; aloë and New Zealand flax.

B. Ammoniacal solution of cupric oxide. 1. Dissolves the cellulose: cotton, the cuticular layer remaining; cottonized china-grass and ramie; raw flax; hemp; sunn. 2. Colors the fibre blue, and causes it to swell up: raw jute; New Zealand flax; aloë; bromelia. 3. Simply colors the fibres: vegetable silk, blue; esparto, green.

C. Sulphate of aniline. Almost without effect on cotton, raw and cottonized china-grass and ramie; raw flax and New Zealand flax. Produces change of color in raw jute (gold yellow), raw hemp (light yellow), esparto (bright yellow), aloë and bromelia (gold yellow).

Microscopical Discrimination of Fibres as used. Fibres of a single cell: cotton, vegetable silk, bombax wool (plant-hairs), cottonized ramie and china grass (isolated bast-cells). Groups of cells chiefly bast: raw jute, flax, aloë. Groups of cells chiefly bast, with traces of parenchyma of the bast: raw sida, abelmoschus, and hemp. Groups of bast-cells mixed with ducts: New Zealand flax, manila hemp, esparto, coir. E. M. SCHAEFFER.

Fi′brin [etymology the same as for *fibre*], an organic substance found in the blood and lymph. In the former it is present in the proportion of two or three parts per thousand; in the latter in smaller quantity. Fibrin derives its chief importance from being an ingredient of the blood, making its first appearance in it about the fifteenth day of intra-uterine life, remaining constantly present thereafter. Its quantity varies, however, in different parts of the body. Arterial blood has more than venous, and the large veins near the heart have less than those at a distance; while in the blood of the renal and hepatic veins it is usually absent entirely.

Fibrin is the only component of the body which coagulates spontaneously; and it is by means of this property that it is extracted from the blood for examination and analysis. But it must be borne in mind that in its natural condition in the blood fibrin is always fluid, and its coagulated form, being abnormal, does not therefore exactly represent the original substance itself.

Fibrin may be extracted from freshly-drawn blood by whipping it with a bundle of twigs, to which, as it coagulates, it adheres. After washing, the coagulum presents a white, tough appearance, and upon placing it under the microscope it is found to consist of colorless and elastic filaments of considerable length, crossing each other in every direction, so as to form an irregular network. These filaments, or *fibrillæ*, are exceedingly small, having a diameter not greater than $\frac{1}{20000}$ or $\frac{1}{40000}$ of an inch. Within a few minutes after blood has been taken from the body it commences to lose its fluid condition, gradually becoming more and more solid until its coagulation is complete. It is then said to be clotted. The blood clots in the interior of the body after death; also during life when effused into the tissues, and also in a blood-vessel itself when a ligature is placed around it. This change depends wholly upon the presence of fibrin, for after its withdrawal the blood remains fluid indefinitely. With regard to the exact nature of coagulation there are many theories, but nothing is definitely known.

In inflammatory diseases the blood contains more fibrin and it clots more quickly. In fevers and exhausting diseases its quantity is diminished, and coagulation is retarded. This clotting of the blood is of the utmost importance in the preservation of life. When a blood-vessel is wounded or cut across, the fibrin of the blood which is poured out coagulates upon the edges of the vessel, forming a plug, so that no more blood can escape. If it were not for this spontaneous coagulation, it would be impossible ever to arrest hæmorrhage.

As one of the organic ingredients of the blood, fibrin must also play an important part in nutrition, but exactly what that part is has never been demonstrated.

G. H. WYNKOOP.

Fibroïn, the substance allied to horny tissue, of which silk and sponge are composed.

Fi′brous Tis′sues, a name applied to a group of histological elements which play an important part in the animal economy. They are generally assigned to two groups—the white and the yellow fibrous tissues, the former found in tendons, fasciæ, and other unyielding parts, the latter elastic and found in many organs, notably in the middle coat of the arteries. Fibro-cartilage is a substance intermediate between the fibrous tissues and true cartilage, and is found in a great variety of gradations, approaching more or less closely to one or the other type. Fibrous tissues, though so important to animal life, always play a merely mechanical part. Sparingly supplied with blood-vessels and nerves, they are not highly vitalized and have no active functions. They are composed of an albuminoid substance, which is changed into gelatine by boiling. They are of probable cell-origin, but when injured are repaired, if at all, by the effusion and subsequent fibrillation of blood-plasma. The white fibrous tissue is the principal seat of rheumatic disease. White fibrous tissue exists also in many neoplasms, constituting fibromata or fibroid tumors.

Fib′ula [Lat., a "pin" or "clasp"], in the vertebrate skeleton, the outer of the two bones of the leg between the knee and the ankle, the inner bone being the tibia. In man the fibula is much smaller than the tibia, and does not quite reach the knee-joint. Its upper extremity is the styloid process; its lower, the outer malleolus. It is developed from three centres, and is regarded as the homologue of the radius in the upper extremity.

Ficherelli, or **Ficarelli** (FELICE), b. at San Gimignano, Tuscany, about 1605; studied painting under Empoli, and became the friend and imitator of Cristofano Allori. He was an admirable copyist of Perugino and Andrea del Sarto, and his original works, now become rare and valued, are very delicately executed, excelling especially in the heads, which are very pleasing. His style is simple and natural. D. in 1660.

Fichet (GUILLAUME), b. at Aunay, near Paris, France, early in the fifteenth century; was in 1467 rector of the University of Paris, teaching at the same time rhetoric, theology, and philosophy. He was employed by Louis XI. in making peace with the duke of Burgundy, and was the patron by whose influence the first printing press was brought from Germany and set up in the Sorbonne at Paris. Among the first books printed in France were his *Rhetoricorum Libri tres* (probably 1470) and *Epistolæ in Parisiorum Sorbona* (1471). Fichet afterwards held office at the papal court of Sixtus IV. The date of his death is unknown.

Fich′te (IMMANUEL HERMANN), son of the great Fichte, was b. at Jena July 18, 1797, and educated at Berlin, where he studied philology. He was early attracted to philosophy, however, especially by the ideas of his father, and made a comprehensive study of its history. He also heard Hegel's lectures, but he is said to have felt rather disgusted at them, and in his own philosophical writings the opposition to Hegel is often sharp and pointed. He spent the earlier part of his life as a teacher, but in 1836 he was appointed professor of philosophy at the University of Bonn, and from 1842 to 187[illegible] occupied the same office at the University of Tübingen. His literary activity has been very comprehensive and very prolific. The most important of his works are *System der Ethik* (1850–53), *Anthropologie* [illegible] (1860), and *Psychologie als Lehre* [illegible] *Menschen* (1864). One of the most interesting of his many essays and speeches is that with which he opened a meeting of philosophers at Gotha in 1847, *On the Philosophy of the Future*. He has also written on politics, *Grundzüge* [illegible] (1848), and on theology, *Die speculative Theologie* (1846). In opposition to the absolute identity of finite and infinite, subjective and objective, matter and mind, world and God, which characterizes the philosophy of Hegel, I. H. Fichte teaches an absolute dualism between world and God, and all his efforts have been directed to the rational demonstra-

tion of the personality of God and to the establishment of a system of true theism. D. Aug. 12, 1879.

Fichte (JOHANN GOTTLIEB), the second of the four greatest philosophers of Germany, was born at Rammenau, in Upper Lusatia, May 19, 1762. He was of Swedish descent, and his father was a ribbon-weaver. In his earliest youth he exhibited the moral characteristics that appeared subsequently in the stern outlines of his philosophic system. When he was in his ninth year his excellent memory attracted the attention of the Baron von Miltitz, who interested himself in his education, and placed him successively in the family of a clergyman at Niederau, at the town-school of Meissen, at the Princes' School of Pforta (1774–80). At the latter place he became acquainted with the writings of Goethe, Wieland, and Lessing. The latter writer exercised an overpowering influence on his mode of thinking and his literary style. He studied theology at Jena and Leipsic, and began to grapple with the problems that form the centre of his philosophic system—those of free-will and necessity. At this time he studied the systems of Spinoza and Wolff, and adopted a fatalistic view of life. While acting as family tutor in Zurich (1790) he made the acquaintance of Johanna Rahn, niece of the poet Klopstock, whom he subsequently married. Returning to Leipsic in 1790, he began the study of the Kantian critiques, which had been published, the critique of *Pure Reason* in 1781, of *Practical Reason* in 1788, and that of the *Judgment* in 1790. He now found a new world, and began to live a higher life. He saw free-will to be the highest principle, and his fatalistic theories crumbled away at once. He visited Kant, and presented as his letter of introduction the manuscript of a *Critique of all Revelation*, a work composed in five days. It won him Kant's respect and esteem, and on its anonymous publication was taken for an original work of Kant by the philosophic public. Fichte, being announced as its author, found himself at once in the foremost rank of philosophers. After his marriage in 1793 he published a work in which he attempted to justify the French Revolution, and by this brought upon himself the suspicion of the German governments. Nevertheless, in 1794 he was called to the chair of philosophy in Jena, to succeed Reinhold, and there came into personal contact with Goethe, Schiller, Wieland, Herder, Humboldt, and Jacobi, and carried on an extensive correspondence with Reinhold, Schelling, Tieck, Novalis, and the Schlegels. Fichte here elaborated the great central work of his system, in which he attempted to demonstrate the basis of the Kantian system by an *Analysis of Consciousness*. Kant had borrowed his categories from the traditions of formal logic, and thus, while he combated dogmatism, had grounded his system on a dogmatic basis. Fichte sought to correct this by supplying a strict deduction of the categories from pure consciousness, and thus to place philosophy for ever beyond the reach of skepticism, and make it rival geometry in the certainty of its results. His *Science of Knowledge* (*Wissenschaftslehre*) appeared in 1794. Goethe, who had read it sheet by sheet as it passed through the press, wrote him: "In my opinion, you will confer a priceless benefit on the human race, and make every thinking man your debtor, by giving a scientific foundation to that upon which nature seems long ago to have agreed with herself." It was the first attempt in the history of human thought to unfold dialectically from the Ego the *a priori* conditions of all knowledge. It was at once adopted by the leading thinkers of the Kantian school. In an essay *On the Ground of our Faith in a Divine Government of the World*, which he published in his *Philosophical Journal* in 1798, he used language in speaking of the moral order of the world implying its equivalence to the idea of God, and thus aroused the charge of atheism against him. This, strengthened by the prejudice created by his work on the French Revolution, resulted in his dismissal from his professorship, notwithstanding a vigorous self-defence. To add to his misfortune, Kant at this time saw fit to publish his disclaimer of Fichte's system as a true interpretation of his own. He declared that in his opinion the *Science of Knowledge* was an altogether faulty system, chimerical and ephemeral. Refused protection by neighboring states, but assured of toleration by Frederick William III. of Prussia, he repaired to Berlin, and came into intimate association with Schleiermacher, Frederick Schlegel, Novalis, Tieck, Schelling, and others. Here he published several eloquent popular expositions of his system, the most prominent of which are the *Destination of Man* (1800), *The Sun-clear Report to the Public upon the True Nature of the Latest Philosophy—an Attempt to Force the Reader to an Understanding of it* (1801), *The Way to the Blessed Life* (1806). An outline of the philosophy of history appears in his *Characteristics of the Present Age* (1806). In his *Addresses to the German Nation* he took a bold, patriotic stand against Napoleon (1808). He became rector of the University of Berlin upon its establishment, and exerted a powerful influence upon its constitution. The new career opening to him after the downfall of Napoleon was cut short by his death from typhoid fever on Jan. 27, 1814.

As a philosopher, Fichte's position is that of the immediate successor of Kant and the completer of the critical system. Kant had endeavored to obtain a critical insight into the nature of knowledge. It was for him the product of two factors—the Ego, or subject, and things-in-themselves. He endeavored to determine accurately the value of the subjective coefficient of our knowledge. The intuitions of Time and Space, and the categories of Quantity, Quality, Relation, and Modality, were found to be the results of the spontaneity (or original action) of the Ego; and these results formed the subjective coefficient of knowledge. Kant did not show how these determinations arise in the spontaneous activity of the Ego; he only inferred that they did thus arise from the demonstrated impossibility of their arising from experience. They were logical conditions of all experience whatsoever, and were presupposed by experience, instead of derived from it. The most obvious difficulties of Kant's theory were removed by Fichte's science of knowledge. They were two: 1. Kant held that the subjective factor of knowledge included the general forms or laws (Time, Space, Causality, etc.), while objective things *per se* furnished the contents of sensation, or in other words affected the sensory. But *to affect* is *to cause*, and hence Kant, while he denied all objective existence to the subjective factor of knowledge, was obliged to apply the category of causality to things in themselves, in order to justify their necessity in his theory. Thus, his subjective coefficient belonged also to his objective coefficient of knowledge. Fichte avoided this glaring inconsistency by showing that the activity of the Ego furnishes the groundwork of the objective. In ordinary consciousness we do not perceive this phase of the activity of the Ego, but by disciplined reflection the mind may acquire the power of seeing the mental genesis of the ideas of Time and Space and of the laws of Causality, Substantiality, etc., and the resulting objectivity which we give to the mere subjective feeling which is the basis of all sensation. 2. Kant's illogical attempt to destroy dogmatism by the critique of *Pure Reason*, as well as skepticism by the critique of *Practical Reason*, has been mentioned. He had not deduced the necessary basis of his categories, but had dogmatically assumed them from logic, without proving them, and hence had left his philosophy open to skepticism. Fichte made a searching analysis of Consciousness, and, starting from the self-identity of the Ego = Ego, or A = A, and proceeding to the self-distinction of the Non-ego not = Ego, or — A not = A, he reaches the idea of limitation or division of the totality by mutual exclusion of the self and the not-self. Thus, the first analysis shows the genesis of the categories of Quality,—Reality, Negation, Limitation. Pursuing this subtle psychological analysis, he arrives at the other categories, and establishes the fundamental distinctions between realism and idealism, between theoretical and practical. The most wonderful characteristic of this psychological analysis—which is valid for all time, although Fichte's concrete applications of his philosophy to the worlds of nature and history lack value by reason of his failure to study each department in its detailed developments—consists in his demonstration of the successive additions made by reflection in the endeavor to become self-conscious. For instance, in order to be conscious of feeling, the mind thinks it under the form of time; to be conscious of feeling *and* time, it thinks it under the form of space; to be conscious of the latter, it thinks the object under the form of causality. Thus, it successively recognizes its own phases of formal activity as conditions of objectivity, and adds these, one after the other, to its sensation, and thereby arrives at the perception of an object in space which affects the organ of sensation. This process is present in all perception of external objects, but is rapid and unconscious. As with Kant, so with Fichte, the greatest stress was laid on the free-will and the moral aspect of human nature.

Fichte's complete works were collected and edited in eight volumes by his son in 1845–46. Access to his system through English translations is now quite adequate. The *Life of Fichte* and his popular writings, including *The Nature of the Scholar, The Vocation of the Scholar, The Destination of Man, Characteristics of the Present Age, Way towards the Blessed Life, Outlines of the Doctrine of Knowledge*, were published in London, translated by William Smith (1848–49). *The Destination of Man* was also translated by Mrs. Percy Sinnett (London. 1846), and a portion of it by one of the contributors to *Hedge's German Prose Writers* (New York, 1856). The *Science of Knowledge* (ed. of 1794) and *Science of Rights* were translated by A. E. Kroeger (Philadelphia, 1868–70). In the *Journal of*

Speculative Philosophy (St. Louis) have appeared (*a*) *The Introduction to the Science of Knowledge* (ed. of 1794), (*b*) *Criticism of Philosophical Systems*, (*c*) *Sun-clear Statement*, (*d*) *New Exposition of the Science of Knowledge* (1801), (*e*) *Facts of Consciousness*. (See articles on KANT, SCHELLING, HEGEL, LEIBNITZ, and GERMAN PHILOSOPHY.)

WILLIAM T. HARRIS.

Fich'telgebirge (the "Pine Mountains") is a short but broad range of mountains, covered with firs and pines, on the northern frontier of Bavaria. They are not remarkable for their height, the highest peak, Schneeberg ("Snow Mountain"), rising only 3633 feet, but by reason of their central position they form the nucleus from which all the chief mountain ranges of Germany diverge, and they separate the affluents of the German Ocean and the Black Sea, the Naab descending from them on the S. to the Danube, the Main on the W. to the Rhine, the Saale on the N., and the Eger on the E. to the Elbe.

Fici'no (MARSILIO), celebrated as the reviver of Platonic philosophy in Italy, was b. in Florence in 1433, and d. at Careggi in 1499. When still a youth he was selected and carefully educated by Cosimo de' Medici with a view to place him at the head of a proposed academy for the cultivation and dissemination of Platonic philosophy. The zeal of Cosimo for Platonism had been kindled by the enthusiasm of a learned Greek—George Gemistus Pletho—who had come from Constantinople with John Palæologus II. to the Council of Florence on the mission which resulted in the union of the churches of the East and West, in 1438. The academy which was founded in 1460 became in after years an asylum for the few learned Greeks who had fled to Italy on the capture of Constantinople by the Turks (1453). About this time the invention of the art of printing contributed the necessary means for the rapid spread of classic study, by multiplying and rendering accessible the originals and translations of the same. Ficino translated into Latin the entire works of Plato (1484) and Plotinus (1492), accompanying them with a more or less complete commentary. Besides these, he made translations of many of the works of Proclus, Jamblichus, Porphyry, Dionysius Areopagita, Hermes Trismegistus, Alcinous, Speusippus, and Xenocrates. His translations are frequently reprinted side by side with the Greek text in modern times, and are found of special value in restoring the original text, as it seems that he had before him manuscripts now lost. His Latin is pure, literal, and perspicuous. His work on the Platonic theology (1482), in eighteen books, treats of the nature of the soul, of spirits, and of God. It is especially devoted to the proofs of immortality and the refutation of the Averroistic doctrine of the World-Soul or Mundane Intelligence, which makes the latter to be immortal and the particular soul to be perishable, being cognizant of universals only through participation in the higher intelligence. The most important feature of the philosophy of Ficino is his claim to harmonize Platonic idealism with Christian doctrine. This made Platonism very popular, and gave rise subsequently to a school of mystics which numbers Pico of Mirandola, Reuchlin, Agrippa of Nettesheim, Patritius, Telesius, Ramus, and others. The supposed connection of Neo-Platonism with Jewish mysticism through the Cabbala, and the discovery of a profound esoteric doctrine beneath the letter of the Bible, stimulated the enthusiasm of its votaries. Freedom in philosophy begins with the conflict of authorities, as Gibbon remarks. The conflict between the schools of Platonism and Aristotelianism at that time prepared the way for the original thinking of the following centuries. Ficino, with Bessarion before him and Pico after him, stands opposed to Pomponatius, the reviver of Alexandrian Peripateticism. The collected works of Ficino (not including the translations of Plato and Plotinus) were published at Bâle in 2 vols. fol., 1561 and 1576; revised with additions, Paris, 1641, 2 vols. fol. W. T. HARRIS.

Fic'tion, in law, in its ordinary meaning, is an assumption that a thing is true which is either not true, or which is as probably false as true. Mr. Best, an author on *Presumptions*, distinguishes it from a presumption, a mere rule of law established for the purpose of reaching a certain conclusion, though it may be arbitrary, which is based on public convenience or on the difficulty of arriving at the exact truth. Thus, the rule that a child under seven years of age cannot commit a felonious crime is a conclusive presumption, rather than a fiction. Some writers—as, *e. g.*, Mr. Maine (see his work on *Ancient Law*)—use the word "fiction" in a broader sense, to signify any assumption which conceals, or affects to conceal, the fact that a rule of law has undergone alteration, its letter remaining unchanged while its operation is being modified. From this point of view fiction is a powerful agency in the improvement of law. By means of it new views more adapted to the age are introduced under color of observance of ancient forms. The agencies causing the progress of jurisprudence are fiction, equity (see EQUITY), and legislation. Among these, fiction has played no unimportant part. In some instances courts have even, by means of it, subverted the will of the legislature. A striking instance of this intentional employment of fiction is found in the early English statute of entailments. The history of this subject is so illustrative that it will be stated with some fulness. It is a well-known rule of the English common law that a conveyance of land "to A and his *heirs*" gives him the complete ownership and power of disposal of the property. If, however, the words "*heirs of the body*" were used, instead of "heirs," the effect would be different. Such language points only to descendants; and as there might be none, the estate was deemed to be a conditional one. If "heirs of the body" should come into existence, the condition on which the estate was given was deemed to be performed, and the title of A for certain purposes became absolute. For example, he could sell, and thus cut off all claim on the part of his descendants, or he could forfeit the property by his treason, or encumber it by his voluntary act. If none of these acts were done, the estate would pass to surviving heirs of the body, and if there were no such persons, would revert to the original grantor.

The English landed proprietors being dissatisfied with this result, through their influence in Parliament caused a statute to be passed in the reign of Edward I. (13 Edw. I. c. 1) which was designed to prevent it, and to vest the ownership in A in the case supposed, and at the same time deny to him the power to sell or to encumber the property. The intention was that he should use it as owner, fell trees, mine, and do other proprietary acts, while at the same time the property should descend according to the line prescribed in the terms of the gift. From this violation of a cardinal rule of ownership mischievous consequences soon developed themselves. Creditors and purchasers were defrauded, lessees were deprived of their leases, for the tenant in possession could make no deed, mortgage, or lease which should outlast his own life, though he appeared to all observers to be the owner. Records of title were unknown, so that fraud was easily practised by one who had all the outward badges of ownership. This state of things was endured for a long period, the nobility being unwilling to repeal a law which tended so strongly to the preservation of their estates.

In the reign of Edward IV., after the lapse of nearly two hundred years, the courts allowed a fictitious legal proceeding to be gone through with, which was declared to have the effect to destroy the entailment, and to enable A in the case supposed to become absolute owner. It was a pure fiction, called a "common recovery," and so understood by all parties to it. It was a fictitious lawsuit with regular and formal parties, and its effect was to destroy the entailment, and vest an absolute title in the first person named in the entailment (A). The rule soon became so perfectly settled that it was impossible for a conveyancer to frame a regular entailment without having it subject to this mode of disincumbering the title, so that a "common recovery" became a mere mode of conveyance. In later times the fiction had become so transparent and so cumbrous that the Parliament substituted in its place a mere deed of conveyance, known as a "disentailing deed" (3 and 4 Wm. IV. c. 74). The case is of interest and value as showing how the fiction, after being allowed for a time, is ultimately recognized as a change or modification of law, and tends to assume the form of a precise provision by means of a statute.

There are many fictions of law now regularly resorted to, and having a powerful influence on the administration of justice. It is a cardinal maxim that a legal fiction must be consistent with equity. This doctrine has not been universally followed, particularly in the so-called doctrine of "relation." The meaning of that doctrine, so far as it refers to time, is, that in some cases when an act is done on a particular day, it shall be considered for legal purposes as being done on some earlier day. The act is then said to "relate back" to that prior day. One mischievous consequence of this rule was that if a law was passed during a session of Parliament, it "related back" to the first day of the session, although weeks or months might have elapsed. By this vicious retrospection an act which was perfectly lawful when committed might be treated as a crime. This result was done away with by the statute of 33 Geo. III. c. 13, which enacted that the time when an act receives the royal assent shall be the date of its commencement, unless some other provision is made by law. The same rule prevails in this country. The doctrine of "relation" is resorted to in bankruptcy, referring the effect of the decree back to some date earlier than that of the commencement of the proceedings. It is also used in

many other cases, not only as to time, but as to place, person, or thing, and in general is made to work consistently with right and justice. An instance of it may be noticed. Should a person deliver a deed conditionally, or in *escrow*, and subsequently, between the time of the first and the ultimate delivery, become disabled to convey, the law will refer the transaction back to the first delivery, for the purpose of upholding it. In other aspects of the case the conveyance would only take effect from the delivery transpiring after the condition had been performed.

Another instance of a fiction is the legal rule that "the law regards no fraction of a day." By means of this theory a person born on the seventh of the month becomes of full age twenty-one years later on the sixth. The fiction, however, gives way where justice requires that a distinction should be taken between two acts done on the same day. In this case a single moment may be decisive, as where two or more conveyances are left for record on the same day by parties having antagonistic interests.

Attempts have been made by various writers to classify fictions, but without much practical success. They are said to be limited by three principal rules: *First*, the fiction must have the semblance of truth: that which is impossible is not to be feigned. *Second*, it shall not be allowed to work an injury. *Third*, it is only to be resorted to to accomplish the end for which it was introduced. To that extent it cannot be contradicted; beyond that it may be impugned. "The law," says Gould J., in *Lord Raymond's Reports*, 516, 517, "does not love that rights should be destroyed, but, on the contrary, for the supporting of them invents notions and fictions." When they are urged to an intent and purpose not within their reason and policy, a party injuriously affected by them may show the truth.

T. W. Dwight.

Fi'cus [Lat., a "fig"]. The genus *Ficus* belongs to the Artocarpaceæ, or bread-fruit family, in which it is associated with the bread-fruit of the Pacific, the jack of the Indian Archipelago, the mulberry, the Osage orange of our own country, and the notorious upas tree of Java. The common fig tree (*Ficus carica*) is the most valued representative of this genus; it is a deciduous tree, attaining to a height of from fifteen to thirty feet, and often living to a great age. The fig itself is a multiple fruit formed from monœcious flowers aggregated together in the interior of a hollow fleshy receptacle. Figs are highly prized in the fresh state, but they are more generally esteemed in the dried condition, in which state they form an important article of commerce from the Mediterranean, and especially from Turkey. They are dried in the sun, and, containing a large amount of grape-sugar, this in the process of drying serves to preserve them. Many trees of the family yield a remarkable milky juice, which, inspissated, forms the caoutchouc of commerce. The original India-rubber plant, or *Ficus elastica*, of Java, is one of these. The celebrated banyan tree (*Ficus Indica*) of India yields the well-known resin gum-lac. Several of the *Fici* have poisonous qualities. One of the most remarkable species is the peepul or Bo-tree (which see). E. C. H. Day.

Fid'dletown, post-tp. of Amador co., Cal. Pop. 1219.

Fid'ei Commis'sum [Lat., "committed to (one's) faith"], a species of trust existing under the Roman or civil law which was employed to effect the testamentary disposition of property to certain persons who by law were incapable of receiving it by direct devise or bequest. Exiles, strangers, unmarried persons, those who had no children, and some other classes of persons were under this disability, and whenever a testator desired to evade this law and leave his property to one thus debarred, he selected some person as heir or legatee who was not incapacitated from taking; annexing a request to the gift that he who was thus constituted a recipient of the property should hold what he received in trust for him who was intended as the real object of the testator's bounty. When this form of trust was first adopted there was no means by which the duty imposed upon the immediate donee could be enforced against him. Its fulfilment depended entirely upon his good faith and honor. From this circumstance the trust received the name of *fidei commissum*. In later times, however, to prevent the frauds which were sometimes perpetrated by failure to fulfil such trusts, laws were enacted rendering their execution compulsory. In the time of Justinian a law was adopted by which a trustee could be compelled to disclose under oath the fact that a trust had been committed to him. From *fidei commissa* was derived the doctrine of uses in the English law. (See Uses.) George Chase. Revised by T. W. Dwight.

Fide'næ, an ancient Latin city on the left bank of the Tiber, 5 miles above Rome. Livy erroneously calls it an Etruscan city. In Rome's early days Fidenæ was her powerful rival and enemy, but it declined as Rome increased, and before Cicero's time was an insignificant village, important only for its tufa-quarries.

Fi'des [Lat., "faith"], in the religious system of ancient Rome, was the personification of good faith, represented as a venerable matron crowned with laurel or olive, and carrying corn and fruits. Fides Publica had a temple on the Capitoline, built by Numa.

Fief, an estate or dignity held of a feudal superior upon condition of military service. (See Feudal System, by Pres. T. D. Woolsey, S. T. D., LL.D.)

Field (Cyrus West), a son of Rev. David D. Field, D. D. (1781–1867), was b. at Stockbridge, Mass., Nov. 30, 1819; was educated in Stockbridge, became a clerk in New York when fifteen years old, and became the head of a prosperous mercantile business. He travelled in 1853 in South America for six months, and on his return became interested in ocean-telegraphy. Having been applied to for aid in building a land-telegraph across Newfoundland, to receive the news from a line of fast steamers to ply between St. John's and Ireland, the idea struck him of carrying the wire across the Atlantic. In 1854 he obtained from the legislature of Newfoundland the exclusive right for fifty years of landing telegraph cables from Europe and America on that island. Mr. Field next formed a company known as the "New York, Newfoundland, and London Telegraph Company," with Peter Cooper, Wilson G. Hunt, Marshall O. Roberts, Moses Taylor, and Chandler White, and in two years the lines were finished from New York across Newfoundland. The first cable to extend from Newfoundland to Cape Breton Island having been lost in a storm while it was being laid in 1855, a second cable was laid in 1856. In that year he went to London and organized the "Atlantic Telegraph Company," of which he furnished one-fourth of the capital. The U. S. and British governments furnished ships for the enterprise. Mr. Field accompanied the expedition of 1857, the two of 1858, and those of 1865–66 for the laying of cables. Of these, the first two were failures, and the cable laid by the third worked but a short time. The public lost faith in the enterprise, civil war followed in the U. S., and Mr. Field could not obtain the capital to renew the attempt until 1865. In that year the Great Eastern laid 1200 miles, when the cable parted, and was lost for the time. In 1866 a cable was successfully laid, and the cable of 1865 was picked up in mid-ocean and completed by the Great Eastern. At last, after nearly thirteen years of unceasing toil, Mr. Field was completely successful. He crossed the Atlantic some fifty times in his work. He has been the recipient of many medals and other honors, and was afterwards interested in establishing telegraphic communication between Europe, India, China, and Australia, and with the West Indies and South America. At present (1874) Mr. Field is engaged in the effort to raise the necessary capital to lay a submarine cable from San Francisco to Japan, thus completing the telegraphic circuit of the globe. Since 1867 three trans-Atlantic cables have been successfully laid, and telegraphic communication has been uninterrupted.

Field (David Dudley), D. D., American clergyman, b. at East Guilford, Conn., May 20, 1781, graduated at Yale College 1802; was settled at Haddam, Conn., from Apr. 11, 1804, to 1818, and then at Stockbridge, Mass., from Aug. 25, 1819, to 1837; then at same church as before in Haddam from Apr. 11, 1837, until 1851, when he returned to Stockbridge. He published a *History of Middlesex County, Conn.*, in 1817, a *History of Berkshire County, Mass.*, in 1829, *Sermons*, etc., and d. at Stockbridge, Mass., Apr. 15, 1867.

Field (David Dudley), an American jurist, b. at Haddam, Conn., Feb. 13, 1805, the eldest son of Rev. David D. Field, D. D., the Congregational minister of the town, who removed in 1819 to Stockbridge, Mass.; and in 1821 the son entered Williams College. In 1825 he commenced the study of the law, and was admitted to the bar in 1828, and settled in New York, where he soon made his way into the front rank of his profession. But finding the practice of the law, which was after the English model, extremely complicated, dilatory, and expensive, he began to study how it could be revised and improved, and so entered upon those labors in favor of law reform which were to occupy so large a part of his life. In 1839 he published his first essay on the subject, which he continued to press on the public attention until in 1847 he was appointed by the legislature of New York one of a commission to reform the practice of the State. Upon this work he was engaged for two years, and the result was contained in two codes of procedure, the one civil and the other criminal. The civil code was in great part adopted by the State of New York, and has since been adopted by twenty-three States and Territories. It is the basis of the legal reform established by the new Judicature Act in England and of the practice in several of the English colonies, including India. After the

completion of the codes of procedure he was placed by the State of New York at the head of a new commission to undertake a complete codification of the whole body of the law. This was a work of years, but in due time the commission reported a civil code, a penal code, and a political code. These five codes, which were mainly the work of Mr. Field, covered the whole province of American law, both common and statute, and were designed to supersede the unwritten or common law—the object being to give the people in this compact form the whole of the laws by which they were governed. This body of law has as yet been adopted in full and intact only by the State of California and the Territory of Dakota, but there is every reason to believe that the substance of it, at least, will before many years be the law of the greater portion of the American Union. In this great work Mr. Field was engaged nearly a quarter of a century, carrying it on at the same time with a professional practice among the very largest in the country. Not satisfied with this, he often turned aside from professional engagements to indulge his taste for literary pursuits, writing essays and reviews and sketches of travel, and discussing, both in the press and in public speeches, the political questions of the day. In 1867 he brought before the British Association for Social Science a proposition to frame an international code. This led to the preparation by him of what was really a complete work on international law, though modestly entitled *Draft Outlines of an International Code*, one feature of which was the introduction of the principle of arbitration to settle disputes between nations. This work has attracted great attention in Europe, and been translated into French and Italian.

Field (FREDERICK), English clergyman, b. about 1800, was educated at Trinity College, Cambridge, graduating in 1823. He has edited the Greek text of Saint Chrysostom's *Homilies on St. Matthew* (1839), *Interpretation of the Pauline Epistles* (1845–62), and the Septuagint version of the Old Testament according to the Alexandrian Codex. In 1842 he was presented to the rectory of R[illegible]ham, Norfolk, resigned in 1863, and has since edited Origen's *Hexapla*.

Field (HENRY MARTYN), D. D., a son of Rev. David D. Field, D. D., b. at Stockbridge, Mass., Apr. 3, 1822; entered Williams College at the age of twelve; graduated at sixteen; studied theology three years at East Windsor, Conn., and one year at New Haven; at twenty took charge of a church in St. Louis, Mo., where he resided from 1842 to 1847, when he resigned, and spent the following year in Europe; was a witness of the Revolution in Paris in Feb., 1848, of which he wrote a very full account, as also of the Italian Revolutions, which he witnessed soon after. A month in Rome, including the Holy Week, led him to write a pamphlet on *The Good and the Bad in the Roman Catholic Church*. Returning to America, he became acquainted with the descendants of the Irish exiles, Wolfe Tone, Thomas Addis Emmet, and others living in New York, which led him to study that tragical chapter of Irish history in which they took part, and finally to write a book entitled *The Irish Confederates, and the Rebellion of 1798*. In 1851 he was settled in West Springfield, Mass., where he remained four years. During this period he published a number of sermons and reviews. In 1854 he removed to New York to become one of the editors of the *Evangelist*, a religious journal with which he has been connected for twenty years, and of which he is now the sole proprietor. Visiting Europe in 1858, he wrote a volume of travel entitled *Summer Pictures: From Copenhagen to Venice*. In 1867 he went abroad again to the Exposition in Paris. In 1866 he published a *History of the Atlantic Telegraph*.

Field (JOSEPH M.), actor and dramatist in the U. S., was b. in England, and d. in Mobile, Ala., Jan. 30, 1856. He lived in New Orleans, La., in St. Louis, Mo., and at Mobile. *The Drama in Pokerville and Other Stories, by Everpoint* (1847), etc. were among his publications, and he edited for some time the St. Louis *Reveille*.

Field (KATE), b. in St. Louis, Mo., was educated in Massachusetts and in Europe, where she enjoyed the friendship of Walter Savage Landor in his later years at Florence; was European correspondent of the Boston *Courier* and *Transcript* and the New Orleans *Picayune*; was afterwards the well-known correspondent "Straws, Jr.," of the Springfield *Republican*; became in 1867 a frequent contributor to the New York *Tribune*, the Chicago *Tribune*, the Philadelphia *Press*, and the London journals; has written much for the *Atlantic Monthly* and other magazines, and is an able dramatic critic. In 1874 she made her first appearance as Peg Woffington at Booth's Theatre, New York. Author of *Pen Photographs of Dickens's Readings*, *Ten Days in Spain* (1874), etc., and is a popular lecturer.

Field (Hon. MAUNSELL BRADHURST), an American lawyer, b. in New York Mar. 26, 1822; graduated at Yale College 1841; admitted to the bar 1847, and became associated with Hon. John Jay in the practice of the law. In 1854 he acted as secretary to the American legation in France, under Hon. John Y. Mason, and subsequently became attached to the Spanish legation, under Mr. Soulé. In 1855 was appointed president of the American commissioners to the Universal Exposition at Paris; deputy sub-treasurer of the U. S. in New York 1861, and subsequently assistant secretary of the treasury at Washington, D. C.; which latter office he resigned in 1865, owing to impaired health, and was appointed collector of internal revenue for the sixth district of New York; which office he held four years. In 1869 he resigned his position and resumed the practice of law in New York City; appointed judge of the second district (civil) court 1873. In early life Mr. Field was a Democrat, but on the second election of Mr. Lincoln voted with the Republicans, and has since continued in that party. In 1874 he published a volume of *Personal Recollections* of the distinguished men with whom he had come in contact at home and abroad. D. Jan. 24, 1875.

Field (RICHARD STOCKTON), LL.D., American judge, was b. at Whitehill, N. J., Dec. 31, 1803; graduated at the College of New Jersey in 1821; was professor in the New Jersey Law School 1847–55; for a long time attorney-general of New Jersey; U. S. Senator in 1862–63, in place of J. R. Thompson, deceased, and then judge of the district court of the U. S. for New Jersey, appointed by President Lincoln, until his death at Princeton, N. J., May 25, 1870. Published *The Provincial Courts of New Jersey* (1849), and contributed to the collections of the N. J. Historical Society.

Field (STEPHEN JOHNSON), a judge of the Supreme Court of the U. S., a son of Rev. David D. Field, D. D., was b. at Haddam, Conn., Nov. 4, 1816; graduated at Williams College in 1837; studied law with his brother, David Dudley, in New York, and on his admission to the bar became his partner; went to California in 1849; in Jan., 1850, was elected first alcalde of Marysville; in October of that year was elected to the legislature, and served one session; in 1857 was elected judge of the supreme court of the State, and in 1859 became chief justice; in 1863 was appointed by President Lincoln an associate justice of the Supreme Court of the U. S.—an office which he now holds. In 1869 he was appointed professor of law in the University of California. In 1873 he was appointed by the governor one of a commission to examine the codes of the State, and to prepare amendments to the same for the consideration of the legislature.

Field'fare, or Gray Thrush (*Turdus pilaris*), a passerine bird of Northern Europe and Asia which winters in England and other comparatively warm regions. It is shot in considerable numbers in winter, and is often trapped and tamed, making a very pleasing song-bird. It is extremely prolific, nesting in the far North. It is ten inches long, and is generally seen in small flocks.

Field-Glass, a form of magnifying apparatus which is essentially a telescope of low power. It may have a single tube (like the antiquated spy-glass), or more frequently of late it is binocular, resembling in form the double opera glass. (See TELESCOPE.)

Field'ing (COPLEY VANDYKE), English landscape painter, b. about 1788, was eminent in water-color paintings, which he began to exhibit in 1810; was president of the Society of Painters in Water-Colors in 1831. D. at Worthing Mar. 3, 1855.

Fielding (HENRY), an English dramatist and novelist, b. at Sharpham Park, near Glastonbury, Somersetshire, Apr. 22, 1707. The founder of the English family was Geoffrey, count of Hapsburg, who came to England in the thirteenth century and assumed the name of [illegible]. Henry Fielding's education commenced at home under the care of Mr. Oliver, the family chaplain, of whom it is said he was the original of Parson Trulliber in [illegible]. As soon as sufficiently advanced, he was sent to [illegible], where he made much progress, particularly [illegible]. Being destined by his father for the law, he was at the age of eighteen, transferred to the University of Leyden, where he maintained his character [illegible] for about two years, when, owing to the [illegible] of his father to continue his pecuniary supplies, he was compelled to return to London, where, at the [illegible], he found himself dependent upon his own [illegible]. His first effort, a comedy entitled *Love in Several Masques*, appeared in Feb., 1728, and was favorably received. Between his first appearance as a dramatic author [illegible], he wrote twenty-three pieces for the stage, [illegible] comedies and farces. Of these only one [illegible] successful, a burlesque entitled *The Tragedy of Tragedies, or the Life and Death of Tom Thumb the Great*, intended to ridicule the extrav-

agant style of the tragedies of the day. *The Mock Doctor* and *The Miser*, translations of Molière's comedies, were also well received. In 1735 he married Miss Cradock, one of the belles of Salisbury, and possessed of a small fortune of £1500. Fielding had succeeded, on his mother's death, to a small estate at East Stour in Dorsetshire, to which he now retired, and assumed the character of a country squire of the first magnitude, by which his slender means were rapidly dissipated, and in a very short time he was compelled to break up and return to London and seek means for the support of his wife and child. Intending to apply himself to his profession, he was turned aside by an opportunity of producing a satirical drama—*Pasquin, a Dramatic Satire on the Times*; its success was so great that in 1737 he produced another, *The Historical Register for 1736*, which attracted so much attention that the Licensing Act, placing the stage under ministerial control, was passed. Resolving now to devote himself to the law, he entered himself (Nov. 1, 1737) as a student of the Middle Temple. In 1740 he was called to the bar, took chambers, and commenced practice. To the columns of *The Champion*, in which he was interested, he contributed largely. He also compiled a valuable work on Crown law. Circumstances now led Fielding to turn his attention to the sphere in which he was destined to win enduring renown. In Feb., 1742, his first novel was published under the title of *The Adventures of Joseph Andrews and his friend Abraham Adams*—a work suggested by Richardson's *Pamela*, which appeared in 1740 and created an extraordinary sensation. Its success was immediate; it soon became a universal favorite, and was regarded as the best work of fiction produced up to that time in the English language. *The Wedding Day*, a comedy written several years before, was produced in Feb., 1743. The *Miscellanies* appeared in 1743; *A Journey from this World to the Next*, in the second volume, is an admirably contrived satire, though in a fragmentary state; the third volume is entirely taken up with *The History of Jonathan Wild the Great*, the least agreeable of Fielding's works of fiction. In this year Fielding's affectionate wife died—a calamity that so deeply affected him that for a time his reason was endangered. As soon as he was sufficiently recovered he again applied himself to his profession. During the memorable events of 1745 he published a political journal, *The True Patriot*, which expired with the suppression of the rebellion. In 1747 he started another political paper, called *The Jacobite Journal*, which was discontinued towards the end of 1748, when he received the appointment of justice of the peace for Middlesex and Westminster—a sphere of duty in which he speedily earned for himself credit and distinction. The office was not at this time held in high estimation by reason of the trafficking in committals and convictions for the fees which formed the compensation of the magistrates, and for which practice they were termed "trading justices." Fielding refused to adopt these discreditable practices, and labored ardently to check the growth of depravity and crime; and his services in this department of life alone were of such importance as to entitle him to the respect of posterity. In 1749 he published his great work, upon which he had been long engaged, *The History of Tom Jones, a Foundling*, which placed him at the head of English novelists. Its success was most decided, and it still maintains a prominent place among works of fiction. In 1749, Fielding was elected chairman of the sessions, which entailed upon him the additional duty of attending at the bench. In addition to these duties, he published several valuable tracts, among which *An Inquiry into the Increase of Thieves and Robbers* attracted much attention. In 1751 he produced another work of fiction, *Amelia*, in which work the heroine is intended as a portrait of his first wife. This was Fielding's last production in fiction. In 1752 he published a literary journal called *The Covent Garden Journal*, and, the following year, several law reports. But the complication of disorders from which he had long suffered was fast undermining his strength; and a vigorous warfare which he successfully waged against the gangs of desperate ruffians then infesting London so wore upon his shattered frame that he was compelled to retire from the active performance of his duties. A trip to Bath was made without beneficial effect, and by the advice of his physicians he embarked for Lisbon on June 26, 1754. After a stormy voyage, of which he left an account, published in 1755, under the title of *The Journal of a Voyage to Lisbon*, he reached Lisbon in August. But his strength was too far declined to rally, and on Oct. 8 he expired. (See MURPHY'S *Life and Genius of Fielding*; SIR WALTER SCOTT'S "Prefatory Memoir" in Ballantyne's *Novelists' Library*; *Life of Henry Fielding*, by FREDERICK LAWRENCE, 1855.) GEORGE C. SIMMONS.

Fielding (Rev. J. H.) was b. in Coleraine, Ireland, Feb. 28, 1796, and d. at St. Charles, Mo., Oct. 14, 1844. Came to the U. S. in his eighteenth year; in 1819 licensed to preach; in 1826 he was called to the chair of mathematics in Madison College, Pa., where he remained five years—one year as acting president. He then spent two years in the chair of mathematics in Augusta College, Ky. In May, 1835, he accepted the presidency of St. Charles College, Mo., and discharged the duties of that office with signal success. He was noted for extensive and accurate scholarship. Though not eloquent, his sermons were finished productions. At the time of his death he was delegate-elect to the Louisville convention which organized the Methodist Episcopal Church, South. "All immortality and eternal life" were his last words. T. O. SUMMERS.

Field-Marshal. See MARSHAL.

Field Mice, a name applied to those mice which live out of doors and do not frequent houses; but given especially to mice of the genus *Arvicola*, of which there are more than six species in the U. S., besides many species of allied genera and similar habits. Europe has also several species, and in England these mice are in some years extremely destructive, not only to grain-crops, but to orchard and forest trees, whose bark they gnaw. At times the British government has paid bounties for their destruction.

Field Officer, in the army, is a colonel, lieutenant-colonel, or major of a battalion or regiment, as distinguished from general officers, who are superior to field officers in rank; from line officers, who are inferior; and from staff officers, general or regimental, who may be of rank superior, equivalent, or inferior to that of field officers.

Field of the Cloth of Gold, the magnificent interview between Henry VIII. of England and Francis I. of France, between Ardres and Guisnes, June 7–24, 1520, within the English Pale. The movement was designed to strengthen the union of the two princes against Charles V.

Field'on, a tp. of Watonwan co., Minn. Pop. 254.

Fields (JAMES THOMAS), A. M., American author and publisher, b. at Portsmouth, N. H., Dec. 31, 1817, read an anniversary poem before the Boston (Mass.) Mercantile Library Association in his eighteenth year, and in 1848 another poem, *The Post of Honor*, before the same society. He was a member of the publishing firm of Ticknor, Reed & Fields, Ticknor & Fields, and Fields, Osgood & Co. for twenty-five years, up to Jan., 1871. By his own exertions he collected and issued De Quincey's *Works* in 21 vols. In 1849, 1854, and 1858, respectively, he printed volumes of his poems for private distribution. He edited *The Atlantic Monthly* at Boston from 1862 to July, 1870, has repeatedly visited Europe, and has had wide acquaintance with literary men abroad. He has also lectured in the U. S., and published *Yesterdays with Authors*—reminiscences of literary men.

Fields (Rev. JOHNSON B.), a minister of the Methodist Episcopal Church, South, was a Cherokee Indian, b. in Murray co., Ga., Oct. 18, 1800, converted in 1827, and entered the ministry in the Tennessee conference in 1833. He served as preacher and interpreter in the Cherokee Nation for twelve years, and d. Feb. 12, 1846. T. O. SUMMERS.

Field-works. See FORTIFICATIONS, by CAPT. O. H. ERNST, U. S. Army.

Fi'eri Fa'cias [Lat., "you cause to be made"], a writ of execution (usually termed a *fi. fa.*) to secure the satisfaction of a judgment recovered against a debtor, directing the officer to whom it is addressed *to cause to be made* of the debtor's goods and chattels or real estate the amount therein specified. By this is meant that he is to levy upon the property and sell sufficient to obtain the requisite sum. Personal property is first sold, and afterwards recourse may be had to the debtor's real estate. In executing this writ the sheriff has no authority to break open the outer door of a dwelling-house after request for permission to enter is refused, as may be done on criminal process; but if he has once secured lawful admission into the premises he may break through inner doors, open chests, etc. to secure possession of the goods. When the property is within the debtor's store or barn, even the outer door may be forcibly entered; so, if it be upon the premises of a stranger and entrance is refused, the house may be broken, for a man's house is a protection only for his own property. If, however, the goods are not found upon the stranger's premises, the sheriff is liable as a trespasser. (For further details see EXECUTION.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fies'chi, de', or **Fies'co** (GIOVANNI LUIGI), count of Lavagna, b. 1523 at Genoa of a celebrated Guelfic family of remote Bavarian origin. A wealthy and ambitious demagogue, he entered into a conspiracy to kill Andrea Doria, doge of Genoa, and to overthrow the government, but the scheme failed in both its objects, and Fieschi, striving to seize the public galleys, was drowned Jan. 2, 1547.

Fieschi (GIUSEPPE MARIA), b. in Murato, Corsica, Dec. 3, 1790; entered the French army in 1808; served in Russia in 1812; was imprisoned 1816–26 for theft and forgery; went to Paris in 1830; invented the infernal machine by which the attempt was made, July 28, 1835, to assassinate Louis Philippe, who escaped with a slight wound, though sixteen of his attendants were killed or mortally wounded. Fieschi was executed Feb. 19, 1836.

Fies′ole [anc. *Fæsulæ*], small town of Italy, 3 miles N. E. of Florence. It is one of the oldest Etruscan towns, and was anciently a great and powerful city; contains many interesting remains, and commands a most magnificent view of the Arno valley. It is a bishop's see. Pop. 2404.

Fiesole, da FRA GIOVANNI, an Italian painter, commonly called ANGELICO, and sometimes IL BEATO, from the character of his art. Was b. at Vicchio, among the Apennines, in the province of Mugello, in 1387. Of his youth nothing is known. At the age of twenty he entered the religious order of St. Dominic, and then changed his original name (Guido) for that of Giovanni, a name of sanctity in the order. His first years were passed in the convent at Foligno, not far from Perugia and Assisi, famous places both of art and piety. The plague drove him to Cortona about 1413, where he stayed four or five years. Then he returned to Fiesole, his spiritual birthplace and the home of his best years. Here and in Florence his greatest work was done. The last ten years of his life (1445–55) were spent by the pope's desire in Rome, where he d. Feb. 18, 1455. Was buried in the Church of Santa Maria sopra Minerva, where his monument, with its quaint epitaph and the effigy of the painter in his monastic habit, is still to be seen.

Fra Angelico was an artist and a saint from his youth, and the soul of his piety was also the soul of his art. Though a student, evidently, of the masters who lived before him in Perugia, and especially in Florence, the impulse and spirit of his art were his own. Piety suggested both subjects and treatment. His first productions were in miniature, after the style of the illuminations done by monks, but an exquisitely tender feeling for Nature made him a student of her forms and colors, thus blending the natural with the spiritual in his compositions. A saintly dislike of nudity deprived him of the knowledge of anatomy required in figure-drawing; his figures were all draped, and lacked the substance that bone and muscle give, but a singular grace of pose and movement marked them all. The charm of a happy serenity is in all his work. His mind was without sorrow and without ambition. His delight was in happy thoughts. His themes were received by him as inspirations from Heaven, to be treated earnestly and carefully. He began his work with prayer, never altered the first design, discarded artful accessories, accepted no orders from the rich or great, held himself at the service of his superiors, and took no mercenary pay. They who wanted paintings from his hand must apply to the spiritual authorities. The works of Fra Angelico are numerous, most of them small panel-pictures executed for convents. Traces of them are in every place where he lived. Many of his pieces are in Perugia. The churches, chapels, and convents of Florence were enriched by his masterpieces, the best of which are now in the Academy of Fine Arts there. The cloister and cells of San Marco possessed noble examples of his art. At the command of Pope Eugenius IV. he painted two chapels in the Vatican—the chapel of the Holy Sacrament, destroyed afterwards to make room for a staircase, and the chapel of Nicholas V. His paintings were in great demand, for in his prime he was regarded as the most famous artist in Italy. An unfinished work of his in the cathedral at Orvieto has for its subject the *Last Judgment*. The best preserved of Angelico's work is in the convent of San Marco at Florence. Worthy of special attention are a *Coronation of the Virgin* in the Uffizi at Florence, a *Descent from the Cross* in the Academy, and a *Coronation of the Virgin* in the Louvre. The sameness of the subjects, as well as of their treatment, is to be explained by the nature of his genius, which was most free in the region of triumphant and glorified faith. The sufferings of faith, the martyrdoms, tortures, crucifixions, were distasteful to him. He had no power to express agony. His *Last Judgments* are weakest where Michael Angelo was strongest. Fra Angelico founded no school, imitation of him being impossible. His disciples fell away from his purity into love of external form and decoration. He left no peer, and was followed by no successor; his works stand alone. The best *Life* of Fra Angelico is that of E. CARTIER, translated from the French, and published in London 1865. The Arundel Society of London has published several excellent copies in chromo-lithography of his pictures. A good copy in chromo-lithography of his finest picture, *The Coronation of the Virgin* in the Louvre, has been made by Kellerhoven in Paris.

O. B. FROTHINGHAM.

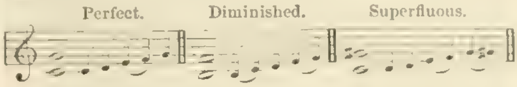
Fife [etymologically related to *pipe*], a wooden instrument chiefly used with the snare-drum in martial music. It is made in one piece, without keys, has six finger-holes, and one mouthpiece or hole for blowing upon one side, as in the flute. Its notes are shrill and somewhat harsh. The fife is variously pitched.

Fife, or **Fifeshire,** county of Scotland, forming a peninsula between the Frith of Forth, the Frith of Tay, and the North Sea. Area, 503 square miles. Pop. 160,499. It is one of the most thickly-peopled and best-cultivated counties of Scotland. Principal towns, Cupar, Dunfermline, St. Andrew's, Dysart, and Kirkcaldy.

Fifteenth′, in music, the interval of a double octave, comprising a distance of fifteen grades of the scale, from the lower to the upper note; also, the name of a stop in the organ, of which each pipe is tuned two octaves above the regular pitch as represented on the keyboard.

Fifth, in music, an interval comprising five degrees of the scale, or the distance, *e. g.*, from C to G, D to A, etc. Fifths, according to their position on the scale or the influence of accidentals, are various in their compass, embracing from six to eight semitones. They are usually classified as *perfect*, *diminished*, and *superfluous* (or *augmented*). The perfect contains three whole tones and one semitone: the diminished, two whole tones and two semitones; and the superfluous, three whole tones and two semitones. For example,

Perfect. Diminished. Superfluous.



In counterpoint the progressions of the fifth are regulated by certain laws, partly arising from the harmonious nature and relations of this chord, and partly in view of the ease with which its use and abuse suggest themselves to the minds of young harmonists, who are unaware of the difficulties of its proper treatment. The restrictions, however, imposed by the old masters have been so far relaxed in modern schools of music that certain progressions of fifths are now freely used which a century ago would have been strictly forbidden. WILLIAM STAUNTON.

Fifth-Mon′archy Men, a small religious sect in England during Cromwell's protectorate and the first part of the reign of Charles II. They professed to believe that the time was near at hand when, to the four great monarchies of Daniel's prophetic vision, was to succeed the fifth, which was to break in pieces all others and to "stand for ever." Of this Jesus was to be King; and in their eagerness to seize the fitting opportunity to proclaim Him they conspired (Apr. 9, 1657) against Cromwell; and again (Jan. 6, 1661), on the prospect of Charles II. being fully restored to power, they rose in insurrection, and attempted to sustain themselves, under a leader named Venner, by force of arms. The insurrection was promptly suppressed, and Venner and several others were executed. The Independents, Baptists, and Quakers formally disclaimed all sympathy with the insurgents, yet were made to suffer odium and civil hardships in consequence of the movement. Two years later another insignificant rising occurred, in consequence of which six persons are said to have been executed. The sect seems to have had no connection with Anabaptists on the Continent, but to have derived encouragement—however unwarrantably—from the views of some eminent men. Clarendon says of Sir Henry Vane that "he did at some time believe he was the person deputed to reign over the saints upon earth for a thousand years." Yet he certainly had no sympathy with the Fifth-Monarchy men. R. D. HITCHCOCK.

Fifth Nerve. See TRIGEMINUS.

Fig [Fr. *figue;* Lat. *ficus*], the fruit of *Ficus carica*, L., a deciduous tree of the Artocarpeæ or bread-fruit family, fifteen to twenty feet high, with rough and deeply-lobed leaves, a native of Asia from Syria to the Caucasus and Koordistan. In the Scriptures the fig tree is often mentioned, along with the vine, as a symbol of peace and plenty. Although unknown in Greece during the Homeric age, it was common in the time of Plato; it was early introduced into Italy, and thence into Spain and Gaul. Charlemagne ordered its cultivation in Central Europe, and it is now cultivated in most warm temperate climates. That it has succeeded even in England appears from the mention of the historian Matthew Paris, that the year 1257 was so inclement that figs, cherries, and plums totally failed to ripen. Figs can be well ripened, and can be raised for preservation in the dried state, only when the summer and autumn are warm and dry. In the Atlantic U. S. the main

obstacle to their cultivation is the cold of winter, which frequently destroys unprotected trees even in Florida. On the Pacific coast they find a more congenial climate. The fig tree bears two crops in a season—an earlier one from the axils of leaves of the preceding growth; a later and longer-continued one from the axils of the leaves of the season. The fig is popularly said to fruit without flowering. This comes from the nature of this particular fruit. It is a hollow, pear-shaped receptacle, nearly closed or barely pervious at the broad apex, lined throughout the interior with innumerable small flowers, male and female. The so-called seeds are the ripened achenia (*i. e.* seed-like fruits) of the latter; the luscious pulp mainly belongs to the ripened and softened receptacle or hollow flower-stalk. A good idea of the botanical nature of a fig is got by comparing it with *Dorstenia*, of the same natural family; in this the flowers occupy the upper surface of a plate or saucer shaped common receptacle. By imagining this saucer to deepen into a cup, and the cup to pass into the form of a jug by a contraction of the summit, the whole peculiarity of the fig-fruit will be apparent. In ripening, the acrid milky sap characteristic of the family is replaced by saccharine matter, chiefly grape-sugar. Fresh figs, most agreeable to many, are too sweet and cloying for other palates, being destitute of acidulous flavor. In the fresh, and still more in the dried state, figs form an important article of food in the Levant, etc. Smyrna is the principal mart whence dried figs are exported to Northern Europe and America. The annual import into Great Britain alone is valued at over $1,000,000. Dried figs are said by the dealers to be *natural* when not compressed in the packing, but retaining their original shape, or *pulled* when after drying they are made supple by kneading, and then packed by pressure into drums or boxes. *Eleme* figs are merely those of superior quality, so called from a Turkish word meaning "hand-picked."

REVISED BY ASA GRAY.

Figeac, town of France, in the department of Lot, on the Sellé. It is a quaint old city, situated in a deep valley surrounded by rocky, vine-clad heights. Pop. 8381.

Fight'ing-fish, the *Ctenops pugnax*, a little fresh-water fish of Farther India, often brought from Siam as a curiosity. It is akin to the perch family. In its native lands this fish is kept for fighting purposes, and much money is often wagered upon the result of the combat. Two of these fishes placed in the same vessel of water will attack each other with the utmost fury.

Figuei'ra da Foz, town of Portugal, in the province of Beira, at the mouth of the Mondego, has a lively trade in salt, oil, wine, and fruit, and is a favorite bathing-place. Pop. 4132.

Figue'ras, frontier-town of Spain, in the province of Gerona. On a height near the town is the citadel of San Fernando, the strongest fortress of Spain and the key of the Pyrenees. Pop. 10,370.

Figueras (ESTANISLAO), b. in Barcelona Nov. 13, 1819; received an excellent education; became at an early age one of the leaders of the liberal party in Catalonia; was elected to the Cortes in 1851; was a member of the revolutionary committee of Tarragona 1854; engaged in the liberal conspiracy of 1866, for which he was imprisoned in 1867, and took a prominent part in the organization of the republican party after the overthrow of Queen Isabella in 1868. On the abdication of King Amadeo (Feb. 11, 1873) he became provisional president of the republic, holding that post until April, when he retired from public life.

Figuero'a, de (FRANCISCO), b. at Alcalá de Henares, Spain, about 1540; author of highly-admired poems in Italian and Spanish. D. about 1620.

Figuier (GUILLAUME LOUIS), French chemist and scientific writer, b. at Montpellier Feb. 15, 1819; became M. D. 1841, professor in the school of pharmacy at Montpellier 1846; then scientific editor of *La Presse* at Paris. Has written largely in scientific journals, publishing also *Exposition et Histoire des Principales Découvertes Scientifiques Modernes* (3 vols., 1851–53; 5th ed. 1858); *Histoire du Merveilleux dans les Temps Modernes* (4 vols., 1859–60); *Vie des Savants Illustres depuis l'Antiquité jusqu'au XIXe Siècle* (1866), etc., and a large number of popular scientific works translated and extensively read in the U. S. and Great Britain.

Fig'urate Num'bers, series of numbers that may be derived from the expression

$$\frac{n(n+1)(n+2)\ldots(n+m)}{1.2.3\ldots.(m+1)} \ldots\ldots\ldots (1),$$

by giving suitable values to m and n. The value of m determines the nature of the series, and n denotes the place of any term in that series.

Figurate series are divided into orders: If $m=0$, the series is of the *first* order; if $m=1$, the series is of the *second* order; if $m=2$, the series is of the *third* order; and so on. If we make $m=0$, expression (1) reduces to n. Making n equal to 1, 2, 3, etc., we have for the figurate series of the *first* order the natural numbers

1, 2, 3, 4, 5, . . . , etc.

If we make $m=1$, expression (1) reduces to $\frac{n(n+1)}{1.2}$. Making n equal to 1, 2, 3, etc., we have for the figurate series of the *second* order the numbers

1, 3, 6, 10, 15, 21, 28, . . . , etc.

If we make $m=2$, expression (1) reduces to $\frac{n(n+1)(n+2)}{1.2.3}$. Making n equal to 1, 2, 3, etc., we have for the figurate series of the *third* order the numbers

1, 4, 10, 20, 35, . . . , etc.

In like manner, figurate series of higher orders may be deduced. They may also be deduced in succession by means of the following law—viz. if the n^{th} term of a series of any order is added to the $(n+1)^{th}$ term of the series of the preceding order, the sum will be the $(n+1)^{th}$ term of the given series. Thus, take the series of the first and second order:

1st *order:* 1, 2, 3, 4, 5, 6, 7 . . .
2d *order:* 1, 3, 6, 10, 15, 21, 28 . . .

If we add the second term in the upper line to the first term in the lower line, we have the second term in the lower line; if we add the third term in the upper line to the second term in the lower line, we have the third term in the lower line; and so on.

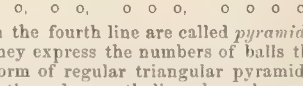
Regarding the series of 1s as a figurative series of the 0 order, we may form from it, in the manner just explained, the following table, called

THE ARITHMETICAL TRIANGLE.

0th *order*......1	1	1	1	1	1	1	1	.	.
1st *order*......1	2	3	4	5	6	7	.	.	
2d *order*......1	3	6	10	15	21	.	.		
3d *order*......1	4	10	20	35	.	.			
4th *order*......1	5	15	35	.	.				
5th *order*......1	6	21	.	.					
6th *order*......1	7	.	.						
7th *order*......1	.	.							

. . . .

This table may be continued to any desirable extent. The numbers in the first line are simple units; those in the second line are the natural numbers; those in the third line are called *triangular* numbers, because they express the numbers of balls that may be arranged in equilateral triangles as in the diagram:



etc.;

those in the fourth line are called *pyramidal* numbers, because they express the numbers of balls that can be piled in the form of regular triangular pyramids; those in the fifth, sixth, and seventh lines have been called *triangulitriangular*, *triangulipyramidal*, and *pyramidipyramidal* numbers. Hence the name *figurate numbers*.

It will be seen that the numbers of the table, read diagonally upward, are the numerical coefficients of the development of $x+a$ to a power whose exponent corresponds to the order of the series. This property, besides rendering the table useful in the formation of powers, enables us to use it, in the calculus of probabilities, to find the number of combinations of m things taken in sets of n. Thus, to find the number of combinations of 7 things taken in sets of 1, 2, 3, etc., we enter the table opposite the 7th order and read diagonally upward: the number in the second column is the number of combinations of 7 things in sets of 1; that in the third column is the number of combinations in sets of 2; that in the fourth column is the number of combinations in sets of 3; and so on.

It is this last property that connects the arithmetical triangle so closely with the logical *Abecedarium.* (See JEVONS, *Principles of Science.*)

W. G. PECK.

Fig'ured (*canto figurato*), a term much used in ancient ecclesiastical music, meaning refined or ornamented. The original Gregorian chants being exceedingly plain, and limited in their range of melody, were, in the course of time, varied and rendered more free by the addition of new inflections, wider excursions of melody, and other traits

of ornament and expression. Music so improved was said to be *figured*, to distinguish it from the *canto fermo*, or plain chant. A similar application of the term was subsequently made in reference to pieces more elaborately and richly harmonized than those of the "strict" style.

Figured Bass, in music, a bass over or under which the harmony is expressed by ordinary figures, dashes, etc., instead of being written out in notes. These figures are not intended to represent the structure or *melodious movement* of the upper parts, but only the nature and elements of the *harmony* on which those parts depend. Nor do the figures usually determine the exact *positions* of chords as played by the right hand on keyed instruments; as such positions may be taken near the bass, or distant from it, or be in either close or dispersed harmony, at the discretion of the performer. The figures represent intervals counted *upward* from the bass; and generally those intervals which *exceed* an octave are expressed by figures denoting the same letter *within* the octave. Accidental flats, sharps, and naturals are used with the figures when necessary, but a sharp is frequently expressed by a stroke drawn through the figure. Figures standing one *over* the other indicate intervals to be struck simultaneously, but those standing one *after* the other are to be taken successively. The triad (or "common chord"), in its fundamental form, requires no figures, unless when succeeding a different chord on the same bass, or when there may be some ambiguity or obscurity in the progression. In keys having sharps or flats at the signature (at the beginning), those sharps or flats will of course affect the figures as well as the notes.

Dotted notes may be represented by dotted figures. Rests also may be introduced, though a small cipher (o) is preferable.

The words *tasto solo* imply that the bass is unaccompanied by harmony until the recurrence of figures.

The present article affords room only for an explanation of the general term, but its practical working will be easily understood; and for fuller information on this subject the student may consult ALBRECHTSBERGER'S *Generalbass-Schule*, CHERUBINI'S *Treatise on Counterpoint*, and BEETHOVEN'S *Studien im Generalbass*.

WILLIAM STAUNTON.

Figure of the Earth. See EARTH, by PROF. A. GUYOT, LL.D.

Figure, Grammatical and **Rhetorical,** a distinction of great importance in the logical construction of figurative language—a subject on which there is an extraordinary amount of confused thinking. The grammatical figure rests upon a *real* relation of the subject and predicate. "My Milton is in four volumes" involves a figure or form of speech departing from strict literalness; but it is a grammatical figure, for the relation on which it rests is real, objective, and undeniable: it is, according to the letter, the grammar, and hence has been styled the grammatical. Milton is literally the author of the works contained in the volumes. The two great grammatical figures are METONYMY (which see) and SYNECDOCHE (which see). They may be at home in the plainest and most commonplace prose—in the language of a will or of an advertisement. The rhetorical figure rests upon an ideal or an idealized relation between the subject and predicate. The mind makes it, and can unmake it; it can exist to one mind, and be denied by another; it may be conceded by the mind at one time and in one state, and denied at another time. "Milton is an eagle" involves a METAPHOR (which see), which is the chief rhetorical figure. The relation is ideal; it may be denied; or the mind may allow it at one time and deny it at another. Some of the most confused and persistent logomachies have arisen from failing to observe this distinction.

C. P. KRAUTH.

Figures, Numerals. See NUMERALS.

Fig'wort (*Scrophularia*), a flowering plant of the order Scrophulariaceæ, common in many parts of North America and Europe. It was formerly prized in medicine for the cure of scrofula and other diseases. Its leaves and knotty root may have active properties, but at present are not much used. Other species of the genus, as *Scrophularia aquatica*, etc. (mostly Old-World plants), have had some repute as medicines.

Fiji. See FEEJEE.

Fil'ament [Lat. *filamentum*, *filum*, a "thread"], in botany, is the support or stalk of the anther of the stamen; "it is to the anther what the petiole is to the blade of the leaf."—*Gray*.

Filangie'ri (GAËTANO), b. at Naples Aug. 18, 1752; entered the army 1766; went to the royal court 1777; became a member of the supreme council of the finances 1787. Is chiefly remembered as author of *Scienza della legislazione* (1780–88, unfinished), a noble treatise on the principles of legislation. D. at Vico-Equense July 21, 1788. His son CARLO (1783–1867), duke of Taormina, was a brave soldier under Napoleon, governor of Sicily under Ferdinand II., and prime minister under Francis II. of the Two Sicilies.

Fil'bert [etymology doubtful; believed to be *full-beard;* Ger. *Bartnuss*, "beard-nut"], the nut of the HAZEL (which see). The name is not often applied to the American wild hazel-nuts; and in commerce the round varieties of European hazel-nuts are called cob-nuts, the name *filbert* strictly belonging to the elongated sorts, which have also a finer-cut and more beard-like envelope; whence perhaps the name. Filberts are chiefly the product of *Corylus Avellana*, the common hazel of Europe and Asia, which is extensively cultivated. Barcelona nuts are a variety of filbert, kiln-dried for better keeping. *Corylus Colurna*, of Turkey, produces large, oily filberts. Filberts are used as dessert-nuts, and large amounts of oil (nut-oil) are also expressed from the kernels. It is a drying oil, much used by artists and makers of choice varnishes. But few filberts are grown in the U. S. Several species are known.

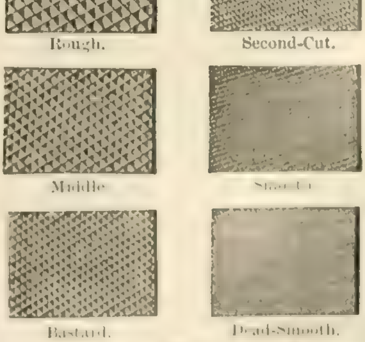
File [Fr. *lime;* Ger. *Feile*]. A file is a tool used in shaping all kinds of materials of construction. It is a bar of steel, the size and shape of which are determined by the use for which it is intended. Its surfaces are covered with sharp cutting edges or teeth, the direction and number of the edges and the magnitude and distribution of the teeth varying with the nature of the material and the degree of smoothness of the surface which the file is required to produce. The cutting edges or teeth are usually made by the edge of a cold chisel. Where the surface has isolated sharp teeth separated by comparatively wide spaces the file is called a *rasp*. The teeth of the rasp are made with a punch having a pyramidal point.

Files are used upon surfaces of all kinds. Rasps are especially fitted for rapid work on surfaces of materials having slight resisting power. They are used by workers in wood and leather, and by the farrier. The effect of rubbing the file upon the surface of the metal, wood, ivory, or other material to be changed in form or dimensions, is to abrade it, cutting from it minute shavings or small particles, and reducing the mass by a very gradual process. Files are therefore only used in shaping small pieces or in "finishing" surfaces which are already of approximately correct figure. The file usually follows the work of the lathe or the planer-tool.

The forms given to files, as well as their shapes and sizes, are almost numberless. Those files which have cutting edges extending unbroken from side to side are called "floats" or "single-cut" files. Those which have two sets of such edges, crossing each other at an angle, are called "double-cut." The effect of such crossing of edges is to produce points or teeth, rather than true cutting edges. The rasp has already been defined.

The coarseness or fineness of the file is known by the trade-terms: 1, rough; 2, middle cut; 3, bastard; 4, second cut; 5, smooth; 6, superfine or dead-smooth. The second grade is rarely found in the market. The most common are the "Sheffield cuts," rough, bastard, and smooth. These are shown in the accompanying sketches.

DOUBLE-CUT.



Rough. Second-Cut.

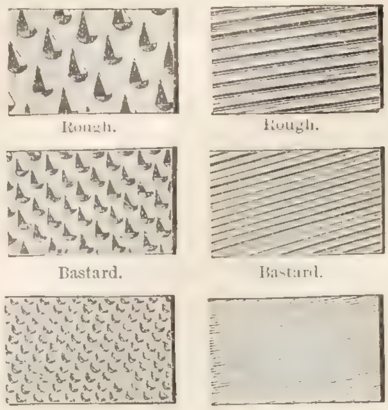
Middle. Smooth.

Bastard. Dead-Smooth.

In what are known as the Nicholson or "increment cut" files, the forms of the teeth and the cutting edges are very similar to those of ordinary files as just described. These are machine-cut files, but they differ from other machine-cut files by being cut with teeth slightly expanding or increasing in size and space from point to heel, thus avoiding

the great regularity of teeth common to ordinary machine-cut files. A writer remarks in regard to this peculiar file:

RASP-CUT. FLOAT-CUT.



Rough. Rough.

Bastard. Bastard.

Smooth. Smooth.

"The difference between this and the perfect regularity of other kinds must be apparent, particularly in double-cut files, as in the one case the file, cut with such extreme regularity, when put to use will in the first inch of its movement produce channels or grooves, and these grooves will continue to be made deeper as the file is shoved along, thus producing that 'grooving' and 'chattering' so often complained of; while with the 'increment cut file' the grooves made by the movement of the file for the first inch will have their sides cut away as the file is moved toward the 'tang' or handle, and *vice versâ;* and while it is cutting as fast as its points permit, it is also said to cut smoother than the best hand-cut file of the same coarseness. The irregularity spoken of consists not only in the spaces between the teeth, but also in the heights of the teeth themselves." The object in having the teeth of differing heights is to admit of their being held down to the work with less effort on the part of the workman. Files having perfectly regular teeth, as is commonly the case with machine-made files, require a great pressure to compel the teeth to take hold of the work in surface filing.

The regularity of the teeth, so characteristic of most machine-work, is not easily obtained by the hand-worker, who, seated with his blank firmly held on a stone block in front of him, strikes the chisel into the blank and raises the first tooth; the chisel is then lifted out of its groove, placed on the blank and slid up until it comes into contact with the tooth previously raised, when the second blow is struck and another tooth is produced. If the force of these blows were alike in each case, the spaces would be equal; but as it is impossible for the most expert workman to strike the great number of blows required in the entire side of a file with exact uniformity, irregularity in the distribution of the teeth must exist. Possibly, the failure of many of the earlier enterprises may be traced in a measure to the defect in their machinery of producing this extreme regularity in the cut of their files.

When a side or an edge of a file is left uncut, it is said to be "safe."

Watchmakers' files are often exceedingly delicate, measuring less than an inch in length, and having a thickness not greatly exceeding that of a coarse bristle. The larger files used by watchmakers seldom exceed four inches in length. Mechanics working on tools, small apparatus, and light machinery, use files of from six to twelve inches in length, and machinists employed on steam-engines and heavy machinery call for files of from ten to eighteen inches in length, and occasionally, for special purposes, use files of double these sizes. The shape of the cross-section of the file is usually either that of a square, a parallelogram, a circle, an oval, a triangle, or a combination of straight lines and arcs of circles. Fig. 1 represents the "parallel hand" file, called, when small, a "pottance" file, or if very slender a "pillar" file. This file is also called a "verge" or a "pivot" file, and when of large size a "cotter" file. Fig. 2 represents the "square" file, which is often, as is the case with all other forms of section, made with parallel sides. Fig. 3 is the "knife" file. This form is usually small, and is of limited use. It is made for the purpose of cutting or enlarging narrow, triangular notches. Fig. 4 exhibits the "half-round" file, the section of which, as seen, is not a complete semicircle. The thickness of the file is usually from one-half to one-fourth the radius of the circle. Fig. 5 is the "round" file. If of small size it is called, when tapering, a "rat-tail" file, and when parallel a "joint" file or "gulletting saw" file. Fig. 6 is the triangular file, often called by the workman a "three-square" file. It is used for sharpening saws, for cutting internal angles, and for cleaning up corners. Fig. 7 resembles Fig. 1, but it is a thinner file. It is known as a "warding" file, and was formerly much used by locksmiths in cutting the wards of the keys of locks. Fig. 8 is the "cross" or "double half-round" file, the two sides usually having different curvatures. The first name is derived from the fact that it was originally designed for trimming out the crosses or arms of small wheels. Fig. 9 is the "slitting," "feather-edge," or "screw-head" file, having two knife edges, and used for the same purpose as the "knife file."

FIG. 1. FIG. 2. FIG. 3. FIG. 4. FIG. 5. FIG. 6.

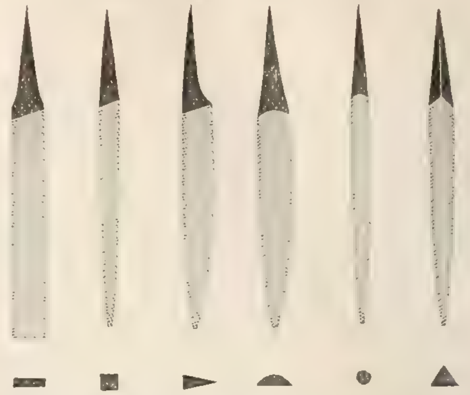
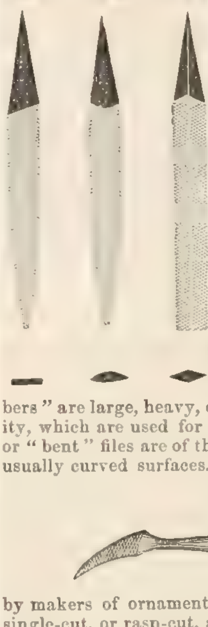
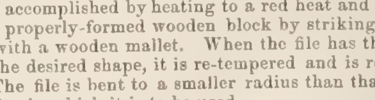


FIG. 7. FIG. 8. FIG. 9.



"Equalling" files are flat and thin. They are always uniform in thickness, and usually in width also. Two opposite surfaces are frequently left "safe." "Rubbers" are large, heavy, coarse files, of usually inferior quality, which are used for rough kinds of work. "Rifflers" or "bent" files are of the shape shown in Fig. 10, and have usually curved surfaces. They are used by sculptors and by makers of ornamental castings. They are double-cut, single-cut, or rasp-cut, and of various degrees of fineness, as required for different kinds of work. They are especially adapted for smoothing up irregular forms, such as are most frequently met with in bronze castings.

FIG. 10.



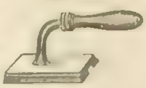
The common kinds of file are frequently bent for convenience in working upon curved surfaces. Bending is readily accomplished by heating to a red heat and shaping over a properly-formed wooden block by striking it light blows with a wooden mallet. When the file has thus been given the desired shape, it is re-tempered and is ready for use. The file is bent to a smaller radius than that of the concavity in which it is to be used.

The tapering end of the file outside the shoulder, and upon which the handle is driven, is called the "tang" or the shank. The tapering form given the tang is not well adapted to give a firm hold to the handle, and it has probably been adopted and retained partly through conservatism and partly because workmen frequently use one handle for several files, and the tapering tang permits the file to be readily inserted into and withdrawn from the handle. To ensure a good "hold," a tang of uniform section, and either cylindrical or prismatic in form, would be far preferable. This has been proposed by Mr. J. E. Sweet. Mr. Sweet is also the inventor of the round "screw-thread" file, in which the cutting edges are formed by making a "ratchet-thread" in the lathe, different pitches of thread thus making different grades of file. The cutting edges of these files are thus formed from the solid stock, and are said to possess remarkable endurance, and, acting like milling tools, do rapid and good work.

The handle of the file is usually driven directly upon

the tang. It sometimes happens, however—as in filing extended flat surfaces, for example—that the file handle interferes with the use of the file by bearing upon the surface and preventing the cutting portion of the file coming down to its work. In such cases the tang is bent or a "holder" is used, as in Figs. 11 and 12.

FIG. 11.



Files are usually made of the best of material, and great

FIG. 12.

care is taken to select steel that is uniformly and highly converted. "Rubbers" for smiths' use are made from blistered steel, but all other files are made from better grades of steel. Files are forged into shape in a similar manner to all small work in steel, the smith taking care not to work the metal at a higher than a blood-red heat. Peculiar shapes are produced in dies or formers. Special care is taken to select good fuel for the fires in which the blanks are forged. It is usually coke, made from coals free from any trace of sulphur. The blanks are very thoroughly annealed after having been forged. The finer qualities are annealed or "lighted" in iron boxes, in which they are imbedded in sand. Cheaper grades are annealed in ordinary annealing ovens—a less expensive method, but one in which the blanks are less completely protected against the access of air. The annealed blanks are next ground into the exact shape demanded, and the scale formed during the antecedent process is removed, leaving a clean and properly formed surface for the file-cutter to work upon. It was formerly customary to shape the blanks by filing, but the use of the grindstone is now much more usual. After grinding, the blanks are greased and sent to the file-cutter.

File-cutting is usually performed by hand, although many attempts have been made during the past two centuries to produce a machine capable of making files of equally good quality. The tools of the file-cutter consist of peculiarly shaped hammers and chisels, an anvil, and packing pieces of lead or pewter. The hammers weigh from one to five or six pounds, the smaller sizes being used for very small and the heavier for very large files. They have a singular form, such as would be obtained by making the head first in the form of a truncated pyramid—the upper and lower bases having a breadth equal to about one-fifth and one-fourth its altitude respectively—and then bending it to an arc of a radius equal to about twice the altitude. The handle is inserted at a point considerably nearest the smaller end. In striking a blow the hammer is pulled toward the workman as it descends, the mass taking a direction approximating to that of the inclination of the chisel. The chisel is short and light, nearly a triangle in form, with a broad, straight edge. It is held between the finger and thumb of the left hand, much as a pen is held by the right hand in writing. The file-blank is placed upon the anvil, where it is held by a strap passing over each end and tightened by the workman, who places his feet in the "bight" of the strap as a horseman places his feet in his stirrups. As each blow is struck the workman moves the blank slightly to bring the chisel over the proper place for the next cut, the strap being loosened at the instant to allow the movement to take place.

In making small and "smooth" or "dead-smooth" files, the blows and these nearly simultaneous movements succeed each other with surprising rapidity. The smallest files are often cut by women or by boys and girls. The surface of the file being "single cut," a second set of cuts is usually made at a large angle with the first, the two sets making angles of about 50 and 80 respectively with the middle line of the file. Before making the second cut the tops of the teeth already formed are smoothed off by lightly running over them a fine file. The blank is then turned over, and the opposite side and the edges are next cut. When a surface already cut is placed downward, a strip of lead or pewter is placed beneath it, to prevent injury of the teeth by contact with the hard surface of the anvil. By constant practice the workman becomes very expert, and the rapidity and accuracy of his work are quite wonderful, and are probably among the finest illustrations of the degree of perfection in workmanship which may be attained by the hand when guided by a delicate sense of touch.

After cutting, the files are next hardened, although those made for use on wood and other comparatively soft substances are frequently left unhardened, and several kinds which are made of peculiar shapes for some purposes, as for sculptors, are made of good iron and case-hardened. The files to be hardened are first besmeared with a mixture of salt and carbonaceous materials which are considered to be best adapted to preserve the teeth from decarbonization and oxidation, and which at the same time, by fusion upon the surface, may indicate the proper heat at which to temper. This surface-coating of comparatively non-conducting material also checks the first sudden change of temperature on immersion in the tempering liquid, and thus decreases the liability of the file to crack. The difficulty which might be experienced from the change of shape which invariably occurs to a greater or less extent on suddenly cooling the file is avoided by giving the untempered file a slight distortion in the opposite direction, so that the subsequent change of shape may leave it in the desired form. In all cases the general shape of the file is determined previous to the operation of hardening.

When the file has been heated in the fire to a temperature at which the surface-coating fuses, it is taken by the tang and suddenly immersed in a tank of water, the rapidity and particular direction of the immersion being determined by the size and shape of the file. Withdrawing it before it becomes cold, the workman inserts it between the jaws of a clamp or between a pair of iron bars, where he corrects by force any slight defect in form, while pouring water over it to thoroughly cool it. The tang is next softened by immersion in molten lead; the file is then scrubbed thoroughly and washed in lime-water to remove the scales of salt mixture. It is carefully dried and oiled, and is then ready for the market.

A careful system of inspection is adopted by the best makers, by which all imperfect files are detected and thrown out to be sold as "wasters." Those files which pass inspection are packed by dozens in papers. In the U. S. some files are packed in boxes.

The time at which files were first made seems to be quite unknown. The manufacture of files was introduced into America very soon after the settlement of the country. File-cutters settled in Pennsylvania at the end of the seventeenth century. The firm of Broadmeadow & Co. began file-making in Pittsburg in 1829. George Chatterton, a Sheffield file-maker, settled in Providence, R. I., in 1839, and is still known (1874) as a leading manufacturer. There are now a considerable number of file-manufacturers in the U. S.

File-cutting machinery was probably first proposed nearly two centuries ago. A Parisian mechanic, Duverger, presented a file-cutting machine to the French *Académie des Sciences* in 1699, and a description of this apparatus appeared in the *Journal des Savants* in 1702. Thiout in his *Traité de l'Horlogerie*, published at Paris in 1740, describes another machine. Still later, Raoul, another French mechanic, made files by machinery, and obtained a report upon them from a committee of the *Lycée des Arts*, in which it was stated that they were equal to the best English hand-made files. In 1812, Morris B. Belknap of Greenfield, Mass., patented a file-cutting machine, and William T. James, who is said to have worked at Union Village, patented another, which has also not been described. In 1836, Capt. John Ericsson, then in England, patented a file-cutting machine, which is described in Holzapffel's work on *Mechanical Manipulation*, where it is stated that one machine could do the work of ten men. In 1847 an ingenious machine was invented by George Winslow of Boston, and was described in Appleton's *Dictionary of Mechanics*. Still later, a machine was invented by M. Bernot of Paris, and was described in detail by Byrne. This machine was used to some extent with success in France and Belgium, and has since 1860 been introduced into Great Britain and the U. S. In this machine the chisel is driven by a cam as the file-blank moves along beneath it, and the difference in height of teeth which is given by the hand-process in passing from the end to the middle of the file, and the reverse, is thus imitated. Considerable sums of money were expended in the effort to make this process a success in Birmingham, but in vain. A few of these machines are still in operation in the U. S., at Pawtucket, R. I. In 1858 the attempt was made at Ballardvale, Mass., to manufacture files by the use of the machine invented by Milton D. Whipple. Extensive works were erected and a large amount of capital was engaged. The company failed in 1869. Some of the machinery was purchased by other manufacturers, and is still in operation. In 1866 the Weed File Company commenced operations at South Boston, Mass., but failed after working two years. The Nicholson File Company of Providence, R. I., was organized in the spring of 1864, with Mr. W. T. Nicholson, the inventor of the machinery, at its head. This company is claimed to have built machines which do satisfactory work.

This problem has, as is seen from the above sketch, taxed the patience and has employed the ingenuity of some of the ablest mechanics of all countries for many years. Very small clock and watchmakers' files have been made by machinery for many years, but the difficulties met with in the

attempt to make larger files have seemed almost insurmountable. Maigne, in his *Dictionnaire des Inventions*, remarks: "It has seemed impossible to obtain machinery having the delicacy of touch of the practised hand of the file-cutter, which varies its action, the position of the chisel, and the force and direction of each blow according to circumstances." The problem to be solved embodies the following conditions: To make direction and intensity of the blow such as to give a cut of precisely the desired depth, and, on curved surfaces, of spread; to draw back the chisel without injuring the edge just made; to avoid a rebound or "chattering" of the chisel; to move the blank with such regularity as shall ensure uniformity in the distribution of the teeth; and to combine all of these movements with absolute precision as to time of succession, and with such speed as shall enable the machine to compete successfully with hand-labor. The Bernot and the Nicholson machines seem to have been the most successful yet invented.

R. H. Thurston.

File-fish (Balistidæ), a family of fishes belonging to the sub-order Sclerodermi of the order Plectognathi. The file-fishes have a conical muzzle, terminating in a mouth furnished with teeth in both jaws. In *Balistes* proper there are eight teeth in a single row in each jaw; their bodies are covered with hard rhomboidal scales, having the appearance of the teeth of a file; and they are furnished with spines in relation with the dorsal and other fins. The file-fishes are brilliantly colored, and abound in warm seas; several species occur on the Atlantic coasts of the U. S. The species represent several very distinct types of structure, varying in the development of the spinous dorsal fin, the position of that fin (which in some is very far forward), the character of the scales, etc. The principal types of structure are two, and represented in the Balistinæ, which has two or three dorsal spines peculiarly articulated, and the Monacanthinæ, which have but one such spine. (See Balistes.) Theodore Gill.

Fi'ler, tp. of Manistee co., Mich. Pop. 376.

Fil'ibuster [Sp. *filibustero*, from *filibote*, a "flyboat," a fast-sailing vessel, first used, it is thought, on the river Vly in the Netherlands], a name formerly applied by the Spanish Americans to the buccaneers and other pirates. In 1849 and 1851 the name was applied by the Cubans to Narciso Lopez and his followers; and from that time it became a common name in the U. S. for the military adventurers who have fitted up expeditions from this country against the Spanish American states. The most famous of the filibusters have been Lopez, above mentioned, and William Walker, who invaded Sonora, Mexico, in 1853, and afterwards three times attempted to make himself master of Nicaragua (1855–57, again in 1857, and afterwards in 1860.) (See Lopez, Narciso, and Walker, William.)

Filica'ja, da (Vincenzo), a celebrated Italian poet, b. at Florence of a noble family Dec. 30, 1642, and d. Sept. 24, 1707. Even in youth his ardent temperament was controlled by a clear judgment and high principles, and he returned to Florence, after his student-life at Pisa, with the character of an accomplished scholar and an earnest, upright man. Eminent as a jurist, and even consulted as a theologian, he occupied every leisure hour with poetry, and when at the age of thirty one he married into the great Capponi family and was made senator by the grand duke, he was already known in Italy as a poet of distinguished genius. His reputation became European after the appearance of his noble *Canzone* addressed to John Sobieski on occasion of the raising of the siege of Vienna in 1683, and kings and emperors congratulated and honored him. His sonnets are models of purity of style, of vigor, and of sublimity of thought. Among the most celebrated of these are *La Provvidenza*, a sonnet of exquisite beauty, and *L'Italia*. The translation of the latter, introduced by Byron into the fourth canto of *Childe Harold*, and beginning with "Italia! oh Italia!" etc., is familiar to every English reader. Filicaja held positions of high trust, and his life was in noble accord with the lofty sentiments of his poems. Tiraboschi says that "he died deeply lamented alike by rich and poor, and beloved by God and man." (Tiraboschi, *Storia della letteratura Italiana*; Fabbroni, *Vite Italiane*; Crescimbeni, *Vite degli Arcadi*.)

Fil'igree [from the Lat. *filum*, a "thread," and *granum*, a "grain"], a delicate kind of ornamental work made of fine wires of silver and gold entwined with beads. It is often extremely elegant, and is considerably employed for personal decoration. It comes chiefly from Italy and the Levant, and from Malacca and China.

Filio'que [Lat.]. The Council of Nice (325 A. D.) affirmed the consubstantiality of the Son with the Father, and simply declared its belief "in the Holy Spirit." The Council at Constantinople (381 A. D.) affirmed, in effect, the consubstantiality of the Spirit with both the Father and the Son, and taught the procession of the Spirit "from the Father." It was not affirmed that the Spirit proceeds from the Father *only*, but this is certainly the *suggestion* of the Creed, and it became at last the established doctrine of the Greek Church. But at first the Greek Fathers were not agreed. Athanasius (d. 373), Basil (d. 379), and Gregory of Nyssa (d. after 394) were non-committal, neither affirming nor denying the procession of the Spirit "from the Father *and the Son*" (*filioque*). Marcellus of Ancyra (d. 373, 374), Epiphanius (d. 403), and Cyril of Alexandria (d. 444) affirmed it. But it was denied by Theodore of Mopsuestia (d. 429), and by Theodoret of Cyrus (d. 457–458). And this, as we have said, is the view which finally prevailed in the Greek Church.

In the Latin Church, on the other hand, the double procession of the Spirit appears never to have been denied. In Saint Augustine's treatise on the Trinity, which was written between 400 and 416 A. D., it is clearly and emphatically taught that the Spirit proceeds from both the Father and the Son. And so firmly did this become the established doctrine in the West, that at the third synod of Toledo in Spain (589 A. D.) the clause *filioque* was added to the Niceno-Constantinopolitan Confession, and the doctrinal basis was laid for the schism—urged on by other influences—which permanently separated the Churches of the East and the West.

In the East, the orthodox doctrine, confirmed by the influence of John Damascenus (d. between 754–787), rejected from the Creed the *filioque;* while in the West, at a synod convened by the emperor Charlemagne, the introduction of the phrase into the Creed was endorsed especially through the influence of Alcuin, Theodulph of Orléans, and the Frank theologians. Pope Leo III. had already expressed his approval of the doctrine which the term implied, while he hesitated to approve its introduction into the Creed. He regarded it rather as speculative than practical. At length, when, in the ninth century, the controversy arose between Photius, patriarch of Constantinople, and Nicholas I., which led to the rupture between the Churches, the doctrinal difference was made a topic of discussion, and the Western Church was reproached with having departed from the faith. Its position was defended by Æneas of Paris, Ratramn of Corvey, and especially by Anselm, archbishop of Canterbury. In 1274 A. D. an attempt was made at the Council of Lyons to effect a reconciliation, but the effort proved futile. In 1439 A. D., at the Council of Florence, the attempt was renewed, but the formula proposed did not secure acceptance, although theologians of both parties were present, and had full opportunities to confer together. Plans of union between the two Churches have repeatedly been suggested, and hopes have been cherished that the breach might be healed. Possibly it might, if the question at issue had been limited to the phrase *filioque*, but in each instance in which its merits have been discussed, other influences have operated to prevent the reunion. Although other characteristic differences separate the two Churches, their diverse views of the *filioque* have become historically the most conspicuous, if not the most important. The two Churches are equally committed to the maintenance of the doctrine of the Trinity; the difference between them relates merely to the philosophy of the doctrine.

R. D. Hitchcock.

Filippi (Camillo), b. in Ferrara about 1510, d. 1574, belonged to the Roman school, and imitated Michael Angelo. His *Annunciation* in the church of Santa Maria in Vado in Ferrara is much admired. Most of his other pictures have perished.

Filippini (Antonio Pietro), b. at Vescovato de Casinca, near Bastia, in Corsica, in 1529; took part in the civil wars which raged in the island from 1555 to 1564, and d. towards the close of the sixteenth century. His *Istoria di Corsica*, published in 1594, and again in 1832, tells the history of the island from the mythical ages to 1594, and although it is wanting in critical respects, and not remarkable for its style, it is very interesting on account of the characteristic facts it communicates and the peculiar nationality it depicts. The earlier part of the history, up to 1559, is given by reprinting the works of earlier chroniclers.

Fil'lebrown (T. Scott), U. S. N., b. Aug. 13, 1824, in the District of Columbia, entered the navy as a midshipman Oct. 19, 1841; became a passed midshipman in 1847, a lieutenant in 1855, a lieutenant-commander in 1862, a commander in 1866. Was in action several times on the Stono and Tagoda rivers, S. C., while in command of the Montauk and Sonoma, during 1864–65, and was favorably spoken of by Rear-Admiral Dahlgren in his official report of July 11, 1864. Foxhall A. Parker.

Fill'more, county of Minnesota, bordering on Iowa, and in the S. E. part of the State. Area, 864 square

miles. Its surface is undulating and very fertile. Grain, cattle, wool, dairy products, and hay are the agricultural staples. It is traversed by the Southern Minnesota R. R. Cap. Preston. Pop. 24,887.

Fillmore, county in the S. S. E. of Nebraska. Area, 576 square miles. The surface is undulating and finely adapted to grazing. It is intersected by the Burlington and Missouri River R. R. Cap. Geneva. Pop. 238.

Fillmore, post-v. of Marion tp., Putnam co., Ind., on the St. Louis Vandalia Terre Haute and Indianapolis R. R., 32 miles S. W. of Indianapolis. Pop. 217.

Fillmore, tp. of Iowa co., Ia. Pop. 1001.

Fillmore, tp. of Allegan co., Mich., on the Michigan Lake Shore R. R., 18 miles N. W. of Allegan, and is traversed by the Chicago and Michigan Lake Shore R. R. P. 1436.

Fillmore, post-tp. of Fillmore co., Minn. Pop. 987.

Fillmore, post-v. of Jackson tp., Andrew co., Mo. Pop. 271.

Fillmore, tp. of Bollinger co., Mo. Pop. 427.

Fillmore, post-v. of Hume tp., Allegany co., N. Y., on the Genesee River and Canal. Pop. 215.

Fillmore (MILLARD), D. C. L., the thirteenth President of the U. S., was b. of New England parentage in Summer Hill tp. (then a part of Locke), Cayuga co., N. Y., Jan. 7, 1800. Worked in youth upon his father's farm in Sempronius (now Niles) in the above county, and when fifteen years of age was apprenticed as a wool-carder and cloth-dresser. His school-education was scanty, but his leisure hours were occupied with study. Undertook when nineteen years of age the study of law with Judge Wood of Montville, N. Y., teaching school a portion of the time. In 1822 removed to Buffalo, N. Y., was admitted to the bar in 1823, and opened a law office in East Aurora, N. Y.; commenced practice in the State supreme court in 1827, and in 1830 removed to Buffalo, where he became a partner of S. G. Haven and the late Judge N. K. Hall. Was sent to the New York assembly 1829–32; was in Congress 1833–35 and 1837–41, where he was an active and useful member, favoring Mr. J. Q. Adams's views upon slavery, and in other public questions acting mainly with the Whigs. While chairman of the committee of ways and means he took the leading part in drawing up the tariff of 1842. In 1844 was the Whig candidate for governor of New York. In 1847 was chosen comptroller of the State, and resigned in 1849. In 1848 was chosen Vice-President of the U. S. on the ticket with Gen. Taylor; and on the death of the latter, July 9, 1850, Mr. Fillmore became President. The great events of his administration were the passage of the Compromise Acts of 1850 and the Japan expedition of 1852. Mr. Fillmore was in Europe 1855–56, and in the latter year was the candidate of the American party for the Presidency. He did not again enter public life. D. of paralysis Mar. 8, 1874. Mr. Fillmore was affable and courteous, and of spotless private character. In his later years he took an active interest in the historical and fine-art societies of Buffalo and in the various local charities of that city.

Fillmore City, post-v., county-seat of Millard co., Ut., 150 miles S. of Salt Lake.

Filter, See WATER, by C. F. CHANDLER, PH. D., LL.D.

Fi'lum A'quæ [Lat., "a thread of water"], a legal term used to denote an imaginary line passing along the middle of a river, and dividing the soil underneath into two equal portions. In navigable streams above the point where the tide ebbs and flows, and in all streams which are not navigable, the *filum aquæ* designates the boundary to which the lands of owners along the river extend. If a grant be made of land adjacent to a river, it includes the soil to the centre of the stream, unless the terms of the grant clearly indicate a contrary intention. If an island forms in the river so as to be divided by the *filum aquæ*, the parts thus separated belong respectively to the opposite proprietors. If there be a gradual deposition of earth upon one bank, and none or little upon the other, the thread of the stream will constantly vary, so as to always be midway between the banks. But if a large portion of land be detached from one side and carried to the other, the thread remains as before, so that the estate of each owner may extend to the same limits as previously. If a single person owns the land on both sides of a stream, of course the entire bed is also his sole property.

The *filum aquæ* in all cases only denotes the ownership of land forming the bed of a river or rising above the surface, but does not indicate any exclusive proprietary right in the water which is thus supposed to be divided. Each riparian owner along the whole course of the stream has a right to have the water flow in its accustomed manner and volume, and no one of the owners is justified in diverting the stream to his own uses, or in so materially diminishing the water-supply which it affords as to occasion unreasonable injury to the others. But any use of the water, as for purposes of irrigation, etc., which does not sensibly impair the rights of such other persons, is allowable.

In the case of public rivers, or those in which there is a flow of tide water, the soil underneath does not belong to adjoining owners, but to the sovereign or state, so that the doctrine of the *filum aquæ* has in general no application. It may, however, denote the boundary-line between two different States or two different counties. In some of the States the doctrine is maintained that though there is no tide, the bed of a stream which is in fact navigable belongs to the State, and not to the riparian owners. (See RIVERS, NAVIGABLE STREAMS.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fin, the principal organ of locomotion in fishes and cetaceans. A fin usually consists of a thin membrane supported by bony spines or cartilaginous rays, often very numerous. When these rays or spines are direct appendages of the internal skeleton, they are homologues of the limbs of the higher quadrupeds, the pectoral fins representing the fore limbs, the ventral the hind limbs, even if (as is the case with the so-called jugular fins of some fishes) the ventrals are before the pectorals. There may be, however, one or more dorsal or anal fins (on the median line of the back or belly respectively), and a caudal fin at the end of the tail. These (called in fishes *vertical* fins) are not appendages of the internal skeleton. The tail of fishes is usually the chief organ of locomotion. The other vertical fins serve as a keel or centre-board, while the proper limbs (the pectorals and ventrals) probably assist in guiding the course. There are a few fishes which are quite destitute of fins. A few others have the pectorals so large as to serve to some extent as organs of aërial flight.

The tail (fluke) of a whale is flattened horizontally, instead of vertically, and the pectorals (arms) are present, while the posterior limbs, which in some cases are represented by the flukes, in others are rudimentary, being represented by a small bone concealed within the body. Some whales have a dorsal tuberosity, whence they are called "finbacks." The flippers of sirenians and of some of the seals approach closely to the character of the cetacean fin.

Fi'nal Cau'ses, causes (see CAUSE) which are not also effects. All other causes are, on one side, caused; they come forth as well as go forth. Final causes do not come forth. The physical sciences, as such, have nothing to do with final causes. When they exhaust physical causes, they exhaust all with which they have to deal, for physical science is the science of second causes. They assume the simples and forces as existent, and the question, *How* these simples and forces came to exist? is not for them. In this sphere the objection of Bacon and Des Cartes to the investigation of final causes is well founded. It was too often an indolent or ignorant evasion of the real work of science. But, as it is no part of the distinctive work of physical science to determine final causes, it is equally remote from its province to assert that there are not final causes. The whole doctrine of final causes has been denied by materialism. (See STRAUSS'S *Old Faith and New Faith*.) Ulrici shows that the argument of materialism at this point rests upon a confounding of "the *notion* of causality with the *mental law* of causality," and that the law of causality "does not affirm that whatever *exists* must have a cause, but only that all that *happens*, all that *comes into being*, must have a cause." (See ULRICI'S *Review of Strauss*, with an introduction by C. P. KRAUTH, 1874, pp. 86–91, and pp. 46–58.) C. P. KRAUTH.

Finance' [It. *finanza*; Fr. *finance*]. The word originated in feudal usages, and primarily signified revenue arising from fines; hence it came to be a comprehensive term for the revenue of a king or state, and taking a wider range it now embraces the medium of exchange, the science of the medium of exchange and liquidation in commerce. Finance has been more briefly defined as the science of money. Although money is universally adopted as the instrument by which value is measured and expressed, it does not include the total of the medium. The science of that medium, of whatever composed, is the science of finance.

The common use of the word is in the plural, *finances*. It is so applied, indiscriminately, to the affairs of individuals, companies, and governments. A merchant who fails to pay his notes at maturity is said to be embarrassed in his finances, or, in usual parlance, to be *hard up for money*. Under this location is embraced a great variety of phenomena, of which no one phrase is conveyed by the literal term used.

In the singular, *finance*, which is the generic term, the word applies not only to experimental phenomena, but also to the principles of administration in connection with the general currency of the country, the assessment of values,

the apportionment of taxes, the negotiation of loans, the husbandry of resources, the liquidation of debt, the policy of commercial intercourse with foreign countries, and, at large, with all the employments and interests of human life. In a scientific view, finance must be regarded as the main pillar of social organization. It supports the entire superstructure of credit, and its combinations extend through every department of industry and enterprise. Practically, it governs the valuation of property, and thus it comes home to every individual. The details composing this wide system of things constitute the subject of continuous classification and generalization. But while, in late years, the gathering of statistics has been pursued with diligence in all active commercial countries, comparatively little attention has been bestowed on the investigation of the laws and principles by which alone their scientific relation can be determined. Hence, no division of human knowledge is less developed in the present day than that which falls under the general head of *Finance*.

Every government has an officer with the title *minister of finance*, or its equivalent, to whom is entrusted the direction of its treasury affairs. In England he is commonly styled *chancellor of the exchequer;* in the U. S., *secretary of the treasury*. The practical scope of finance is signified by the duties assigned to this officer. The secretary of the treasury is required to "prepare plans for the improvement and management of the revenue and the support of public credit;" to report to each session of Congress, on its assembling, the receipts and disbursements of the fiscal year past, and estimates thereof for the year ensuing; to superintend the collection of the revenues; to grant all the warrants for moneys to be paid in pursuance of appropriations by law; to execute necessary services in the sale of the public lands; and "to make report and give information to either branch of the legislature, in person or in writing, respecting all matters referred to him."

A vivid conception of the scope of duties which devolve on a competent minister of finance may be obtained by reference to two pre-eminent examples. One is that of Colbert, minister of Louis XIV. of France, who, we are told, "labored for sixteen hours a day during twenty-two years in his tariffs, his custom-house regulations, his mercantile negotiations." In his view, "the question of free exchange could not be separated from the general state of the world. . . . He possesses and sums up in his strong head," says one of his biographers, "a living encyclopædia in which are arranged in good order the innumerable regulations of industrial pursuits and the details of so many admirable ordinances which were provided for the management of forests, the entry of sailors, the security of the merchant. He knows to a fraction all the merchandise that enters the kingdom, and all that leaves it.

The other example is that of the British chancellor of the exchequer, who may be said, with almost exact literal truth, to govern the financial destinies of the world. The foreign commerce alone (exports and imports) of Great Britain for the year 1872 amounted to the prodigious sum of $3,346,000,000. The industrial capacity of this "speck on the globe" is estimated by the force of machinery at twenty times its population, or the equivalent of six hundred million man-power. That this astonishing result is due, chiefly, to the organization of its financial system is an incontrovertible proposition. A single fact will suffice to show the diligence and the exhaustive application with which that system is maintained. In order to establish a contested point in the practice of the House of Commons with respect to the appropriation of money, Mr. Gladstone "personally examined the titles of all the statutes passed since the Restoration (embracing a period of over two hundred years), and selecting from the mass those which had reference to finance from year to year, observed for himself, in each particular instance, the component parts of those statutes." J. S. GIBBONS.

Fin-back, a name given to the whales of the family Balænopteridæ, on account of their prominent dorsal fin—an appendage which in most other whales is either absent or comparatively small and rudimentary. The fin-back whales have not been much sought for by whalers, on account of their fierce disposition, and from the fact that their oil, though excellent, is not abundant, while their baleen is often scanty and poor; but the "Bahia finner" (*Megaptera Braziliensis*), is much sought for its baleen. Fin-backs are frequently of very large size; and of late they have been much hunted off the coast of Norway for their oil and their flesh and bones, which are converted into fertilizers for the European markets. There are several species, mostly of the genus *Balænoptera*.

Fin'castle, a post-v. of Eagle tp., Brown co., O. Pop. 140.

Fincastle, post-v. and tp., cap. of Botetourt co., Va., at the head of the Great Valley of Virginia, 30 miles S. of the Chesapeake and Ohio R. R., 14 miles N. of the Atlantic Mississippi and Ohio R. R., 12 miles from the present terminus of the James River and Kanawha Canal, and 4 miles N. of the Valley R. R., now under contract. It has a large flouring-mill, a woollen-factory, a savings bank (just chartered), 2 hotels, 4 churches, 1 newspaper, and a number of stores. Principal business, farming and merchandise. Pop. of tp. 3501. M. W. CAMPER, ED. "HERALD."

Finch [Ger. *Fink*], a name given to various birds, especially to certain European and American birds of the family Fringillidæ, and more particularly to those of the sub-family Fringillinæ. The American finches are mostly of the genera *Carpodacus, Chrysomitris, Pipilo, Cyanospiza, Poocætes, Chondestes, Zonotrichia*, etc. They feed on seeds as well as insects, are generally bright, active birds, and some are good songsters. (See GOLDFINCH, BULLFINCH, CHAFFINCH, etc.)

Find'horn, a river of Scotland, which after a course of about 90 miles enters the Moray Frith. In 1829, in August, it rose at one place 25 feet, and caused the great floods known as "Moray's Floods."

Find'ing, in law. The finder of lost property upon land who takes it into his possession becomes invested with a special property therein, which is superior to the claims of all persons except that of the true owner. He is under no legal obligation to take into his custody any articles he may thus discover, but if he does, certain important rights and obligations immediately attach to his possession. His primary duty is to preserve the property intact, and in as excellent condition as its nature and state at the time of finding will permit, in anticipation of the owner's appearing to reassert his title. A finder thus becomes a kind of bailee, and, like other bailees, he may defend his possession and interest by bringing action against any third person who injures the property, or asserts dominion over it, or interferes with his immediate ownership. If the absolute owner ever appears, restoration must be made to him, and the finder will be entitled to no reward if none had been previously offered, and can only claim to be remunerated for the actual and necessary expenses incurred in the proper care of the goods. But if a specific reward had been promised, of which the finder had knowledge, he would be authorized in demanding it, and would have a lien upon the property until such charges were satisfied. If at the time of making the discovery the finder knew, or had means of readily ascertaining, to whom the property belonged, it would be his duty to seek out the owner and return whatever he had thus acquired; and if he failed to do this his retention of the goods would be a fraudulent appropriation of them which would constitute larceny. But in cases where knowledge of ownership could not be acquired no larceny could be committed. Retaining the chattels would then not be wrongful, but reasonable and obligatory. If the former owner can never be discovered or never asserts any claim to the property, it vests absolutely in the finder. The place where the finding occurred is immaterial as regards his rights. If an article which was lost in a store was picked up by any stranger, he would have the first claim to it, and if the owner never reappeared might enforce his title even against the storekeeper. This would not be the case, however, if the article was only left by accident, for it would then be regarded as confided to the keeping of the proprietor of the store, who might demand it from any one by whom it was discovered.

The finder of a chose in action, as a check or lottery-ticket, cannot enforce payment of it if the party liable under it has notice that the applicant is not the real owner. If in such a case payment was made, the proper owner would not be debarred from a subsequent recovery. If, however, the finder transferred the instrument for value to a *bona fide* holder, who was ignorant of his defective title, it would, if negotiable, be good in the latter's hands, according to the general principles governing commercial paper.

At common law there were special rules concerning the finding of *estrays*—*i. e.* of cattle whose owner is unknown—but this matter is now generally provided for by statute. (For the rules applying to TREASURE TROVE, see the article on that subject; in regard to goods found at sea, see SALVAGE.) GEORGE CHASE. REVISED BY T. W. DWIGHT.

Find'lay, post-v. and tp., cap. of Hancock co., O., is situated in the N. W. part of the State, 46 miles S. of Toledo, on the Lake Erie and Louisville Railway, midway between Fremont and Lima. It has 10 churches, 3 weekly newspapers, 4 banks, 3 machine-shops and foundries, 3 flouring-mills, 3 planing-mills, 1 oil-mill, 1 flax-mill, 1 woollen-factory, 3 carriage-factories, 1 spoke-factory, 1 stave-factory, 2 wagon-shops, and a goodly number of fine business-houses. It is the terminus of a branch of the Cin-

cinnati Sandusky and Cleveland R. R. Pop. of v. 3315; of tp. 4073. L. GLESSNER, ED. OF "HANCOCK COURIER."

Find'lay (JAMES), b. in Franklin co., Pa., about 1775, went to Cincinnati, O., in 1793; was in the legislative council for that Territory in 1798, and became a prominent Democratic leader, filling various civil offices until 1824. As colonel of the Second Ohio volunteers in 1812 served under Gen. Hull at Detroit, Mich. Was in 1825–33 M. C. from Ohio, and d. at Cincinnati Dec. 28, 1835.

Findlay (WILLIAM), b. at Mercersburg, Pa., of Scotch-Irish stock, June 20, 1768; was a prominent Democratic State legislator; State treasurer 1807–17; governor of Pennsylvania 1817–20; U. S. Senator 1821–27; treasurer of the U. S. mint, Philadelphia, 1827–41. D. at Harrisburg, Pa., Nov. 12, 1846.

Find'ley, tp. of Webster co., Mo. Pop. 625.

Findley, tp. of Allegheny co., Pa. Pop. 1170.

Findley, tp. of Mercer co., Pa. Pop. 1710.

Findley (WILLIAM), American politician, b. in the north of Ireland about 1750, came to Pennsylvania while young; served in the war of the Revolution; at its close became a member of the legislature, then of the State constitutional convention, and was M. C. 1791–99 and 1803–17. He published a *Review of the Funding System in 1794*, etc., and d. at Unity, Westmoreland co., Pa., Apr. 5, 1821.

Finds, a name sometimes given, without special propriety, to discoveries of collections of relics associated with mankind during the pre-historic ages; such as weapons or other implements, bones of man or of animals eaten by him, etc. (See KITCHEN MIDDENS; PALEFITS, and PRE-HISTORIC MAN.)

Fine, post-tp. of St. Lawrence co., N. Y., has iron ore and timber. The village of Andersonville has some manufactures. Pop. 603.

Fine [Lat. *finis*, "an end"], a pecuniary mulct imposed by a court upon a criminal offender as a means of punishment. The precise amount of the fine is commonly left to the discretion of the court, though a maximum and minimum sum appropriate to each particular offence is, in general, designated by statute, and the exercise of judicial discretion must be confined within these limits. There is a provision in the U. S. Constitution that "excessive fines shall not be imposed."

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fine Arts is a general term applied to certain methods of embodying the beautiful in human productions. To the degree in which any work of man is produced according to the laws of taste only, and is intended to awaken æsthetic emotions solely, to that degree is it a work of fine art. But even among the works of poetry, music, painting, sculpture, and architecture—which five branches of art denote the five primary methods of embodying beauty in human productions—many do not serve æsthetic purposes solely. Hymns, oratorios, and church edifices serve also religious purposes; patriotic songs and statues, legislative buildings, and halls of justice, also patriotic or governmental purposes; drawings and paintings of animals, plants, and fossil remains, also scientific purposes, etc. Such works form a transition from the fine arts to the useful arts, or, as they often are called, the mechanical or industrial arts, in whose productions usefulness is the primary quality, beauty only a secondary. A further distinction is often made between those arts which use language as their medium—poetry—and those which do not; and the term fine art is thus confined to music, painting, sculpture, and architecture. A transition between poetry and art is formed by eloquence and acting.

The physical senses, the channels through which all external objects are cognized by the human spirit, furnish the basis for the classification of the fine arts. Taste, through which perceptions can be formed only by destroying the object, is entirely excluded from the realm of beauty. With feeling and smell—being more abstract, consequently more refined senses—beauty begins to dawn, but it has its true home in the spheres of sight and hearing, and these two senses being the chief avenues for the reception of all our external knowledge, the fine arts are divided into two great groups upon the basis of them. Those which appeal to the eye are termed the *formative arts*. Those which appeal to the ear may be termed the *sounding* or the *hearing arts* (though no such generic term has yet gained a foothold in the English language), and include music, oratory, and poetry, with the other forms of belles-lettres or artistic literature. Sometimes several arts are combined in the same work, as architecture, sculpture, and painting in a monumental edifice; poetry, dramatic action, and scenic painting in a theatrical representation; and these, together with instrumental and vocal music, in an operatic representation. The *multiplying arts*, such as engraving, chromo-lithography, and photography, are those by which, through the aid of mechanical and chemical means, many repetitions can be quickly and cheaply produced, which shall contain most or all of the prominent features of a work of art. G. F. COMFORT.

Fine of Lands, a species of conveyance formerly in use in the English law. It was in form a judgment of a court of justice. There was, however, no real litigation. The party against whom the action was apparently brought admitted upon the records of the court that the claim of the apparent plaintiff was just. This admission created a species of *estoppel*, so that he was prevented from afterwards denying a statement thus solemnly made. This would be true, notwithstanding his title before the admission was perfect. In this way a fine might be resorted to as a conveyance. At an early day (18 Ed. I. § 4) it was required by statute that a married woman in making such an admission should declare before the court or an authorized officer, separately and apart from her husband, that she made the admission freely, and without fear or compulsion of her husband. This last feature of "fines" has been much used in the U. S. as applied to an ordinary conveyance by married women, the acknowledgment being made, *e. g.*, before a justice of the peace, commissioner of deeds, or even, in some States, before a notary-public. A fine might on these principles be resorted to to "bar an entail" (see ENTAIL), though another fictitious proceeding, termed a "common recovery," was more effectual. (See RECOVERY, COMMON.) Another important use of a fine was to operate as a short statute of limitations. (See LIMITATIONS, STATUTE OF.) The rule is well expressed in the statute already referred to of 18 Ed. I.: "The fine is so high a bar and of so great force, and of a nature so powerful in itself, that it precludes not only those who are parties to the fine and their heirs, but *all other persons in the world* who are of full age, out of prison, of sound memory, and within the four seas the day of the fine levied, unless they put in their claim within *a year and a day*." In the reign of Henry VII. the time was extended to five years, and the claim must be made within that period, except in the case of persons under disability. In their case five years was allowed after the disability was removed. It was further required that there should be a proclamation of the fine in open court. This method of limitation has been in use in this country with some modifications. An instance of it, when it became the support of an important title, is found in the case of *MacGregor* v. *Comstock*, 17 New York Reports, 162 (decided 1858). T. W. DWIGHT.

Fine's Creek, post-tp. of Haywood co., N. C. P. 1048.

Fin'gal's Cave, a remarkable cavern on the island of Staffa, off the W. coast of Scotland, hollowed out in a mass of volcanic rocks. Two ranges of basaltic rocks are supported upon a lava-like mass beneath, and the unequal hardness of the materials, combined with the perfection of the columnar structure, has permitted the carving out, by the waves of the sea, of one of the most picturesque pieces of natural architecture in the world. The discovery of tertiary plants, associated with the corresponding volcanic rocks on the neighboring island of Mull, enables us to fix the time of the eruption of these basalts as belonging to the miocene period. A similar age has been assigned to the beds of basalt on the coast of Antrim, Ireland, which were, in fact, probably but a part of the same great outpouring of lava. (See GIANT'S CAUSEWAY.) EDWARD C. H. DAY.

Finger. See HAND, STRUCTURE OF THE, by PROF. EDWARD HITCHCOCK, A. M., M. D.

Fing'ering, in music, (1) the mode or system devised for the proper use of the fingers in playing on certain instruments, as the organ, pianoforte, violin, etc.; (2) the application or practical use of such system. In elementary instruction books and exercises for the organ or pianoforte the notes are "fingered"—*i. e.* accompanied by the marks x, 1, 2, 3, 4 (the x indicating the thumb), or by the figure 1 for the thumb, and 2, 3, 4, 5 for the fingers.

Fin'ial [from the Lat. *finis*, an "end"], in architecture, a decoration designed to surmount a spire, gable, or other projecting point within or without a building. Finials are of wood, metal, or stone, and often are carved with great delicacy and good taste or with grotesque and fanciful designs. The ornamentation is sometimes of a heraldic character.

Finiguer'ra (TOMMASO or MASO), Italian niello worker and goldsmith, b. at Florence 1424, d. in 1475, is reckoned the inventor of the art of taking engravings from metallic plates on paper.

Fi'ning, or **Clarifica'tion,** the process of clearing turbid liquors, generally used in connection with wines and malt liquors, though the process is resorted to for clearing a great variety of solutions, such as syrups, jellies, coffee, argol, etc. In the manufacture of wine and

beer the yeast, which either rises to the surface as a scum or forms a deposit at the bottom, generally carries with it all suspended impurities, and leaves the liquid limpid. When this is not the case, "finings" must be employed.

Filtering.—For fining small quantities of many liquors the process of filtration is the simplest. A funnel lined with porous filter-paper is the most convenient apparatus, though filters are made of a great variety of porous substances, such as cotton, flannel, earthenware, sand, charcoal, etc. Filtration is not always effective, as the impurities which render the liquid turbid are often so fine that they pass through the filter. This is generally the case with wines and malt liquors. Another objection to filtration is the difficulty of conducting it without exposing the liquor to the air, which in the case of light wines and malt liquors would be fatal.

Isinglass, or gelatine, is most frequently employed for beer and ale. "Brewers' finings" are made by softening the gelatine in four times its weight of cold water or sour beer. As the gelatine swells, more water or sour beer is added. The thick jelly thus obtained is dissolved in eight times its volume of the liquor to be fined, when it presents the consistence of a syrup; 1 pound of isinglass makes about 12 gallons of finings. This is added in about the proportion of 1 to 2 pints to a barrel of ale or to a hogshead of cider or wine. The gelatine is coagulated, or rendered insoluble, by the astringent tannic acid of the liquor, and as the insoluble compound gradually settles to the bottom of the barrel, it inviscates and carries with it all the suspended impurities, and leaves the liquor clear. In some cases this removal of the astringent principle is objectionable, as it modifies the flavor and diminishes the keeping qualities of the liquor. In the case of red wines, this is so important a consideration that albumen is employed instead of gelatine. Coffee is often clarified by the addition of a piece of the skin of salted codfish, which furnishes gelatine which is coagulated by the tannic acid present. Carrageen moss is sometimes used for clarifying beer, as are also the dried stomachs of the cod, called *sounds. Lime* in the water used is supposed to aid materially in the clarification of beer by combining with the acids of the malt, forming insoluble salts, which carry down the suspended matters. The spring water used in the breweries at Burton-on-Trent contains a considerable quantity of sulphate of lime, which is thought to aid in clearing the ales.

Albumen is coagulated either by heat or by alcohol. It is used in large quantities by sugar-refiners, who clarify or "defecate" their solutions of raw sugar with bullock's blood. The blood is added while the solution is below 140° F., and then, on raising the temperature to a boil by means of steam, the albumen of the blood is coagulated, and the coagulum, forming flocks, collects and envelops the suspended impurities, and partly rises to the surface as a scum, to be skimmed off, and partly settles to the bottom, to be separated by the "bag filters."

In making calf's foot jelly fresh egg-shells are often thrown in, that the adhering albumen may be subsequently coagulated by heat and clear the liquid, from which the shells and coagulum are separated by a bag filter of flannel. When albumen is added to wines, it is coagulated by the alcohol, and operates as when coagulated by heat. Heat alone clarifies many vegetable and animal juices by coagulating the albumen which they naturally contain.

Vegetable acids clarify many expressed juices, and the juice of sour cherries will completely separate the pectin of currant and raspberry juice, so as to fit them for syrups.

Alum is sometimes used. It is specially serviceable in clarifying waters which are rendered turbid by fine mud, a pinch of alum thrown into a barrel of water being sufficient to render it clear and limpid after a few hours' standing. The alumina is probably precipitated by the carbonate of lime, which is always present in river as well as in spring water.

Acetate of lead has been used for clarifying liquors, its precipitation being effected by a subsequent addition of half its weight of sulphate of potassa. It is a very dangerous agent on account of its poisonous character.

Plaster of Paris, clay, sand, and *marl* are often effective in clarifying turbid solutions, such as cider, etc.

Soluble salts, as a solution of sal-ammoniac, often cause the separation of finely-divided precipitates, which remain long in suspension in pure water. They also greatly facilitate the filtering and washing of precipitates, which otherwise pass through the filter. C. F. CHANDLER.

Finistère, or **Finisterre** [Lat. *Finis Terræ,* "Land's End"], is a department of France, comprising the western part of the former duchy of Bretagne. It has an area of 2648 square miles, and a population of 642,963. Its coasts along the English Channel and the Atlantic are formed of rugged and broken granite rocks, but in the interior the soil is generally fertile and well cultivated. Its silver and lead mines are very valuable.

Finisterre, Cape ("Land's End"), is a promontory at the north-western extremity of Spain; lat. 42° 54′ N., lon. 9° 21′ W.

Fink (FREDERICK), American painter, b. at Little Falls, N. Y., Dec. 18, 1817, became known at the age of eighteen by his portrait of W. S. Parker; went to Europe, and d. in 1849. Among his *genre* pictures are *An Artist's Studio, Shipwrecked Mariner, Young Thieves, Negro Woodsawyer,* etc.

Fin'land [Fin. *Suomesimaa,* the "land of lakes"] is a grand duchy of Russia, lying between lat. 59° and 70° N. and lon. 21° and 33° E., and bounded by Russia, Norway, Sweden, and the Gulfs of Bothnia and Finland. It includes a portion of Russian Lapland. Its area is about 135,000 square miles, one-third of which is occupied by lakes and marshes. The ground may generally be described as a table-land from 400 to 600 feet high, with occasional elevations, depressions, and ranges of hills covered with dense forests of fir and pine, which, in connection with the beautiful lakes, give the country a picturesque and romantic though somewhat sombre aspect. The coast is low, except the southern part, which presents a line of rugged cliffs skirted with innumerable rocky islands. While Finland was united to Sweden it exported yearly a great quantity of rye and barley; indeed, it was called the "granary of Sweden." But since its annexation to Russia it seems to have given up agriculture and taken to cattle-breeding, for which the country in many places is eminently adapted. The most valuable exports are, however, the products of its forests, as timber, pitch, potash, tar, and rosin. It yields also some copper, iron, lime, and slate. Reindeer, wolves, elks, beavers, various kinds of game, and, among fishes, salmon, trout, and herring, abound. The climate is rigorous. A severe winter of seven or eight months passes through a short spring, immediately into a hot, dry summer. Yet the time in winter when the sun never rises, and in summer when he never sets, has its very peculiar charms. The population, which numbers, according to the census of Dec. 31, 1871, 1,766,880, consists of Finns, interspersed with Laplanders, Swedes, and Russians. The Finns are a branch of the Ugrian race, kindred to the Laplanders and the Magyars of Hungary, but different both from the Swedes and the Russians. They are tall, strongly built, and well proportioned, but the shape of their faces is nearer the square than the oval, and their features do not indicate any high degree of intellectuality. They are an honest, industrious, and energetic people, however, and their peculiar language and literature have of late attracted much attention. In olden times they formed an independent empire, but in the twelfth century they were conquered and converted to Christianity by the Swedes. During the union with Sweden the Swedish language and civilization took deep root among the Finns, and when in 1809 Russia conquered and secured the country, she was met with great opposition and aversion by the people. She has governed the country with great prudence, however, granted the Finns many privileges, and her attempts at eliminating the Swedish elements by supporting and developing the original Finnish foundation have been somewhat successful. All the native population are able to read and write; and in 1872 the work of Russianizing Finland was commenced by rendering education in Russia compulsory in the public schools. The most important towns are Helsingfors, Åbo, Sweaborg, and Viborg. The emperor of Russia is grand duke of Finland. The state church is Lutheran. The government is nearly independent of the rest of the Russian empire, and is administered in accordance with the Finnish constitution of 1772. (See FINNISH LANGUAGE AND LITERATURE.) (GERSHAU, *Versuch einer Geschichte Finlands,* 1821; *Bibliographia hodierna Fenice,* 1846; FRIIS, *Beskrivelse over de norske Finlapper,* 1841; TAPELIUS, *Finland fremställdt i Teckning,* 1860.) CLEMENS PETERSEN.

Fin'land, Gulf of, the great eastern arm of the Baltic, situated between lat. 59° and 61° N. and lon. 22° and 30° E. Its water is only very slightly salt, having come from the great lakes Onega, Ladoga, Peipus, and Saima through the river Neva. At its E. end is St. Petersburg, and along its coasts are Narva, Reval, Frederikshamn, Helsingfors, and Viborg.

Fin'lay (GEORGE), LL.D., the learned historian of *Greece under Foreign Domination,* was born of Scottish parents, near Faversham, Eng., Dec. 21, 1799. In 1823, before the death of Lord Byron, he joined the Greeks in their struggle for independence, and has remained in the country ever since, making his home in Athens. His ardent Hellenic hopes have been disappointed. He speaks with regret of having "abandoned the active duties of life, and the noble task of laboring to improve the land, for the sterile occupation of recording its misfortunes." His works are in seven vol-

umes, as follows: I. *Greece under the Romans*, 146 B. C. to 716 A. D. (1843; 2d ed. 1856); II. *History of the Byzantine Empire*, 716–1057 A. D. (1852; 2d ed. 1856); III. *History of the Byzantine and Greek Empires*, down to 1453 A. D. (1854); IV. *History of Greece from its Conquest by the Crusaders to its Conquest by the Turks*, 1204–1566 A. D., and of *the Empire of Trebizond*, 1204–1461 (1851); V. *History of Greece under Othoman and Venetian Domination*, 1453–1821 A. D. (1856); VI., VII. *History of the Greek Revolution* (1861). He has also written much for the London *Times*, proving himself a real friend of Greece, but often offending Greek pride by his strictures upon public men and measures. D. Jan. 26, 1875. R. D. HITCHCOCK.

Fin'ley, tp. of Scott co., Ind. Pop. 1102.

Finley, tp. of Christian co., Mo. Pop. 1276.

Finley, tp. of Douglas co., Mo. Pop. 332.

Finley, tp. of McDowell co., N. C. Pop. 580.

Finley (JAMES BRADLEY), an American Methodist preacher, b. in North Carolina July 1, 1781, removed to Ohio in 1801; joined the Methodist ministry in 1809; took charge of the Wyandotte Indian mission in Upper Sandusky in 1811, where he spent six years. For forty-five years was one of the most successful Methodist itinerants of the North-west, and was eight times a delegate in the General Conference of his denomination. Published numerous works, among which are an *Autobiography*, *Wyandott Mission*, *Sketches of Western Methodism*, etc. D. in Cincinnati Sept. 8, 1856. ABEL STEVENS.

Finley (JOHN P.), American Methodist clergyman and educator, b. in South Carolina in June, 1783, taught in various academies in Ohio from 1810 to 1822, and in the latter year was chosen professor of languages in Augusta College, Ky. About this time he joined the ministry. D. in May, 1825.

Finley (MARTHA), ("MARTHA FARQUHARSON"), American writer, b. in Chillicothe, O., has published Sunday-school books, *Casella, or Children of the Valleys*, *Old-Fashioned Boy*, *Lilian*, and *Wanted, a Pedigree*. She resides in Philadelphia, Pa.

Finley (ROBERT), D. D., American Presbyterian clergyman, b. at Princeton, N. J., 1772; graduated at the College of New Jersey 1787, was tutor or trustee there from 1793 to 1817, and June 16, 1795, was ordained pastor of the church at Baskingridge, N. J. Originated the colonization of emancipated blacks from the U. S. in Africa, helping to form and organize the American Colonization Society. Became in July, 1817, president of Franklin College, Athens, Ga., and d. there Oct. 3, 1817. Published sermons, etc. on colonization.

Finley (ROBERT W.), American Methodist clergyman, b. in Bucks co., Pa., June 9, 1750, studied for seven years at Princeton, N. J., and in 1774 entered the Presbyterian ministry. In 1788 emigrated to Kentucky, and opened a theological school. In 1811 became an itinerant in the Methodist Church, and labored as such until eighty years of age. D. at Germantown, O., Dec. 8, 1840.

Finley (SAMUEL), D. D., Presbyterian clergyman and president of the College of New Jersey, b. at Armagh, Ireland, 1715, arrived in Philadelphia, Pa., Sept. 28, 1734, was licensed to preach Aug. 5, 1740, and was ordained at New Brunswick, N. J., Oct. 13, 1742. Beginning his ministry in the revivals of the time, he preached at New Haven, Conn., in violation of a law forbidding itinerants to preach in the parishes of settled ministers without their consent, and in Sept., 1743, was seized and carried beyond the colonial limits as a vagrant. From July 11, 1744, to 1761, was pastor and teacher of an academy which he established at Nottingham, Md. In July, 1761, was chosen president of the College of New Jersey at Princeton, N. J. Published sermons, and edited those of his predecessor, Pres. Davies. D. July 17, 1766.

Fin'mark, province of Norway, comprises the northernmost part of continental Europe, and lies between lat. 68° 30′ and 71° N. and lon. 17° and 31° E. Its area is 24,000 square miles; its population, 20,329. Finmark is a high table-land, sometimes rising 3000 feet above the level of the sea, indented by numerous deep, narrow, winding fiords, and skirted with innumerable islands. As agriculture becomes impossible at an elevation of 100 feet, at which height only a few wild berries will ripen, and as it is possible only along the fiords to raise a little barley and potatoes, the two only sources of wealth which the inhabitants possess are the reindeer and the codfish; 3000 boats and 15,000 men are employed at the fisheries, and the average annual produce is 16,000,000 fish, 21,500 barrels of cod-liver oil, and 6000 barrels of roe. The reindeer, of which a Finn may own several thousands, roam in large herds over the table-land, fattening in the summer on the fine grass, and starving in the winter on a small, colorless lichen which lives under the snow. The Norwegian and most of the Finnish (Lappish) population have fixed abodes, but a few Lapps are nomades. The principal town is Hammerfest, the northernmost city of the world.

Finn (HENRY J.), comedian, b. at Sydney, Cape Breton, about 1788, performed in London, England, Montreal, Canada, New York City, Savannah, Ga., Boston, Mass., and Portland, Me., and was lost with the burned steamboat Lexington, on which he was a passenger, Jan. 13, 1840. Finn was an exceedingly popular actor of broad comedy, and a representative of a decidedly American school of art. He was also a successful humorous writer.

Fin'ney (CHARLES G.), American clergyman and college president, b. at Warren, Conn., Aug. 29, 1792, and studied law in Jefferson co., N. Y., but was ordained as a minister in 1822. Has been specially noted as a revivalist. In 1835, Mr. Finney became a professor at Oberlin College, O., and its president in 1852, holding that office until 1866. In 1857 began his pastorate of the college church. In 1848–51 preached in England with eloquence and effect. His publications have been *Guide to the Saviour*, *Lectures to Professing Christians*, *Lectures on Revivals of Religion*, with notes and memoir, *Sermons on Important Subjects* (1839), *Skeleton of a Course of Theological Lectures* (1840), *Lectures on Systematic Theology* (1851). D. Aug. 16, 1875.

Fin'nish Language and Literature. The Finnish language is a branch of the Turanian family, also called the Scythic, Mongolian, or Uralo-Altaic, which comprises the languages of the Magyars, Turks, Samoyeds, Tunguses, Tartars, and Mongols, and whose chief branch is the Mantchoo. Of these languages it is nearest allied to that of the Magyars, both in form and substance, a large number of its roots always consisting of two syllables, with the accent on the first, nearly identical with the monosyllabic roots of the Hungarian language. It is spoken in the north-western part of European Russia, in Finland, and the adjacent districts by over 2,000,000 people, and in three different dialects—the E. Finnish or Karelian, which is the oldest, most primitive, and least developed; the S. Finnish, spoken in the districts around Abo and Helsingfors, from which the written language of the Finnish literature has been developed; and the W. Finnish, which extends along the Bothnian Gulf into Sweden and Norway. Kindred dialects are spoken by the Lapps along the Arctic Ocean, by the Wotes, S. of the Gulf of Finland, and by the Tschudis, in the governments of Olonetz and Novgorod.

With respect to the character of its substance, the Finnish language is decidedly vocalic, and its system of vocalization is very elaborate, so that Rask called it the most sonorous and harmonious of all tongues. The consonants *b*, *c*, *d*, *f*, and *g* occur only in foreign words. Two consonants never occur at the beginning and very seldom at the end of a syllable; foreign words are most curiously altered in order to submit them to this rule. Hiatus, on the contrary, is very frequent. Besides the five fundamental vowels, *a*, *e*, *i*, *o*, and *u*, and the three modified vowels, *ä*, *ö*, and *ü* (*y*), the Finnish language employs twelve diphthongs, and the arrangement of this large number of vocalic sounds is governed by very minute rules. Thus, the vowels *a*, *o*, *u* can never occur in the same word with their modifications, *ä*, *ö*, *y*, and the vowel of the suffix has to be changed according to this rule, in order to correspond to the vowel of the theme. With respect to its formal character, the Finnish language is agglutinative, like all languages of the Turanian family, and it expresses the grammatical relations between the different parts of the speech by suffixes only, never by prefixes. The noun is the principal class of words. It is used without any article, and has no gender, but it is declined, both in singular and plural, through fifteen different cases, expressive of those relations which in the Indo-Germanic languages are often denoted by prepositions. The verb has only two tenses, the present and the past; the future tense is formed periphrastically. But its conjugation is very complicated, and it has a great capacity of expressing even the finest shades and modifications of the original signification by slight augmentations to the theme. The infinitive mode has five different forms, expressing five different modifications of the idea, which can be diversified still further by declensions through different cases. (The best dictionaries are that by ROTHSTEN, *Latin-Finnish*, Helsingfors, 1864, and that by EUROPÆUS and AHLMAN, *Swedish-Finnish*, Helsingfors, 1865. Grammars have been given by RENVALL, 1840, EUROPÆUS, 1849, and KOSKINEN, 1860.)

From the twelfth century, when the Swedish king Erik the Saint made his first crusade to Finland, in order to convert the pagan Finns to Christianity and stop their piracy, and up to the beginning of this century, when Sweden ceded all its possessions E. of the Bothnian Gulf to Russia by the treaty of Frederikshamn (1809) Finland

was a Swedish province, and during this long period the Swedish language was the official language of the country and the bearer of civilization to the people. The Finnish language was slowly but steadily retreating. It was forgotten by the educated classes, and for literary purposes it was hardly used at all. There existed a translation of the Bible, commenced in 1548 by Michael Agricola, bishop of Åbo, but not finished until 1642. There also existed some religious and moral tracts; but even in these few literary monuments the language was not pure. As soon, however, as Finland became a Russian possession, its political situation at the same time becoming more independent, a great change took place with respect to the position of the original language of the population. The Russian government saw that the most efficacious, perhaps the only, means by which to wean the Finns from their long and very cordial adherence to the Swedes would be a revival of the Finnish language. It consequently encouraged and supported all exertions in this direction, and the endeavors at resuscitation succeeded beyond expectation. To-day the Finnish language is the official language of the country. It is heard in the church, the court, the school, the theatre, and the educated circles of society. It is used in poetry and science, and cultivated in all branches of literature with care, with enthusiasm, and with talent. About twenty periodicals are issued in it, among which are several newspapers of good standing and a couple of magazines of merit.

The reason of this extraordinary success was not that there existed among the Finns any secret rancor against Swedish civilization; on the contrary, the feeling of sympathy and fellowship was as general as it was deep. But at the bottom of the Finnish language lay hidden a great treasure, and when it was lifted, and all Europe admired it, the Finns naturally became proud of themselves. Among the peasants of Eastern Finland and Karelia there still lived a great number of old popular songs, called *Runot* (sing. *Runo*), which evidently originated from the pagan times. They describe the strifes between the people of Kaleva, the Finns, and the people of Pohjola, the Lapps, and sing the courtship of Kaleva's sons, Wäinämöinen, Illmarinen, and Lemminkäinen, to the daughters of the princess of Pohjola—their heroic exploits and their wonderful adventures. These songs had never been written down; they were handed over by oral tradition from one generation to the other, and when sung by the "Runolainen," strolling singers, to the kartele, a sort of harp with five strings, they were listened to by the people with great rapture. In 1835, Lönnrot published a collection of these songs which he called *Kalevala*, "the land of Kaleva," and which was immediately recognized by the Finns as their great national epos. With the support of the Finnish literary society in Helsingfors he gave a new and complete edition in 1849, containing 50 runot, consisting of 22,800 verses. *Kalevala* was translated into Swedish by Castrén in 1841 and Collan in 1865; into French by Léonzon le Duc in 1845; into German by Schiefner in 1852; and everywhere it charmed with the perfect epic objectivity of its descriptions, and with the splendid views it revealed of a new mythology, a new popular character, a new sense of beauty. The verses of *Kalevala* consist of four trochees. The foot is formed according to the quantity, not according to the accent of the syllables. The verses are bound together not by rhymes, though such occur now and then, but by alliteration. The general character of the poem is somewhat monotonous and melancholy, even plaintive. A striking peculiarity of the poetical style is the periphrastical repetition of the same idea through several verses.

In 1840, Lönnrot published *Kanteletar,* a collection of ballads and lyrical pieces, and in 1842 *Suomen kansan sananlaskuja*, a collection of 7077 popular proverbs. From 1854 to 1862, Eero Salmelainen published a collection of Finnish popular tales in prose. CLEMENS PETERSEN.

Finsbury, or **Fen Town.** See LONDON.

Finsteraar'horn, the highest peak of the Bernese Alps, Switzerland, 14,026 feet in elevation.

Fin'sterwalde, town of Prussia, in the province of Brandenburg, manufactures cloth, flannel, cotton, and linen fabrics, and trades in wool. Pop. 6621.

Fiord [Scandinavian], a narrow inlet of the sea or a bay penetrating deeply into the land and bounded by high and precipitous sides. Such inlets are found breaking up, deeply indenting, and giving wild and picturesque outlines to many coasts contiguous to mountainous regions; they are, in fact, continuations of the valleys that intersect the mountain-ranges. The coasts of Norway, of Iceland, and Greenland, of Chili, and around Cape Horn, and again of North-western America and of parts of New Zealand, afford examples of fiords. The water in fiords is often of great depth, and extends for many miles into the heart of a mountain-range, though in some instances the valley is partly filled up towards its head by alluvial or diluvial deposits. As fiords are often chasms excavated by glaciers, they generally indicate the former existence of glacial conditions in the regions in which they occur, and in some cases they are still partly the beds of ice-streams; they also prove the submergence of the coast on which they are found, as they were formed by sub-aerial conditions.

EDWARD C. H. DAY.

Fiorel'li (GIUSEPPE), b. about 1823 in the province of Naples, won early fame as a director of the Pompeian explorations, but was displaced on account of his liberalism. After Victor Emmanuel came into possession of Southern Italy, Fiorelli was made (1860) chief director of the operations at Pompeii. Is editor of the *Giornale dei Scavi;* has published maps and reports of his work, etc.

Fir, the English name for all coniferous trees of the genus *Abies* (and in England, indeed, even the native pine is called Scotch *fir*, but incorrectly); but there is a prevailing tendency to restrict the name to the group represented by the silver fir of Europe (*Abies pectinata*), the balsam firs of Atlantic North America (*A. balsamea* and *A. Fraseri*), and the noble *A. grandis, A. amabilis,* and *A. nobilis* of Oregon and California; *i. e.* to those species which bear lateral and erect cones, the scales of which at maturity fall away with the seeds. Most of these yield fir balsam. (See BALSAM, CANADA.) The numerous species of the other main division properly takes the name of *spruce*. These are known by their cones hanging from the tips of branches and their scales remaining permanently attached to the axis. There is a peculiar group of spruces or spruce-firs represented in the Northern Atlantic U. S. by the hemlock spruce (*Abies Canadensis*), and in and W. of the Rocky Mountains by the noble Douglas spruce (*A. Douglasii*). Fir timber generally is light, soft, and white; that of some species is excellent for masts and spars, but not otherwise of high value. That of the spruce is more valuable than that of the proper firs, excepting, however, the European silver fir. This genus furnishes some of our best and most available evergreen trees for ornamental planting. As to the Northern and Middle U. S., to which they are mainly adapted, the commonest and one of the best spruce firs is the Norway (*Abies excelsa*), much excelling our native black spruce (*A. nigra*), but it is excelled for all northern regions by our beautiful white spruce (*A. alba*) and by the Menzies spruce (*A. Menziesii*) of the Rocky Mountains. As to the true firs, our balsam firs are very short-lived; the European silver fir is apt to die down from the winter, at least when young; and it remains to be seen whether any of our magnificent Western species are sufficiently hardy to be generally planted with success. ASA GRAY.

Firbolgs', an ancient and half-mythical tribe who, according to the Irish historians, once inhabited that island and other parts of Europe. To this people belonged the first dynasty of Irish kings.

Firdou'si, or **Firdusi,** surnamed ABOOL KÂSIM MANSOOR, Persian poet, b. near Toos, Khorassan, about 940 A. D. The surname is thought to have been given because his father was a gardener. His great poem, *Shah-Namah* or *Shah-Nameh* ("Book of Kings"), has about 56,000 distichs. D. 1020 or 1022 A. D. Of *Shah-Namah* Sir William Jones says: "If it should ever be generally understood in its original language, it will contest the merit of invention with Homer himself." (Consult the preface to JULIUS VON MOHL's translation and commentary on the work; SIR W. GORE OUSELEY's *Biographical Notices of the Persian Poets;* and ATKINSON's biographical notice prefixed to the *Abridgment of the Shah-Nameh*, London, 1832.)

Fire. See FLAME, by PROF. E. W. HILGARD, Ph. D., M. N. A. S.

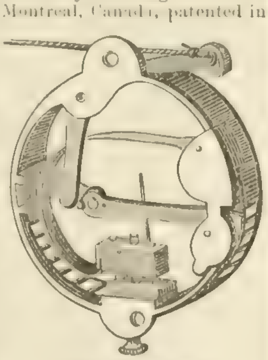
Fire-Alarms are used for giving notice of the occurrence of a fire, and are classified as fire-alarm telegraphs, automatic electric fire-detectors, and mechanical fire-detectors. In the first named a system of signal-boxes is distributed over a given district, and connects by electric circuits with a central station, and thence with a series of alarm-bells on a second circuit. By giving a signal at one of the boxes the place of the fire is telegraphed to the central station, and from the latter to the signal-bells at the local stations, to direct the engines to the place where needed. The first practical trial of a fire-alarm telegraph system was made in 1851 in Berlin and New York, but the plan was much modified in succeeding years, and as thus changed was fully adopted in some of the cities of the Eastern States before being put into regular use in New York in 1871. Although simple in principle, the details of the system are somewhat complex, and for a full description the reader is referred to the U. S. patent of Farmer and Channing, dated May 19, 1857. It is well known that

different substances or mechanical devices change their volume or position with change of temperature; and if we imagine one of these substituted in lieu of human fingers to break or close, by such changes, an electric circuit connected with alarm mechanism, we have an idea of the essential principle of a self-acting electric fire-detector. Mechanical detectors depend for their action upon agencies altogether mechanical; such, for example, as the burning of a string to set the annunciating appliances in motion.

The fire alarms of most interest are those of the automatic electric variety, of which in recent years a number have been devised. The insurance companies of New York City have reduced their rates 5 per cent. on buildings fitted with such apparatus. In each of these alarms a thermometric device, acting, when heated, by change of form or position, is used to break or close a circuit; but the arrangement of the circuit wires, the thermometric devices, and the accessory mechanism in the different plans are widely different.

The earliest record of an electric fire-alarm appears to be the English patent of N. Rutter (1847), in which the mercurial column of a thermometer closes the circuit when the temperature is high enough to be dangerous. A galvanometer, alarm-bell apparatus, and electro-magnetic coil are included in the circuit. Thermometers properly fitted with wires are placed in important parts of the building, so that any unusual increase of temperature becomes instantly known. On the completion of the circuit, a soft iron bar, detached from a permanent magnet, falls upon the detent of a spring or other alarum, putting it into action, and at the same time deflects the galvanometer needle, so as to show the place of the danger. Rutter also proposed the modified use of his invention as a "burglar alarm" and for the detection of undue pressure of steam in boilers, etc. In 1852 one John Hunter suggested applying fusible or combustible conductors to render electric telegraphs self-communicating in case of fires. In the same year Price patented a thermometric circuit-actuating device, the principle of which has been, and still is, in practical use. Lloyd describes an indicator for completing the circuit by means of a curved compound metallic strip made of steel and hammered zinc, connected with one battery pole; the other battery pole is fixed to the opposite part of the instrument. On elevation of temperature the strip straightens itself and completes the circuit. Lloyd describes an alarum in which a detent lever, actuated from the circuit, releases a toothed wheel, which is then rotated by a cord and weight, whereupon a suitable escapement causes a hammer to strike a bell. In 1857, Greenhow patented a valuable modification, in which, instead of setting the alarm in action by completing the circuit, the same effect is produced by breaking it.

In 1866, Charles Dion of Montreal, Canada, patented in France fire-alarms embracing contrivances both electric and mechanical, in which the thermo-actuating device consisted of an inverted cone, with a small orifice at the top, fixed to one end of a balanced lever. On the occurrence of a fire, the heated air rising through the perforated cone tilts the lever and puts the apparatus into operation. In the electric apparatus the tilting of the lever trips a detent, which sets free a wheel actuated by a spring or weight. The periphery of the wheel carries a series of teeth which, acting upon a key similar to that of the Morse telegraph, transmits the alarm to a fire station at a distance. A local alarm is at the same time produced, apprising the inmates of their danger. In 1871, W. B. Watkins of Jersey City, N. J., patented elaborate schemes for fire-alarms, which are set forth in his patents of Jan. 31 of that year. He uses a metallic "thermostat," so termed, as the thermo-actuated agent for closing a local circuit to operate a local magnet, the armature of which is arranged to release the detent of the signal-box mechanism of a fire-alarm telegraph.



Dion's Fire-Alarm.

The patents of John H. Guest of Brooklyn, N. Y., 1873, display features of importance, some of which are also claimed by Mr. William Gates of New Haven, Conn., who, at the present writing, has pending an application for a patent on certain points claimed by Guest. The gist of Mr. Guest's improvement lies in the use of thermometric devices that under ordinary conditions themselves form a portion of the circuit, so that elevation of temperature will break the circuit and transmit the alarm; the same also occurring when the circuit is broken by accident. This is an improvement on Greenhow's apparatus. In his patent of Nov. 11, 1873, Mr. Guest claims, among other things, the combination in a closed circuit of distinct alarm signal-boxes, automatic fire-alarms, indicators for each fire-alarm, and a mechanism to alarm the central station and the house where the automatic fire-alarms are placed, and to show the point whence the alarm originates. But one line-wire is required for any number of rooms in a building, and the signal-boxes of the ordinary alarm telegraph are retained.

In automatic electric alarms a thermometric device for breaking or closing the circuit is essential. The mercurial thermometer of Rutter does not appear to have met with favor, although on a small scale it has been applied to apparatus for artificial incubation, and found to operate satisfactorily. The quicksilver used in some electric clocks for closing the circuit becomes partially oxidated, and gives but an imperfect connection. This could hardly, however, occur in the thermometer. As regards sensitiveness, the funnel and balance lever of Dion is claimed to excel any other device. Mr. Guest proposes a glass bulb filled with quicksilver, having a horn at each end, around which an elbow spring is wound, one of the ends of which acts as a stop for the detent of the circuit-changing mechanism. With elevation of temperature the expansion of the mercury bursts the bulb, the two ends of the spring fly farther apart, the detent is released, and the mechanism is put in operation.

Instead of the compound bar of Dion, Mr. Gates has proposed a thermometric balance lever, said to be of such extreme sensitiveness that it may be tilted by the warmth of the breath.

Although mechanical fire-alarms, strictly so termed, cannot compete for cities, villages, or even for large buildings, with those employing an electric circuit, they may perhaps be found useful in isolated dwellings, or under circumstances where batteries would be troublesome or the regulation of the mechanism difficult. They are even now receiving as much attention from inventors as telegraphic alarms.

Joseph Smith patented in England in 1802 a fire-alarm set in motion by the burning of a string. In another device for the same purpose all the apartments of a building were connected with a single one by means of tubes. It was expected that the occurrence of a fire in any apartment would send a current of air through the corresponding tube, and thus make it manifest. Still another device employed the rupture of a brass wire softened by mercury brought into contact with it by expansion to start a train of wheels, and thus ring a bell. In what is known as Tunnicliffe's invention a small cylinder of gunpowder is furnished with a fuse igniting at 200° F., the device being hung to the ceiling of the room and the explosion sounding the alarm. In more recent times (1872), F. F. Herman combines with an alarm a gun cotton cord connecting with the wick of a lamp, to light the latter when the alarm is started. This, presumably, may be used with either mechanical or electric apparatus. In 1873, Wm. A. Barnes patented an alleged improvement in alarm-cartridges, acting on the same plan as Tunnicliffe's, but not so liable to fly into dangerous fragments when exploded. Also in 1873, Henry L. Brown patented a contrivance which the patent-office brief describes as follows: "The detent lever of a wound up alarm bell mechanism is connected with the arm of an inflated bellows or air-chamber, which is in air-tight communication with a tube of fusible metal running through the rooms to be protected. On the melting of the closed tube by a fire at any point, the escape of air collapses the air-chamber and the alarm is sounded." This *modus operandi* is reversed in the contrivance patented in the same year by Charles H. Lehnis, consisting of one or more U-shaped tubes containing mercury, one arm being in connection with a closed and exhausted fusible tube extending to the locality to be guarded. In Dion's mechanical application of his funnel thermometric device the balanced lever was made hollow, and a sphere of some heavy substance was placed therein above or near the point. On the tilting of the lever by the upward movement of the funnel the ball rolled out against the detent of a bell-sounding device, and thence into the mouth of an inclined tube that conducted it to a receiver in the office of the hotel, for which class of buildings the apparatus was more especially designed, the balls being marked with the numbers of the rooms. It was also proposed to use the conducting tubes for the passage of balls marked with the names of articles likely to be called for by the occupants, so that orders could be received from the rooms without first ascending to them. In Dion's application of the principle of the compound bar in the construction of a mechanical fire-alarm the straightening of the curved bar composed of an outer strip of iron and

an inner strip of brass) tilts a weight, which unlocks a horizontal lever, that in its turn releases a secondary lever. To the outermost end of this is attached a cord extending to the alarm-bell mechanism, which is so constructed and arranged as to sound when the cord is slackened. Provision is made for the adjustment of the parts to trip the weight at any desired temperature, the device being set to the proper pitch by a pointer and scale on the front of the instrument.

The importance of automatic fire-alarm apparatus is far from being adequately appreciated. Contrivances operating on similar principles are capable of being successfully applied to many other purposes. JAMES A. WHITNEY.

Fire-Armor. Appliances known by this name are equally fitted for use in burning buildings to facilitate escape or the management of fire-extinguishing apparatus; in mines filled with choke or fire-damp; or in the pursuit of occupations that, like stoking, puddling, loading guano, etc., involve exposure to undue heat or noxious gases. It is about half a century since fire-armors were proposed for practical use, but it is only recently that they have been made sufficiently light, simple, and cheap to commend them to public favor. They are of two kinds, in one of which the wearer breathes from a supply of compressed air carried in a suitable reservoir fastened upon the person; the other, in which the air is filtered through a moistened porous material interposed between the respiratory organs and the atmosphere. The efficacy of each has been proved beyond dispute. The invention of M. Galibert, on the former plan, has been extensively introduced in the French navy; the American invention of Crofutt, on the last-named system, is being adopted in several cities of the U. S.

The idea of fire-armor was naturally derived from that of submarine armor, and the first apparatus of the kind was adapted for either use. The U. S. patent of W. H. James, granted in 1828, describes a diving-dress which the inventor stated could be employed "in mines and other places filled with deleterious gases, wherein it may be used with perfect safety and very great advantage." In this a circular air-receiver was placed around the waist of the wearer under the arms and extending down to the hips, this receiver being held in place by straps. It was formed of a coil of metal pipe, and provided with a valve through which passed air under pressure, either from a pump or from a stationary reservoir kept filled for the purpose. A water-tight helmet was fitted over the head. The helmet connected with the air-receiver by a pipe, which thus admitted air to the nostrils, the pipe having a suitable valve to control the flow of air. Within the helmet was a mouth-piece, held by the teeth and lips of the wearer, and extended by a short tube to the outside of the helmet, but fitted with a valve opening outward. It was through this that the expired air was driven. To avoid too great pressure of air within the helmet, the latter was provided with a safety-valve, and to permit vision a strong glass plate was fixed in its front. (This glazing of the helmet, it may be mentioned, was derived from Dr. Halley's submarine armor, tested about the year 1715, and which, moreover, in some other respects suggested, if it did not show, some of the other essentials of more modern fire and submarine armor.) James also fitted to the lower part of the helmet "a water-proof garment," which was brought down over the breast and shoulders, and held snugly around the lower part of the body by elastic straps. It was calculated that an apparatus within a manageable compass could be made to hold air enough to last one hour, but to do this a pressure of fifteen atmospheres, or about 225 pounds to the square inch, was required. This, together with the somewhat cumbrous character of the apparatus, seems to have led to its abandonment. The simpler apparatus of M. Galibert (see p. 344 of Dr. Barnard's *Rep. Paris Ex.*, 1867) has an air-receiver of India-rubber cloth, from which the air passes by a tube to the mouth of the wearer, the expired air passing out through a valvular device attached to the nostrils. Within a few years past a somewhat similar appliance has been put on sale in England, the air being in this case contained in a sheet-metal cylinder strapped to the back like a fire-extinguisher.

Crofutt's Eye and Lung Protector.

That class of fire-armors in which the air is filtered on the way to the lungs appears to have been primarily derived from the old and well-known "aspirator" used by surgeons in making dissections, etc., and comprising a wire-cloth shell filled with powdered charcoal, and held over the mouth and nose by a strap buckled around the head. After the James's device just described a British miner named Roberts designed a "hood and mouth-piece," which attracted considerable attention, and, as a writer of that time avers, "its efficacy was repeatedly proved in the presence of numerous scientific individuals, amidst the most dense smoke arising from the combustion of wool, wet hay, straw, shavings, and large quantities of sulphur, in temperatures varying from 90° to 240° F." This certainly showed the utility of filtration in such appliances, but the apparatus was somewhat complex, and required considerable dexterity and time in its application to the person, as will be seen from the following description: A leather cap or hood was arranged to entirely enclose the head, the lower part being drawn tight around the neck by a strap and buckle; the said lower part being padded with cotton and covered with wash-leather to cushion snugly upon the throat. The hood was furnished with strong glass eye-pieces, and below this with what was termed "a proboscis," affording space within for the nose and mouth of the wearer, and provided externally with a tube about two feet and a half in length, with a five-inch funnel at the end filled or stuffed with sponge, which, when the device was to be used, was well moistened with water. The expired air appears to have been forced outward through the sponge. An opening, closed by a removable cork stopper, was provided in the front of the hood, so that on occasion the wearer could breathe the outer air direct, as might be permitted during intervals in the excess of smoke, heat, or foul gases in the place where used.

The latest invention, brought out by George A. Crofutt of New York City in 1873–74, differs in many respects from the fire-armors previously devised, although the principle of filtering the air on its way to the lungs is retained. It is termed an "eye and lung protector," and is really a mask of novel construction held over the face by an elastic band passing about the head. A duplex shell, formed of thin steel covered with India-rubber, fits over the eyes of the person using the device; the external edges of the rubber being flexible, and so shaped as to fit tight around the eyes to exclude dust, smoke, etc. from the eyes; while the eyeholes provided in the shell have flexible lips, with a groove between, which receive plates of transparent mica, a tight joint being formed between the mica and the rubber. Provision is thus made for the protection of the eyes, independent of the respiratory organs. To protect the latter the duplex shell is provided with a curtain of porous cloth, which, being gathered in at the bottom by means of a string around the neck of the wearer, forms a semi-elastic bag over the lower portion of the face. In this is placed a wet sponge of suitable size and shape, held by the bag against the mouth and nostrils. The wearer breathes through the moist sponge, which eliminates from the air passing through it the dust, noxious gases, foul odors, etc. with which it may be impregnated, and also cools the air during such passage. The entire device weighs but a few ounces, and may be fitted in place for use in less time than is usually taken by a lady to tie her bonnet-strings. Some of the experiments made with this appliance are worthy of note, as illustrating the efficacy of the filtration of air, which might be carried into effect with exceedingly advantageous results on a larger scale, under quite different conditions and for many other purposes. In San Francisco, July 28, 1874, a small room was filled with smoke of "pulo" and tobacco until daylight could not be seen through the glass doors; four men provided with the "protector" remained in this atmosphere during more than half an hour without inconvenience. On Aug. 6, 1874, at a trial at Toronto, Canada, persons remained for twenty-three minutes in an atmosphere of smoke from damp straw and tobacco-stalks, in which the chief of the city fire brigade found it impossible to remain more than one minute without the protector. In October of the same year, in Boston, Mass., the inventor wore the device for nearly half an hour, without inconvenience, in a small apartment containing all the fumes generated by the burning of two pounds of brimstone. These facts, taken in connection with the trials, now more than forty years old, with Roberts's "hood and mouth-piece," suggest the feasibility of purifying the air on an extensive scale where, under present practice, its impurity is taken for granted as irremediable. It may be mentioned, in conclusion, that Crofutt's invention has been adopted in the remoter West with great alacrity; for example, by the fire departments of Virginia City, Gold Hill, Los Angeles, and Placerville, and by the Crown Point, Belcher, Yellow Jacket, and Ophir silver-mines on the Comstock Lode, Nev. J. A. WHITNEY.

Firearms, arms loading with powder and ball; all arms which expel their charge by the combustion of powder, whether cannon, such as guns, howitzers, mortars, or small arms, such as muskets, rifles, pistols, fowling-pieces. (See ARTILLERY; SMALL ARMS.) P. V. HAGNER.

Fire-Brick, a name given to brick made from very refractory clay, and used for the lining of furnaces, stoves, grates, etc. As they are largely consumed in iron-making, the manufacture is an important branch of industry which has been carefully perfected by experience, and is now largely carried on at certain localities where the somewhat rare materials used for the purpose are most easily attainable. Fire brick are usually made from FIRE CLAY (which see), but other materials are used in their manufacture; as, for example, the "Dinas brick," the fire-brick most esteemed in Wales, is made of pulverized quartzose rock cemented with a little lime. In America the best fire-brick are made from the "Amboy clay" (a cretaceous clay found in New Jersey) and from the fire-clays of the coal-measures of Pennsylvania, Ohio, Illinois, and Missouri. In the manufacture of fire-brick both plastic and non-plastic clays are employed. In the use of a plastic clay like that of New Jersey, this is first burned in a kiln, losing its plasticity by the process, and becoming what is known as "cement." This is then coarsely ground, mixed with from one-sixth to one-tenth of plastic clay, moulded and burned. The Mt. Savage fire brick are made at Mt. Savage, Md., from two varieties of carboniferous fire-clay; one of which is non-plastic, in its natural state has the properties of the "cement" before mentioned, and is treated in the same way. The Mt. Savage brick are of great excellence—being equally esteemed with the Amboy brick—and are extensively used throughout the U. S. At Mineral Point, Tuscarawas co., O., a non-plastic clay is found similar in appearance and properties to that used at Mt. Savage. It is here manufactured in the same way, and the brick made from it are scarcely inferior to those before mentioned. In all factories of fire-brick the refuse of the kilns is ground over and cemented with a little fresh plastic clay, and in this way brick are manufactured which have great power to resist fire. From their mode of manufacture the most refractory fire-brick are necessarily tender, and have little power to resist mechanical strain or violence. They are therefore employed only for the central portions of furnaces, where they are exposed to the greatest heat. Higher up in the blast furnace and near the doors of puddling furnaces brick of greater strength and less resistance to fire are used. These are made in large part of plastic clay, to which more or less sand is added. In the various parts of the different kinds of furnaces used in smelting operations brick of different shapes and qualities are required. Hence, at all factories may be seen bricks of various forms and sizes, and those in which the materials are differently mixed. As all iron furnaces frequently require to be relined with fire-brick, the impression generally prevails that they are rapidly destroyed by the action of the heat. This, however, is not true, as the best fire-brick are infusible by ordinary means. The rapid destruction of fire-brick which takes place in a furnace is for the most part due to the union of the iron with the silica of the brick, forming a fusible slag; in this way the brick are eaten or dissolved away. In the selection of clay for fire-brick it is important that it should contain as little iron, lime, soda, potash, etc. as possible, as these readily combine with the silica, forming a fusible silicate. The price of the best fire-brick in the U. S. varies from $35 to $60 per 1000 at the kiln, and these are made at comparatively few localities. Cheaper brick, and those of somewhat inferior quality, and yet adapted to most purposes for which fire-brick are used, are or may be manufactured at a thousand different localities; wherever, indeed, a reasonably good fire clay can be obtained. (See BRICK, by GEN. Q. A. GILLMORE.) J. S. NEWBERRY.

Fire-Clay, the name specifically applied to the beds of clay which underlie most of the coal seams in the carboniferous strata. They are so called because as a class they are very resistant to the action of fire. These clay-beds are fine sediments which accumulated at the bottom of shallow pools of water, subsequently filled up by growing vegetation. The roots of aquatic plants penetrating this clay have generally abstracted its potash, soda, lime, iron, etc., and have removed such a percentage of silica as to leave it with a larger relative quantity of alumina than it had before being subjected to their action. Thus, they have taken from it its more fusible ingredients, and have imparted to it the peculiar property it possesses of remaining unchanged at a high heat. Clays very like our fire-clays are now found underlying many beds of peat, and we may in such circumstances see the formation of fire-clays going on.

In the U. S. we have two varieties of fire-clay—the one non-plastic, and specially adapted to the manufacture of fire-brick; and the other plastic, and used also for fire-brick, and for pottery, glass-pots, etc. In the first class are the clays of Mt. Savage, Md., Mineral Point and New Lisbon, O., and from these large quantities of superior fire-brick are made. The second class includes most of the fire-clays of the coal-measures. These differ much among themselves as regards purity and excellence, but they are very largely employed for the manufacture of stoneware and second-quality fire-brick. Analyses are given below of some of the best and best-known fire-clays, Nos. 2 and 3 being non-plastic—4 and 5 plastic clays.

ANALYSES OF FIRE-CLAYS.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Water	17.74	12.74	11.70	5.34	5.45
Silica	45.25	50.45	49.20	59.95	70.70
Alumina	28.77	35.90	37.80	33.85	21.70
Oxide of iron	7.72	1.50			
Lime	0.47	0.13	0.40	2.05	0.40
Magnesia	......	0.20	0.10	0.55	0.37
Potash					

No. 1 is from Stourbridge, England; 2, Mt. Savage, Md.; 3, Mineral Point, O.; 4, Port Washington, O.; 5, Springfield, O. J. S. NEWBERRY.

Fire-Damp, Methane, Marsh-Gas, or **Light Carburetted Hydrogen**, is a dangerous gas often disengaged in great abundance "in coal mines from the fresh cut surface of the coal, and from remarkable apertures or 'blowers,' which emit for a great length of time a copious stream or jet of gas, probably existing in a state of compression pent up in the coal." With seven or eight times its volume of atmospheric air this gas becomes highly explosive, and fearful accidents are constantly occurring in coal-mines, owing to the incautious introduction of a naked flame into such mixtures accumulated in the workings. It was to meet the dangers of this gas that Sir H. Davy devised his safety-lamp.—*Fownes*. E. C. H. DAY.

Fire-Eater, a term the invention of which is ascribed to Col. Howell Rose of Coosa co., Ala., who in the Southern Rights Convention at Montgomery co., Ala., in 1851, applied this epithet to the avowed Disunionists of that body. The term was afterwards applied in political parlance to extremists among the Southern Rights men, whether Disunionists or not.

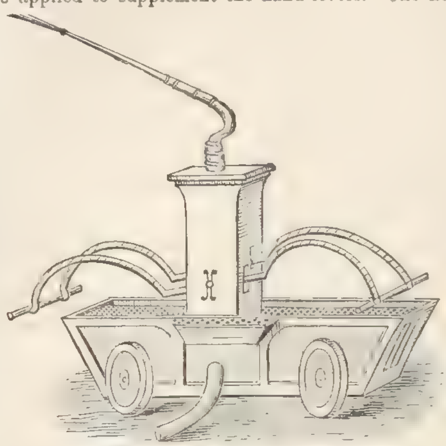
Fire-En'gines, apparatus used for projecting water upon or into burning buildings. Their utility depends upon the fact that fire may be extinguished either by reducing the temperature of the combustible below the point at which ignition occurs, or by preventing access of air to the flame. The application of water induces both of these conditions; the vaporization of the liquid rendering latent a large amount of heat, and the volume of steam shutting away the surrounding atmosphere. Until within the past half century the construction of fire-engines has been extremely rude, but the same principle (that of the force-pump) is found in all.

Hand-syringes, termed *siphos*, were, after buckets, the first devices used for casting water upon fires; and although a fire engine, comprising two pumps furnished with valves, having an outlet in common and worked by levers or brakes like a modern garden-engine, was invented in Egypt in the second century before Christ, the "squirt" or syringe seems to have been in use for the same purpose during many hundred years. In England, however, even this primitive apparatus appears to have been for ages forgotten, for in 1558 reliance was had "upon leathern buckets, ladders, and crooks;" nor does it appear that the hand-squirt was revived until near the close of the sixteenth century. The Great Fire of London in 1666 was followed by a law dividing the city into four districts, each of which, in addition to other appliances, was to be furnished with "two brazen hand squirts." Small "engines" are also mentioned, and it is probable that such were previously, to some slight extent, in use in London, several apparatus of this character having been previously described in printed publications. These were commonly provided with handles at the sides, whereby they were carried and directed by porters, while others worked the piston of the forcing-pump. Five of the old hand squirts formerly used by the firemen of London are still to be seen in the vestry room of St. Dionis Backchurch, Fenchurch street, in that city.

The first portable engine appears to have been invented in Germany, and is stated by Decaus to have been successfully used in that country previous to 1615. His illustration shows a single-acting pump furnished with a jointed outlet pipe for directing the jet, and mounted upon a double ended sledge. There are known to have been used in Augsburg in 1618 huge syringes mounted upon wheels.

An English writer, one John Batts, in a *Treatise on Art and Nature*, published in 1634–45, describes "divers squirts and petty engines drawn upon wheels," which he asserts have "been found very commodious and profitable in cities and large towns." He shows seven different engines, each including a tub mounted on wheels and furnished with a force-pump. Fire-engines were introduced into Paris in the year 1699 by a projector named Duperrier, who held a patent from the Crown. They do not appear to have differed materially from the English except in the addition of an air-vessel. This latter is believed to have been used in Hero's Egyptian engine previously referred to, although its invention has been very commonly attributed to Leupold in 1620. In 1657 one John Hautch of Nuremberg made an apparatus which, worked by twenty-eight men, threw an inch stream 80 feet high; it was placed upon runners and drawn by two horses. In 1676 the knowledge of leathern hose for fire-engines was brought to England from Holland; in it the seams were sewed. It was not until 1808 that Messrs. Sellers & Pennock of Philadelphia (U. S.) substituted a line of rivets for the stitching, the former an improvement which Jacob Perkins carried to England ten years later.

Little improvement in fire-engines was made until about the year 1734, when there was considerable rivalry in their manufacture in England, and the fire-engine became an important and efficient machine. According to one plan, the engine threw two jets at once; in another, treadles were applied to supplement the hand-levers. One noted manufacturer, Newsham, claimed that his engine had thrown a stream 165 feet in height. He was the first to arrange the brakes at the sides, instead of at the ends of the machine, although some of his engines were made on the latter plan as late as 1750 or thereabout: he "applied an improved three-way cock, and arranged it to work by suction or from the cistern." The first manual engine used in New York City was made by Newsham. Fifty-eight years later, so slow in those days was the progress of invention, metal valves, in valve-chests apart from the cylinders and air-chamber, were substituted for the leather valves previously located within the cylinders, etc. Ten years before this, however, Joseph Bramah patented a rotary pump for use upon fire-engines, and afterwards one in which a semi-rotary movement alternately in opposite directions was adopted. Some of these engines are still in use in London.



NEWSHAM'S FIRE-ENGINE.
From a Dictionary of Arts and Sciences, 1754.

Floating fire-engines worked by manual power were first employed on the Thames. The exact date is not known, but they were certainly in use in 1793. At first they were constructed with rotary pumps, but the rapid wear of these caused them to be discarded for plunger pumps. In one arrangement the same mechanism that worked the pumping apparatus was also capable of connection with the paddle-wheels to propel the vessel. An English engine on this system was built for the Russian government as recently as 1841. In the year 1834 an English writer stated that the "*ne plus ultra* of fire-extinguishing machinery would be a steam floating fire-engine of about thirty horse-power." Manual power, however, was employed in working floating fire-engines for several years later. The first one operated by steam was that designed for the use of the East India Docks in 1850, in which a pump was fitted upon a propeller and geared with the engine; it threw 600 gallons of water per minute 20 feet above the roofs of the highest buildings on the docks. A floating steam fire-engine was built by the London fire-engine department in 1852, and others at a later date. Such apparatus have been of great utility in extinguishing fires along the water-fronts of cities and on shipboard in harbors. The John Fuller, a floating steam fire-engine furnished with rotary pumps that when not engaged in throwing the stream through the hose serve as jet-propellers to propel the vessel, has been doing good service on the East and North rivers, New York, during some years past.

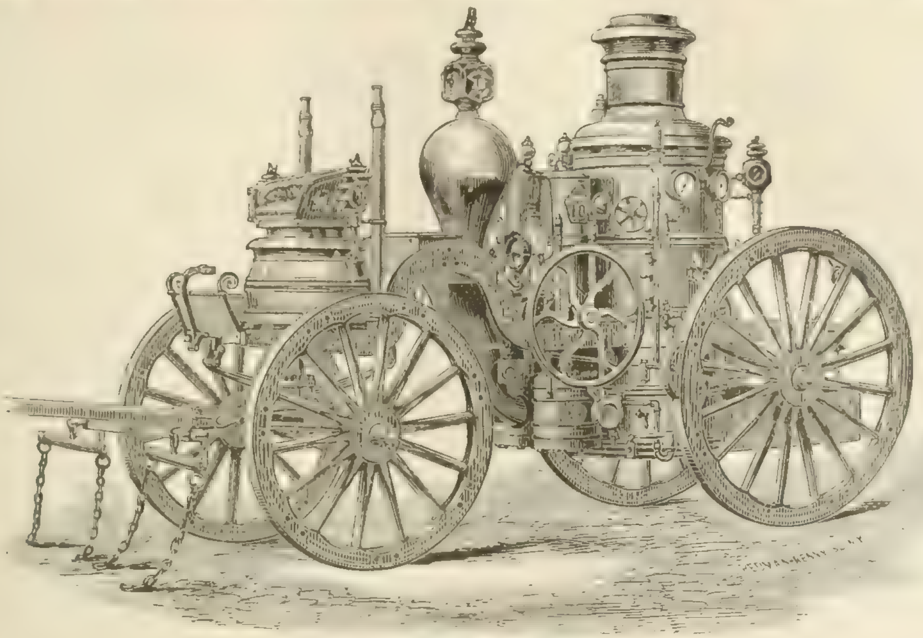
The earliest *steam* fire-engine for use on land was made in London by Braithwaite and Ericsson in 1829; five of these engines were built—some of which were sent to France, Russia, and Prussia—but after 1832 they met with no favor in England during twenty years. They had plunger pumps worked direct from the piston-rods of the steam-cylinders. From a mechanical stand-point they were successful, and were used in subduing several large fires, but were popularly objected to as throwing *too much* water. In 1840 an English steam fire-engine was introduced in New York, and the system gradually made its way to extended favor in this country. In England, from 1852 forward, steam fire-engines were the subject of much experiment, but it was not until 1860 that the London establishment used a land steam-engine in extinguishing a fire in one of the back streets of Doctors' Commons.

The comparatively early adoption of steam fire-engines in the U. S. about the year 1840, and their continuous use thereafter, led to their rapid improvement in the details of construction; and concerning the steam fire-engine trials at Sydenham, England, it has been remarked by an English writer that "as to the workmanship of American engines, there has been nothing seen in England at all approaching it, and it was the universal theme of commendation by all practical men." The engines now in use in New York and Brooklyn are made both with rotary and cylinder pumps, and show various arrangements of pumps, air-chambers, valves, etc., designed to secure a maximum of lightness, manageability, and great projecting force, some having been made almost wholly of steel. Self-propelling steam fire-engines have been constructed both in Europe and America, but have been found, all things considered, very much less efficient than those drawn by horses in the usual way: they are much less economical and less readily available, as they must be kept "with steam up" continually, in order to avoid delay when suddenly called upon for use. As to the superiority of the steam over the manual fire-engine, careful English experiments have shown that, taking as a standard a given height and volume of water thrown, the expense of the latter is £9 sterling, and of the former 2*s.* 6*d.* But this is not the only, or indeed the main, consideration, for hand-engines are of little use when the height of the burning building is greater than 60 feet, whereas a well-constructed steam fire-engine will play with effect upon the roof of a building 150 feet high.

According to the most recent authority, Paris places the most reliance upon manual engines worked by eight men, and which throw a $\frac{5}{8}$-inch jet to a height of 100 feet. Hanover has a steam fire-engine in the city of that name, but hand-engines are commonly used, and the people of each district are bound by law to assist the firemen in working them. In Holland, Amsterdam and Rotterdam have regularly organized fire brigades and steam fire-engines. In Prussia, Berlin was the first European city to adopt the steam fire-engine, but very little is known of its fire department. In Russia the working of fire-engines, which are commonly small and operated by four or five men, is a punishment for military misdemeanors. In Switzerland each village has its volunteer fire brigade; these are said to be remarkably prompt and efficient, keys to the engine-houses being kept by three or four persons in the vicinity of each, to permit quick action in emergencies. Turkey has had fire brigades during several centuries, but the fire-extinguishing apparatus is only a slight improvement on the squirt. In China pumps mounted on stretchers suspended from poles, and carried by four men, constitute rude engines, which are worked amid much noise and confusion on the part of the populace.

In the U. S. the use of fire-engines dates back to 1731, when it was resolved by the common council of New York to import two of Newsham's engines, which were received the following year. Five years later the common council ordered that £10 be advanced to one Turk to enable him to finish the first fire-engine built in the country. Steam fire-engines are now universally used in all of the larger cities, and the number of paid firemen aggregates many thousand; twenty thousand marched in procession at the firemen's celebration in Philadelphia in 1865. The New York City fire department has now thirty-five engine companies, of twenty-four men each, and an aggregate of thirty-five steamers. It may be remarked, in conclusion, that American steam fire-engines possess a demonstrated superiority over those of foreign make, due to the high

speed at which they are worked, which in its turn is dependent upon the fact that in many important respects they are proportioned in close imitation of railway locomotive-engines. JAMES A. WHITNEY.



AMOSKEAG STEAM FILE-ENGINE.
First and Second Class Double Plunger Engine. Crane-neck Frame.

Fire-Escapes. The common fire-escape is simply a system of fixed iron ladders attached to a building to permit descent from the upper windows: ordinarily, a platform or balcony is provided to each story, and the ladders are extended from one to another, either in a vertical or inclined position. Such devices are unsightly, and are limited to tenement-houses and the like. It is usual for many persons to provide a long rope attached at one end to a bar, which latter may, on emergency, be fixed across a window with the rope pendent, to permit sliding down the same. A similar idea has been embraced in several recent inventions, a reel with a rope wound on it being provided within the base of a chair, stool, table, or similar article of furniture, so as to be capable on occasion of the use aforesaid, but ordinarily kept out of the way. As it is difficult in descending the rope to grasp it securely enough to prevent a too rapid descent, several plans have been brought forward, in which a mechanical clutch is provided to grip the rope, and enable the person escaping to regulate the rapidity of the descent. In some cases a thin metallic strip, giving greater strength and capable of being coiled in less space when not needed for use, has been substituted for the rope. Such appliances have operated successfully in experiments where the experimenter was cool and clear-headed, but have seldom been of much use in the confusion of actual danger. As the value of land increases in cities, the buildings are made higher, and this materially increases the difficulty of escape in case of fire. It also enhances the obstacles in the way of constructing an entirely practicable fire-escape. The want of such an apparatus is felt in every large city in the civilized world, but, although scores of fire-escapes have been projected, reliance is still had by firemen upon sectional ladders manipulated at a great disadvantage by hand. These were in use previous to A. D. [illegible], as also were flexible ladders with hooks at the ends, which were thrown to catch upon walls and window-sills. Telescopic tubes raised perpendicularly from a base-frame by means of a screw, and carrying a basket large enough to hold several persons, also lazy-tongs, or jointed superposed bars lifting a platform, were also known at that date. Both of these principles of operation are embraced in numerous fire-escape apparatus projected in recent times.

Apart from fixed ladders attached to the building, and the sectional ladders of the hook-and-ladder companies, fire-escapes may be classified as follows: 1st, those whereby the inmates of a burning building may slide down a rope grasped by the hands or by a gripping device; to which class belong the simple rope devices hereinbefore referred to; 2d, those embracing extensible ladders carried upon a suitable carriage and provided with winches for elevating; 3d, those in which a chute is employed, through which persons may slide to the ground; 4th, those in which a platform is raised and lowered by a system of lazy-tongs; and 5th, those in which a platform or basket is suspended from a rope or chain worked by a winch from the ground. Of the first class, one of the most efficient was brought forward nearly half a century since, and was known as the "sling" fire-escape. It comprised a rope passed over a sheave temporarily hooked to the window-sill, the rope being furnished at one end with a sling or loop serving the purpose of a seat, and also with a belt passing around the waist; the opposite portion of the rope being grasped by the hand, and slowly payed out until the person was let gently to the ground. Within a few years past the same plan has been re-invented, with the addition of a hollow iron window-sill provided to contain the apparatus when not in operation. In the second class a number of ladders lie flat upon a vehicle during transport from place to place, and when required for use are lifted to a nearly vertical position, and then moved out longitudinally, one from the other, until their utmost limit is reached. Numerous modifications of this system have been made in the arrangement of gearing to elevate the ladders. It was stated, on apparently good authority, in 1869, that the city of New York had paid $25,000 for the right to use a certain improved apparatus of this kind, but it was never adopted in practice. The third class attracted much notice in England about forty years ago. The apparatus comprised a strong sail-cloth tube distended by a hoop at the upper end, which was attached to a window; the diameter of the tube being such that a person sliding down could regulate his speed by pressing his elbows outward against the sides. The tube should be stretched from the window to the street at an angle of 45°. That it provides for the safe descent of persons from a great height without danger has been often demonstrated by experimental trials; among others, by one in the neighborhood of the city hall in New York as recently as 1869. But the canvas is liable to ignite from the contiguity of the flame, and the apparatus, unless kept ready in the building itself, is difficult to put in place. A recent apparatus, embracing the same principle of operation, is constructed with a telescopic tube to be elevated from the sidewalk, and formed at its lower end with a curved outlet to gradually check the rapidity of the descent. The fourth or lazy-tong system is open to the apparent objection of being somewhat complicated, but its practical operation dates from the fourth century, when the plan was employed for raising soldiers to the tops of walls. The "lazy-tongs" have been actuated by various combinations of screws, gearing, etc., and provision has been made for keeping the elevated apparatus in the perfectly perpendicular position essential to its successful operation, by providing jack-screws to the main frame, which is thus capable of adjustment to a horizontal position by lifting the wheels clear of the ground, from the

working of the screws separately to the required extent. A tolerably efficient device of the fifth class was proposed, and to a slight extent adopted, in England in the beginning of the present century. It consisted of a strong pole of from 36 to 40 feet in length surmounted by an iron cross-bar designed to rest against the side of the building and to keep the pole from turning. About three feet from its upper extremity the pole carried a pulley over which was a rope having at one end a basket, the rope being worked from the pavement to raise and lower the basket. The rope, pulley, and basket have been frequently combined with a ladder, the last taking the place of the pole previously described. Many years ago the town of Leith in Scotland temporarily adopted a fire-escape in which a telescopic pillar elevated by pulleys raised a telescopic ladder furnished with a platform, to which latter a hose-nozzle was attached. This was a combined fire-escape and fire-extinguishing apparatus; it would be well if its double object were embodied in all fire-escapes.

The numerous fire-escapes that have been projected and experimentally tried have hitherto done little to prevent loss of life, but it is to be supposed that in course of time some one or more will be sufficiently perfected to meet all the conditions of success; and there can be no doubt that something more than fire-ladders should be available by firemen, both for facilitating the escape of occupants from burning buildings and for playing water upon the flames. But perfect security can never be obtained until in the construction of buildings the contingencies of fires and the necessity of escape therefrom are kept especially in view. If a fireproof well two feet square extending from the attic to the ground floor, and opening to the street, was provided in each dwelling, and furnished with mechanism for lifting or lowering persons, many of the losses of life with which the public have been made familiar during the past few years would have been avoided. JAMES A. WHITNEY.

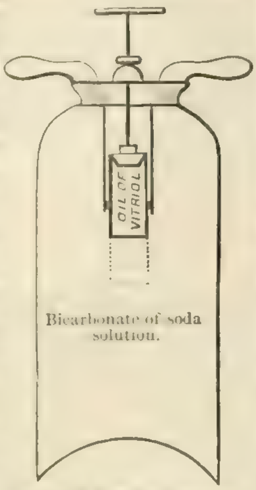
Fire-Extinguishers. This term designates a large class of fire-extinguishing apparatus in which water is surcharged with some other body antagonistic to flame. Ordinarily, the water is charged with carbonic acid, but other substances, some of a saline character, have been used. A fire-extinguisher, commonly so termed, is of small size, having a capacity of about one-fourth of a barrel; of cylindrical form; provided with a strap by which it can be secured upon the back of a fireman or other person; and having a short hose and nozzle attached, whereby a small but forcible jet may be thrown in any direction. In some varieties there are provided within the cylinder, filled with water, two vessels or receptacles, one containing a bicarbonate, the other a strong acid; as, for example, oil of vitriol. When the apparatus is to be used the contents of the two receptacles are thrown into the water, and the chemical reaction sets free the carbonic acid, which, being confined and consequently under pressure, is absorbed by or dissolved in the water. In some, however, as we shall have occasion to explain, the water is charged by other agencies. On opening a suitable valve in the hose or outlet the pressure of the confined gas forces out the liquid in a strong jet, which carries with it a very considerable portion of the carbonic acid gas contained therein. This non-combustible gas, being thus brought in intimate contact with the flame, excludes the atmospheric air, and in a very high degree assists the action of the water in its extinguishment. The same effect is of course produced when the water in the extinguisher has a sufficient portion of either acid or bicarbonate dissolved in it, and a single receptacle is used to hold either acid or bicarbonate, as the case may be, apart from the liquid until the device is required for use. As fire-extinguishers occupy but little space, are extremely portable, and can be made available at a moment's warning, they have been introduced by thousands during the past few years, and for subduing small fires, and thereby preventing larger ones, their utility is unquestioned; and recently many improvements and modifications have been made in them, most of these, however, relating merely to details of construction. The essential principle of operation (the use of water charged with, and forced out in a jet by the pressure of, carbonic acid gas) has been applied on a larger scale in the so-called chemical fire-engines. The first portable fire-extinguisher was made and successfully used in London in the year 1816. It embraced a cylindrical vessel fitted to be carried on the back in the same manner as the apparatus of the present day. The vessel was partially filled with a solution of pearl-ash, and air was forced into the remaining space to any required pressure by a force-pump. This done, the inlet valve was closed, and in opening the outlet the jet was projected with a force proportioned to the pressure of the compressed air. At a much more recent date it has been proposed, in France, to charge the water with ammonia.

The attention of the public was first forcibly drawn to the possibility of extinguishing fires by means other than the simple application of water about the year 1851, at which time the Phillips fire-annihilator, so called, was introduced. In this a slightly conical shell was fitted internally with an annular brick or tile composed of 20 parts powdered charcoal, 60 parts saltpetre, and 5 of gypsum, the whole boiled in water and subsequently dried at 100°. In the central cavity of this brick was placed a bottle containing a mixture of chlorate of potash and sugar, the bottle surmounted by a globule of sulphuric acid. The shell was perforated in numerous places, and placed within another, also perforated, to permit the outflow of the gases. The whole was placed within a double cylindrical receiver containing water in its lower part, and having two covers, the outermost also perforated. The cover carried a spike, which, being forced down, broke the bottle to permit the sulphuric acid to fall on the chlorate and sugar, and ignite the same; the ignition spreading to the surrounding composition, caused the evolution of gases therefrom, which, accumulating under a certain degree of pressure, forced the water in the bottom of the receiver up between the walls, where it became converted into vapor, and mingling with the evolved gases passed out in a dense cloud to envelop and smother the contiguous flame.

The Phillips fire-annihilator was wholly different in its *modus operandi* from the extinguishers now in use. But before these latter were perfected numerous other ingenious plans were put forth of more or less theoretical value, but none of them meeting with much favor in practice. Among these was one patented in 1867, in which the expansion of mercury caused it to reach a wire, the integrity of which was destroyed by the contact. The fracture of the wire set in motion certain previously arranged mechanism, which mingled chemicals to generate carbonic acid gas, which, filling the apartment, was expected to extinguish the fire. In the same year it was proposed to provide for extinguishing fires in the holds of ships or in closed apartments by providing them with strong closed vessels containing ammonia, carbonic acid, or sulphurous acid, compressed nearly or quite to the point of liquefaction; the vessels to be opened from the outside of the hold or room by any suitable mechanical devices.

Baragwanath's fire-extinguisher was the first to employ water charged with carbonic acid generated by chemical action within the vessel (the reaction being identical with that whereby soda-water, so called, is charged); but for some reason the invention lay idle until brought into use by subsequent inventors. The changes made by these, although important in bringing the apparatus to its present high efficiency, are, as before remarked, mainly in matters of detail, and any elaborate description of even the more important would occupy more space than can be here afforded. But those modifications of the essential principle of the apparatus which materially extend its usefulness beyond its original sphere may be briefly sketched. Among these was the employment in 1867 of a sealed glass vessel to hold the acid, which is fractured on occasion by suitable mechanical devices; also the use (in 1870) of one or more perforated plates, partitions, or diaphragms arranged within a portable fire-extinguisher and below the acid vessel, to distribute the acid through the alkaline solution previously provided therein, to facilitate the chemical action, and to prevent the accumulation of the acid at the bottom of the vessel. Previous to this, in 1868, an apparatus was made that when used was "inverted, having the effect of mixing dry acid on a foraminous internal shelf with the water already charged with the opposite material, thus producing and charging the water with carbonic acid gas, which, upon the opening of the cock, forcibly discharged the water from the vessel." An apparatus which combined in a measure the characteristics of the old "annihilator" and the more recent "extinguisher" was patented in 1868. A charge of peculiar composition was placed in the upper part of the closed chamber containing the liquid, and being ignited produced a gas which, accumulating until a high pressure was reached, remained to exert a constant pressure upon the water. This invention is in reality merely a method of charging the water without the use of the chemicals hereinbefore specified. Of course, the apparatus is kept continually under pressure, and in this respect acts mechanically, upon the same principle as that of the first fire-extinguisher ever made, the compressed gas in the one case being simply an equivalent for the compressed air in the other. The Babcock extinguisher is filled with a solution of bicarbonate of soda, and has in its upper part a vessel of acid suspended by lateral pivots to a stirrup depending from the top of the apparatus. The stopper of this vessel is worked by a rod through the top of the extinguisher. By withdrawing the stopper the vessel tilts over, and mingles the acid with the solution thereby discharging the carbonic acid from the latter.

The use of salts in solution, which by evaporation of the water will be left encrusting the burning material, thereby excluding air, or by decomposition by the heat giving off incombustible gases, has been indicated in several cases. Among the substances used for this purpose are common salt and the sulphate and hyposulphite of soda. The idea of casting prepared bodies into the flames, to give off extinguishing gases when subjected to the heat, has also been attempted. In one of these devices a compound of coal-dust, saltpetre, sulphur, and chalk was provided in a portable cylinder, the ends of which were covered only with paper rendered highly combustible by saturation with nitre.



Babcock's Fire-Extinguisher.

The transition from a fire-extinguisher small enough to be carried on the back to one sufficiently large to require wheels was easy and natural, and under the name of chemical fire-engines these latter have been put in practice with a certain measure of success. Among the alleged improvements is one (1867) in which there is arranged upon a truck or carriage "two or more cylinders or reservoirs, connected by pipes which are controlled by stopcocks, and which connect with an issue-pipe or nozzle common to all the pipes, so that in extinguishing a fire one reservoir may be resupplied while another is being exhausted, and thus a continuous supply and stream be kept up and thrown upon the fire." Another apparatus, produced a year or two anterior to the above, was constructed with a chamber, in the upper part of which was placed the gas-generating material, determinate portions of this latter being brought automatically from the chamber and mingled with the stream of water ejected by a forcing pump. In another a stream of carbonic acid gas from a separate receptacle was caused to mingle with the jet issuing from an ordinary fire-engine. Such apparatus, however, are of comparatively limited utility, the steam fire-engine alone being sufficient to cope under all conditions with fires that have passed that incipient stage in which they may be readily subdued by the small extinguishers carried by the operator.

Numerous methods have been proposed for ensuring the automatic action of fire-extinguishing apparatus through the inevitable increase of temperature. Pipes extending from a central reservoir charged with water or extinguishing gases, and provided with fusible plugs, have been suggested, and under some conditions could be made available. Even the explosion of gunpowder, and much more feasibly the severing of a combustible cord, have also been projected as suitable means for ensuring the automatic turning on of the extinguishing element to the place where needed.

James A. Whitney.

Firefly, the name of many nocturnally luminous coleopterous insects of the families Lampyridæ and Elateridæ, the former including the glow-worms. According to some writers, some of the Fulgoridæ, which are hemipterous insects, are luminous also, but the weight of the evidence is quite to the contrary. The luminous organs of fireflies and glow-worms are composed of yellow masses of cells filled with granular matter and traversed by many tracheæ. It is now generally held that the light is produced by the slow combustion of granular and perhaps fatty matter, oxygen being abundantly supplied by the tracheæ. It is not thought at present that phosphorus is present in any noteworthy amount in the luminous matter. Spectroscopic examination of the light of insects of both families gives a very beautiful continuous spectrum without lines. The fireflies of Central and South America are chiefly Elateridæ of the genus *Pyrophorus*. They generally give a very intense light, which comes from two spots on the prothorax. The U. S. have some Elateridæ with luminous larvæ (*Melanactes*). Our common "lightning-bugs" are of numerous species, all Lampyridæ, and mostly of the genera *Photinus* and *Photuris*. *Photuris Pensylvanica* is the most common. Both sexes are winged. *Photuris* is distinguished from the old genus *Lampyris* by the females being winged. (See Glowworm.)

Fire-hole Basin. See National Park.

Fire-hole River, or the main fork of Madison River, is a stream flowing from Madison Lake, a small sheet of water of some 60 acres area. It flows N. W. through the Fire-hole Basin, one of the most remarkable geyser regions of the National Park. It is in Wyoming Territory. The Fire-hole is, in fact, the upper part of Madison River.

Fire Insurance. See Insurance.

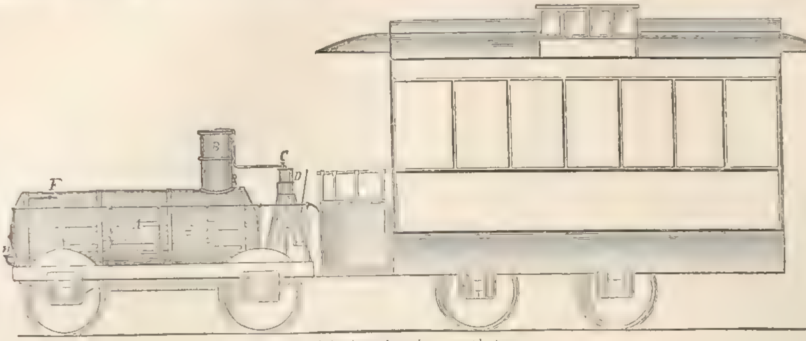
Fire Island, a small island in the Great South Bay, S. of Long Island, is a place of summer resort. It is reached by rail to Islip and by steamer. It is in Brookhaven tp., Suffolk co., N. Y.

Fire Island Beach, a low, sandy spit of land broken by a few inlets, separates the Great South Bay of Long Island from the Atlantic. It is some 30 miles in length, and belongs to the township of Brookhaven, Suffolk co., N. Y. At its W. extremity is Fire Island Inlet and a lighthouse of brick 166 feet high, with a flashing light of the first order; lat. 40° 37′ 54″ N., lon. 73° 12′ 48″ W.

Fireless Engine, a successor to the ammoniacal gas-engine. Dr. Émile Lamm, a native of France, but for many years a citizen of New Orleans, La., was the inventor and patentee (July 19, 1870) of an engine in which the power was derived from the vapor of ammonia. The ammonia, on escaping from the engine which it propelled, was recondensed (absorbed) by water, over which it was passed. This ammoniated reservoir of water, on being heated to the temperature of about 135° F., gave up the ammonia in the form of vapor. The same vapor was again returned to the engine, and was again scaped, to be absorbed by its bath of water. The detail of the construction of the engine and water-bath need not be given, since the engine has been superseded by the incidental discovery, by Dr. Lamm, of a convenient method of using detached steam for the like purpose. Suffice it to say, that the ammonia engine was successfully used in propelling street-cars in the city of New Orleans on the Canal street railroad, at the rate of about 8 miles per hour, and with decided economy as compared with horse-power. This was used in the year 1871. A stock company was formed, and the invention, under ample patent guaranty, was placed upon the market. While perfecting the methods of applying the ammonia propelling power, and studying heat in its latent and active forms, Dr. Lamm was impressed with the facility with which the vapor of water may be condensed, even at high temperature, in water under high pressure; and following up the experiments, he was led to the invention of the fireless engine, patented Apr. 9, 1872, and now in complete use in New Orleans, but first perfected by Dr. Lamm himself, and applied to the selfsame engine used for driving the ammonia cars.

The whole invention and method of its use are so simple and obvious, when once stated or conceived, as to lead to surprise that men familiar with every principle involved should so long have blundered directly around the invention, without seeing the application. It has been long and familiarly known that water, which is converted into steam at 212° F. in the open air, may be raised to a very high degree of heat under steam pressure without being evaporated. A boiler half filled with water and heated to 212° will soon fill with steam, a cock permitting the air to escape until vapor condenses in the scape, and then closed. Above this temperature, continually increased, no more steam will be generated, excepting what is due to compression. There is no limit to the temperature you may apply without changing the status of the water contained, short of the red heat which weakens the boiler and ultimately bursts it. It follows as a corollary, that steam injected into this water while under pressure will be condensed, giving out to the water its 967 degrees or units of latent heat, and increasing the volume of water by the amount injected as steam, as condensed therein. It was further obvious to Dr. Lamm that any steam let off through a valve from the steam-chamber above the water would be replaced by the evaporation of a corresponding amount of water, the total pressure and heat being reduced in proportion; and without any new heat applied this supply of steam would be kept up till the heat should be reduced to about 212°, and the pressure to about one atmosphere, or 14.07 pounds. The reasoning was verified by experiment, and the use of steam thus cumulated and detached was resolved upon. One street-car was fitted up and furnished with cylindrical receivers in the form of boilers, and inserted beneath the floor, under the longitudinal seats of the car. These were furnished with a perforated tube lying near the bottom of the receiver and projecting through its end, where it was readily connected with a steam-pipe leading from a stationary boiler and furnace at the depôt. Through this pipe steam was injected into the half-filled receiver till it reached a temperature of some [illegible], and a pressure of about [illegible] pounds. The steam-valve in the tube was closed and the pipe detached. Two small engines working an endless chain geared to a drum

on one of the axles of the truck were placed upon the forward platform of the car, and properly connected by pipe and valve with the steam-chamber of the receiver. The usual facilities for slacking, accelerating, stopping, starting, and backing were supplied as in ordinary engines. The effect was immediate and complete. After running this dummy for some time on the Carrollton road it was removed, and a number of like "dwarf-locomotives" were ordered by the Carrollton R. R. company. These were on greatly improved patterns.



Fireless Engine, with Car.

The receiver in this locomotive is placed upon a four-wheeled truck, not unlike those on which the passenger street-cars are mounted. A single tank or receiver, 6 feet 6 inches long and 3 feet in diameter, is covered with a non-conducting substance about two inches thick, and lined outside with wood and sheet iron. The steam drum or dome rises about $2\frac{1}{2}$ feet, not unlike the locomotive chimney. Inside of the insulated receiver, at the bottom, is the perforated tube through which the steam is injected into the water, which fills about seven-eighths the capacity of the tank. On the rear end of the receiver's platform is located a pair of small $4\frac{1}{2}'' \times 8''$ engines, standing upright, worked by steam from the dome and pipes. These are geared by cranks to the pinion-wheels, that operate by cog-gearing the driving wheels of the dummies. The scape-pipe rises some six feet and discharges in the air. The steam is injected till the gauge reads 125 pounds to 135 pounds, at option. The temperature corresponding to the latter is 355° F. These cars run from the dépôt at Carrollton, where the receivers are charged from stationary boilers, down to Napoleon Avenue (halfway to Canal street, the city centre), and return in half an hour, $5\frac{1}{2}$ miles, thus working off the pressure to about 60 pounds. They are then recharged in about two minutes, and are ready to start again. So perfectly manageable are they, towing usually only one car, but capable of two more, that no serious accidents of any kind have delayed or missed a connection in running the ten locomotives for (now) six months. No engineer is needed on the cars; the ordinary laborer who can drive a mule is entirely competent for their management.

These fireless locomotives have been tried on the streets of Philadelphia, Brooklyn, Chicago, and New Orleans, and the statistics of their working show a saving in cost, safety, and simplicity that must at an early day remove all horse-power from street-cars. Gen. G. T. Beauregard, president of the Carrollton R. R. Co., and a distinguished engineer of great practical experience, expresses himself well satisfied with the results thus far obtained with the ten fireless engines he has had in operation on his road since Sept., 1873, and says that the economy over the horse-system will necessarily be materially increased as the number of these dummies is augmented.

It is due to the memory of Dr. Lamm to state that his accidental death by drowning in 1873 deprived his invention (destined to work such a revolution in street and perhaps other locomotion) of the benefits of his gifted mind in completing its improvements. The New Orleans Academy of Sciences, of which he had been an active fellow for many years, paid a proper tribute to his memory.

C. G. Forshey.

Fireproof Buildings. Absolute security from fire is alone obtained by constructing buildings of material that is not only in itself incombustible, but which will not be decomposed by an extreme degree of external heat, and by the utter absence as storage of quickly combustible merchandise. The necessity of these conditions is shown by the rapidity with which structures only partially of wood are consumed, and also by the wholesale destruction in the recent fires of Chicago and Boston of great iron, marble, and granite buildings, and by the experience of London warehousemen, from the tumbling down of solid walls because of the expansion of iron beams in so-called fireproof buildings filled with saltpetre, oils, and other highly inflammable substances. As a material for building, hard-burned brick has been found to have the greatest fire-resisting properties; the evil results of the expansion of iron girders have been measurably overcome by supporting them on roller bearings, which relieve the walls of their thrust; and the danger of the common mansard roof has been in a material degree reduced by the substitution of iron for wood as a support for the slate. Nevertheless, as concerns warehouses, the security is only relative, for no safeguard can be provided to prevent the weakening and falling in of iron beams raised to any temperature approaching that of a cherry red, and with inflammable contents there are no buildings that are really proof against fire. Of late years the danger has been materially increased by the storage of petroleum oils, the vapors of which combine with atmospheric air to form explosive compounds; but this may be somewhat provided against by securing a free circulation of air throughout the building, to carry off the vapors before the explosive point is reached. It was an axiom of architects nearly a century ago that good party-walls between buildings form the best preventives of the spread of fires from house to house, and that similar means will prevent it passing from one room to another in the same building. But a defect in many brick walls exists in the mortar, which frequently crumbles from heat. The quality of the mortar used is of even more importance than that of the brick. The covering of walls with a fire-resisting cement has been suggested, but this would be open to the same drawbacks as stone and cast iron—viz. splitting and cracking when heated and subjected to the contact of cold water. To secure as far as possible immunity from the worst results of fire, the building should be constructed with special reference to the class of merchandise it is designed to hold. The storage of petroleum, rosin, turpentine, etc. would be best in underground receptacles covered only by a light structure, the rule holding good in this, as with oilcloth factories and the like, that it is better that the whole should be rapidly swept away than that the standing walls should hold the flames like a blast furnace.

In warehouses the nearest approach to perfect fireproofing is found in the employment of brick walls, and concrete floors and ceilings supported by girders having their weight uniformly distributed upon the walls. In New York, floors of corrugated iron and cement have long been in use, but the objection to iron is so great that some architects have recommended wood strongly pugged with cement as preferable. It is notable that wooden beams having only their sides exposed to flame are seldom burned in to a greater depth than one inch; and when the surface is protected by cement, even this is much diminished. But the end-section of wood exposed to fire burns away with great rapidity. The construction of perfectly fireproof stairs is a greater problem than that presented by walls or ceilings; and for these well-pugged wooden beams have been recommended as preferable to iron as supports for the brickwork, which should always be used instead of stone. The utility of brick as a fire-resistant received a remarkable demonstration during a large fire in Tooley street, London, some years since. In this instance, says an eye-witness, "an immense range of cellars was filled with oil, which ignited. For weeks this oil was burning, a rolling sea of flame. The cellars were vaulted with brick. They had this glowing mass below and the heated *débris* above, and yet, upon a careful examination after the oil was removed, scarcely a trace of injury could be detected." When brick arches cannot be used, the same writer recommends "strong wooden timbers thickly pugged, and supported on strong wooden posts, in preference to iron girders or iron columns." But it must be remembered that in this use of wood everything depends upon the character of the pug-

ging, and the cement used in this country is inferior to that which has shown the utility of the system abroad—a fact having a positive bearing on the construction here of fireproof dwellings after the French manner, hereinafter referred to. The isolation of the several stories from each other is also a matter of importance, but is seldom provided for; the most perfect example of its practice in this country is the building of Harper & Bros., New York. In this there are no openings through the floors, and it has neither internal stairs nor hoistways, the stairways being provided in an isolated tower connecting with the building by iron bridges, and the hoistway being outside of the enclosure.

The number of fires of late years occurring from the use of wood as a material for mansard roofs has led to the introduction of several new methods of applying iron as a support for the slates; and such should always be employed. It may be remarked that, as concerns fireproof floors, some of the older fireproof structures, so called, in New York, were floored with boiler-plate riveted into large sheets and bolted to the beams or girders. A more recent plan, that experimentally resisted severe tests, embraced a thick layer of clay bedded upon a metal support. The idea of filling the spaces between floors and ceilings and between inner walls with a fireproof composition capable of evolving water and incombustible gases when subjected to heat, has a certain degree of plausibility, but would be too expensive to meet with favor, and would be subject to dampness. Gunpowder magazines have been surrounded with walls filled in with alum and sawdust as a safeguard against the conduction of heat to the explosive contents.

As a means of increasing the proof of buildings against fire, a plan first proposed by Sir Samuel Bentham in 1793 is now somewhat widely adopted in London. An example is shown in the workshops at Nine Elms of the London and South-western Railway, in which "cast-iron pipes with small holes in the direction required are laid along the roofs on the inside, and so arranged that each shop or portion supplied with these pipes can be put in connection with the water-supply, and in turning a cock the pressure of the water from a suitable head drives it through the tubes and out through the various holes, deluging the whole area." Westminster Abbey has recently been provided in one of its towers with a tank holding 6000 gallons, and connected with a system of pipes and hose, whereby the roof may be flooded at will; the apparatus cost upwards of £2000. It would not be difficult to provide for the automatic turning on of the water by the action of the fire itself; as, for example, by the use of fusible plugs. The mere filling of hollow beams, columns, etc. with water is but a poor precaution, the water being quickly dissipated if any outlet is afforded, and if hermetically enclosed providing exploding steam generators when subjected to great heat. A fireproof monolith has been projected by the inventor of the *béton Coignet*, the water-passages, as well as flues and ventilating shafts, being formed within the plastic mass of cement during the process of construction.

For dwellings in which economy dictates a comparatively slight structure, and to a greater or less extent the use of wood, the Paris system is preferable, provided a plaster or cement equal to the French is used for pugging. This plan is, in brief, as follows: The central idea is to secure the strength of wood on end, and to utilize the resistance of plaster to the direct action of fire. In France oak timber is commonly used, and being comparatively dense adds somewhat to the efficiency of the system, the closer woods being less liable to quick ignition than our hemlock, spruce, and pine. The framing is made in any ordinary manner, but battened with oak battens nailed several inches apart. Rubble, burnt clay, stone chips, or brickbats freshly broken are laid into the space between the two series of vertical battens, and plaster of Paris is then applied to each side, filling up the interstices and leaving smooth cement surfaces. The wood is thus firmly imbedded in stone and plaster, and put practically beyond the reach of fire. The floor timbers are laid in the usual manner, with battens nailed on their lower sides covering about half the area. Underneath is provided a temporary platform reaching nearly to the battens. Plaster of Paris is then worked in below and around the battens, the platform being allowed to remain until the plaster has set. In this manner the ceiling of the room below is formed. Above, upon the timbers, are laid transverse billets or battens of wood, that receive an upper layer of plaster, which constitutes the floor, either with or without a flooring of boards, which latter in this case forms a mere fixture of the room, and is incapable of communicating fire to parts from which it is separated by thicknesses of concrete or plaster. The inner or partition walls are made in the same manner as the outer ones just described, even when these latter are replaced by bricks. The stairways are of wood, but are placed between walls of brick or in some cases of stone, in others of wood filled in and pugged, and are filled in with solid rubble and plaster, which practically secures immunity in case of fire. JAMES A. WHITNEY.

Fireproof Construction in Italy. Destructive fires sometimes occur in Italy in magazines and other buildings where great quantities of combustible materials are stored, as also in wooden structures in the rare cases in which such are built; but in stone or brick private houses and other buildings the fire is almost always confined within the walls of the house where it originated.

The *old* and substantial dwellings of most Italian towns are built on the following general plan: The *outer* walls are of rubble masonry, and very thick. They are not lined with furring or otherwise, but the plastering is applied directly to the inner surface. In many of the better class of Italian houses a lining, or a thin detached wall—sometimes more than 20 feet high, of brick laid *edgewise*, and only 2 inches thick—is built a couple of inches within the inner surface of the outer wall, to receive the plaster. This inner wall is stiffened and bound with the outer wall by an occasional single brick, and is of course continuously bound with it around the openings. A better method of stiffening and binding would be with short strips of hoop iron, which might also be used advantageously at the corners and exposed places. Such linings are very nearly as dry and as warm as wooden framing. All the *partition* walls, even of small chambers and closets, are of stone or brick, and the door and window casings are of stone. The *staircases* are all wholly of stone (cheap constructions often with *treads* of tiles laid on a segment of a stone arch).

It is obvious that in this mode of construction there is absolutely no combustible connection between story and story, and consequently a fire can communicate from one story to another only by the breaking down of the floor. The following description and measurements, taken from a house of the fourteenth century now in good condition in Florence, will serve as a type of this mode of construction. The *floors* are either vaulted with brick, the crown of the vault, including the tile flooring, resting on it, not exceeding 4″ or 5″ in thickness, even in a room 30 feet square, or they are of timber, boards, tiles, and mortar laid thin. Across the room, at distances of 8 or even 10 feet in the clear, are laid pine or fir timbers of 10″ by 16″, and reaching from wall to wall. On the sides of these timbers, from 4″ to 6″ below the upper surface, are spiked moulded planks, and on these planks are laid joists of 3″ by 4″, or, in the large rooms we speak of, 4″ by 6″ scantling, the upper surface of the joists being flush with that of the timbers. The joists are from 10″ to 12″ apart, and between the ends of each pair strips of board are nailed to the timbers to keep the joists in place; but there is no mortising in the framework of the floor. On the joists is laid a flooring of 1¼″ plank, about a foot wide, with a narrow strip of thin stuff nailed along the joists on the under side. On this flooring tiles are laid in mortar, and over the tiles, usually, but not always, a thin coating of stucco. The under side of the flooring is left exposed. Sometimes lathing of strips of wood, rush wickerwork, or wire netting is used to receive plastering, being secured to the under surface of the joists; and very often painted cloth, stretched on a frame secured to the under surface of the joists, is used as a ceiling. It is evidently next to impossible that such a flooring should take fire, or even be set on fire.

So far, the Italian method of building might be employed in the U. S. at a little advance on the cost of our common tinder-box method of construction, and with little or no inconvenience or disadvantage. In ordinary houses the principal partitions of stone or brick are carried up to the roof, and where they occur answer the purpose of principal rafters. In the house above described the wooden principal rafters are of fir-wood, 10″ by 16″ square, and reach from the wall plate to the ridge pole, which is a stick 6″ by 10″ square. The principal rafters are from 10 to 14 feet apart. On the principal rafters are laid cross timbers or joists 6″ by 10″ square, about 4 feet apart; and on these the rafters proper, of 2″ by 3½″, or in some places [illegible] or 3″ by 4″ scantling, about 14 inches apart in the clear. Spikes or nails are occasionally used to hold the frame of the roof together, but there is no mortising. On these rafters there is no boarding, but [illegible] such that tiles 6″ by 13″, and on these [illegible] in mortar. Slates might be employed upon a roof of this construction. Such a roof will certainly not take fire from sparks or any ordinary exposure, and it would indeed be a hard matter to set it on fire. The cornices and mouldings ought to be of pressed brick, but even if of wood the roof would not be very much exposed.

In 1871 the [illegible], a large thirteenth-century structure in Florence, was burned. Its floors and some of its partitions were of wood. In some of its apartments large quan

tities of straw, lumber, and other inflammable material were stored, yet though the upper story was an open *loggia*, over which the roof was upheld by pillars, and, though all combustible matter in the structure was burned, the fire did not spread to any of the adjacent buildings, nor did the falling roof crush in the vaults of the lower story. It should be noted that although the fire departments of Italian cities can not compare in efficiency with those of New York, it is extremely rare in Italy for a fire to pass from a burning building to a contiguous structure, owing to superior modes of construction. It may be observed, too, that the people of Europe are generally much more careful in the use of fire than those of the U. S.

In Central (and even in Northern) Europe tiles are almost exclusively used for roofing, except in rural districts. They are commonly thin, often less than half an inch thick; very hard burnt, or indeed almost vitrified; and they also have a glazing which almost entirely prevents the lodging of snow; and to prevent the driving in of rain under the tiles, as well as to reduce the probability of the piling of snow on the roof, it is common to give the roof a very steep pitch. GEORGE P. MARSH.

Fireproofing. On Mar. 17, 1735, one Obadiah Wyld obtained an English patent for "making or preparing paper, linen, canvas, and such like substances which will neither flame nor retain fire, by mixing alum, borax, vitriol, or copperas dissolved," and dipping the fabrics "into a strong infusion of the said materials in water or thin size made hot." Although nearly a century and a half have passed, no other method of fireproofing has avoided its use of mineral salts; and impregnation with alum, borax, or copperas, as the case may be, is at the present time the best treatment for fireproofing and preserving wood, which thus treated has been strongly urged as the proper material for railway cars subjected to risk of fire from overturned stoves and lamps in cases of collision, etc. Copperas especially seems to be equally efficacious against the quick oxidation of combustion and the slow oxidation of decay; the bodies of miners buried by accident in English mines have been recovered intact after forty years' immersion in the water holding copperas in solution, and the woollen garments of a warrior buried during the Stone Age, the most ancient fabrics known, were preserved in the grave down to a few years since by a like agency. The use for fireproofing of sulphate of ammonia was proposed by De Breza in 1838; that of soluble glass by Bethell in the same year; that of hydrochlorate of ammonia by Froggant in 1851, but this last does not appear to have received serious attention. The use of tungstate of soda and phosphate of ammonia was at a later date found by Dr. Versemann, after a series of the most careful experiments, to be the best adapted for common use with cloths, etc., either of these rendering the lightest muslins uninflammable. The tungstate of soda, however, has this advantage over the other, that it may be used with starch, and does not interfere with ironing. A mixture of this salt with starch is sold in London under the name of fireproof starch.

Alum, borax, sulphate of iron, soluble glass, sulphate of ammonia, phosphate of ammonia, and tungstate of soda are the substances most advocated hitherto for fireproofing by impregnation. In their application the process must be varied with the material treated. Cloth fabrics should be immersed or soaked; wood should have the solution forced through its pores; and with paper the solution should be worked into the pulp during manufacture. The first four are better suited to timber than for fabrics. Soluble glass may be used for surface impregnation of the same material, but experience has shown it to be a treacherous substance, liable to effloresce; and theoretically, at least, its free alkali tends to the deterioration of any organic substances with which it may be brought into contact. Sulphate of ammonia does not appear to have ever been thoroughly tested; and although a fabric treated with it would perhaps be difficult of ignition, the salt would probably be dissipated by anything approaching a high heat. The phosphate of the same base is efficacious as a fireproof, but leaves the fabric harsh to the touch. The tungstate of soda, therefore, should be used in preference to the others for light articles of apparel, curtains, upholstery, etc.

As combustion depends upon access of air, light woodwork may be measurably protected by fire-resisting paints. These are especially applicable to the shingled roofs of farm-houses, cottages, etc. One of the oldest is composed of 3 parts wood-ashes ground with 1 part of boiled linseed oil, and applied with a brush when fresh. Another is made by mingling lime and ashes with skimmed milk, the casein of the latter serving as the binding substance for the mineral particles. A German recipe for fireproof coating is three successive applications of a hot solution of 3 parts alum and 1 part copperas, and after this of a solution of copperas brought to the consistence of paint by the admixture of pipe-clay. JAMES A. WHITNEY.

Fireproof Safes. The idea of rendering the contents of an iron strong-box secure against fire by lining it with a fire-resisting medium originated with James Conner, a type-founder of New York City, between the years 1829 and 1832. This safe was filled in with plaster of Paris, and was used in the office of the inventor during some years. He, however, does not appear to have fully appreciated the importance of his invention, for the safe was allowed to pass into disuse, and seems to have been nearly or quite forgotten, even by the inventor, until in the year 1843 it was reinvented by one Fitzgerald. The latter, in defending his patent, was met by proof of Conner's previous invention, but the U. S. courts decided that as the former had abandoned his invention without giving a knowledge of it to the public, the latter must in equity and sound public policy be adjudged the legal patentee. From this date the manufacture of fireproof safes received a lasting impetus. Numerous new compounds were devised for filling, the advocates of each claiming for it a marked superiority over all others as a fire-resistant. But, although Conner was the first to make a fireproof safe, William Marr of London was the first to patent and make public a method of construction. This he did in 1834. Marr's invention differed materially from Conner's; the former filling the spaces between the inner and outer shells or casings of the safe with sheets of mica pasted upon paper, and crowding the space between with burnt clay and powdered charcoal, or in lieu of these with powdered marble. The next alleged improvement was that of Charles Chubb, also of London, in 1838, who used a series of concentric linings of iron plates, the intermediate spaces filled with baked wood-ashes, or "such other slow-conducting materials as will retard the transmission of heat." A third improvement was that of Thomas Milner of Liverpool, which in 1840 was set forth by him as consisting in forming "boxes, safes, or other depositories of an outer case of iron, enclosing one, two, or more inner cases, with spaces between them containing an absorbent material, in which are distributed vessels, pipes, or tubes filled with an alkaline solution or any other matter evolving steam or moisture, or otherwise discharging themselves, on the exposure of the box or other depository to heat or fire, into the surrounding absorbent matter; which, thus pervaded with moisture and rendered difficult of destruction, protects the inner cases or boxes and their contents." In 1843 three gentlemen named Tann brought out the method of making safes fireproof by filling the spaces with ground alum, finely sifted, and gypsum, also finely pulverized. The alum and gypsum were intimately mingled, heated to liquefaction, and after cooling to a hard and brittle condition comminuted to a coarse powder for use. This mixture, when subjected to an extreme heat, would give off water from the plaster; but the lack of chemical knowledge on the part of the projectors is plainly indicated by the calcination of the alum before putting the filling in place. In 1855, George Price of Wolverhampton coated the surfaces of metal exposed to the filling with a composition to prevent corrosion from the contact of the same. He used powdered alum and sawdust as a filling. During the previous use of alum it had been discovered that various other salts containing water of crystallization would serve the same purpose in the filling.

The construction of fireproof safes has of late years formed a very important branch of manufacture, and many improvements have been made which in the aggregate have much increased their utility. But the essential features remain the same, so that these fireproof receptacles may still be classified as 1st, those having a filling of some simply non-conducting material, like clay or concrete; 2, those fitted with plaster capable of giving off water by calcination, though only in moderate quantities; 3, those in which alum or other salt yielding a large percentage of water by decomposition is mingled with the plaster; and 4, the steam-safes, in which vessels either of glass or metal and filled with water are arranged between the inner and outer walls to give off steam when subjected to a high heat. The first-named class is of doubtful utility; the second of measurable value under many conditions; the third and fourth are the best as yet devised, although their efficiency in any case depends wholly upon the judgment and care displayed in their manufacture.

Very many inventions relating to fireproof safes have been developed in the U. S. during the past few years, among others as follows: In 1860, the attachment of the plaster filling to plates suspended between the walls, so that in shrinking its diminished size will not permit its falling from its place; also, the use for filling of pure alumina; also, for the same purpose, of sulphate of iron mixed with plaster of Paris. In 1863, the construction of a safe with two air

and steam-tight casings, one within the other, and with the intermediate space filled in with material capable of generating steam under high heat, the latter melting fusible plugs in the outer casing to permit the exit of the steam; also, the use of filling made of plaster of Paris set with a solution of starch; also, a filling formed of a compound of calcined and powdered gypsum and alum in pieces imbedded in the plaster in such relative proportions that the water of crystallization in the alum evolved by heat shall set the plaster (this last is the filling of one of the most noted and efficient safes in the market); also, the furnishing of the filling with cavities to prevent the rupture of the parts from the expansion of moisture by freezing. In 1864, a filling of alum in small lumps rolled in plaster and then bedded in dry clay. In 1865, a filling of epsom salts, either alone or combined with sulphate of lime or plaster of Paris (this also is the filling used in a celebrated and efficient fireproof safe). In 1866, a novel arrangement of vessels containing water between the inner and outer walls to form a steam safe (this feature is essential to a well-known safe, as that of imbedding water-receptacles in the plaster filling is of another hereinafter mentioned). In 1867, providing upon the wooden inner casing a layer of felt surrounded consecutively by a metallic lining, a layer of cement, a water chamber, a second layer of cement, and the external metallic casing. In 1868 nearly a score of patents for fireproof safes were granted; among others, upon wood imbedded in the plaster filling to enhance its non-conducting power, the introduction of non-conducting material between the plates of the door and door-casings, the use of fine common salt as a filling, water-vessels stopped with glue or mucilage inserted in the cement filling, the construction of the set filling with cells for the reception of a vaporizing substance; also several novel forms of steam safes, in one of which a space external to the water filling was provided to receive the steam from the filling, and thus provide a non-conducting jacket to the whole. In 1869, the use, external to an alum or similar filling, of cans containing steam or vapor producing substance placed between such filling and the outer casing of the safe; also, the construction of safes with a water-supply from an elevated head. Later modifications of each type of fireproof receptacle have been made, but none appear to merit particular notice in this connection. It must always be remembered that no safe is absolutely fireproof, although several manufacturers make them capable of withstanding an exceedingly high temperature. Wherever possible, a safe should be imbedded in brickwork, which experience has shown to be one of the most effective of all protections against the injurious transmission of heat.

JAMES A. WHITNEY.

Fire-ship, a vessel, often old and unseaworthy, which is laden with combustibles, fired, and sent into the midst of an enemy's ships for the purpose of setting them on fire. This ancient device has been frequently tried in modern warfare; and though sometimes of much service, as in the war of Greek independence, it can never be of much effect when employed against a well-managed steam-marine. This service is moreover fraught with great danger to the aggressive party.

Fireworks. See PYROTECHNY.

Fire-Worshippers. See GHEBRES and PARSEEISM.

Firk'owitsch (ABRAHAM), a Jewish archæologist, was b. at Lutzk, in the Crimea, in 1786. He was the son of Caraite parents, and was reared in the faith of his forefathers. (See CARAITES.) Of a ready mind and eager for learning, he was afforded all the advantages which the Jews of the Crimea had at their command. These were but scanty; most of his knowledge consisted, therefore, of a thorough mastery of the Hebrew of the Old Testament canon and of tradition, acquired mainly at Eupatoria, where he had enjoyed the use of a manuscript library belonging to the Caraite synagogue. He became a rabbi, and led the congregations at Chełm and Koslov. His study of the MSS. at Eupatoria had instilled in him a love for ancient Jewish antiquities, particularly Caraites, and a desire to see the study of Hebrew literature and of Caraism revived among his nation. His opportunity to urge the matter successfully came in 1825, when the Caraites of Eupatoria established a printing press. Firkowitsch became the principal guide of the Crimean Caraites not only in the reproduction of ancient MSS., but also in the selection of modern works worth printing. Assisted by the [illegible] support of the Crimean, Firkowitsch visited the scattered Caraite communities in Turkey, Syria, Palestine, Persia, and the Caucasus, not fearing any danger or privation, determined to unearth the treasures of the past. He penetrated into the very depths of Asiatic wildernesses, searching wherever he might hope to find a fragment of Caraite antiquity. "He unearthed rolls of the Law and other MSS. that for ages were not imagined to exist, having ceased to be legible even to their possessors. Entire books of mutilated MSS. were brought out of hiding places previously unexplored—some of high antiquity and in excellent preservation; others faded and rotting in tattered fragments. . . . His keen eye discovered and deciphered inscriptions in broken or abraded marbles that the showers or frosts of ages had nearly obliterated." (RULE, *Hist. Karaite Jews*, p. 198.) He dug under cellars, tore up the rotten rafters of old buildings, anywhere, everywhere, in search of his precious MSS. He brought together and deposited in the Imperial Library at St. Petersburg no less than 1[illegible]0 MSS.—"a collection," says the *Academy*, London, July 25, 1874, p. 10[illegible], "which in value, if it does not surpass, the fine collection of Hebrao-Arabic codices at Oxford." In the decipherment of these MSS., Rabbi Samuel Pinsker assisted and frequently guided Firkowitsch. They are not yet as widely known as they deserve to be. Mr. Neubauer, the Jewish savant of Oxford, and others have drawn attention to the great value of the Firkowitsch fragments of ancient MSS. of the Old Testament, both for the various readings of the Hebrew text and for the Masora. Firkowitsch d. in 1874. (See CARAITES.)

J. H. WORMAN.

Fir'man [Pers. *fermân*, a "command"], in Oriental countries the certificate or written mandate of a sovereign or government. It is especially applied to the passports issued to travellers in Turkish countries.

Fir'micus Mater'nus (JULIUS), a writer on mathematics and astrology, was b. in Sicily, and flourished in the time of Constantine. He followed at first the profession of an advocate. He wrote in Latin a work entitled *Matheseos libri VIII.* (A. D. 345), which treated of astrological subjects, such as nativities, the influence of the stars on human life, etc., more than of mathematics. The work is still extant, and was printed by Aldus (1499). The author was evidently, from several passages of his work, a heathen. If the treatise *De errore profanarum religionum*, which is ascribed to Julius Firmicus Maternus, be by the same author, he must in his later years have become a Christian. But it is more probable that this work is by another writer of the same name, who flourished at the same period, as his book is dedicated to Constantius and Constans, the sons of Constantine. It is a vigorous defence of the Christian religion against the errors of paganism, which he exhorts the emperors to destroy. The best edition is by Münter (Copenhagen, 1826); also, with Minucius Felix, by Oehler (Leipsic, 1847). (See HERTZ, *Dissert. de Julio Firmico Materno*, Copenhagen, 1817.)

H. DRISLER.

Fir'min (GILES), English clergyman and physician in America, b. in Suffolk, England, 1615, came to New England with Rev. John Wilson in 1632. Returning to England, he came again to New England in 1637, and Jan., 1639, was settled at Ipswich, Mass., where he also practised medicine. Went to Europe again in 1644, was settled at Colchester, England, in 1646, and in 1651 at Shalford, whence he was ejected in 1662. His last settlement was at Ridgewell, Essex, England, where he d. in Apr., 1697. *The Real Christian* (1670) was often reprinted in England and America; also wrote theological treatises.

First-born [Heb. בְּכוֹר, בְּכוֹרָה; Gr. πρωτότοκος, LXX. and N. T.; Lat. *primogenitus*, Vulgate]. The first-born son among the Hebrews was the first child of the father and the mother; hence he is spoken of in regard to the father as "the beginning of his strength" (Gen. [illegible]; Deut. xxi. 17), and in regard to the mother as "the opening of the womb" (Ex. xiii. 2). Before the establishment of the Hebrew theocracy the rights of primogeniture were recognized, but they were sometimes transferred from the eldest to a younger son, as from Esau to Jacob (Gen. xxv. 29–34; xxvii. 18–40), and from Reuben to Joseph (1 Chron. v. 1, 2). After the Mosaic [illegible] such a transfer was forbidden (Deut. xxi. [illegible]). The birthright consisted in a double portion of the [illegible], that is, the eldest son received twice [illegible] as any one of the younger sons (Deut. [illegible]; 1 Chron. v. 1, 2). When Elijah was [illegible], Elisha said to him, "I pray thee let a double portion of thy spirit be upon me" (2 Kings ii. 9). He meant that like a first-born son, he might inherit [illegible] prophetic prerogatives: not that he should be twice as great a prophet as his master [illegible], but at the head of "the sons of the prophets"—their superior in office; and [illegible] that the [illegible] government. As to the [illegible] [illegible] [illegible] [illegible] Exceptions [illegible]

the first-born males of the Hebrews should be consecrated to him; also the firstlings of their cattle and the first-fruits of their ground. After the Exodus their first-born sons, numbering 22,273, were substituted by 22,000 Levites, and the 273 surplus were redeemed at five shekels a head (Num. iii.). The tribe of Levi thus became the priestly tribe for the nation. But how this affected the family priesthood does not appear. So the right of government naturally inhered in the eldest son in the absence of the father, or in the case of his death while the family remained together. This pre-eminence attached to the eldest son in the royal family, as he succeeded to the throne (2 Chron. xxi. 3), though in special cases this rule was reversed; as, *e. g.*, Solomon, who for theocratic reasons was substituted for his eldest brother (1 Kings i.). The first-born son seems to have had authority over the rest of the family from the earliest times; but this appears to be distinguished from the peculiar birthright prerogative, for Esau says of Jacob, "Is he not rightly named Jacob [a supplanter]? for he hath supplanted me these two times: he took away my birthright, and behold now he hath taken away my blessing" (Gen. xxvii. 37). In the blessing, Isaac said, "Let people serve thee, and nations bow down to thee: be lord over thy brethren, and let thy mother's sons bow down to thee" (Gen. xxvii. 29). So it is said that the birthright was taken from Reuben and given to Joseph: "For Judah prevailed above his brethren, and of him came the chief ruler, but the birthright was Joseph's" (2 Chron. v. 1, 2; cf. Gen. xlix. 8–10; Mic. v. 2; Matt. ii. 6). As the first-born was considered more vigorous than younger children, having been begotten and brought forth before the parents had lost their strength, and first developing into manhood, he was naturally invested with superior prerogatives in the family. This has been the case among almost all people. Hence the destruction of the first-born of Egypt was considered so great a calamity, and hence so much importance was attached to the first-born of man and beast that by the Levitical law they were consecrated to Jehovah. The male first-born of men, being represented by the priestly tribe, were redeemed. When the child was a month old the father paid five shekels of the sanctuary to the priest, and so redeemed him. If the child died before he was a month old, the rabbins say the father was excused from the payment. The firstling of an unclean beast was also redeemed, as not fit to be offered in sacrifice. The firstling of an ass, for instance, was to be redeemed by a lamb, otherwise his neck was to be broken. The firstlings of clean animals were not to be redeemed, but offered in sacrifice (Ex. xiii. 11–15; xxii. 29, 30; Num. viii. 16–18; xviii. 15–17).

The term first-born is used metaphorically for the first, or chief, or pre-eminent; thus (Job xviii. 13), "The first-born of death shall devour his strength"—*i. e.* the most deadly disease shall destroy him. "The first-born of the poor" (Isa. xiv. 30) are the poorest and most wretched. God said of David (Ps. lxxxix. 27), "I will make him my first-born, higher than the kings of the earth," where the second clause explains the first. David, as the royal representative of the theocracy, enjoyed a higher prerogative than any heathen monarch. In the New Testament, *prōtotokos* occurs nine times. Thrice it is used literally (Matt. i. 25; Luke ii. 7; Heb. xi. 28). Christ is "first-born among many brethren" (Rom. viii. 29), as he is "the Son of God" in a peculiar sense—pre-eminent among the sons of God, who are made so through him by adoption and regeneration. He is called "first-born of every creature" (Col. i. 15) or of all creation, as he is "Lord of all," being the Creator of all (cf. Col. i. 16; Heb. i. 1–6). He is called "first-born from the dead" (Col. i. 18) and "first-begotten of the dead" (the same word, Rev. i. 5), because he was the first "raised from the dead to die no more," and so is "become the first-fruits of them that slept" (Rom. vi. 9; 1 Cor. xv. 20). He is called "the first-begotten" (same word, Heb. i. 6), as he was destined to occupy the highest position of honor in the universe (cf. Ps. lxxxix. 27; Phil. ii. 9–11). The righteous are spoken of as "a society of first-borns, registered in heaven" (Heb. xii. 23), because they enjoy the freedom of the city of God, the heavenly Jerusalem; it expresses their pre-eminent dignity and distinguished prerogatives. (Cf. Ex. iv. 22; Jer. xxxi. 9.)

"The English doctrine of primogeniture," says Bouvier, "by which, by the common law, the eldest son and his issue take the whole real estate, has been universally abolished in this country. So, with few exceptions, has been the distinction between male and female heirs." (See BOUVIER'S *Law Dictionary*, under the words "Descent" and "Primogeniture.") T. O. SUMMERS.

First-Fruits [Heb. רֵאשִׁית; Gr. ἀπαρχαί; Lat. *primitiæ*]. The offering of the first-fruits of the season, with more or less of religious ceremony, is a natural expression of pious gratitude in acknowledgment of the Divine bounty, and was practised by the ancient Egyptians, Greeks, and Romans, as well as by the Hebrews. The form in which it is first expressly commanded by Moses (Ex. xxii. 29) implies a custom already existing. We may trace it back, perhaps, to the very beginning of history (Gen. iv. 3, 4). Under the Mosaic ritual these offerings were of two kinds—the one national, the other individual. The national offerings were in connection with two of the great national festivals; the first, a sheaf of barley at the Passover, when the barley-harvest began; the second, two loaves of bread at Pentecost, when the wheat-harvest ended. These national offerings, which had a solemn representative character, were to be made, of course, at Jerusalem, and ceased with the destruction of the Temple. The rules to be observed are laid down in Lev. xxiii. Still more minute directions are given in the Talmud. Individual offerings were not merely in acknowledgment of dependence upon God, but also for the sustenance of the priesthood, and were to be made throughout the country, as well as at Jerusalem. Specific directions, bringing out the religious significance of the act, are contained in Deut. xxvi. 1–11. Some kinds of offerings were expressly devoted to the priests' use (Num. xviii. 12), as the best of the oil, wine, and wheat, in addition to which mention is also made (Deut. xviii. 4) of the fleece of sheep. Of young trees no fruits could be taken till the fourth year, in which they were offered to the Lord, subsequently to which they might be eaten. Of every kind of produce of the earth, as it ripened, a basketful was to be presented by each Israelite, some in their natural, and others, as wine and oil, in their prepared state. The amount of the gifts of the first-fruits was not specified in the Law, and the field was thus left open for Talmudic casuistry to busy itself in deciding what was proper or obligatory. The gift was not to be taken from the portion designed for tithes, nor from the corners left for the poor. One-fortieth (or, according to the school of Shammai, one-thirtieth) was accounted a liberal proportion of the entire produce, while a moderate portion was a fiftieth, and a scanty portion a sixtieth. But whatever was offered must be the produce of the Holy Land. Beyond Palestine it might be converted into money, and thus sent to the Temple. (See SPENCER, *De Legibus Hebræorum Ritualibus*, iii. 9.) R. D. HITCHCOCK.

Fir-wool, a fibre prepared to some extent in Germany from the leaves of *Pinus sylvestris* (Scotch fir), and made into cloth and wadding, which are believed to be useful in the treatment of rheumatism and skin diseases. Fir-wool oil is an oil of turpentine made from these leaves. Fir-wool extract is a residual substance prepared from the leaves, and used to some extent in medicine.

Fisch (GEORGES), D. D., a noted French Protestant clergyman who figured prominently at the "Evangelical Alliance" held in New York in 1873, was b. in Switzerland July 6, 1814, and was educated in the academy at Lausanne. After entering the ministry he preached for nearly five years to a German-speaking congregation at Vevay, and then emigrated to France and joined the French Evangelical Church. Became in 1846 the successor of the celebrated Adolphe Monod at Lyons. In 1855 removed to Paris, and is now pastor of the church Taitbout, where he is the colleague of his brother-in-law, Edmond de Pressensé, the most learned French Protestant ecclesiastic. Since 1863, Dr. Fisch has held the presidency of the "Union" seeking the coalition of French Protestants, and is a director of the Evangelical Society of France, a powerful auxiliary to the "Union." JAMES H. WORMAN.

Fisch'art (JOHANN), surnamed MENTZER, German satirist, b. at Mentz or Strasburg about 1545, wrote in prose and verse, and is highly admired. Published *Glückhafft Schiff* in 1576, and d. in 1614.

Fisch'er (ERNST KUNO BERTHOLD), German philosophical critic and historian, b. at Sandewalde, Silesia, July 23, 1824, studied at Leipsic and Halle, and delivered lectures as a privatdocent at Heidelberg in 1850. Received in 1855 his call as professor of philosophy in the University of Jena. *Diotima, the Idea of the Beautiful* (Pforzheim, 1849), *History of Modern Philosophy* (6 vols., 1852–72), *Apology for My Doctrine* (1854), *Logic and Metaphysics* (1852), *Bacon of Verulam* (1856), and *Die Selbstbekenntnisse Schillers* (1858), are among his works.

Fish [cognate closely with the Ang.-Sax. *fisc*, Ger. *fisch*, Dutch *visch*, Gothic *fisks*, Scandinavian *fisk*, and remotely with the Latin *piscis* and its derivatives]. This name is applied, in a popular sense, to the vertebrated and all other inhabitants of the waters; in a scientific sense, restricted at first to vertebrates dwelling in the waters and inspiring air through its medium by means of branchiæ or gills, and later to a still more limited group. (See ICHTHYOLOGY.)

General Characters.—Fishes, in the last acceptation of

the term, may be defined as *lyriferous vertebrates, with a skull provided with membrane or dermal bones;* in other words, the shoulder-girdle forms a lyriform or furcula-shaped apparatus, like a bird's wish-bone, the scapular bones and their adjuncts of the two sides being connected below at the median line; an air bladder (sometimes lung-

Skeleton of the Perch.

like) is, as a rule, developed, and either connects with the œsophagus by a single duct (as in the Ganoids and soft-finned fishes), or is entirely closed (as in the spine-finned fishes); the skull is highly developed, and is provided with membrane bones, or with dermal shields which are homologous with them; the shoulder girdle is formed, in great part, by large furcula-like bones, which bound the region behind the head, and which, besides meeting at the median line, are generally connected, by means of intervening bones, with the skull; these external scapular bones are also membrane or dermal bones, and are not developed in the Selachians; to the internal surfaces of these bones are attached smaller ones or cartilages (homologous with the shoulder girdles of sharks), which support the pectoral fins.

The gills and branchial apparatus are contained entirely within the cephalic cavity, in front of the scapular arch, and consist of five arches, the hindmost of which are, however, generally modified into pharyngeal bones; the gills are free at their distal margins. The brain is well developed, and has, generally, approximately equal cerebral and optic lobes and a moderate cerebellum. The heart is also well developed, and in all the forms (except some Dipnoi) is divided into an auricle and a ventricle. The members, anterior or "pectoral," and posterior or "ventral," whenever present, are developed as "fins." In addition to these there are also generally median or unpaired fins sustained by rays (peculiar to lyriferous vertebrates), and of which the dorsal and anal are connected by the intervention of "interspinal" bones with the dorsal and inferior spines (neurapophyses and hæmapophyses) of the vertebral column; these fins are respectively termed "dorsal," "anal," and "caudal." The caudal must by no means be confounded with the "tail" or "flukes" of the whales, which are to a certain extent homologous with the hind limbs.

Such are the characters which are common to all true fishes; that is, the classes Fishes and Ganoids of Agassiz, etc., embracing such forms as the flat-fishes, cod-fishes, perches, mullets, bill-fishes, pikes, herrings, carps, electrical eels, mormyroids, cat-fishes, true eels, ganoids, etc. There is, however, much variation in other respects among these numerous constituents of the class. The skeleton may be bony or cartilaginous; the caudal, ventral, and even pectoral fins present or absent; scales, of very various character, present or absent; the air-bladder, either membranaceous or lung like, present or absent; and, in fact, every

European Perch.

portion of the framework and organization generally is liable to modification of some kind. The character and mode of association of some of these modifications may be best exhibited in connection with the systematic relations of the class.

In the typical fishes, known as Teleosts, the skeleton is ossified (whence the name); the optic nerves cross (decussate) each other; the heart has only two opposite valves; the outer elements of the scapular arch (proscapula) are simple, the inner elements mostly ossified, and usually three or two in number; the pectoral member destitute of any representatives of the humerus, and connected with the scapular arch by several (generally four) narrow bones (actinosts). To this great division belong by far the largest number of species and those most familiar to most persons: they are grouped in a number of orders which have been named Plectognathi, Lophobranchiates, Pediculates, Hemibranchiates, Teleocephals, Scyphophores, Nematognaths, Apodes, and Opisthomes; and to these the reader is referred.

In the remaining fishes, united by most recent naturalists under the name of Ganoids, the skeleton is variable in its composition; the optic nerves do not cross, but are united by a commissure; the heart has a thickened bulbus arteriosus, provided with several rows of valves (but with those of each row sometimes united into a ridge, as in the Lepidosirenids); the elements of the outer portions of the scapular arch (proscapula) are in some double, in others united; the inner scapular element is cartilaginous and simple; the pectoral member is provided with two basilar elements (bounding the insertion of the pectoral fin on each of its sides), or with a single pedicle corresponding with the humerus.—The fishes combined under this last division, although not now numerous in species, exhibit extreme differences when compared with each other, and have been even considered (and with at least some degree of propriety) as constituting several sub-classes. Commencing with those types which are most nearly related to the typical fishes, the characteristics may be briefly given and contrasted as follows:

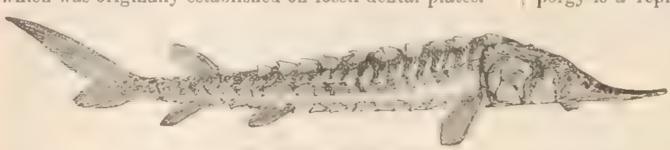
In the first group (Hyoganoids) the skeleton is ossified; the skull also exhibits well ossified bones; supramaxillary and intermaxillary bones are well developed; the nasal apertures are both external; preopercular and interopercular bones are present; the hyoid apparatus is well developed; the ceratohyals sustain a number of branchiostegal rays; the pectoral fin has two external cartilaginous basilar elements entirely separated from each other; and the air-bladder connects with the œsophagus by a duct which enters it from above. This group contains the orders Cycloganoids (represented in the U. S. by the bowfins or Amiids) and Rhomboganoids (represented by the alligator-gars or Lepidosteids).

In the second group ([illegible]) the skeleton is also in great part ossified, but the centra or bodies of the vertebræ may be either osseous, or (in extinct types) represented by a persistent notochord; the skull is provided with well ossified but superficial bones; supramaxillary and intermaxillary bones are distinguishable; the nasal apertures are external; preopercular and interopercular bones are both wanting; the hyoid apparatus is defective in the branchiostegal rays; the pectoral member is connected with and interposed at its base between two bones converging and uniting at their base with a cartilage representing a humerus; the air bladder is highly cellular, and connects by its duct with

the floor of the œsophagus.—The group is represented in the present age of the earth by a single order (CROSSOPTERYGIANS) with two genera (*Polypterus* and *Calamoichthys*), but was in ancient times rich in species.

The Lepidosiren Paradoxa.

In the third group (DIPNOANS) the skeleton is in part ossified and in part cartilaginous, and the bodies of the vertebræ, instead of being ossified, are represented by a simple notochord; the skull is in great degree cartilaginous, but is also encased with superficial and thin membrane bones; no supramaxillary or intermaxillary bones are distinguishable; the posterior nasal apertures are internal, *i. e.* in the mouth; no preopercula or interopercula are developed; the hyoid apparatus is more or less defective, especially in branchiostegal rays; the pectoral member is connected by a pedicle (homologous in part, at least, with the humerus) to the intrascapular (coracoid) cartilage; the air-bladder is replaced by a true lung, which is more or less divided into two, and which is connected with the œsophagus by a duct or rudimentary trachea, which enters it from beneath.—This type is represented at present by three very distinct genera—viz. *Lepidosiren* in South America, *Protopterus* in Africa, and *Ceratodus* (so called) in Australia. Formerly, the members of the group were among the principal representatives of the class, and in the triassic period of Europe the *Ceratodus* of Australia was represented by several typical species of that genus, which was originally established on fossil dental plates.



The Common Sturgeon

In the last group (CHONDROGANOIDS) the skeleton is almost entirely cartilaginous (and from this circumstance the group has been named); this is the case especially with the vertebral column and its appendages; the skull is also cartilaginous, but is covered by dermal bones; no supramaxillary or intermaxillary bones are differentiated; the nasal apertures are external; both the preopercular and interopercular elements are wanting; the hyoid apparatus, as in the last types, is defective in branchiostegal rays; the pectoral member, as in the Hyoganoids, has external cartilaginous basilar elements entirely distinct; and the air-bladder connects with the œsophagus by a duct which enters from above.—To this group belong the sturgeons (constituting the order CHONDROSTEI) and the "shovel-noses" or "paddle-fishes" of North America and Eastern Asia (constituting the order SELACHOSTOMI).

While the four groups just enumerated are the only great primary types of ganoid fishes that have members in the waters of the present epoch of the earth, in ancient times there were some very strange and peculiar forms which are not referable to any of those divisions, but which appear to stand isolated and afar from all others, and thus necessitate still another primary group. The types alluded to flourished among the first-known fishes, and in the Silurian and Devonian epochs. So strange are some of these in their appearance that remains of them have been referred to the Crustaceans. Such are the forms which have been called Cephalaspidæ. Others ("Placoganoidea") are almost equally aberrant in appearance, and their relations would not be suspected from their external characters; but the dental armature and scapular arches of a species discovered by Prof. Newberry in Ohio have convinced the writer that they were closely allied to the order Sirenoidei, and with them formed the super-order Dipnoi. The vomerine and palatine dental plates were contiguous, and seem to be homologous with the palatine plates of the Sirenoidei.

Limitations of Characters.—The student of the fishes, more than of any other class of vertebrates, must dissipate all prejudices with regard to the value of form in determining the relations of members of the class. Forms as diverse, almost, as any among all the quadruped mammals or among all the birds are found combined in the same natural family among fishes, and on the other hand we have forms that are very similar associated with structural characteristics that are very dissimilar. The student must also dismiss prejudices respecting the constancy of members (fins in fishes) in weighing their systematic relations. The members, for example, may vary in the same family, and ventral fins may be present or absent in closely-related genera; scales are also by no means invariably characteristic of fishes, for they likewise may be present in one genus and absent in another in other respects very closely related. But although the presence or absence, *per se*, of parts may be comparatively immaterial, their structure, when present, is all important. The pectoral and ventral members, for example, are always constructed on the same *general* plan, and contrast markedly with those of the higher vertebrates. The character and mode of development of the scales, too, though not so distinctive as the fins, are *sui generis* in fishes.

Geographical Distribution.—About 9000 species of living fishes are now known, variously distributed and found in greater or less numbers in almost all the waters of the globe, fresh and salt; the greatest numbers of species, however, are found in the tropical waters, and especially in the seas of the Indo-Moluccan Archipelago. The distribution of the types, especially of the marine species, to a considerable degree coincides with thermometrical conditions. In the polar and northern temperate regions, for example, are found representatives of the families of Gadoids or codfishes, Lycodoids, Stichæoids, Liparidoids, Cottoids or sculpins, and others less known; in the tropical regions many forms are distributed throughout the entire zone (and therefore designated as tropicopolitan), this being especially the case with many genera of Labroids (of which our tautog is a northern type), Scaroids or parrot-fishes, Pomacentroids, Gerroids, Serranoids or groupers, Sparoids (of which our porgy is a representative), Carangoids or horse-mackerel, and others; numerous species of these families being found in torrid waters, while very few extend far northward or southward. In the antarctic regions, again, we have another combination of forms; typical cod fishes and the other types characteristic of high northern latitudes are wanting, but are replaced by several peculiar groups, which seem to fill an analogous place in the economy of nature, having a superficial resemblance in general aspect, although they are not at all (comparatively speaking) related in structure. The Gadoids, for example, are replaced by Notothenioids, the Lycodoids by peculiar genera, the Cottoids by Harpagiferoids, etc. In the contrast between these antarctic and the arctic forms we have evidence of the absence of any paramount causal relation between temperature and structure; and it is necessary to remark here that, in addition to the "tropicopolitan" types, each great region has a number of characteristic and peculiar types.

But the distribution of the inhabitants of the great open seas and those of the inland waters are determined by different conditions, as might *a priori* be supposed. While, for example, the inhabitants of the opposite sides of converging continents are, to a great extent, similar, the freshwater species of those continents are mostly quite dissimilar, and especially so as we progress southward.

There are numerous families of fishes which are represented in the fresh waters, some exclusively so; others with marine species. The geographical limitation and relation in space of these families may be exhibited under combinations in several categories—viz.:

(1) Peculiar to North America: Sciænidæ (Haploidonotinæ), Centrarchidæ, Aphredoderidæ, Amblyopsidæ, Percopsidæ, Hyodontidæ, and Amiidæ.

(2) Peculiar to tropical Asia: Platypteridæ, Helostomidæ, Osphromenidæ, Nandidæ, Luciocephalidæ, Ophiocephalidæ, Notopteridæ, Salangidæ, Homalopteridæ, and Sisoridæ.

(3) Peculiar to Africa: Kneriidæ, Mormyridæ, Gymnarchidæ, and Polypteridæ.

(4) Peculiar to tropical America: Centropomidæ, Polycentridæ, Sternopygidæ, Electrophoridæ, Hypophthalmidæ, Trichomycteridæ, Callichthyidæ, Argiidæ, Loricariidæ, and Aspredinidæ.

(5) Peculiar to Australia: Gadopsidæ, Ceratodontidæ.

(6) Peculiar and common to the cis-tropical hemisphere—that is, Northern America, Europe, and Northern Asia: Gadidæ (Lotinæ), Cottidæ (Uranideæ), Percidæ (Percinæ), Gasterosteidæ (Gasterosteinæ), Esocidæ, Umbridæ, Catastomidæ (America and Eastern Asia), Salmonidæ, Acipenseridæ, and Polyodontidæ (America and Eastern Asia).

(7) Peculiar and common to Europe and Asia: Cobitidæ.

(8) Peculiar and common to South America and Australasia: Percophididæ, Haplochitonidæ, Galaxiidæ, and Osteoglossidæ.

(9) Peculiar and common to tropical and sub-tropical America and Africa: Cichlidæ, Characinidæ, and Lepidosirenidæ.

In addition to these, the family Cyprinidæ is represented in the entire cis-tropical or "arctogæan" hemisphere as well as in tropical Africa and Asia; and there are several monotypic families limited to very small regions, such as the Comephoridæ, the single species of which is only known from Lake Baikal. There are, further, a number of families (in addition to several already mentioned) which are chiefly represented by marine species, but which have also a greater or less number of representatives in fresh water in different regions of the earth: such are the Brotulidæ, Blenniidæ, Gobiidæ, Atherinidæ, Mugilidæ, Cyprinodontidæ, Microstomidæ, Clupeidæ, Dorosomidæ, etc.

Others, again, were represented in former epochs in parts of the world where they are not now found, and especially to be noted among these are two families at present characteristic in their distribution: the first of these is the Cobitidæ, which, in the early tertiary, were inhabitants of Western America, and which thus increased the similarity of the fauna of our (cis-tropical) continent with that of Northern Asia; the second is the Ceratodontidæ, a family whose representatives have been long known from fossil teeth found in palæozoic and mesozoic deposits (and which were referred by Prof. Agassiz to the sharks), and had been supposed to have expired toward the end of the triassic epoch; yet recently (since 1870) two species, closely allied to those found in the triassic beds of Europe, have been discovered *living* in Australia; and thus another ancient type has been preserved in that continent to illustrate the past life of our own hemisphere.

If we now seek to apply the knowledge thus gained to the appreciation of the different fish-faunas of the globe, we are forced to the following conclusions:

Inasmuch as the cis-tropical hemisphere shares in common the same families, and to a considerable extent the same genera, and even some species, it is presumable that the different regions of that hemisphere have derived their ancestors from a common primitive source, although North America has quite a large proportion of forms peculiar to it. The relations of those peculiar forms, however, are in all cases rather with some found in the northern hemisphere (fresh water or marine) than with any found elsewhere; but, at the same time, towards the south-western limits of our country occur representatives of families which are characteristic of tropical America.

Tropical Asia also nourishes a number of peculiar forms, but the relations of those are either intimate with cis-tropical ones or with marine types.

Africa likewise has Cyprinoids and Anabantids in common with tropical Asia, and Cyprinoids in common with the cis-tropical hemisphere, but it also supports several very peculiar families for whose relations we have to seek in other continents.

In tropical America are to be found the nearest relations of some of those African types, and several almost or quite limited to those two continents; on the other hand, in South America are found several families having no analogues in the parts of the world yet mentioned, but for which we have to turn our eyes to Australasia; and there we find representatives of not only the same families, but even, it has been contended, one of the same species. Under these circumstances we are almost compelled to believe that the first fauna of South America was derived, at a distant epoch, to some extent, from a common source with that of Africa and that of Australia. We have, however, at first sight, contrary indications, but they are not irreconcilable: the most conspicuous and, as it were, obtrusive types of South American fishes are analogues of African forms, members of the families Cichlidæ and Characinidæ, but the species belong to widely different genera. On the other hand, although the types common to South America and Australia are not conspicuous in numbers or importance, they are much more nearly related to corresponding Australian species than the former, and, in common with other facts, somewhat tend to verify Huxley's views respecting an "Austro-Columbian" fauna.

In fine, dividing the earth into regions distinguished by general ichthyological peculiarities, several primary combinations may be recognized, viz. (1) an *Arctogæan*, embracing Europe, Northern Asia, and Northern America; (2) an *Asiatic*, embracing the tropical portions of the continent; (3) an *African*, limited to the region S. and E. of the Desert; (4) an *American*, embracing the America *par excellence* dedicated to Amerigo Vespucci, and including the tropical and trans-tropical portions; and (5) an *Australasian*. Further, of these (*a*) the first two have intimate relations to each other, and (*b*) the last three others among themselves; and some weighty arguments might be adduced to support a division of the faunas of the globe into two primary regions coinciding with the two combinations alluded to—(*a*) PELOGÆA, and (*b*) EOGÆA.

Chronological History.—No representatives of the class of fishes have been found in the lowest fossiliferous rocks, and it is only when we reach the uppermost Silurian or lower Devonian that we find evidences of their existence in fossil bones or teeth. The most ancient known fishes belonged to types entirely distinct from any that are in existence at the present time. As already mentioned in the remarks on the primary groups of fishes, the Placoganoids, first of known fishes, heralded the advent of the class, and these were the predominant species apparently in the Devonian epoch; from somewhat later formations have been obtained the remains of representatives of orders still existing, but in very small numbers; such were especially the Dipnoans, which were then represented by numerous genera and species; coeval with these were various Selachians or sharks. Almost all of the true fishes existing during the mesozoic epoch have been referred to the great group of Ganoids, but it is probable that some have been erroneously identified, and that they belonged to the sub-class of Teleosts. No universally recognized species of that group, however, have been found in deposits lower than the cretaceous; in that epoch they began to culminate, and in time became the greatly prominent forms; and in the present epoch almost all the species (excluding the Selachians) belong to this great group; and, so far as numbers go, all of the living Ganoids might disappear, and yet the loss would scarcely be apparent in the sum-total of the class. Of about 9000 existing species of fishes or Teleostomes, less than 100 do not belong to the Teleosts, and that number alone represents the various primary groups of the ganoid fishes, and yet, great as is the number of the Teleostomes, and small as is that of the Ganoids, the latter exhibit much greater differences in contrast with each other than do all the Teleosts among themselves. Such is the character of the difference between the animals of the present and the distant past periods of the earth's history; and it is fortunate for the fulness of our knowledge of that history that, although with few lineal heirs left, most of the ancient types are still represented by some examples of their organization. THEODORE GILL.

Fish (HAMILTON), LL.D., b. in New York City Aug. 3, 1808, a son of Nicholas Fish; educated at Columbia College in his native city; graduated in 1828, was admitted to the bar in New York in 1830; was in 1837 chosen to the State legislature; then served in Congress in 1843–45; was lieutenant-governor of New York 1847–49; governor of New York 1849–51; and from 1851 to 1857 was one of its U. S. Senators. Was in 1862 one of the U. S. commissioners to visit soldiers confined in Confederate prisons, and rendered valuable service in negotiating for the exchange of prisoners. In 1869 was appointed secretary of state in the cabinet of President Grant, his term of office commencing in March. Mr. Fish suggested the Joint High Commission between the U. S. and Great Britain which met in 1871 to settle the various difficulties between the two nations, including the famous Alabama claims. In 1872 he became president of the order of the Cincinnati.

Fish (HAMILTON, JR.), b. in Albany, N. Y., Apr. 17, 1849; graduated at Columbia College 1869; was private secretary to his father 1869–70; in 1873 graduated at the Columbia College Law School, and was elected to the New York Assembly; was colonel, and aide-de-camp to Gov. Dix. He is a lawyer in New York City, and resides at Garrison's, Putnam co., N. Y.

Fish (HENRY CLAY), D. D., American Baptist clergyman, b. at Halifax, Vt., Jan. 27, 1820, graduated at Union Theological Seminary, N. Y., in 1845. From 1845 to 1850 was pastor of the Baptist church at Somerville, N. J., and since then of the First Baptist church at Newark, N. J. Has contributed largely to the extension of Baptist churches and to the interests, educational and missionary, of New Jersey. *Primitive Piety Revived*, *History and Repository of Pulpit Eloquence* (2 vols.), *Select Discourses from the French and German*, *The Price of Soul Liberty, and Who Paid it*, are among his works. D. at Newark, N. J., Oct. 2, 1877.

Fish (NICHOLAS), b. in New York Aug. 28, 1758, entered the College of New Jersey at Princeton, N. J., at the age of sixteen, but left, and commenced the study of law with John Morin Scott, with whom he served in 1776 as aide-de-camp, and subsequently as major of brigade; Nov. 21 major of the Second New York regiment, and at the close of the war was a lieutenant-colonel. Col. Fish was in both battles of Saratoga, commanded a corps of light infantry at the battle of Monmouth, served in Sullivan's expedition against the Indians in 1779, was with the light infantry

under La Fayette in 1780, and in 1781 was active with his regiment in the operations which resulted in the surrender of Cornwallis at Yorktown, Va. He was adjutant-general of the State in Apr., 1786, and thereafter for many years. He was revenue supervisor under Washington in 1794, and a New York alderman from 1806 to 1817; president of the New York Society of the Cincinnati in 1797. D. at New York June 20, 1833.

Fish (NICHOLAS), A. M., LL.B., b. in New York City Feb. 17, 1846: graduated at Columbia College in 1867, and at Harvard College Law School in 1869; became assistant secretary of U. S. legation at Berlin July 1, 1871, and in July, 1874, was appointed secretary of the same legation.

Fish'burn (WILLIAM), American major-general, b. in 1760, was on the staff of Gen. Anthony Wayne at the capture of Stony Point, N. Y.; was in the convention which framed the State constitution of South Carolina; then a member of the State legislature, and d. at Walterborough, S. C., Nov. 3, 1819.

Fish Creek, tp. of Humboldt co., Nev., in Fish Creek Valley, which has 4000 acres of arable land. Pop. 11.

Fish-Culture. The propagation of fish has for many centuries been practised by various nations to a greater or less extent, but in recent times it has received an immense impulse from the discovery of a method of artificial impregnation of the ova. As is well known, the egg in oviparous animals generally is impregnated within the body of the creature; and this rule was supposed to hold in regard to fishes as with the rest. It was found, however, with fishes that the eggs are impregnated after leaving the parent, and it was also found—and this was what gave the discovery its practical importance—that fish-eggs could be impregnated and hatched artificially by man with vastly better results than were produced when the fish were left to themselves. This discovery has already raised fish-culture from a position of no importance to one of great practical consideration.

The main fact upon which the economical importance of modern fish-culture rests is that by artificial means, fish, one of the great staples of human subsistence, can be indefinitely increased in quantity with a very slight corresponding increase of cost; and this fact in turn rests on the following considerations: (1) The possible yearly increase of fish is very great, the ratio of increase varying from 100 to 1 in a yearling trout to perhaps 1,000,000 to 1 in a full-grown sturgeon. (2) This increase, which is nearly all lost in nature, can be almost entirely saved at a comparatively insignificant expense by artificial impregnation and hatching. (3) The food which the fish get their growth on in the water after they are hatched is not a source of expense to man. It is obvious that under these conditions fish can be multiplied to a vast extent at a trifling cost, and that consequently the culture of so important a staple for food must be one of great value.

The culture of shad in the U. S. furnishes an illustration of this. At an expense of a few hundred dollars shad were artificially hatched and returned to the Connecticut River in 1867 by Seth Green, one of the pioneers of American fish-culture. In three years, the time required for shad to mature, these fish had become more abundant in the river than they were before the white man began to fish them out. (See *Connecticut Fisheries Report*, 1871.) The increase was enormous, and the fish having obtained their food in the ocean, their growth had cost nothing. Thousands of tons of shad were added to the produce of the Connecticut River that year, and we think it is safe to say that the investment of stocking the river artificially in 1868 returned an increase of a thousand-fold.

The experiment was repeated the next year in the same river, and also extended to other rivers; and since then shad artificially impregnated and hatched have been transported in great numbers to the Mississippi, the Sacramento, and various other rivers of the U. S. and their tributaries, which were destitute of shad; and from the U. S. they will be carried to other countries, making the ultimate benefit to the world of the artificial culture of shad almost incalculable, and showing how great the importance of the universal culture of fish must be when the results of the culture of one variety are so stupendous.

The honor of the discovery of the artificial impregnation of the eggs, on which the achievements of modern fish-culture rest, is generally conceded to a lieutenant (afterwards major) of the Prussian army named G. L. Jacobi of Hollenhausen, whose experiments were published in the *Hanover Magazine* in 1763. Four hundred years before that, however, a Roman Catholic monk of the abbey of Rêome, named Dom Pinchon, hatched some fish-eggs by an artificial process, but the account is not clear as to whether they were impregnated naturally or artificially. The publication of Jacobi's successful experiments attracted considerable attention for a time, but led to no important practical results, and the art seems to have remained forgotten for nearly a hundred years, when it was rediscovered and again practised by Joseph Rémy, a fisherman of the Vosges Mountains between Alsace and Lorraine; and it is to Joseph Rémy that the discovery of the artificial impregnation of fish-eggs, as far as it has led to permanent results, must be attributed. Rémy's discoveries soon came into public notice, chiefly through the agency of M. Coste, professor of biology in the College of France, and eventually led to the establishment of the extensive fish-breeding works at Hüningen in 1851, formerly the property of the French government, but now in possession of the German emperor. This was the first practical effort at fish-culture on a large scale that was based on the artificial impregnation of the eggs. Since then the practice of the art has spread over Europe and America, and there is now hardly a civilized country which has not one or more fish-breeding establishments, public or private.

The principle of the artificial impregnation is substantially the same with all the varieties of fish that have been experimented with. It consists in mixing the eggs of the female fish with the milt of the male in some convenient receptacle immediately after the eggs and milt leave the fish. The fecundation of the eggs being a merely mechanical process, this artificial mixing impregnates them better than if the fish had mixed the eggs and milt themselves. The subsequent treatment of the eggs after impregnation is quite various with different kinds of fishes; and in order to fully illustrate these differences we will give a brief description of the treatment of the eggs of the salmon (*Salmo salar*), the shad (*Alosa præstabilis*), the glass-eyed pike (*Lucioperca*), and the yellow perch (*Perca flavescens*). These are representative fish, the salmon representing the class of fish depositing their eggs separate like shot, and spawning in cold water; the shad representing the fish which have similar eggs, but spawn in warm water; the glass-eyed pike representing the fishes whose eggs come separate from the fish like shot, but which stick inseparably together upon entering the water; and the yellow perch representing the fish which deposit their eggs united in a gelatinous mass, resembling frog-spawn.

(1) In taking salmon eggs the parent fish are usually confined in some enclosure where they can be conveniently caught, and a female with ripe eggs having been found, the eggs are stripped from the fish into a dry pan or pail. As soon as they are taken the milt of the male is also stripped into the same pan. The eggs and milt are then thoroughly mixed by stirring, and left to stand two or three minutes. Sufficient water is then poured into the pan to stand to the depth of one or two inches over the eggs They will now stick together for some time, and must be left quiet till they separate of themselves, which is in half an hour, more or less, cold water requiring more time than warmer water. After the eggs are separated they are thoroughly washed from the superfluous milt, and when perfectly clean are placed in the hatching apparatus. This apparatus consists of a box, trough, or any wholesome vessel, through which a steam of pure cold water is conveyed which is free from fungus and sediment, and protected from living enemies. They are then left here till they hatch.

The time that it takes salmon eggs to hatch depends wholly on the temperature of the water. If the water stands at 45°, as at the Cold Spring Trout-Ponds at Charlestown, N. H., it will take 70 days; if at 50°, 50 days; if at 55°, as at the U. S. salmon-breeding station at the head-waters of the Sacramento River, it will take 35 days. After the young salmon are hatched they are usually kept in confinement and artificially reared for a time before being placed in the natural waters intended for their final destination. They are retained in this way sometimes three or six months, and sometimes a year; at the expiration of which time they are turned loose and their artificial life is at an end. The same general treatment of the eggs is usually adopted with brook-trout, salmon-trout, char, graylings, white-fish, and other Salmonidæ.

(2) *Shad* (*Alosa præstabilis*).—In operating with shad the eggs are generally taken from the parent fish as they are drawn up in the seine, this fish being too delicate to be caught and kept alive in confinement. Shad eggs are usually taken in water instead of in a dry pan, the eggs impregnating as well in water as without, while with Salmonidæ eggs, unnatural as it seems, the presence of water is unfavorable to impregnation. The eggs after being taken are treated at first in the same way that salmon eggs are, but after they are washed they are placed in a box with a wire-netting bottom, which is so anchored in the river from which the parent shad are taken that there is a constant circulation around the eggs. The water always being warm in shad rivers at the spawning season, these eggs hatch in

a few days. Unlike the salmon, the young shad are not kept any great length of time in confinement, but are soon turned loose into the river, or if intended for transportation are moved as soon as possible after being hatched.

(3) *Glass-eyed Pike* (*Lucioperca*). The eggs of the glass-eyed pike are taken on plates of glass or something similar, care being taken to deposit only one layer on each plate. This care is necessitated by the fact that the eggs, being coated with a very adhesive film, will, if piled together, stick so closely that the interior layers, being wholly excluded from the air and water, will suffocate and die. The eggs which have been taken on the glass adhere to it very strongly, and may be placed in any favorable spot under running water where they will be protected against sediment, fungus, and living enemies. As but little is now known about the habits and requirements of the very young fish, it is thought the best way after hatching them is to place them as soon as possible in the waters which they are intended to stock. A favorable temperature for hatching *Lucioperca* eggs is 50° F., and a number of these eggs experimented with by the writer in 1873 were one month hatching in water averaging 47° F.

(4) *Yellow Perch* (*Perca flavescens*).—The eggs of the yellow perch, which come out in gelatinous folds, are the easiest to hatch of all fish-eggs. It is only necessary to impregnate them in the usual way, and to keep them in moderately clean safe water having a slight circulation. A temperature of from 50° to 60° is favorable for them, and they hatch in this temperature in two or three weeks.

The methods by which modern fish culture is now practised may be reduced to four, as follows:

(1) The fish are operated upon at their own river, and when the eggs are hatched the young fry are replaced in the river for the purpose of increasing the stock. This is the way in which fish culture has been practised with salmon in the Tay, Galway, and other rivers in Great Britain; in the Connecticut, Hudson, and other rivers in the U. S. with shad, and in trout-brooks in various places with brook-trout.

(2) The young fish when hatched, or in some cases the eggs when sufficiently matured, are transported from the place of their nativity to other waters which it is thought desirable to stock with them. This is the case with the German (formerly French) imperial fish-breeding establishment at Hüningen, with the U. S. government establishments at the head-waters of the Sacramento and on the Penobscot, and in part with the shad-hatching works of various rivers of the U. S.

(3) The fish are bred and raised at private establishments, which are supported by the sale of the spawn, young fry, and mature fish to parties who wish to stock other waters, and also in the case of the full grown fish for the purpose of the table. This is true of the Troutdale Fishery at Keswick, Cumberland, in England, and of the various trout breeding establishments of the U. S.

(4) Fish of different varieties, naturally bred, are caught and transported alive to waters which are destitute of these varieties. This is the way in which hundreds of ponds and lakes in New York and New England have been stocked with black bass, salmon trout, glass eyed pike, and various other fish. It was in this way also that the attempt was made to stock the waters of California with Eastern varieties of fish by means of the California aquarium car, which was wrecked at the Elkhorn River in Nebraska.

It is mainly by the above methods that fish-culture is practised in modern times. Actual operations in fish-culture at the present time are quite extensive, especially in the U. S. Besides the large fish-breeding works at Hüningen and others similar, both public and private, in the European states, there are in the U. S. several hundred places where trout breeding is carried on. In most of the Northern and Middle States, and in some others, there are duly-appointed fish commissions, for which annual appropriations are made, and through whose instrumentality great results have been already accomplished in the increasing of shad, black bass, and other varieties of fish, and greater undertakings are still contemplated. The U. S. government also is doing a great deal in the way of distributing shad and salmon over the country, and has a large salmon-breeding station in California and another in Maine. By means of all these agencies trout, salmon, shad, salmon-trout, black bass, and all the other finer varieties of fish have been, or will soon be, introduced into the principal waters of the U. S.

Fish culture is without doubt destined to be one of the great practical arts of the present civilization. Vast as were the resources of the land before they had been reached by agriculture, they did not surpass the vast unreached resources of the sea; and when aquaculture, even in its earliest infancy, has attained the point of perfection which centuries of study and practice have given agriculture, the sea will yield a harvest of marvellous magnitude; for the fish, large and small, which swarm in the waters of the earth have a life-producing capacity which lies hardly within the reach of figures to compute, and certainly not within the power of the mind to measure. For instance, a single spawning-ground of the herring contains, without doubt, a hundred thousand million eggs. Even this number the mind cannot grasp, yet this is an insignificant fraction of the whole amount of fish-eggs in the sea, a mere dot in the waste of waters, or as the leaves of a single tree compared with the boundless universal flora of the earth. These vast life-producing powers of the sea are now just where the productive powers of the land were before agriculture, with its skill and inventions, made them fruitful. But how wonderfully the art of agriculture has multiplied and remultiplied the productiveness of the land! A no less brilliant future awaits the art of aquæculture. It is only making its first infant efforts now, but we think it is safe to prophesy that it will stand side by side in magnitude and utility with its sister art of agriculture.

The following brief account of what has been done at the Cold Spring Trout-Ponds may serve as a specimen of the average work accomplished at the larger trout-breeding locations of this country. This establishment, at Charlestown, N. H., was the first of the kind in New England, and began business in 1866, when 15,000 trout were hatched. In 1867, 100,000 trout eggs and 40,000 salmon eggs were laid down in the hatching-troughs. In 1868 a black bass branch was added to the establishment, which yielded 100,000 young fry, and salmon-breeding works were erected in New Brunswick, as another branch of the same place, which yielded 450,000 salmon eggs. In the same year 200,000 trout eggs were hatched at Charlestown. In 1869, 175,000 trout eggs were hatched at the same place. In 1870, 250,000 trout eggs were laid down; one of the largest hotels in Boston was supplied with large trout through the summer, and several consignments of large trout were sent to Fulton Market. In 1871, 300,000 trout eggs were laid down, and an order for eggs was received from Europe. In 1872 the proprietor went to California, and the business of the Cold Spring Trout-Ponds was considerably contracted, and only 100,000 trout eggs were hatched. In 1873, 200,000 trout eggs were hatched, also 50,000 California salmon eggs, and 160,000 Penobscot salmon for the State of Vermont. Large orders were received during the last two or three years from England and California.

(Among the American works on fish culture are NORRIS, *American Fish Culture*, 1868; *Trout Culture*, by SETH GREEN, 1870; *Fish-Culture*, J. H. KLIPPART, 1873; *Domesticated Trout*, 1873; and various State, U. S., and Canadian reports, etc.) LIVINGSTON STONE.

Fish'dam, post-tp. of Union co., S. C. Pop. 1120.

Fish'er, the largest of the martens, is the *Mustela Pennanti*, a carnivorous quadruped of the family Mustelidæ, found in Canada and the U. S., arboreal in its habits, and receiving its name, as it is said, from its fondness for fish; which, however, it probably does not capture, but which it often steals from the traps of fur collectors, who use fish as a bait for the pine marten. The fisher is not often trapped, being very skilful in escaping this fate. It is some three feet long, inclusive of the tail. In color it is chiefly black, often with gray or brown tints towards the head. It is a fierce nocturnal animal, living chiefly upon birds and small quadrupeds. Its fur in winter is good, and is used chiefly in Europe. The black tail was once a favorite ornament to the caps of the Polish Jews, and brought a high price; but this fashion has gone by.

Fisher, tp. of Fremont co., Ia. Pop. 748.

Fisher (ALEXANDER METCALF), b. in Franklin, Mass., in 1794, graduated at Yale College, New Haven, Conn., 1813; was tutor there in 1815, and then professor of mathematics and natural philosophy in that college from 1817 until his death, Apr. 22, 1822, by shipwreck on the coast of Ireland. Wrote upon his special topics in *Silliman's Journal*.

Fisher (ALVAN), an American painter of landscapes and portraits, b. in Needham, Mass., Aug. 9, 1792; studied under Penniman, an ornamental painter. His native talent overcame the more serious disadvantages of so cramped an education. In 1824 he took his position as an artist; in 1825 visited Europe and pursued his studies in Paris; returned to Boston, and d. at Dedham, Mass., Feb. 14, 1863. Was a pleasing painter, without remarkable force or brilliancy. His portrait of Dr. Spurzheim, taken immediately after his death and finished from recollection (1832), was admired. O. B. FROTHINGHAM.

Fisher (Hon. CHARLES), D. C. L., b. in York co., New Brunswick, graduated at King's College, N. B.; studied law, was admitted to the bar, and elected to the provincial Parliament in 1837. In 1848-57 was a member of the

executive council; in 1852 a commissioner to codify the provincial statutes; from Oct., 1854, to May, 1856, was attorney general, again in 1856–61, and again Apr., 1866. Always advocated the union of all the provinces of British America, and in 1857 was a member of the conference of the representatives of British North America in London, by which the terms of the union were arranged. Is (1874) a judge of the supreme court of New Brunswick.

Fisher (EBENEZER), D. D., American Universalist clergyman, b. in Charlotte, Me., Feb. 6, 1815. Was president of the theological department of St. Lawrence University, Canton, N. Y. (Apr. 15, 1858–79). D. Feb. 21, 1879.

Fisher (ELWOOD), American editor and statistical writer, b. Oct. 1, 1808; though of Quaker descent, for years defended American slavery and advocated the secession of the Southern States. *The Southern Press*, established by him in 1850 at Washington, D. C., had this avowed object. D. at Atlanta, Ga., Oct. 1, 1862.

Fisher (GEORGE JACKSON), M. D., b. Nov. 27, 1825, in Westchester co., N. Y.; graduated in medicine at the medical department of the New York University Mar. 1, 1849; physician and surgeon of the male and female departments of the New York State prisons at Sing-Sing in 1853–54; president of the village of Sing-Sing 1856; fellow of the New York Academy of Medicine 1857; permanent member of the Medical Society of the State of New York 1857; president of the Medical Society of Westchester co., N. Y., 1857–58; permanent member of the American Medical Association 1858; honorary degree of A. M. from Madison University 1859; corresponding member of New York Lyceum of Natural History 1860; corresponding member of New York Historical Society 1862; vice-president Medical Society of the State of New York 1864; corresponding member of the Gynæcological Society of Boston 1869; resigned (after 20 years' service) surgeon Seventh brigade N. G. S. N. Y. 1873; president of Medical Society State of New York 1874. Author of *Biographical Sketches of Deceased Physicians of Westchester co., N. Y.*, 1861; *On Animal Substances employed as Medicines by the Ancients*, 1862; *Diploteratology, an Essay on Compound Human Monsters*, pp. 200, 33 lithographic plates of 126 figures, 1865–68; *On the Influence of Maternal Mental Emotion in the Production of Monsters*, pp. 55, 1870.

Fisher (GEORGE P.), b. in Milford, Kent co., Del., Oct. 13, 1817; graduated at Dickinson College, Pa., in 1838; was admitted to the bar in 1841. In 1843–44 was in the Delaware house of representatives; in 1846 was secretary of state for Delaware; in 1850 was appointed a commissioner by President Taylor to settle claims against Brazil; from 1855 to 1860 was attorney general of Delaware and a representative in Congress 1861–63. President Lincoln appointed him to a judgeship in the supreme court of the District of Columbia. In 1874 he was appointed district attorney of the District of Columbia.

Fisher (GEORGE PARK), D. D., was b. in Wrentham, Mass., Aug. 10, 1827; graduated at Brown University in 1847, and studied theology at New Haven (1848–49), at Andover, where he graduated in 1851, and in Germany. Became professor of divinity in Yale College in 1854, and in 1861 was transferred to the chair of ecclesiastical history. The degree of D. D. was conferred on him by his alma mater in 1866. Has published *Essays on the Supernatural Origin of Christianity* (1865), *Life of Benjamin Silliman* (1866), *History of the Reformation* (1873), and numerous articles in the *Bibliotheca Sacra*, *North American Review*, *British Quarterly*, and *New Englander*. Since 1866 has been one of the editors of the *New Englander*. His writings are marked by learning, acuteness, solidity, and breadth of vision. R. D. HITCHCOCK.

Fisher (JOHN), bishop of Rochester, b. at Beverley, Yorkshire, 1459, took his M. A. at Cambridge University in 1491; in 1501 became chancellor of the university, and in 1504 bishop of Rochester. In 1505 was master of Queen's College, Cambridge, and on Shrove Sunday, 1527, burned Tyndale's Bibles at Paul's Cross; besides this, in opposition to the Lutheran doctrines, he wrote several treatises. In 1530 he opposed the divorce of Henry VIII. from Catharine of Aragon, was imprisoned in the Tower of London in 1534, and, receiving the cardinal's hat from Pope Paul III. May, 1535, was convicted for denying the royal supremacy on June 11, and executed at London June 22, 1535.

Fisher (JOHN CHARLTON), LL.D., journalist, d. Sept., 1849, on the Sarah Sands steamer from England. Founded and edited the *New York Albion*, went to Quebec in 1823, and conducted *The Official Gazette*, then the *Quebec Mercury*, and in 1841 *The Conservative*, a weekly. Was president of the Quebec Literary and Historical Society.

Fisher (JOHN DIX), M. D., American instructor of the blind, b. in 1799; graduated at Brown University in 1820, assisted in the organization and management of the Perkins' Institution for the Blind at Boston, Mass.; was visiting physician to the Massachusetts General Hospital. He wrote *Description of the Small-pox, Varioloid*, etc. (1834). D. Mar. 3, 1850.

Fisher (JONATHAN), American clergyman, b. at New Braintree, Mass., Oct. 17, 1768; graduated at Harvard University 1792, was licensed to preach Oct. 1, 1793, and was minister at Blue Hill, Me., from July 3, 1796, to his death, Sept. 22, 1847. Was a thorough Calvinist, an able linguist, and compiled a Hebrew dictionary.

Fisher (JOSHUA), M. D., American physician, b. at Dedham, Mass., May, 1749; graduated at Harvard University 1766; was surgeon in a private armed ship in 1775, was captured and escaped to France, but returning to America settled in practice at Beverly, Mass. Bequeathed $20,000 to Harvard University to establish a professorship of natural history, was president of the Massachusetts Medical Society, and published a *Discourse on Narcotics* (1806). D. at Beverly, Mass., Mar. 21, 1833.

Fisher (REDWOOD), American statistician, b. at Philadelphia, Pa., 1783; was a merchant there, then edited a daily paper in New York, and published several volumes on political economy, dying at Philadelphia May 17, 1856.

Fisher (THOMAS), American poet and scientist, b. in Philadelphia, Pa., Jan. 21, 1801; was a merchant and active member of the Academy of Natural Sciences; and published *Dial of the Seasons* (1835), *Song of the Sea-shells* (1850), *Mathematics Simplified and made Attractive* (1853), etc. D. in Philadelphia Feb. 12, 1856.

Fisher (WILLIAM MARK), American painter, b. at Boston, Mass., Dec. 15, 1841; studied with George Innis, then in 1864 and 1867 at Paris, and has painted many *genre* pictures, as also landscapes and cattle-pieces.

Fish'eries. The right to catch fish on the high seas, on banks in the same, on the coasts, or in the bays and rivers of lands not pertaining to the jurisdiction of any organized state, is open to all; but by international law, as the sea for a marine league is under the jurisdiction of the sovereign of the adjoining land, no one can lawfully fish there without liberty expressly given or conceded by law or treaty. Much less has any one a right to dry and cure fish on the soil belonging to any organized state without permission.

In the treaty of 1783, by which Great Britain acknowledged the independence of the American colonies, their right to take fish on the Bank of Newfoundland was admitted, as well as in the Gulf of St. Lawrence and at all other places of the sea where they had been wont to fish in earlier times. *Liberty* also was conceded to them to take fish without drying or curing them on parts of the coast of Newfoundland used by British fishermen, and "on the coasts, bays, and creeks" of all other British dominions in America; and also to take, cure, and dry fish in any of the unsettled bays, harbors, and creeks of Nova Scotia, Magdalen Islands, and Labrador, so long as they should remain unsettled, but to dry and cure fish after the settlement of such coast, etc. "only with the consent of the inhabitants, proprietors, or possessors of the ground."

The treaty of Ghent (1815), terminating the war of 1812–15, said nothing of the right of fisheries. Our government claimed that the old treaty of 1783 survived the war, and the British government denied such a claim, on the general principle that war dissolves ordinary provisions of treaties. In 1818 a convention made at London conceded to fishermen from the U. S. the right to take fish on the southwestern and western coasts of Newfoundland within certain limits, on the shores of the Magdalen Islands, and on those of Labrador from Mount Joly eastward and northward. The liberty of drying and of curing fish was confined to the southern coasts of Newfoundland and the coast of Labrador, as defined in the treaty, so long as they should continue unsettled, but afterwards only with the consent of proprietors, as before. These grants were expressly made perpetual, and therefore suspended only, but not terminated, by war. On the other hand, the U. S. renounced for ever the right to take, cure, or dry fish within three marine miles of any coasts of the British dominions not named in the treaty. Liberty to enter bays or harbors thus excepted from the right of fishing was granted for purposes of shelter, repairing damages, and obtaining wood and water.

In 1854 a new treaty relating to the fisheries on the eastern coasts was negotiated, which went by the name of the Reciprocity Treaty, and considerably enlarged the liberties conceded to fishermen from the U. S. The rights created by the old treaty remained untouched and unenlarged; this treaty granted the additional right of taking fish, except shell-fish, of every kind on the sea-coasts and shores

and in the bays, harbors, and creeks of Canada, New Brunswick, Nova Scotia, Prince Edward's Island, and of the islands thereto adjacent, and the permission of landing to dry their nets and cure fish on all these coasts, as well as on those of the Magdalen Islands, provided it be done without interference with private property. From the permissions given by this treaty those of catching salmon and shad and of fishing in the mouths of rivers were excepted. On the other hand, similar liberties were given to British fishermen to fish along the shores of the U. S. as far S. as the 36th degree of latitude, with similar permission to dry and cure, and with the restriction of fisheries similar to those already mentioned. Other rights, such as the free navigation of Lake Michigan by both parties, and that of using the St. Lawrence within British territory, were provided for.

This treaty, terminable after ten years on twelve months' notice, was actually terminated by the action of the U. S. Mar. 17, 1866, in pursuance of notice given a year before. Consequently, the treaty of 1818 alone regulated the fisheries on British American eastern coasts, and many irritating exercises of power and claims that the Americans had surpassed their rights occurred on the part of the authorities of the British dominions. Five years passed away before the treaty of Washington of 1871 put the fisheries on a new basis. In this treaty most of the particulars which enter into the intercourse of border states were considered, and form a system in which the advantages were intended to be equal. The fisheries were again placed substantially, as far as rights of fishing, curing, and drying were concerned, on the basis of the reciprocity treaty of 1854; only, the southern limit of British rights of fishing, etc. along the coasts of the U. S. was moved northward to the 39th parallel. A new and important feature of the treaty was that of article 21, the admission of fish oil and fish (except fish of inland waters and fish preserved in oil) into the territories of the U. S. from those of the Dominion of Canada and of Prince Edward's Island, being the produce of their fisheries, and *vice versâ*, free of duty. Another provision of the treaty arose from the claim on the British American side that the concessions were of more value to the U. S. than to themselves. In order to determine this, article 23 provides for the appointment of commissioners to meet at Halifax and determine what gross sum, if any, ought to be paid to the British government as a compensation for the excess of advantages conceded to the U. S. Such commissioners have been appointed, but have not yet met (1874). This part of the treaty of Washington is by article 33 terminable after ten years, and after one year's notice.

T. D. WOOLSEY.

Fisheries. Under this designation are embraced all that relates to the capture of fishes on a large scale, the mode of curing and preparing them, and the economical and statistical information relating to them. Involving, etymologically, the consideration of fishes in the original or popular significance of that term, it is still used in connection with the pursuit of all the animals of economic importance formerly (and still popularly) confounded under the name of "fishes;" it hence relates not only to the true fishes, but also to the cetacean and even pinniped mammals and invertebrates which are the object of a regular industry; it is, however, unless qualified, to be understood to refer to the fishes and the cetaceans.

The fisheries may be considered with reference to the objects of pursuit, the places and modes of capture, and the numbers and value of the captures. We have only space to consider (1) the subjects of capture, and (2) statistics respecting them so far as the U. S. are concerned.

Leaving out of consideration, for the present, "whale fisheries" and "seal fisheries," the fisheries *par excellence* will be treated of and may be considered under the heads of sea fisheries, in-shore fisheries, and lake fisheries.

Sea Fisheries. Those whose objects of pursuit are found in the high seas, and which may engage together the industry of several nations on common or neutral grounds, may be designated sea fisheries. The subjects of these are chiefly arctopolitan species—that is, those which are generally distributed in the colder regions of the northern hemisphere—and are severally, in the order of their importance, the cod fish, the mackerel, and the herring. These are all too well known to be described here, but information respecting them may be found under their several names in the alphabet. It is only necessary to add here information in brief respecting their economical relations and mode of capture.

The cod fish far outranks all others in its commercial value and in the number taken. Besides forming the objects of capture on bitting coasts between the 40th and 60th degrees of latitude, it is found in immense numbers on the great Banks of Newfoundland, a table land in the sea about 500 miles long by about 100 in width; thither vessels of the English, Americans, and French resort; there the fish is taken in great numbers, on favorable occasions the men being incessantly employed in pulling in the lines, which are scarcely thrown in baited before they are pulled out with fishes attached, so that a single man occasionally takes 300 to 400 a day. From the nature of their habitat, as well as on account of the facility with which they take the hook, the fishery for them is almost entirely restricted to line-fishing, the baits used being various, but by preference capelin, herring, and squids. Some are sold fresh (but form a very small proportion of the total); most, after their heads are cut off, are split and flattened out, salted, and dried on flakes; their tongues are also separately preserved; the liver forms an important contribution to medicine in the form of cod-liver oil for consumptives; the air-bladder yields a valuable glue; and the intestines even are in some countries used as a bait, especially for the sardine fishery. It has been the object of a well-known fishery since at least as early as the fourteenth century.

The mackerel is a species which periodically approaches the coasts in the northern seas in immense schools. One of the visitations is made in the spring of the year by larger fishes, and another in the fall or early winter by smaller ones. On their first approach they are comparatively poor, but soon become fat. They are caught with line, and also with deep nets with meshes just large enough to prevent them from passing through; the night is in many places regarded as being the most favorable time for fishing; the baits used are various, almost any, and even the bare hook, being often eagerly seized upon. For curing they are split along the middle of the belly to the head, and, with their heads retained, salted or pickled.

Both the cod and mackerel (in common with allied species) deposit eggs whose specific gravity is so light that they ascend to the surface and there undergo development.

The herring, like the mackerel, is a deep water fish which visits the coasts periodically for the purpose of finding spawning grounds. It associates in immense schools, of which the females are said to exceed the males in the proportion of more than three to one. The principal season for its capture is the spring; it is caught in deep nets whose meshes are just sufficient to restrain from passing through ordinary sized fishes, and thus somewhat smaller than those used for mackerel. They are chiefly cured by being smoked, a process introduced, it is said, by a native of Holland named Buckolz, in the fifteenth century.

The eggs of the herring are deposited on the ground, and there become matured and hatched.

In-shore Fisheries. The in-shore fisheries by which the various markets of the country are supplied with fresh fish are very extensive, employing many thousand men, and the objects of capture are quite numerous. Between 80 and 100 species may be seen at one season or another every year in the markets of the city of New York, but in this number are included a few lake and river fishes, as well as the off-shore and in-shore species: comparatively a small number of these, however, are of great economical importance, and chief of these are the shad (*Alosa sapidissima*), river herring (*Pomolobus mediocris*), alewife (*Pomolobus pseudoharengus*), porgy (*Stenotomus argyrops*), rock fish or striped bass (*Roccus lineatus*), and bluefish (*Pomatomus saltatrix*). These fishes are chiefly caught in pound-nets, and a considerable supply is also obtained by the hook and line, as well as by seines and (in the case of the anadromous clupeids) by gill-nets and fykes. There has been for some time, and still is, a growing tendency to the concentration of the industry on the coasts in the hands of small capitalists, who erect and own pounds, sometimes in considerable number, at different points along the coast.

Another industry of recent origin and of rapidly increasing importance is the appropriation of the menhaden or mossbunker for preservation in oil as sardines. Although inferior to the true sardine, it appears to be favorably received by a large community, inasmuch as there are, especially in the State of New Jersey, several large factories devoted to the curing of the fish in this way. Their bones are softened for this purpose by exposure to steam. Until within late years the menhaden had been used almost solely as manure or for conversion into oil and guano. An extensive industry of this kind is also carried on in Norway.

Lake Fisheries. Extensive fisheries are also carried on in the great lakes between the U. S. and Canada. The objects of capture are of course fresh-water species, and the most important are two Salmonines: (1) the salmon, or Mackinaw trout (*Salmo namaycush*), and (2) the siscowet (*Salmo siscowet*); two Coregonines: (1) the white fish (*Coregonus albus*), and (2) the lake herring (*Argyrosomus clupeiformis*); and the lake sturgeon (*Acipenser rubicundus*).

The salmon, or Mackinaw trout reaches an average weight of about 5 pounds, although it frequently attains a weight

of 15 pounds or more, exceptionally reaching even about 100 pounds. Except in the spawning season, it is found in comparatively deep waters of the lakes, a depth of over thirty fathoms being the most favorable for finding them, although some, in winter, are caught in comparatively shallow bays, through holes cut in the ice. They are taken almost exclusively in gill-nets, but are, however, easily taken by the hook, as they are extremely ravenous, and will bite at almost any bait. Their chief food in the depths which they affect is a peculiar species of herring-like white-fish or cisco (*Argyrosomus Hoyii*) peculiar to such depths.

The siscowet is a smaller fish than the preceding, only averaging about 4½ pounds, and one of 8 pounds weight is unusually large. It inhabits, except during the breeding season, the deep waters of Lake Supèrior, rarely going upward beyond the horizon of forty fathoms below the surface. It is caught with gill-nets. Its food appears to consist in large part of a peculiar Cottid or sculpin (*Triglopsis Thompsonii*) found in the same waters.

The white-fish varies in size with the locality, at some places averaging 1½ pounds, and at other places as much as 4 pounds or even more, and exceptionally it is said to reach the weight of 22 pounds. It frequents the moderately deep waters of the lakes, but also approaches the shoal waters, and is caught in pounds as well as gill-nets and seines. Its food consists of minute crustaceans and mollusks. It will very rarely take bait.

The lake-herring (which has no relation to the sea or river herrings) averages in weight about 9 or 10 ounces, frequents shoal waters, and is caught chiefly in pound-nets. It is very destructive to spawn, and especially that of the white-fish, feeding upon it by preference.

The sturgeon is the largest of the lake fishes, averaging little less than 5 feet in length and about 50 pounds in weight. It frequents the shoal waters of the lakes and their bays, and is generally caught in pound-nets. Its food is chiefly the various kinds of mollusks (but especially the thin-shelled ones) occurring in the stations which it frequents.

On the Pacific coast of the U. S. are numerous peculiar species. Among the most prominent of these are the species called rock-fishes (Scorpænidæ) and the so-called perches, under which name is confounded a number of viviparous fishes (Embiotocidæ). Other esteemed species are the turbot (*Platichthys stellatus*) and several species of flat-fishes, confounded under the name of sole; the so-called sea-bass (*Atractoscion nobilis*), which belongs to the family Sciænidæ, and the so-called sheepshead (*Pimelometopon pulcher*), belonging to the same family as the Eastern tautog or black-fish. There are also several species of smelts, representing the families Atherinidæ and Microstomidæ, and the cod of the San Francisco market (*Ophiodon elongatus*), which is in nowise related to our own codfishes, but belongs to a peculiar family (Chiridæ). The true codfish is not found in the Californian waters.

Statistics.—The statistics of American fisheries have been collected in a very unsatisfactory manner, and represent quite inadequately the facts respecting the different branches of industry and their relations *inter se.* This has been appreciated by none more clearly than by the superintendent of the late census (Gen. Francis Walker) and the present chief of the bureau of statistics (Hon. Edward Young); to the latter gentleman we are under great obligations for manuscript transcripts of tabulated statistics relating to our fisheries from the archives of his bureau; and from these we have selected the most significant for present publication. Reliable statistics respecting our lake fisheries have not yet been published, but with the consent of the U. S. commissioner of fisheries (Prof. S. F. Baird) we have been favored by the deputy commissioner (Mr. J. W. Milner) with statistics collected by him for publication in the forthcoming report of the commissioner; and the selection from them herewith published will give at least some idea of an industry which has grown into importance within a comparatively few years, and concerning which very little is exactly known even to the few specially interested in the subject.

Statistics of Product and Consumption of Fisheries in various countries, in order of values.

Countries	Value of Product.	Annual Consumption	Per capita.
Norway	$13,625,415	$1,000,000	$0.60
France	12,807,113	9,845,786	26
United States	8,898,196	8,777,955	25
Great Britain	7,803,870	9,429,431	32
Russia	5,745,000	8,659,568	11
Newfoundland	5,600,000	244,893	2.00
Nova Scotia	3,476,462	374,770	1.12
Holland	3,100,000	3,105,620	83
Italy	3,048,000	5,426,976	24
Spain	3,000,000	5,496,825	35
Japan	2,500,000	2,362,635	07
Austria	1,750,000	2,813,303	08
Siam	1,600,000	1,177,708	10
Canada	1,225,000	1,096,770	41
Denmark	1,100,000	1,027,991	38
German Zollverein	1,000,000	5,500,056	15
Sweden	1,000,000	3,126,449	76
Portugal	800,000	1,695,693	43
New Brunswick	500,000	192,570	76
Belgium	450,000	1,359,099	27
Prince Edward's Island	400,000	100,085	1.24
Greece	250,000	325,000	30
Total	$79,688,264	73,159,183	

Statement of Vessels of the U. S. Enrolled and Licensed in the Cod and Mackerel Fisheries during the fiscal years from June 30, 1854, to June 30, 1874, inclusive.

Fiscal Years 1854 to 1874, inclusive	Cod Fisheries	Mackerel Fisheries	Total.
	Tons	Tons	Tons
1854	111,928	35,041	146,969
1855	111,915	21,625	133,540
1856	102,452	29,887	132,339
1857	111,868	28,328	140,196
1858	119,252	29,594	148,846
1859	129,637	27,070	156,707
1860	136,653	26,111	162,764
1861	137,666	54,795	192,461
1862	123,601	80,596	204,197
1863	117,290	51,019	168,309
1864	103,742	55,499	159,241
1865	65,185	41,209	106,394
1866	51,642	46,589	98,231
1867	44,567	31,498	76,065
1868	83,887	....	83,887
1869	62,704	....	62,704
1870	91,460	....	91,460
1871	92,865	....	92,865
1872	97,547	....	97,547
1873	109,518	....	109,518
1874	78,290	....	78,290

Subsequent to the year 1867 the cod and mackerel fisheries are combined under the head "Cod Fisheries."

Domestic Exports of Fish from U. S. from 1854 to 1874, inclusive.

Years.	Dried or Smoked.		Pickled.			Preserved in oil.	Fresh.	Other cured
	cwt	dols	barrels	kegs.	dols.	dols.	dols.	dols.
1854	131,316	389,973	25,209	3,673	162,187			
1855	119,926	379,892	16,988	1,505	94,111			
1856	168,971	578,011	30,801	4,065	173,939			
1857	174,765	570,348	35,759	2,313	211,383			
1858	161,269	487,007	30,470	3,375	197,441			
1859	209,350	642,901	34,948	3,307	203,760			
1860	219,628	690,088	33,815	2,433	191,634			
1861	219,324	634,941	48,352	2,662	244,028			
1862	250,819	712,584	65,575	8,538	330,685			
1863	228,234	921,131	74,793	3,750	429,316			
1864	192,505	967,918	73,756	12,190	508,568	29,543		
1865	157,532	1,107,955	55,790	8,670	632,690	....	13,890	
1866	139,693	734,427	33,394	7,288	360,074	....	192,198	
1867	109,114	596,586	22,044	4,372	217,494	....	189,281	
1868	129,074	598,137	24,162	6,967	209,461	....	184,774	
1869	88,415	398,825	24,228	......	213,455	....	65,348	
1870	111,672	579,334	30,935	......	253,211	....	69,131	344,117
1871	119,618	592,598	29,653	......	226,369	....	39,983	440,412
1872	126,613	588,194	30,642	......	209,077	....	67,832	635,533
1873	118,076	569,151	16,747	......	109,201	....	64,577	677,171
1874	129,982	612,589	29,000	......	226,041	....	56,974	1,128,208

Imports of Fish from Canada and other British North American Provinces (free of duty), other than under the Reciprocity Treaty, for the half year to June 30, 1855, and the fiscal years ending June 30, 1856–66.

Years.	Dried or Smoked.		Pickled.		All other (in barrels).		All other (not in barrels).	
	bbls.	dols.	bbls.	dols.	bbls.	dols.	pounds.	dols.
½ year 1855	....	.....	1,058	5,582	....	....	256,892	6,211
1856	240,585	1,336,268	....	....	....	....	19,569,744	548,788
1857	226,064	1,162,933	....	....	....	....	13,289,717	470,416
1858	935,096	1,172,916	....	....	....	....	10,448,069	341,855
1859	[illegible]	1,328,969	....	....	....	....	15,244,423	422,505
1860	301,917	1,389,852	....	....	....	....	8,847,099	313,491
1861	202,876	945,603	....	....	....	....	13,577,887	415,201
1862	183,462	684,258	....	....	....	....	4,728,875	137,337
1863	131,132	483,631	....	....	....	....	4,872,954	144,305
1864	7,533	6,054	152,327	781,000	51,233	50,467	6,141,306	234,126
1865	9,789	18,787	241,412	1,510,257	45,691	71,782	3,914,007	197,932
fr. July 1, 1865, to Mar. 17, 1865, exp. of treaty.	....	28,784	....	1,527,352	....	28,062	....	326,715

Imports of Fish from Canada and British North American Provinces from Mar. 17, 1866, to June 30, 1874.

Years, 1866 to 1874	Mackerel, $2 per bbl.		Herring, $1 per bbl.		Salmon, $3 per bbl.		All other in bbls., $1.50 per bbl.		All not in bbls. sold by weight, 50 cts. per 100 lbs.		Fresh and cured, not of Am. fish	Others not otherwise specified	Total Duty.
	bbls.	dols.	bbls.	dols.	bbls.	dols.	bbls.	dols.	pounds.	dols.	dols.	dols.	dols.
1866	[illegible]	[illegible]	2,070	5,189	488	1,975	16,392	29,697	1,051,190	26,[illegible]	....	....	43,997.95
1867	77,503	675,986	97,595	321,404	6,216	125,323	24,629	152,688	6,505,942	197,686	....	....	308,192.57
1868	41,[illegible]	354,429	54,301	181,[illegible]	6,513	90,090	14,188	64,912	7,788,017	230,201	est. duty	....	216,372.00
1869	......	....	......	....	......	....	......	....	....	....	1,117,757	....	257,084.00
1870	......	....	......	....	......	....	......	....	....	....	1,169,407	....	268,964.00
1871	......	....	......	....	......	....	......	....	....	....	1,201,175	....	276,270.00
1872	77,731	438,110	64,200	225,144	......	....	......	....	....	....	....	355,761	240,493.00
1873	89,698	605,778	53,039	179,377	......	....	......	....	....	....	278,687	‡278,687	
1874	89,693	[illegible]	63,931	†229,522	......	....	......	....	....	...	850,537	§48,939	

Statistics of the Number of Pounds of Lake Fishes received by First Handlers for the year 1872.

Place.	Hard fish.	Mixed fish.	Soft fish.	Lake herring.	Sturgeon.	Salt fish.
Rochester, N. Y.	11,725	78,000				
Buffalo, N. Y.	1,471,028	....	656,530	....	....	3,008,000
Erie, Pa.	193,146					
Conneaut, O.	187,498					
Ashtabula, O.	27,820					
Cleveland, O.	1,016,843	....	54,460	98,207	....	1,750,000
Sandusky, O.	1,646,315	394,405	501,046	1,560,249	720,500	
Put-in-Bay, O.	85,000	....	12,000	146,600		
Huron, O.	197,891	....	76,603	913,252		
Toledo, O.	1,263,095	....	883,505	1,080,400		
Detroit, Mich.	2,346,100	....	160,880	21,000	....	1,800,000
Mackinaw, Mich.	471,468	....	25,000	135,240		
Green Bay, Wis.	....	662,000				
Milwaukee, Wis.	....	....	....	....	....	852,300
Chicago, Ill.	4,712,198	18,800	17,784	167,673	25,147	2,519,500
In the hulls of vessels frozen in on Lake Superior	....	....	....	....	....	270,000
Total	13,630,427	1,153,205	2,387,808	4,122,621	745,647	10,199,800

The two ports handling the largest amounts of fish are Chicago and Buffalo, as shown in the following table:

Place.	Hard fish.	Mixed fish.	Soft fish.	Lake herring.	Sturgeon.	Salt fish.	Total.	Value.
Buffalo, N. Y.	2,428,750	....	937,350	....	....	3,008,000	6,374,100	$333,625.08
Chicago, Ill.	4,712,198	18,800	17,784	167,673	25,147	2,519,500	7,461,104	414,717.50

The fishes in the preceding tables are classified according to the system adopted at Sandusky, Toledo, and Cleveland. Under this system the marketable fishes are divisible into several classes: (1) "hard fish," including the wall-eyed pike or pickerel (*Stizostedion Americanum*), the black bass (*Micropterus nigricans*), the Oswego bass (*Micropterus salmoides*), the lake pike (*Esox lucius*), the muskellunge (*Esox nobilior*), the salmon trout (*Salmo namaycush*), the white fish (*Coregonus albus*), and the skinned cat fishes, selling for the highest prices in the market; (2) "soft fish," under which are comprised the sauger (*Stizostedion griseum*), the white bass (*Roccus chrysops*), the suckers (*Catostomus teres*, *Catostomus aureolus*, and *Catostomus melanops*), and the carp (*Carpiodes cyprinus*); (3) "mixed fish" includes both kinds, and several species are kept independent of these categories. All quantities exchanged between the places named, after being recorded for their original market, are deducted from the receipts of the subsequent one, and hence arises the difference in the several tables for Buffalo. The figures opposite Sandusky include both the fresh and salt fish; those for Mackinaw, Green Bay, and Milwaukee are incomplete. The sum total of this record is 32,239,508 pounds of fish, and their value was about $1,600,000. The manufacture of caviare from the roe of the lake sturgeon is an accessory industry of importance recently introduced into the U. S.

With the figures in these tables may be compared those for 1873 of the Canadian province of Ontario. The Canadian cabinet has a minister of fisheries and marine, and the statistics in the Dominion are collected much more systematically and thoroughly than in the U. S.; and those here given will afford some idea of the relative proportions of the several species taken in the lakes. The orthography of the names is that used in the official reports.

Kinds, Quantities, and Prices (in coin) of Fish.

	Barrels.	Pounds.	Number.	Value. Fresh.	Value. Pickled.	Total Value.
White-fish	16,453			$		$
"	...	1,430,514				
"			[illegible]			
Trout	9,188					
Herring	7,[illegible]					
Siscowet	288					
Maskinonge	113					
Bass	731					
Pike	1,248					
Pickerel	1,055					
Coarse fish	2,806					
Total	[illegible]	1,430,514	43,586	253,505	69,585	[illegible]

A barrel of fish is equal to about 200 pounds.

*Of this free of duty, 89,50[illegible] barrels; value $[illegible]. † 51,123 barrels; value $181,721. ‡ Of these sardines and anchovies preserved in oil or otherwise, dutiable, value, $[illegible]. § Sardines, etc., $125.

Investment in Fishing stocks on Lake Michigan in 1871.

281 pound-nets, average value, $500	$140,500
102 gill-nets, "heavy rigs," average value, $725	73,950
348 gill-nets, "light rigs," average value, $225	78,300
98 boats, average value $500	49,000
348 Mackinaw boats, average value, $100	34,800
143 pound-net boats, average value $50	7,150
100 anchor-boats, average value $25	2,500
4 steam fishing-boats, average value, $1800	7,200
1 schooner	3,000
500 shanties, average value $50	25,000
100 ice-houses, average value $100	10,000
Total of fishing investment	$431,400

The current working capital employed in the fisheries, omitting wages and including packages, inspection, salt, ice, freightage, and repairs, is a large sum of money—probably as much as $150,000. (See WHALE FISHERY, PRECIOUS STONES, DIVERS, SEAL FISHERIES, SALMON FISHERIES, MENHADEN, and the names of the principal species of fishes.) THEODORE GILL.

Fish'erman's Ring (*annulus piscatoris*), a seal ring worn by the pope, who with it seals certain briefs, which are said to be "given under the fisherman's ring." It bears a figure representing Saint Peter fishing, and is borne by the popes as Saint Peter's successors. It has been employed since the thirteenth century.

Fish'ersburg, post-v. of Stony Creek tp., Madison co., Ind. Pop. 96.

Fish'er's Grant, in the tp. and co. of Pictou, N. S., is the N. terminus of the Nova Scotia Railway. It is on Pictou Harbor, and is connected with Pictou, 2 miles distant, by a ferry. Pop. about 300.

Fisher's Island, an island of Long Island Sound, lying near the Connecticut shore, but belonging to Southold tp., Suffolk co., N. Y., is 7 miles long and $1\frac{1}{2}$ miles broad. Area, 4000 acres.

Fish'ersville, post-v. of Merrimack co., N. H., constituting the first ward of the city of Concord (which see), is on the Merrimack River and on the Northern R. R., 7 miles N. of the main part of Concord. It has two churches, an academy, woollen and cotton mills, and considerable local trade. Pop. 1439.

Fish'ery, Law of. The rules of the English common law regulating the subject of fisheries are of a twofold variety, since navigable waters—by which is meant, in legal usage, those in which the tide ebbs and flows—are distinguished, as regards the right to fish, from those which are not navigable. In streams above the reach of the tidal flow the soil to the centre of the river-bed belongs to the riparian proprietors upon the opposite banks (see FILUM AQUÆ), and each of them possesses an exclusive right of fishery in that half of the stream over which his independent ownership exists. If the land upon both sides is vested in the same person, his fishing privilege pertains to the whole width of the river as far as the boundaries of his property along the course of the river may extend. But this exclusive right must be exercised so as not to interfere with the public convenience in passing along the stream in boats or rafts, and no dams or other obstructions can be made which would prevent the free passage of the fish, unless such privilege be given by statute. In navigable or tide waters, on the contrary, the soil is vested in the sovereign, and the right of fishery is common to the entire public. A special or exclusive privilege can only be created by legislative grant or by prescription, which must be clearly proved. This, however, is very unusual. This right of all persons to fish in public waters is called a *common fishery*. When several have a right to fish in a private stream in derogation of the owner of the soil, it is termed a *common of fishery* or *of piscary*. The designation *free fishery* is applied to an exclusive right in a navigable river arising by grant or prescription, without any right in the soil, while the term *several fishery* is employed when, in connection with such an exclusive grant, a property in the soil is also given. These various terms are, however, often employed without precision of meaning.

The doctrines of the English law concerning fisheries have been generally adopted in the U. S. In some few States, however, the common right of the public to take fish has been extended to streams ordinarily considered private, being above the flow of the tide. Thus, in Pennsylvania and North and South Carolina it is declared that the great rivers of those States, even above tide-water limits, are subject to no exclusive privileges, but open to the general public. The regulation of fisheries by statutory provisions is very general, particularly in recent years, when such great attention is given to the breeding of choice varieties of fish and the stocking of lakes and rivers. The modes and times of taking fish are often thus appointed, and penalties imposed for any violation of the restrictions created.

In the absence of any special statutory prohibition, it is supposed the inhabitants of one State may exercise the same right of fishing in the waters of another as the citizens of the latter possess. But the important question has come before a few of the courts for adjudication, whether, if any State imposes upon the citizens of other States restrictions in regard to the power of fishing within its limits which are not imposed upon its own citizens, that clause of the U. S. Constitution is not violated which provides that "the citizens of each State shall be entitled to all the privileges and immunities of citizens in the several States." Some decisions have held that the right of fishing is in the nature of a right of property incident to the right of territory, and that the legislation of any State appropriating it to the use of the citizens of that State, either exclusively or with the grant of peculiar privileges, would therefore not be unconstitutional. But this reasoning has been impugned, and the question needs further adjudication before the law upon it can be considered as completely settled. (Consult *Corfield* v. *Coryell*, 4 Washington Circuit Court Reports, 380; *Bennett* v. *Boggs*, Baldwin's Reports, 60; *The State* v. *Medbury*, 3 Rhode Island Reports, 138; *Dunham* v. *Lamphere*, 3 Gray's Reports, 276.)

The U. S. government at an early period adopted important measures of legislation to promote cod-fishing along the coast, providing for the payment of bounties to those persons who would engage in the business. Thus, a law was passed in 1819 establishing the following bounties, which continued to be paid annually until the year 1866 to the owners of all vessels employed in the cod-fisheries for at least four months in the fishing season: For vessels between five and thirty tons, $3.50 per ton; for those above thirty tons, $4 per ton, except that the allowance to any vessel was not to exceed $360. But in 1866 fishing-bounties were abolished, and the only privilege now granted to the cod-fishermen is that duties shall be remitted on imported salt in bond which they take on board for curing purposes.

In the prosecution of the cod, mackerel, and other fisheries along the coast of Newfoundland and the other British possessions much hostility was created between British and American fishermen on account of the practices of the latter in fishing unlawfully in bays and inlets, and in drying and curing their fish upon British shores. The high seas are free and open to all nations, and people of any nationality may fish therein without restriction, but this right ceases at the mouths of rivers and in bays and harbors along the coast of any country. Foreigners can acquire a privilege to catch fish in places of this kind only by grant of the state or sovereign. At one time the colonial authorities used force to drive away American fishermen from the Newfoundland and Canadian coasts. In order to remedy these difficulties, various treaties have from time to time been negotiated between the U. S. and Great Britain granting certain privileges reciprocally to the inhabitants of either country. The treaty-regulations now (1874) in force are those agreed upon by the Alabama Claims Commission in 1871. (For the provisions of this treaty, see the article FISHERIES, by PRES. T. D. WOOLSEY, S. T. D., LL.D.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fish-glue, a species of isinglass not sufficiently refined for culinary and medicinal purposes, but suitable for making cements, etc. It is prepared from the offal of the fisheries, and sometimes has a strong fishy odor.

Fish-Hawk, the common American name of the *Pandion haliaetus*, a raptorial bird of the family Falconidæ, inhabiting a large part of North America, and identical with the osprey of the Old World (*Pandion haliaetus*). It subsists upon fish alone, and takes its prey by plunging from a considerable height into the water. It nests upon a tall tree near the water, and constructs its large nest of sticks and weeds. It is often robbed of its prey by the bald eagle while flying from the scene of capture.

Fish-hook, a curved, barbed, and pointed steel wire used in angling and the fisheries. The most famous seats of the fish-hook manufacture are Limerick in Ireland and Redditch, Worcestershire, England, but fish-hooks of the best quality are made in the U. S., not inferior to those of Limerick except in reputation and cost. The Limerick hook has a barb which is forged solid and then filed into the proper shape, while the English and other ordinary hooks have a barb which is raised by cutting into the wire. These are inferior in temper and durability to the best hooks.

Fish'ing Creek, tp. of Granville co., N. C. Pop. 2413.

Fishing Creek, tp. of Warren co., N. C. Pop. 1598.

Fishing Creek, tp. of Wilkes co., N. C. Pop. 912.

Fishing Creek, post-tp. of Columbia co., Pa. P. 1372.

Fishing Frog. See ANGLER.

Fishing River, tp. of Clay co., Mo. Pop. 2798.

Fishing River, tp. of Ray co., Mo. Pop. [illegible].

Fish'kill, post-tp. of Dutchess co., N. Y., on the E. bank of the Hudson River. The Fishkill Mountains are in the S. part. The Fishkill River intersects the town, which has important manufacturing, agricultural, and commercial interests. It contains several churches and numerous thriving villages, of which the most important are the following: 1. FISHKILL, post-v. on the Dutchess and Columbia division of the New York Boston and Montreal R. R., 5 miles from the Hudson River. It has a national and savings bank, a weekly newspaper, a machine-shop, four churches, and a number of stores. Pop. 755.—2. FISHKILL ON THE HUDSON, or FISHKILL LANDING, a beautiful post-v. on the Hudson River and the Hudson River R. R., 58 miles from New York, is the S. W. terminus of the Dutchess and Columbia division of the New York Boston and Montreal R. R. It has a national and a savings bank, four churches, a machine-shop, two newspapers, an armory, and many fine residences. It has a steam-ferry running to Newburg. Pop. 2662.—3. The villages of Matteawan, Glenham, Wappinger's Falls, and many others belong to this township. The more important are noticed under their alphabetical heads. Pop. of tp. 11,752. G. W. OWEN, ED. "JOURNAL."

Fish Lake, tp. of Chisago co., Minn. Pop. 385.

Fish-Louse, a name applied to numerous parasites (generally entomostracous crustaceans) which infest fishes and whales. They are of the genera *Argulus*, *Caligus*, [illegible], *Dichelestium*, [illegible], [illegible], [illegible], [illegible], *Anchorella*, [illegible], [illegible], [illegible], [illegible], and many others; some of them are the most degraded forms now known of the crustacean type. To the above may be added certain parasitic cirripeds which in structure and habit are properly associated with the fish-lice.

Fish Oil, the oil of the menhaden or moss-bunker (*Alosa menhaden*) and of other fishes, which, not being marketable, are caught in large quantities for their oil on the Atlantic coast of the U. S. The refuse is dried and sold as "fish guano," and is a valuable fertilizer. The oil is used in dressing leather and in adulterating the higher-priced oils. Similar products are manufactured in Norway.

Fish Pond, tp. of Barnwell co., S. C. Pop. 1120.

Fish-skin, in mechanical arts. See SHAGREEN.

Fisk (FRANKLIN WOODBURY), D. D., b. at Hopkinton, N. H., Feb. 16, 1820; graduated at Yale in 1849, and at Yale Divinity School in 1852; was tutor in Yale College 1851–53; professor of rhetoric and belles-lettres in Beloit College 1854–59; was ordained at Chicago in 1859; and in the same year became professor of sacred rhetoric in the theological seminary of Chicago.

Fisk (JAMES), b. 1762, was a lawyer, and represented Vermont in the U. S. Congress from 1805 to 1809 and from 1811 to 1815; in 1815–16 was a judge of the supreme court of Vermont; then U. S. Senator from Vermont in 1817–18; afterwards, for eight years, collector of customs in the district of Vermont. D. at Swanton, Vt., Dec. 1, 1844.

Fisk (JAMES), JR., b. at Pownal, Vt., Apr. 1, 1834, was a peddler in early life, but became a clerk and then partner in Jordan, Marsh & Co.'s dry-goods store in Boston, Mass. Removing to New York, he became a banker and vice-president of the Erie Railway, colonel of the Ninth regiment N. Y. S. M., and was assassinated by Edward S. Stokes Jan. 6, 1872.

Fisk (Rev. WILBUR), D. D., a son of Judge Fisk, was b. in Brattleborough, Vt., Aug. 31, 1792. Joined in 1812 the sophomore class in the University of Vermont, but spent his senior year at Brown University, where he graduated with high honor in 1815. Entering with great zeal upon the study of the law, he was arrested in his course by what threatened to be a fatal illness, and in 1818 was licensed as a local preacher in the Methodist Episcopal Church. He soon took high rank as a pulpit orator. Was appointed in [illegible] principal of the Wesleyan Academy, Wilbraham, Mass., removing thither in 1826; in 1830 was chosen first president of the Wesleyan University, Middletown, Conn., and entered upon the duties of this office in 1831. Poor health compelled him to visit Europe in 1835–36. D. at Middletown Feb. 22, 1839. He was a man of the Fénelon type of character. Published *Calvinistic Controversy* (1837), *Travels in Europe* (1838), *Sermons and Lectures on Universalism*, *Reply to Pierpont on the Atonement*, and other tracts and sermons. (See his *Life*, by Rev. JOSEPH HOLDICH, D. D., 1842.) R. D. HITCHCOCK.

Fisk'dale, thriving post-v. and manufacturing place in Sturbridge tp., Worcester co., Mass., on the Quinebaug River.

Fiske (Miss FIDELIA), a niece of Pliny Fiske, noticed below, b. at Shelburne, Mass., May 1, 1816. Graduating at Mount Holyoke Female Seminary in 1839, and subsequently a teacher there, she was brought into close contact with Miss Mary Lyon, and imbibed much of her spirit. In 1843 she went as a missionary to the Nestorians in Persia, and was the first principal of the female seminary at Oroomiah. In 1858, after fifteen years of service, she returned to America with broken health, and d. at Shelburne July 26, 1864. Her *Life*, under the title *Faith Working by Love*, by the Rev. Daniel T. Fiske, D. D., was published in 1868. R. D. HITCHCOCK.

Fiske (JOHN), American sea-captain in the Revolutionary war, b. at Salem, Mass., Apr. 10, 1744, was captain of the Tyrannicide, the first war-vessel commissioned by the State of Massachusetts, July 8, 1776, and in her had many sanguinary conflicts. Dec. 10, 1777, he commanded the State ship Massachusetts; after the war he engaged in commerce, and was made major-general of militia in 1792. D. at Salem, Mass., Sept. 28, 1797.

Fiske (JOHN), M. A., LL.B., b. in Hartford, Conn., Mar. 30, 1842; graduated at Harvard in 1863. Author of *Tobacco and Alcohol* (1868), *Myths and Myth-makers* (1872), *Outlines of Cosmic Philosophy* (1874), *The Unseen World* (1876), etc. Lecturer on philosophy, 1869–71; instructor in history, 1870, and assistant librarian at Harvard. Member of American Oriental Society, 1867.

Fiske (Rev. NATHAN WELBY), b. in Weston, Mass., Apr. 17, 1798; graduated at Dartmouth in 1817, in the same class with President James Marsh of Burlington, Vt.; was tutor from 1818 to 1820; graduated at Andover Theological Seminary in 1823, and was professor in Amherst College (first of Greek and Latin, and then of intellectual and moral philosophy) from 1824 to 1847. Was a critical linguist, an acute metaphysician, and a pungent preacher. His chief literary work was a translation (with large additions) of Eschenburg's *Classical Manual*, first published in 1836, and finally stereotyped in 1843. A posthumous volume of *Discourses*, with a memoir by Dr. Heman Humphrey, was published in 1850. D. in Jerusalem May 27, 1847, and was buried on Mt. Sion. He was the father of Mrs. Helen Hunt, known to the public as "H. H." R. D. HITCHCOCK.

Fiske (Rev. PLINY), a descendant of William Fiske of Suffolk, England, who came to Salem, Mass., in 1637, and shortly after removed to Wenham. In 1761, Ebenezer Fiske, the grandfather of Pliny, settled in Shelburne, Mass., where Pliny was b. June 24, 1792; graduated at Middlebury College in 1814, and at Andover Theological Seminary in 1818, in the same class with his biographer, Dr. Alvan Bond, and the veteran missionaries, Dr. Levi Spaulding and Dr. Miron Winslow. On Nov. 3, 1819, he sailed from Boston, in company with the Rev. Levi Parsons, to establish a mission under the care of the American Board in Palestine. Landed at Smyrna Jan. 15, 1820, and was afterwards at Scio, at Alexandria, where Mr. Parsons died, at Malta, and at Damascus, studying the modern Greek and Arabic languages. Prepared at length for his work, he went to Beyroot in May, 1825, and d. there, greatly lamented, Oct. 23, 1825. (See his *Life*, by ALVAN BOND, 1828; and SPRAGUE'S *Annals*, ii. 622.) R. D. HITCHCOCK.

Fiske (Rev. SAMUEL), a relative of Pliny Fiske, noticed above, b. in Shelburne, Mass., July 23, 1828; graduated at Amherst in 1848; was in Andover Theological Seminary from 1850 to 1852; was tutor at Amherst from 1852 to 1855, then travelled a year in Europe and the East; was settled over the Congregational church in Madison, Conn., in 1857; entered the Federal army as a private in the Fourteenth Connecticut regiment in 1862; became captain, distinguished himself in several battles, and fell at the head of his company on the second day of the bloody battle of the Wilderness May 6, 1864, dying in the hospital at Fredericksburg May 22. He was a man of rare genius and force of character. His letters from Europe and the East, first published in the *Springfield Republican* under the nom de plume of "Mr. Dunn Browne," appeared in a volume in 1857. His *Experiences in the Army*, under the same assumed name, appeared in 1866. Prof. W. S. Tyler's discourse, preached at the funeral, was an admirable tribute to his memory. (See also *The Congregational Quarterly*, Jan., 1866, and the *New Englander*, [illegible].)

R. D. HITCHCOCK.

Fis'tula [Lat., a "pipe"], a term used in pathology to designate an abnormal canal, usually of small length and diameter, leading from one organ to another (vesico-vaginal fistula), or from some cavity of the body to the external world (gastric fistula, fistula in ano).

Fistulæ are (1) complete, when it has two openings; (2) [illegible], when it has but one; (3) external, when the opening is through the skin; (4) internal, when the opening is [illegible]. The [illegible]

prominent characteristics of a fistula are the constant discharge from it of a thin purulent fluid, with which the secretions of the organ affected are mixed, and the obstinacy with which it resists the healing process. This latter results from the nature of the wall of the fistula, which in recent cases is formed of soft, unhealthy granulation-cells which have no tendency to unite to form either cicatrix or cuticle. In older cases the walls consist principally of condensed connective tissue, inseparable from the surrounding parts. A fistula of long standing also exerts a change in the tissues through which it passes, these becoming more dense, and finally indurated, and the integument around its orifice callous and sometimes warty.

Fistula is caused (1) by wounds which penetrate passages giving natural exit to the secretions, or those which follow a long and deviating course through many tissues; (2) by ulceration and the sloughing process; (3) by abscess. The last is the most frequent cause.

The passage of a bullet through any region of the body sometimes leaves a canal which fails to unite; and whenever a necrosis of bone occurs there are usually one or more tracks following a winding course from it to the outside of the body. These passages are often called fistulæ, but the more appropriate name for them is *sinus*.

Fistula commonly occurs in persons of an enfeebled constitution. Where it results from abscess it is more frequently the chronic than acute form which gives rise to it. Fistulæ were formerly supposed to furnish exit for morbid humors, and surgeons hesitated to attempt their cure. At the present time some surgeons refuse to operate on a fistula in ano in a patient having phthisis.

The cure of fistula depends upon producing union of its walls through the agency of healthy granulation-cells. This may be brought about by stimulating applications, as the injection of nitrate of silver, corrosive sublimate, etc. in solution, or the application of the red-hot iron. Where the walls are old and indurated, it is necessary to dissect them out and remove them altogether, bringing the lips of the wound together by sutures. The most common treatment consists in laying the fistula and soft parts above it freely open by an incision, and keeping the orifices of the wound apart, so that it may slowly heal by granulation from the bottom. There are other modes of cure, but they are less serviceable than the above, or else only applicable to special cases. G. H. WYNKOOP.

Fistula, in horses, is the farrier's name for a deep-seated chronic abscess, usually situated upon the withers, and discharging pus through fistulous pipes or sinuses. When seated upon the top of the head it is called poll-evil. Blows and strains of the tendon of the nape are the most fruitful causes of the disease, which most frequently attacks old or ill-kept animals. The thorough application of hot caustic solutions is often curative; but sometimes it is well to lay open the sinuses and retrench unhealthy masses of granulation-cells.

Fit, a term employed by Newton in accounting theoretically, upon the corpuscular theory of light, for certain phenomena of refraction and reflection at the surfaces of transparent bodies. The term is meant to denote the periodical alternations of condition in the corpuscle, disposing it to be reflected or refracted. (See THIN PLATES, COLORS OF.)

Fit. See CONVULSION, APOPLEXY, and EPILEPSY.

Fitch, the commercial name of the fur of the European polecat (*Putorius fœtidus*). It is collected in Northern Europe, and though in general inferior in quality to the fur of martens and sables, it is very handsome and serviceable, and when it is in fashion brings a good price. The animal which affords it is often called *fitchet*. (See POLECAT.)

Fitch. See VETCH.

Fitch (CHARLES ELLIOTT), an American journalist, b. in Syracuse, N. Y., Dec. 3, 1835; graduated at Williams College in 1855, and at the Albany Law School in 1857; was admitted to the bar in Syracuse, and practised law till 1866, when he assumed editorial charge of the *Syracuse Daily Standard*, where he remained till 1873, when he became managing editor of the *Rochester Democrat and Chronicle*. J. B. BISHOP.

Fitch (EBENEZER), D. D., b. at Norwich, Conn., Sept. 26, 1756; graduated at Yale College, New Haven, Conn., 1777; was tutor there 1780–83 and 1786–91; Oct., 1791, was principal of the Williamstown (Mass.) school, until its erection as a college; then its president from Aug., 1793, to May, 1815. Having been ordained as a minister in June, 1795, he was subsequently pastor of the Presbyterian church in Bloomfield, N. Y., from Nov. 29, 1815, to Nov. 25, 1827. D. at West Bloomfield, N. Y., Mar. 21, 1833.

Fitch (ELEAZAR THOMPSON), D. D., b. at New Haven, Conn., Jan. 1, 1791; graduated at Yale College in 1810; was Livingston professor of divinity in the theological department of Yale College 1817–52; author of theological reviews and articles for periodicals. A volume of his sermons has been published since his death. D. Jan. 31, 1871.

Fitch (ELIJAH), A. M., b. 1745; graduated at Yale College 1765; was Congregational minister in Hopkinton, Mass., from 1771 until his death Dec. 16, 1788. The *Beauties of Religion, addressed to Youth*, poem in five books, and *The Choice*, short poem (Providence, 1789), were his productions.

Fitch (JAMES), b. at Bocking, Essex co., England, Dec. 24, 1622, came to New England when sixteen years of age; studied seven years under Hooker and Stone, and was pastor at Saybrook, Conn., 1646–60, and then at Norwich, where he was the first settled minister. He preached to the Mohegan Indians in their own tongue, and wrote *First Principles of the Doctrine of Christ* (Boston, 1679), etc. D. at Lebanon, Conn., Nov. 18, 1702.

Fitch (JOHN), b. in Windsor, Conn., Jan. 21, 1743. His education was limited, but included the rudiments of surveying, subsequently of great service to him. After an apprenticeship at clockmaking he established a brass-foundry, and subsequently engaged in the manufacture of potash. In his twenty-sixth year he established himself at Trenton, N. J., as a silversmith. During the early part of the Revolution he had large contracts for the repair of arms, but when the British army entered Trenton his shop and its contents were burned. He served as lieutenant in the New Jersey volunteers, and afterwards resumed the business of repairing arms. Having accumulated about $4000 in Continental money, he procured an appointment as deputy surveyor for Virginia, sold his paper money for $100 in silver, and started for the Western wilderness. After suffering many hardships, he reached the place of destination and commenced his surveys. In 1781 he returned the owner of 1600 acres in the valley of Salt River, and spent some time in Philadelphia. In 1782 he raised a party of ten emigrants, and again started for the West. Having purchased a cargo of flour and groceries, he proceeded to the mouth of the Muskingum, where the party were attacked by Indians. Two of the number were murdered, and the remaining nine, including Fitch, were carried into captivity. After suffering great hardships and travelling with different tribes more than 1200 miles, in the mean time gathering information regarding the locality of lakes and rivers, he was purchased by a British officer at Detroit, became a prisoner of war, and was released at Montreal. Several years after his return he engraved on wood a rude map of the vast country through which he had passed, and worked off impressions of it by means of a cider-press at Warminster in Berks co., Pa.

The happy thought of propelling vessels by steam, he says, originated with him in 1784. He rapidly matured his plans, and in Aug., 1785, he petitioned Congress for aid in constructing his boat. In his statement before a committee appointed by the assembly of Pennsylvania he averred that he had seven different plans and four different models of steamboats. The records of the American Philosophical Society of Philadelphia show that "a model, accompanied by a drawing and description of a machine for working a boat against a stream by means of a steam-engine, was laid before the society by John Fitch on Sept. 27, 1785." With the pecuniary assistance of several gentlemen, Fitch immediately undertook to build a steamboat. In the *Columbia Magazine* for Dec., 1786, he gave a description of this vessel and its machinery. A steam cylinder over three feet long and one foot in diameter was placed horizontally in the bottom of the boat; the steam was let in at each end of the cylinder alternately, and after moving a reciprocating piston was discharged into a condenser, which formed a vacuum in the cylinder behind the moving piston. The force of the piston was transmitted to cranks on each side of the boat; which, by means of connecting bars, moved twelve paddles, three on each side being in the water and three out at the same time. The engine of Fitch was the first double-acting condensing engine, transmitting power by means of cranks, ever constructed; for although Watt had proposed to apply to his pumping-engine the double-acting piston devised by Delahire and used in his pump, the manner of its application being set forth by Watt in his patent of 1782, yet he did not construct a steam-engine producing a rotary motion and applicable to general use until several years later; and many years elapsed before he could lawfully employ the crank in connection therewith.

On May 1, 1787, Fitch's steamboat, The Perseverance, was put in motion on the Delaware River, and made three miles per hour. This speed did not satisfy Fitch, and various improvements were soon added, among which were a boiler and a condenser, both made of spiral pipes invented

by Henry Voight. A new cylinder, eighteen inches in diameter, was also constructed. The steamboat, with its greatly increased power, was successfully tested in the fall of 1788. The late Dr. Thornton, long at the head of the U. S. patent-office, and many other prominent men, certified that the steamer moved in dead water at the rate of 8 miles an hour, or 1 mile in 7½ minutes. With thirty passengers the vessel left Philadelphia and, moving against the current of the Delaware, reached Burlington, a distance of 20 miles, in 3 hours and 10 minutes. Dr. Thornton stated that the Perseverance afterwards made 80 miles in one day. This speed will excite wonder when the difficulty of keeping the piston tight against the comparatively rough interior surface of the cylinder is taken into consideration. The steamboat was run for some time as a packet to Burlington, but after several mishaps it was burned.

Fitch was sent to France by the steamboat company, under the auspices of Consul Aaron Vail, who was anxious to have a steamboat built in that country; but finding all the machinists engaged on government work, Mr. Vail furnished Fitch with means to return to his native country. He crossed the British Channel, and during his stay in London, in 1793, he published his pamphlet entitled *An Explanation for Keeping a Ship's Traverse at Sea by the Columbian Ready Reckoner*. He remained in London until his funds were exhausted, then secured a passage on a homeward bound vessel, and landed at Boston in 1794 in a state of destitution. From that time to 1796 he resided with his brother in law at Sharon, Conn. In the *Documentary History of New York*, vol. ii. p. 585, will be found an interesting account of experiments subsequently made by Fitch in propelling a small boat by steam on the Collect Pond, formerly existing in the lower part of the city of New York. This boat was arranged with side wheels, and a screw propeller at the stern. In 1797, Fitch went to Kentucky to obtain possession of lands he had purchased while surveying there. Soon after taking up his residence in Nelson county, his health began to decline, and he died at Bardstown, Ky., July 2, 1798.

The career of Fitch was filled with thrilling adventures. It commenced amid the political troubles which culminated in the Revolution, and it terminated before his country had fully recovered from the shock of war. The failure of the inventor of the steamboat to realize his most sanguine hopes was chiefly due to a want of mechanical facilities for carrying into effect plans which, when subsequently modified and perfected by his ingenious countrymen Fulton and Stevens, proved to be not only feasible, but of inestimable value. SAMUEL D. TILLMAN.

Fitch (LE ROY), U. S. N., b. Oct. 1, 1835, in Indiana; graduated at the Naval Academy in 1856; became a master in 1859, a lieutenant in 1861, a lieutenant-commander in 1862, a commander in 1870; served on the Mississippi River from 1861 to 1865, during which period he was noted for his sound judgment, enterprise, and gallantry. Participated in the capture of Forts Donelson and Pillow, the reduction of Island No. 10, and the victory over the Confederate fleet at Memphis, Tenn.; and as commander of a division of gunboats was engaged in many brilliant operations, the conduct of which gained him the admiration of both the army and the navy. On July 27, 1863, Hon. Gideon Welles, secretary of the navy, addressed to him the following complimentary letter: "SIR: Since your attachment to the Mississippi squadron it has been gratifying to the department to observe the commendable zeal (as shown by reports to it) displayed by you in the execution of the duties with which you were entrusted. In affording convoy on the Tennessee and Cumberland rivers, in punishing and dispersing the guerilla bands which infested the banks of those streams, and in your timely and important assistance to the garrison at Fort Donelson when attacked on the 3d of February last by the forces under Gen. Wheeler and others, you have acted with promptness, and reflected credit on the naval service. Your recent pursuit of the flying guerilla Morgan—following him upwards of 500 miles, intercepting him, and frustrating him in his attempt to recross the Ohio, capturing his train, a portion of his guns, and routing his band—all of which materially crippled his strength and led to his final capture—gives additional evidence of your zeal and ability, and reflects additional credit on the service and yourself." D. Apr. 14, 1875. FOXHALL A. PARKER.

Fitch (THOMAS), governor of Connecticut from 1754 to 1766, b. in Connecticut 1699; graduated at Yale College 1721; practised law and filled the offices of counsellor, judge of the supreme court, chief justice (1750–54), lieutenant governor and governor. In 1766 was driven into retirement for having taken the oath of office prescribed in the Stamp Act in 1765, and d. July 18, 1774.

Fitch'burg, city, one of the capitals of Worcester co., Mass., on a branch of the Nashua River and at the junction of the Fitchburg, Cheshire, Fitchburg and Worcester, Boston Clinton and Fitchburg, and Vermont and Massachusetts R. Rs. It has 10 churches, 2 national and 2 savings banks, mutual fire insurance company, a public library, a county court-house, a county jail, 1 daily and 2 weekly newspapers, and manufactures of paper, chairs, machinery, woollen goods, rattan, etc. The annual product of the first four branches of industry amounts to $4,600,000. There are eighteen corporate companies in the city, with an aggregate capital of about $2,000,000. It has a paid fire department with electric fire-alarm telegraph, and an excellent system of water-works. Pop. 11,260.

J. E. KELLOGG, ED. "DAILY SENTINEL."

Fitchburg, post-tp. of Dane co., Wis. Pop. 1152.

Fitch'ville, post-tp. of Huron co., O. Pop. 795.

Fitz (HENRY), American telescope-maker, b. in Newburyport, Mass., 1808, was a printer and then a locksmith, but in 1835 made a reflecting telescope, and in 1844 invented a method of perfecting object-glasses for refracting telescopes, making the first one from the bottom of an ordinary tumbler. He finally made an instrument of 16-inch aperture, his telescopes having come to notice through the fair of the American Institute at New York in 1845. His instruments were so delicate that the change in the form of the object-glass by expansion, caused by passing the finger over it in a frosty night, could be detected. He was about visiting Europe to select a glass for a 24-inch telescope, and to take patents for a camera involving a new form of lenses, but d. in New York City Nov. 6, 1863.

Fitz'gerald (AUGUSTUS FREDERICK), third duke of Leinster, b. in London Aug. 21, 1791, succeeded to the title on the death of his father in 1804, and took his seat in the House of Lords; in 1831 was appointed lord lieutenant of the county Clare in Ireland and member of the queen's privy council. Was the grand master of the order of Freemasons in Ireland. For many years he was the sole Irish duke, and he also held the rank of first marquis and first earl among the Irish nobility. In politics he was a Liberal, but conservative on the question of a repeal of the union with England. In 1818 the duke married the daughter of the earl of Harrington. Four children resulted from the marriage, of whom the eldest, known as the marquis of Kildare, succeeded to the ducal honors of his father. D. at London Oct. 10, 1874.

The Fitzgerald family of Ireland is a very ancient Anglo-Norman one, long thoroughly Hibernianized, and the late duke was a descendant of the barons of Offaly, first ennobled in 1205. In 1747 his family was elevated to the British peerage, and in 1766 the then head of the family was created duke of Leinster.

Fitzgerald (Lord EDWARD), Irish revolutionist, b. near Dublin Oct. 15, 1763, having served in the British army as aide-de-camp to Lord Rawdon in America, travelled in North America, and imbibed republican ideas, from 1788 to 1790, and was a member of the Irish Parliament in the latter year. In Paris, in 1792, he publicly renounced his title, and was dismissed from the army. Becoming president of the United Irishmen in 1796, he was arrested May 19, 1798, receiving wounds in the arrest from which he d. in prison June 4, 1798. In Oct., 1798, a bill of attainder was passed against him, which was reversed in 1819.

Fitzgerald (Rt. Hon. JOHN DAVID), P. C., Q. C., LL.D., b. in Dublin in 1816, was educated at Trinity College, Dublin; called to the bar in 1838, and became a Q. C. in 1847. In 1855–56 was solicitor general of Ireland, and in 1856–58 and 1859–60 attorney general. In the House of Commons he represented Ennis from July, 1852, to Feb., 1860, and was then made a judge of the court of queen's bench in Ireland, where he is also a commissioner of national education, of charitable donations and bequests, and of endowed schools. In 1856 he was sworn of the privy council.

Fitzgerald (PERCY HETHERINGTON), M. A., F. S. A., b. at Fane Valley, county of Louth, in 1834; educated at Stonyhurst College, Lancashire, and Trinity College, Dublin; came to the Irish bar, and was for a time a crown prosecutor on the north-eastern circuit. Has written largely in *All the Year Round*, *The Dublin University Magazine*, *Household Words*, etc., nearly all his productions being works of fiction, with a *Life of Sterne* and *Life of Garrick*.

Fitzgerald (WILLIAM), D. D., Anglican bishop of Killaloe, Kilfenora, Clonfert, and Kilmacduagh, Ireland, b. in Ireland Dec. 3, 1814, and educated at Trinity College, Dublin, where he had B. A. in 1837, and of which he became a fellow. In 1840 he wrote in opposition to *The Tracts for the Times*. In 1848 was appointed professor of moral philosophy in Trinity College, and in 1852 professor of ecclesiastical history. Has edited *Constable's Ethics* and *Butler's Analogy*, and is author of one of the answers to

Essays and Reviews. He was joint editor of *The Irish Church Journal* with Dr. Abeltshauser, was consecrated to the see of Cork in 1857, and transferred to his present see in 1862.

Fitzgerald (Sir William Robert Seymour Vesey), D. C. L., G. C. S. I., English member of Parliament and governor of Bombay, b. in 1818; graduated at Oriel College, Oxford, in 1837, and had M. A. in 1844, and D. C. L. in 1863. In Jan., 1839, was called to the bar at Lincoln's Inn, and gained a seat in Parliament for the borough of Horsham in June, 1848, being re-elected in 1854. Was in the earl of Derby's cabinet in 1859 as under-secretary for foreign affairs, and was made governor of Bombay in 1866, being made a privy councillor Dec. 28th of that year, and sailing for India Feb., 1867. The same year he was nominated grand cross of the order of the Star of India.

Fitz'hugh (Andrew), b. in Virginia in 1795, was a midshipman U. S. navy June 8, 1811, lieutenant Apr. 21, 1816, master Feb. 9, 1837, captain Feb. 14, 1843. D. in Fairfax co., Va., Oct. 2, 1850.

Fitzhugh (William), delegate to the Continental Congress from Virginia 1779–80; b. in 1726; d. in 1809.

Fitzpat'rick (Benjamin), U. S. Senator, b. in Greene co., Ga., June 30, 1802, emigrated to the valley of the Alabama River, near Montgomery, Ala., in 1815; studied law, and began to practise in 1821, and being soon chosen solicitor of his judicial district held the position until 1829. Was presidental elector in 1840, and governor of Alabama in 1841–45. In 1852 he was appointed U. S. Senator from Alabama, and then elected to the same position for the term ending in 1861. He left the Senate in Feb., 1861, and took an active part in the Confederate cause. Was often president *pro tem.* of the U. S. Senate, president of the Alabama constitutional convention in 1865, and a delegate to the Philadelphia Union National convention in 1866. D. in Autauga co., Ala., Nov. 25, 1869.

Fitzpatrick (John Bernard), D. D., b. of Irish parents in Boston, Mass., Nov. 1, 1812, was educated at Boston, at the College of Montreal, and the Sulpitian Seminary, Paris. In 1840 was ordained a Roman Catholic priest; in 1844 was consecrated coadjutor-bishop of Boston, *cum jure successionis;* and in 1846 succeeded Bishop Fenwick in the bishopric. D. Feb. 13, 1866. Bishop Fitzpatrick was a man of learning and ability, and received his doctorate from Harvard University.

Fitzpatrick (William John), Irish author, b. Aug. 31, 1830, is a magistrate and grand juror for the county of Dublin, and has published *Life, Times, and Contemporaries of Lord Cloncurry, The Friends, Foes, and Adventures of Lady Morgan, Memoirs of Archbishop Whately*, etc.

Fitzroy' (Robert), English vice-admiral, meteorologist, and navigator, b. July 5, 1805, entered the British navy Oct., 1819; was lieutenant in Sept., 1824, and took part in a government expedition to the coast of South America in 1828 and 1831. (Charles Darwin accompanied the latter expedition as naturalist.) In 1841, Fitzroy was M. P. for Durham, and governor of New Zealand from 1843 to 1846. In 1854 became superintendent of the meteorological department of the board of trade, rear-admiral in 1857, and in 1862 established a system of "storm-warnings." Was made vice-admiral in 1863, and d. at Norwood Apr. 30, 1865. With Capt. King he wrote *Narrative of the Surveying Voyages of H. M. S. Adventurer and Beagle, 1826–33* (1839), and himself published *Barometer Manual* (1861) and *Weather-Book* (1863).

Fitzsim'mons (Thomas), b. in Ireland in 1741, was a merchant in Philadelphia, Pa., and commanded a volunteer company in the Revolutionary war. Was for many years a member of the Pennsylvania State assembly; in 1782–83 a delegate to the Continental Congress, and in 1787 to the Federal constitutional convention. From 1789 to 1795 was M. C. His firm subscribed £5000 to supply the American army in 1780. Mr. Fitzsimmons was president of the Philadelphia chamber of commerce and of the North American Insurance Company. D. at Philadelphia, Pa., Aug., 1811.

Fitzwil'liam, post-tp. of Cheshire co., N. H., on the Massachusetts State line and on the Cheshire R. R., 27 miles N. W. of Fitchburg, Mass. It contains two post-villages (Fitzwilliam and Fitzwilliam Dépôt), and has important manufactures of cooperage and wooden wares. Pop. 1140.

Fiu'me, an Austrian seaport on the coast of the Adriatic, at the mouth of the Fiumara, where it falls into the Gulf of Quarnero, 40 miles S. E. of Trieste. The most important branch of its industry is shipbuilding, for which the splendid forests of the Julian Alps afford the greatest facilities. The most important branch of its trade is the export from Hungary, to which two railways extend. Pop. 13,314; with surroundings (district of Fiume), 17,884.

Five Forks, a name given to a locality in Dinwiddie co., Va., the junction of the White Oak and Ford's road with the one leading to Dinwiddie Court-house. An important battle was fought here Apr. 1, 1865.

Battle of. The possession of this radiating centre was one of great strategic importance, inasmuch as by Ford's road the Southside R. R. could be reached, and, indeed, the whole country which the intrenched Confederate lines were intended to cover. Isolated from the extreme right of his main lines some 4 miles, to Lee it was regarded of such importance that he had detached, from the already attenuated force by which this line was held, 15,000 men, by which to hold it. The attempt to gain possession of this position had been made (Mar. 30–31) by Gen. Sheridan, with momentary success (Mar. 31), during the absence of most of the Confederate force, engaged in fighting Warren on the White Oak road, but which now, being recalled, regained possession, driving Sheridan back towards Dinwiddie Court-house. On the morning of Apr. 1, Sheridan renewed the attempt. His force now comprised his own cavalry, to which McKenzie's division had been added—about 9000 in all; together with the Fifth corps, numbering, at this time, 12,000 to 13,000. During the previous night Sheridan had been placed in command of the entire force. His plan of attack was to force, by means of his cavalry, the enemy within his works at Five Forks, holding him there by demonstrating upon his right, while under cover of this feint the Fifth corps should strike his left flank, thus detaching the whole body from Petersburg and assuring its capture. At daylight the fulfilment of this plan was successfully inaugurated; by 2 P. M. the enemy was forced behind his works, and Merritt began his work upon the Confederate right. To guard against attack from the Petersburg lines, McKenzie's division was detached to watch the road leading thence. In the mean time, the Fifth corps (Warren) had reached its position, and now advanced towards the White Oak road, crossing which it changed front, thus facing westward at right angles with the road. McKenzie now returning, having met and driven back a body of Confederates, was sent around to the right of Fifth corps. Ayres' division, forming the left of the line, was first engaged by skirmishers, which were driven back, the division advancing up to the breastworks, encountering a severe fire which extended to the left of Crawford's division (forming the right of the attacking line). The latter officer, to withdraw his exposed flank, obliqued to the right, thus uncovering Ayres' right, which now gave way under the hot flank-fire; Warren, however, at once throwing in Griffin's division, which had been massed in rear of Crawford, the line was repaired, Crawford swinging out towards the Ford road, in the enemy's rear. Ayres' division by a brilliant charge now carried the right of the intrenchments, capturing upwards of 1000 prisoners; while Griffin, whose line overlapped the Confederate position, took the works on the left and rear, with 1500 prisoners. Crawford, meanwhile, had gained Ford's road, down which he now advanced, and Merritt forcing the attack from the S., the Confederates were nearly surrounded, leaving the White Oak road to the west the only means of escape. Before this road could be reached the victorious Union army, pouring in from every direction, compelled the surrender of nearly all the Confederate force, pursuing such as escaped till after dark. Over 5000 prisoners were captured, with four guns. The Union loss was not above 1000, all told. The effect of this decisive battle was to determine Lee to abandon Petersburg, which he did under cover of night (Apr. 2), but not before his entire outer line of works had been carried during the day. One week later Lee surrendered his army at Appomattox Court-house.

Five Islands, post-v. of Colchester co., N. S., on the Basin of Minas, has considerable mineral wealth and manufactures of baryta paint, an imitation of white lead; also shipbuilding, and a cataract 90 feet high. Pop. about 600.

Five Mile, post-tp. of Hale co., Ala. Pop. 766.

Five Points, tp. of Elmore co., Ala. Pop. 370.

Five Points Mission. Long before 1850 the Five Points had come to be regarded as the plague-spot of America—the synonym of all social and moral deformity—the Sodom of the nineteenth century. How to deal with it, and with the ever-increasing class of which it was the exponent, had become a question difficult of solution. There were four churches and two mission-stations either within or immediately on its borders. These had failed to make any perceptible impression upon this mass of impurity or to retard its steady increase. Yet over this moral waste many wept and prayed. In May, 1850, Rev. Lewis M. Pease, of the New York Annual Conference of the Methodist Episcopal Church, was appointed a missionary to this field, under the auspices of the Ladies' Home Missionary Society of this Church. To the character and wants of

this locality he was no stranger, for he had been for years quietly studying both, yet with little hopes of ever applying the means which he had devised. When the time came to test the practicability of his plans he gave to his work all the love, enthusiasm, and ability he possessed, with no thought of failure, but with success ever as real, with him, as it became in the results of after years.

Aided by an advisory committee, he secured a room on the corner of Cross and Little Water streets, the very heart of the Five Points. The next step was to gain an influence over the children. This end was sought to be accomplished through their physical necessities. While the missionary was yet unknown to them he engaged with a number of boys in a game of marbles first, and then in a wholesome lunch. During the next few days he was frequently accosted by, "Say, mister, ain't you goin' ter have a Sunday-school? And you'll have cake too, won't you?" When the time came for the school there was no lack of children; and for apparent badness of material this first gathering was never surpassed. There were singing, dancing, laughing, crying, swearing, praying, strangely intermixed, and all equally earnest. A visit to the two schools now upon the Five Points will afford ample proof that from such chaos order can be evolved. The great secret of success was found to lie in attending first to the physical well-being of the children.

At this time every house in this vicinity was a den of infamy, and to lead their inmates to a better life was the work of the missionary—the means to be used, tracts, Bibles, exhortation, and prayer. Repeated failures made it apparent that as first means such agencies were not only inadequate, but inappropriate. The great first want was honest industry and proper home-influences. With much difficulty these were provided, and for years hundreds, otherwise hopeless, found their way back to virtue and respectability. The owners as well as the keepers of disreputable houses were indicted, and their trade in virtue broken up. House after house was secured by the missionary until eight were joined for the purposes of a Home. During years of varied industries here not one article was purloined, though abundant opportunities offered for so doing. Thousands of garments were given out to be manufactured by the poor. When the rescued were placed in situations and homes, as they came to be by hundreds annually, they more than fulfilled the utmost hopes entertained of them.

Employment and a home provided, the next step was a day-school. Two years before this the church of the Ascension of New York had contributed means for a day-school on the Five Points, at the solicitation of the widow of Rev. Dr. Bedell. The fund, so long kept in waiting, here found a channel for its appropriation, but with the understanding that the school should not be denominational. Sept., 1850, was the date of its commencement. This was the first of a class of schools in this country known as industrial schools. For fifteen years this school derived its entire support from the church of the Ascension.

The work of Mr. Pease, in its directly religious aspects, was denominational, and sustained by the Methodist Episcopal Church, but in its educational, industrial, and home features it was catholic, deriving its supplies from the general public. At the close of the first year the work had assumed such proportions it was deemed best to leave Mr. Pease to the temporal, and have another missionary appointed to attend to the strictly spiritual interests. Rev. John Luckey was thus appointed in May, 1851. During this and the succeeding year the famed "Old Brewery" was purchased, and a house erected on its site by the Ladies' Mission for the prosecution of their part of the work, while Mr. Pease retained the old ground. Here the agencies of the two became somewhat modified, the Ladies' Mission employing more of the temporal than at first, and Mr. Pease using all the spiritual ones ordinary in such an enterprise.

Thus were the two institutions originated, and thus have they grown up on the Five Points, great moral landmarks of the nineteenth century. The House of Industry was incorporated in Mar., 1854. Up to this period its expenses had been $18,981.87, its earnings $26,684.20, and its donations received $23,938.63, while it had provided for more than 2000 of the once wretched denizens of this region.

L. M. PEASE.

Fixed Air, a name given by Dr. Black to CARBONIC ACID (which see). That this gas was liberated in the burning of lime was known to Van Helmont, who called it *gas sylvestre*, but Dr. Black's name came into more general use. Fixed air is properly carbon dioxide, CO_2; carbonic acid is formed by combining this with water; it is H_2CO_3.

Fixed Oils, those oils which are not volatile without decomposition, in contradistinction to the volatile or essential oils, which evaporate at ordinary temperatures. (See OILS and FATS.)

Fixed Stars. See STARS.

Fix'ing, a name applied in PHOTOGRAPHY (which see) to the removal of the unchanged silver salts after the picture has been developed.

Fix'ture [Lat. *figo*, supine *fixum*, to "fix"], an article or structure which, in itself personal property, has been made an annexation or become accessory to real estate. There has been a bewildering variety of legal definitions given to the term, and it is hardly possible to fix upon any which would reconcile their various discrepancies and receive general acceptation; but the one here stated will probably make as near an approximation to accuracy and completeness as any that have been suggested. Annexations of this nature, when made under certain conditions and circumstances, still continue to be considered chattels, while in a different class of cases they are regarded as constituting a part of the realty, merely as a result of the change that has been effected in their situation and relations. Two structures identical in every respect, not only in construction, but also in the manner of their attachment to a house or land and in the uses to which they are applied, may be treated in law at one time as personalty, at another as realty; and as the rules as to management and disposition would be essentially diverse in the two cases, and additions to real property are very common for purposes of improvement, trade or manufacture, agriculture, etc., the "law of fixtures" is manifestly of great importance. The subtlety of the distinctions resorted to makes the subject one of exceptional intricacy, and has been the cause of much conflict in the decisions.

The question to be determined in every instance is, Has an addition to land become itself real property? It was formerly a well-established legal principle that such a result was consequent upon every case of attachment, and the rule was stated in a concise Latin maxim, as if universally applicable (*quicquid plantatur solo, solo cedit*—whatever is affixed to the soil belongs to the soil—*i. e.* becomes a part of it), but the exceptions which have been established have become so numerous that the formerly received doctrine, though still applicable as a general principle relating to fixtures, can no longer be regarded as of much practical value. In the elucidation of the subject the primary and fundamental inquiry must be whether there has been a true annexation in the legal meaning of the term. This annexation may either be *actual*, as where there is some real substantial attachment to land or buildings, or it may be merely *constructive*, as in cases where, though there is apparently no connection, and the articles are easily portable or removable, they are yet properly considered as appurtenant to certain real property and indispensable to its integrity. Thus, machinery attached to buildings, furnaces, mirrors fastened to walls, etc. would be illustrations of actual fixtures, while door-keys, window-blinds, or bells temporarily detached, fences that have been removed, but are to be replaced, etc., would constitute *constructive* fixtures. Such articles as the latter kind are, by common consent and necessarily, considered essential to the complete idea of a dwelling or a plot of land, as being requisite for its ordinary and proper use. But if, on the one hand, things originally chattels have been completely incorporated into real property, as where boards are fashioned into floors or plaster wrought into walls, or, on the other hand, chattels are merely suffered to rest upon land or lie within buildings, but are not naturally considered as essential thereto, no difficulty can arise as to whether the articles are real or personal. They are real in the former instances, and personal in the latter, beyond any possibility of doubt.

After the subject of annexation has been considered, another leading inquiry is the presumable intention with which the erections or additions were made, and by the establishment of what principles the requirements of a wise and judicious public policy would best be promoted. As the standard of "public policy" is necessarily very indefinite and general, it might be expected that the conclusions to be derived from its application would be largely determined by the more specific inquiry as to "intention," if the results which the latter afforded were entirely consistent with public welfare; and such seems to have been the case, since the rules referred to both these criteria mainly coincide. One test, however, serves to supplement and modify the other. In examining into the intent with which fixtures were erected, the actual purpose is not so much in question as the reasonably and justly *presumable* intention which the law can gather from all the attendant circumstances and the relations of the parties concerned to have been the instigating and guiding motive. When, for instance, a person sells land with or

taia additions upon it of the equivocal nature of fixtures, and which the purchaser may naturally have presumed to pass with the grant, and to have been intended for the permanent improvement of the property, the law will not permit the vendor to claim that his actual intent, though secretly indulged, was to consider the articles as personalty and remove them for his own use. An intent is fastened upon his conscience which his acts fairly and justly warranted, and which alone is consistent with any understanding which the opposite party could have formed under the circumstances. The dictates of public policy also support the same rule, since otherwise fraud could be readily committed, and free transfers of property would be hampered by suspicion and uncertainty. But if a vendor's actual intention is made known to the purchaser at the time of sale in regard to additions strictly within the class of fixtures, or if a chattel mortgage has been made in regard to them, which the purchaser can ascertain, presumed intent will coincide with actual intent, and the relations of the parties will be determined accordingly. Again, when additions for purposes of trade are made upon leased property by a tenant for years, it is necessarily presumable that he does not intend that they shall be permanent attachments, but that he only purposes their maintenance during the time of his tenancy. Considerations of public policy also support this conclusion, since the establishment of a prohibition upon tenants to erect fixtures which they could remove when their interests expired would materially interfere with the leasing of property and with commercial enterprise and progress. In all cases, however, in which specific contracts are made, or persons have a clear understanding of the terms upon which their interests are created, no opportunity for presumption can exist, and if the agreements be legal public policy can interpose no obstacle. The parties may determine upon what stipulations they will.

On these grounds has been made a division of the parties in regard to whom questions concerning fixtures most generally arise into two great classes: (*a*) One class consists of those interested in property on which fixtures have been erected by one having a *permanent* interest therein; (*b*) the second class is where the fixtures were annexed by one having only a *limited* interest in the land. Under the first class questions arise (1) between heir and executor of one adding fixtures to land; (2) between mortgagor and mortgagee of property on which fixtures had been erected by the former; (3) between vendor and vendee of land with fixtures thereon; (4) between vendor and contractor to buy land under similar circumstances. Under the second class questions occur (1) between landlord and tenant where the latter erects fixtures after the commencement of his lease; and (2) between tenant for life and remainder-man or reversioner. When the interests of all those varieties of parties grouped under the first class are concerned, the presumption is quite rigid that attachments to the land constitute a part of it, and consequently are governed by all the rules appertaining to real estate. Fixtures, therefore, which the law would presume to have been attached for permanent continuance will pass to heirs rather than to executors, will be conveyed under a deed or mortgage of the property to the vendee or mortgagee, or will be included within the contract of one who agrees to purchase the land. But a large number of annexations may, even in this class of instances, be considered as personal property, for those additions, as has been stated, are alone treated as realty in regard to which the legal presumption is that they were added for the *permanent improvement and habitual enjoyment* of the premises. In order to determine whether such a presumption can justly be entertained, regard is had to a variety of tests, as, for instance, to the nature of the annexation, whether bulky and unwieldy or light and easily removable; to the adaptability of the attachment to the proper and natural use of the building in which it is placed, or of the land with which it is connected; and to many diverse considerations which must evidently depend upon the circumstances of each particular case. If a building were erected in such a location and with such peculiarities of construction that it could only be used to advantage by the employment of certain machinery which had been placed within it, or could be adapted to different purposes only at great expense, the deduction would be necessarily made that such machinery was intended to be no mere temporary attachment, but that it was designed for permanence.

One test of considerable importance and frequent application is to consider the manner in which the fixture is joined to or connected with the property to which it is attached—whether it can be removed without injury to the premises, or whether its fastenings can be readily detached. This was formerly said to be the chief distinguishing test in all questions concerning fixtures, the statement being made that all objects firmly fastened were real property, while those not so annexed remained chattels; but this rule would exclude all constructive fixtures from the category of realty, and cannot be upheld. The criterion is only valuable as indicative of intention to have the articles remain constant attachments to the land. But it is so indefinite and general in its character, and leaves so much room for fine-drawn distinctions and delicate subtleties of discrimination whose reasonableness is oftentimes difficult to discern, that to this cause alone is attributable much of the confusion in the legal decisions upon the subject of fixtures. Thus, machinery attached to a building by means of rods passing through joists and there secured by nuts has been held to be real estate, while looms merely fastened to the floor by screws have been considered personalty. Some courts have gone so far as to hold that articles fastened by bolts or nails would become realty, when if fastened by screws they would still remain chattels, since screws can be so much more readily removed that it is natural to believe that in the latter case a removal was intended. Other courts deny the distinction. In regard to such objects as stoves, boilers, kettles, and various articles of machinery of moderate size, the cases have exhibited much discrepancy. Buildings erected upon wooden blocks merely are generally considered chattels. In New York a statue resting upon a pedestal in the garden of a dwelling-house has been decided to be real property as between a mortgagor and a mortgagee, as probably erected for permanent continuance. The rolling-stock of railroads is by some courts considered real, by others personal property, in perplexing variety. As between mortgagor and mortgagee the decisions preponderate that it may be treated as real estate. But by a recent decision in New York it has been held to be personal property. (*Hoyle* vs. *Plattsburg and Montreal R. R. Co.*, 54 New York 314 [1873]).

But it would be useless to multiply illustrations; only the general principle can be satisfactorily stated. In New York a particular provision has been established by statute in regard to the conflicting claims of heir and executor. In accordance with this, "things annexed to the freehold or to any building for the purpose of trade or manufacture, and not fixed into the wall of a house so as to be essential to its support, are deemed assets, and go to the executor." The common-law rule is that trade-fixtures, in regard to the rights of those classes of persons that have hitherto been considered, are not to be treated differently from fixtures of other kinds, but in the relations of landlord and tenant it will be seen that they attain to great importance.

In regard to the rights of those persons forming the second class above mentioned—viz. landlord and tenant and tenant for life and remainder-man—the law concerning fixtures is very different. Both the question of presumed intent and the dictates of public policy, as has been seen, lead to conclusions essentially diverse from those which have been stated as applying to other cases. But the doctrine of presumed intention is not carried so far as to permit a tenant to erect anything he may choose upon his landlord's premises, with the privilege of removing it when his tenancy is ended, since the landlord's interests, which are equally deserving of protection, might be unduly sacrificed. The tenant, therefore, may only take away additions he has made when they belong to one of these special classes. (1) He may remove all fixtures which he has erected for purposes of trade or manufacture. This rule is established to promote business enterprise. Thus, brewing-vessels, cider-mills, closets, shop-counters, engines, presses, etc. may all be rightfully removed. The rule has also been extended to buildings constructed by the tenant for purposes of trade, as, *e.g.*, additions to an inn, tavern-keeping being deemed a species of trade. The removal must be made by the tenant so as not to injure the landlord's premises. (2) In the U. S. the general rule is established that fixtures annexed for agricultural purposes may be removed. In England a contrary rule was maintained at common law, but some exceptions have been established by statute. Nursery trees would be an illustration of agricultural fixtures. (3) Articles erected for domestic use and convenience and the necessary enjoyment of the premises are, in general, removable. This privilege would not probably extend to objects of mere ornament. In any case, it is necessary that the tenant should exercise his right of removal before the expiration of his interest and his yielding up possession, as otherwise he will be deemed to have abandoned the fixtures to his landlord. But the executor of a tenant for life, as the necessity of the case demands, has a reasonable time after the tenant's death to take away the fixtures.

The rights of landlord and tenant may be variously modified by mutual agreement. They may contract to consider certain articles chattels which would otherwise become real estate according to general rules, and *vice versâ*.

It is quite common to find a provision in leases that the fixtures at the end of the term shall be taken by the landlord at a valuation made in a specified manner; as, *e. g.*, by appraisers selected by the parties. By such an agreement, matters which, legally speaking, would be real estate may be made to appertain so far to the tenant as to entitle him to compensation. (Consult AMOS AND FERARD on *Fixtures*; WASHBURN on *Real Property*; CHITTY on *Contracts*, etc.) GEORGE CHASE. REVISED BY T. W. DWIGHT.

Flac'cus, a *cognomen* of several Roman families, of which the most important belonged to the gentes Fulvia, Valeria, and Pomponia. The poet HORACE (which see) also bore this name. Among the illustrious men of the name we may mention (1) LUCIUS VALERIUS FLACCUS, consul with C. Marius in 100 B. C., censor in 97, and again consul in 86 B. C., when he was murdered by Fimbria.—(2) Q. FULVIUS FLACCUS, consul 237, 224, and 212 B. C., often prætor, and distinguished in the second Punic and many other wars, in which he was fortunate; but his character is stained by his cruel treatment of the Campanians. His family produced many public men, among whom his son, Q. Fulvius Flaccus (d. 173 B. C.), and his grandson, M. Fulvius Flaccus, were the most renowned. The former was a distinguished general in Spain, the latter a partisan of the Gracchi, and was put to death 121 B. C.

Flaccus (CAIUS VALERIUS), an epic poet who flourished in the reign of Vespasian. He is supposed, from some words of Martial, to have been a native of Padua, though, from the name given in the Vatican manuscript (G. Valerius Flaccus Balbus Setinus), it is thought that he was born at Setia. He d. in the reign of Domitian, probably about A. D. 89, and Quintilian speaks of his death as a loss to literature. He was the author of a poem entitled *Argonautica*, on the expedition of the Argonauts, in imitation of the poem of Apollonius of Rhodes, which extended to eight books, but was left unfinished. His style is an imitation of that of Virgil, but more declamatory and artificial. Its involved construction and too crowded figures often produce obscurity, while the poet too often and on too slight occasions calls in the aid of the gods. The best editions are those of Burmann, Utrecht, 1702, Leyden, 1724; of J. A. Wagner, Göttingen, 1805, 2 vols.; and of G. Thilo, Halle, 1863. H. DRISLER.

Flaccus (SICULUS), a writer on agriculture who probably lived soon after the reign of Nerva. Nothing is known of his life. Of his extant fragments the most important is *De Conditionibus Agrorum*, which is full of legal learning and valuable information.

Flaccus (VERRIUS), a freedman by birth, distinguished as a grammarian and teacher at Rome under Augustus. He was so successful in his method of instruction that the emperor placed his own grandsons under his charge, and allowed him to bring his other pupils into the Palatium, on the condition that no additions should be made to their number. At his death, under Tiberius, a statue was erected to him in the forum at Præneste. He was the author of several works, historical, antiquarian, and grammatical, the most important of which, and the one the loss of which is most deplored, was entitled *De Significatu Verborum*. This is referred to occasionally by later grammarians, and a few extracts from it (and the other writings of Flaccus) have been collected by Lindemann in his *Corpus Grammat. Latinorum*, but it was superseded in general use by the abridgment of Festus, which no doubt caused the final disappearance of the larger treatise. (See FESTUS, POMPEIUS.) A brief notice of Flaccus is given by Suetonius in his *De Grammaticis et Rhetoribus*. H. DRISLER.

Fla'cius, Flach, or **Vlacich Francowitz** (MATTHIAS), one of the greatest Lutheran scholars and polemics, "the Achilles of pure Lutheranism," of the second generation of the era of the Reformation, b. Mar. 21, 1520, at Albona, in Venetian Illyria (hence *Illyricus*). He desired to become a monk, but was dissuaded by Lupetinus, provincial of the Minorites, who put into his hands some of Luther's writings and counselled him to study theology in Germany. He went to Bâle 1539; became private teacher at Tubingen 1540; went to Wittenberg 1541. Out of great spiritual darkness and distress, connected with his views of election, he was led by Luther, of whose faith he became one of the most earnest defenders. He received the chair of Hebrew 1544; in 1545 he married; 1547 the Schmalcald war compelled him to leave Wittenberg. In the time of theological conflict on the Adiaphora which followed the INTERIMS (which see), Flacius took a position of uncompromising fidelity to the principles of Luther, which Melanchthon and his school were perilling by indecision. He was a defender of the faith against open enemies and misjudging friends. (See OSIANDER, MAJOR, STRIGEL, SCHWENKFELD, SYNERGISM.) In Magdeburg he began (1557) his immortal church history, the *Magdeburg Centuries*, in which he was the main worker, though he had a body of able colaborers, among whom were Wigand, Judex, Faber, and Nicholas Amsdorf. Brischar, a Catholic divine, says: "It is impossible to ignore the erudition, the acuteness and the gift of combination which express themselves in this book." The *Catalogus testium Veritatis* (1556) was meant to trace in a long line of witnesses the evangelical protest of the ages against the errors of Rome. In the same interest he published the *Missa Latina* (1557), a copy from a missal of about A. D. 700. In 1561 he was dismissed from the University of Jena for his resistance of the encroachments of the state on the liberties of the Church. His whole after-life was one of wandering and suffering, amid which he finished his other great works, the *Clavis Scripturæ Sacræ* (1567) and his *Glossa on the New Testament*. He d. in the hospital at Frankfort Mar. 11, 1575, at the age of fifty-five, having displayed a tenacious courage, mostly for the truth, not unlike that of Luther. "He was," says Kling, "a man of faith, one of that cloud of witnesses of whom the world was not worthy." A lack of metaphysical accuracy in the use of language—which, however, he finally modified—involved him in a controversy which arose from his assertion that ORIGINAL SIN (which see) is a substance, and not accidental. This view, called "Flacianism," was condemned, in the strict sense of its phraseology, in the CONCORD, FORMULA OF (which see). Its adherents were styled Flacians and Substantialists. (*Lives* by RITTER, 1725; TWESTEN (vindicating Flacius), 1844; PREGER (the best), 2 vols., Erlangen, 1859–61 (reviewed in the *Bibliotheca Sacra*, 1862).) C. P. KRAUTH.

Flag, the name of various long-leaved aquatic plants, such as sweet-flag (see ACORUS CALAMUS), blue-flag (see IRIS), and cat-tail flag (see CAT'S TAIL). The fixed seaweeds are often called flags.

Flag. Webster defines *flag*, "that which *flags* or hangs down loosely" (Lat. *flaccere*); "an ensign or colors;" a cloth bearing usually certain devices and attached to a staff; it is synonymous with the Fr. *drapeau*. It is, in fact, one of the forms of *insignia* by which nationality is distinguished, by which the sway or jurisdiction of a political power is asserted. Hence, its predominating use in those organizations of a country by which its sovereignty and jurisdiction are asserted and maintained—*i. e.* the army and navy. Hence, too, its powerful appeal to the patriotism of all those who see in it the symbol not only of their country's power, but of its claim upon themselves. Pendent over a fortress or ship, and throwing out, with the varying breeze, its folds to the four quarters of the heavens, it seems to hold above them the imperial ægis of a nation's power. A history of such "insignia" would occupy volumes. The Chinese flags or banners are said to have been, in essentially their present forms, in existence at a date earlier than the siege of Troy. The term "vexillum" of the Romans applies to anything that is *borne as an ensign*, whether it be a flag or banner, or some other device; but it became specifically applied to the *drapeau à croix* (*i. e.* a flag suspended to a horizontal cross-piece, attached by cords to the upright staff, with which arrangement the term "banner" has become identified) after the time when the emperor Constantine introduced the LABARUM (which see); and *this* form of flag has been ever since affected by the Church, as it is now. It is also the most usual form of the banners of lay societies.

In this country, during the early days of the Revolution, the colonists made use of flags of various devices; the first legally established national emblem was that adopted by Congress June 14, 1777, which provided that the flag of the thirteen United States should be thirteen stripes, alternately red and white; that the union be thirteen stars, white in a blue field, representing a new constellation: this form was altered by act of Jan. 13, 1794, which provided that after May 1, 1795, the flag of the U. S. should consist of fifteen stripes, etc., and fifteen stars, etc.; in 1818, however, act of April 4, the flag was re-established as thirteen horizontal stripes, alternately red and white; the union to consist of twenty stars, white, in a blue field; one star to be added to the union on the admission of every new State; the addition to be made on the 4th day of July succeeding such admission. This flag went into effect July 4, 1818, and is the present prescribed national emblem of the U. S. of America.

In the U. S. army the garrison flag is the national flag, 36 × 20 feet; the storm flag is 20 × 10 feet, and the recruiting flag 9 feet 9 inches by 4 feet 4 inches. Each artillery regiment has two silken colors—the first, the national emblem, 6 feet 6 inches fly and 6 feet deep on the pike; the number and name of the regiment embroidered with gold on the centre stripe. The second, or regimental color, to be yellow, of same dimensions as the first, bearing in the centre two cannon crossed, with the letters U. S.

above and number of regiment below. Infantry regiments have likewise two colors of silk and of similar size—the first of which is the national flag, with the number and name of the regiment in silver on the centre stripe; the regimental color to be blue, with the arms of the U. S. embroidered in silk on the centre; the name of the regiment in a scroll underneath the eagle. Camp colors are 18 inches square, of bunting—white for infantry, red for artillery, with the number of the regiment thereon. Each mounted regiment has a silken standard bearing the arms of the U. S. embroidered in silk on a blue ground, with the number and name of the regiment in a scroll underneath the eagle. Each company has a swallow-tailed silken guidon, half red, half white, divided at the fork, the red above; on the red the letters U. S., and on the white the letter of the company in red.

There are flags also which are symbols of individual authority. Among such are royal standards, flag officers' flags, etc. An admiral's flag is usually the flag of the country which such admiral serves, with the exception of the union. The flag of the admiral, vice-admiral, and rear-admirals of the U. S. is rectangular, and consists of thirteen alternate red and white stripes. The admiral hoists this at the main; the vice-admiral at the fore; the rear-admiral at the mizzen. Should there be two rear-admirals present, the junior hoists a flag at the mizzen similar to the one described, with the addition of two stars in the upper left-hand corner. The commodore's flag differs from that of the admiral's in form alone, it being a swallow-tail instead of rectangular.

Should the President go afloat, the American flag is carried in the bows of his barge or hoisted at the main of the vessel on board of which he may be. In foreign countries the royal standard is worn at ceremonies in honor of the sovereign or at which the sovereign may be present.

The white flag is the symbol of peace, and is used as the flag of truce or in token of surrender.

The red flag, bidding defiance, is often used by revolutionists. In our service it has a more peaceful signification, and when hoisted at the fore of a vessel shows that she is receiving or discharging her powder.

The yellow flag shows a vessel to be in quarantine.

Flags are said to be at half-mast when they are hoisted but half the height at which they are ordinarily worn, and in this position designate mourning.

Dipping the flag is a salute to a fort or passing vessel by lowering it slightly and hoisting it again. (See Gen. S. Hamilton's *Hist. American Flag.*) J. G. BARNARD.

Flag'ellants [Lat. *flagellum*, a "whip," "scourge"], a name given to companies of persons in the Middle Ages who marched and sang and scourged themselves in public places for their own and others' sins. Self-flagellation, as a penance, had its origin in the monasteries, and is of early date. It was first recommended to others than monks about the year 900 by Regino (d. 915), abbot of Prüm in Rhenish Prussia, in his *De Disciplina Ecclesiæ*, ii. c. 442, but it did not become a popular penance till after the time of Peter Damiani (1007–72 A. D.), by whom it was earnestly advocated. During the thirteenth, fourteenth, and fifteenth centuries the Flagellants became a sort of intermittent order of fanatics, frequently reappearing here and there in times of extraordinary declension or distress. Three such outbreaks are specially prominent: 1, in Upper Italy, 1260 A. D., in connection with the struggle between the Guelphs and the Ghibellines; 2, in 1349 A. D., while the Black Plague was raging; 3, in 1414, when so many good men were waking up to the corruptions and errors of the papal Church. The Flagellants generally enrolled themselves for the term of 34 days—a day for each year in the life of Christ. Stripped to the waist and scourging themselves with knotted whips, they marched with songs and banners from town to town. In market-places they would fling themselves upon the ground, with arms extended in the form of a cross, plying their whips till the blood came. Blood so drawn was thought to have an atoning efficacy. Other wild notions were entertained. The celebrated John Gerson (1363–1429) wrote against them, and they were condemned by the Council of Constance (1414–18). Their last appearance in Germany was in 1481. In spite of all their extravagances, their existence served as a sort of protest against the blind ritualism of the age. (See BOILEAU'S *Histoire des Flagellans* (1701), and DELOLME'S *History of the Flagellants among Different Nations* (1785); but the standard authority on the subject is Dr. E. G. FÖRSTEMANN'S *Die christlichen Geisslergesellschaften* (1828).) R. D. HITCHCOCK.

Flageolet', a musical instrument consisting of a wooden or ivory tube with a mouth-piece at one end, the other end being open. It has one large aperture near the mouth-piece and six or more finger-holes. Its invention is ascribed to one Flavigny in 1580, but the flutes of the ancients, like those of some modern barbarous nations, were simply flageolets.

Flaget (BENEDICT JOSEPH), D. D., Roman Catholic bishop of Bardstown, Ky., b. in France Nov. 7, 1763, was consecrated Nov. 4, 1810. The name of the diocese was changed, and he became in 1848 bishop of Louisville. D. Feb. 11, 1850. His *Life* has been written by Archbishop M. J. Spalding.

Flagg, tp. of Ogle co., Ill. Pop. 2288.

Flagg (AZARIAH C.), American Democratic politician, b. in Clinton co., N. Y., in 1790, served as a soldier in a New York regiment in the war of 1812, participating in several engagements; in 1823–24 represented Clinton co., N. Y., in the State legislature, and was secretary of New York State from 1826 to 1833. In 1834 he was appointed State comptroller, and held the office for five years. In 1842–46 he was reappointed to the same position. He contributed for years to the Albany (N. Y.) *Argus*, opposed the U. S. Bank, and was a founder of the Barnburner (afterwards the Free-Soil) party. He was elected comptroller of New York City in 1852 and in 1855. In 1859 he became blind, and d. in New York City Nov. 25, 1873.

Flagg (EDMUND), American journalist and author, b. at Wiscasset, Me., Nov. 24, 1815; graduated at Bowdoin College, Me., 1835; taught at Louisville, Ky.; was admitted to the bar in 1837; practised with S. S. Prentiss at Vicksburg, Miss., in 1844–45; conducted the St. Louis (Mo.) *Evening Gazette*, and was reporter of the county courts. In 1848–50 was secretary to E. A. Hannigan, U. S. minister at Berlin, Germany; in 1850–51 consul at Venice. Since 1854 he has been chief clerk of a commercial bureau in the state department at Washington, D. C. Mr. Flagg has contributed to and conducted during his life Prentice's *Louisville* (Ky.) *Journal*, the *St. Louis Daily Commercial Bulletin*, *Louisville* (Ky.) *Literary News-Letter*, and published *The Far West* (2 vols., 1838), *Carrero, or the Prime Minister; Venice, The City of the Sea*, dramas, etc.

Flagg (GEORGE WHITING), a painter, b. in New Haven, Conn., June 26, 1816, a nephew of Washington Allston, with whom he studied, and from whom he derived his most earnest impulses toward excellence in his profession. His passion for art was intense and appeared early. Was considered in his youth a prodigy, and great expectations were cherished of him. His boyhood was passed in Charleston, S. C., his youth in Boston, his early manhood in London. His principal pictures in America are in New Haven—*The Landing of the Pilgrims*, *The Landing of the Atlantic Cable*, *The Good Samaritan*, *Washington receiving his Mother's Blessing*. They were painted for James Brewster, Esq. In London he painted portraits mainly, though his taste for composition pictures occasionally showed itself. The *London Art Journal* spoke in praise of a canvas of his, *Columbus and the Egg*: "It is generally low in tone, but rich and harmonious in color, and the heads are distinguished by much nobility of character." Hawthorne's *Scarlet Letter* gave him a subject, and Byron's *Haïdee* another. His resemblance in style to the artists of the Venetian school is due probably to his close association with Allston. Mr. Flagg has been a sufferer from ill-health, and consequently has done comparatively little work in later years. At present he is living at New Haven. O. B. FROTHINGHAM.

Flagg (JARED BRADLEY), D. D., brother of George, b. in New Haven June 16, 1820; began drawing at the age of thirteen; studied with his brother and uncle; devoted himself mainly to portrait-painting; went in 1849 to New York, and exhibited in the National Academy his *Angelo and Isabella*, which secured his election as an academician. In 1854, Mr. Flagg engaged in the study of theology, and took deacon's orders in the Protestant Episcopal Church. After living in Brooklyn, L. I., for some years as rector of Grace church, he removed to New Haven, and thence to New York. His clerical duties have not put a stop wholly to his career as an artist. He has painted many portraits, some ideal pieces, and has been active in the establishment of the art-gallery at Yale College. O. B. FROTHINGHAM.

Flagg (J. F. B.), M. D., American physician, b. in Boston, Mass., 1804, resides in Philadelphia, Pa., and has written *Ether and Chloroform, their Employment in Surgery, Dentistry, Midwifery, Therapeutics, etc.* (1851).

Flag Officer, a term applied to those officers who command fleets or squadrons, and are thereby entitled to hoist a flag at the mast-head of the vessel (called the flagship) in which they sail, as the token of their authority. Flag officers, in our navy as well as those of other naval powers, are divided into the grades of admiral, vice-admiral, rear-admiral, and commodore. Their stations in time of action or of tactical exercise depend somewhat upon the size of the fleet; but the commander-in-chief and the commanding

officers of divisions, if large, should have no fixed position, but be at liberty to move at their discretion. They should ordinarily, however, be found near the centres of their commands. They direct the fleet or squadron under their command as to their diplomatic as well as to their naval relations. RAYMOND P. RODGERS.

Flag'staff Plantation, tp. of Somerset co., Me. P. 112.

Flag'stone, stone cut or split in thin layers, and used for walks, floors, etc. In all cities and towns the consumption of stone for this purpose is large; and since the best quality of flagging is comparatively rare, it becomes an article of very considerable value, and one which in its production and transportation gives employment in the U. S. alone to some thousands of workmen and several millions of dollars of capital. Good flagging is strong and smooth without being slippery; hence, a stone which will furnish it must be readily worked into slabs of from two to four inches in thickness, with an area of from ten to a hundred or even more square feet, and one on which a uniform surface can be readily produced. By far the greater part of flagging used is composed of stone which splits readily into slabs of the proper thickness, and of which the natural surfaces are so smooth as to require little dressing. The rock which best fulfils these requirements is generally a laminated sandstone, but mica slate, marble, and granite are frequently used for the walks of our cities. Some of our limestones cleave readily and afford a handsome flagging, but when worn smooth in wet weather they become slippery, and from this cause dangerous. The same objection holds against granite. This material is frequently wrought into slabs of large size, which are so laid as to stretch entirely across the sidewalk in front of business buildings; but, while very strong and durable, and forming a convenient roof to vaults below, they are rough and uncomfortable to the feet when new, and are dangerously smooth when worn. The perfection of flagging is found in a strong, fine-grained sandstone laid in accurately joined flags of considerable size, of which the surfaces have been sawed or rubbed. Even when wet the grain of such a stone holds the foot firmly and makes walking easy and pleasant. Marble flagging has, from its crystalline, granular texture, the same excellence with sandstone, but it is much more expensive. Some varieties of mica-slate afford good flagging, like that in front of the Capitol at Washington, which is clean, bright, and silvery in appearance and pleasant to the feet; but it wears unevenly, and is apt to crimp at the edges. One of the best varieties of flagging known in the world is that most generally used in New York, and popularly known as the *bluestone*. This is a fine-grained, somewhat metamorphosed sandstone, derived from the Hamilton group, and chiefly quarried on the Hudson at Rondout. It lies in strata from half an inch to six inches in thickness, which cleave readily, work with accuracy, and are very strong. A belt of this formation stretches across from the Hudson to the line of the Erie R. R. near Port Jervis; much good stone coming to market from the last mentioned district. As this stone is so readily quarried, and the facilities for its transportation are so great, it is furnished in New York at a very low rate; and the inhabitants of this city may congratulate themselves upon having an inexhaustible supply of such material to meet the great demand created by the rapid extension of its street lines. Slabs of any required dimensions can be furnished at the Rondout quarries, and in several instances they have been laid in New York 12 by 15 feet in area. The natural surface of these flags is so smooth that they usually require but little dressing. Where more perfect finish is desired they are crenelled, sawed, or rubbed. When so treated this stone affords a walk not surpassed in excellence by that made from any other material. Another excellent flagging-stone, which has recently found its way to the New York market, is the "Buena Vista flagging," which comes from Southern Ohio. This is a fine-grained sandstone, considerably softer than the Rondout flagging. It is brought in large slabs, of which the surfaces are sawed. When accurately laid, these form a sidewalk scarcely excelled by any other. It is, however, somewhat less durable than the bluestone.

Artificial flagging made from some preparation of asphalt or hydraulic cement has of late come into quite general use, and is, in the judgment of many, destined to supersede stone flagging. While well adapted to certain kind of walks, especially those which traverse public parks, it is very doubtful whether the asphalt or cement can ever be given the strength and durability necessary for the walks of our crowded thoroughfares. (See FLEXIBLE SANDSTONE.) J. S. NEWBERRY.

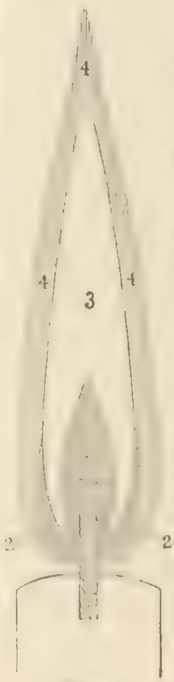
Flahaut de la Billarderie, de (AUGUSTE CHARLES JOSEPH), COUNT, French general and diplomatist, b. at Paris Apr. 20, 1785, entered the army at the end of 1799, became a colonel in 1809, and was aide-de-camp to Napoleon in 1813. In Oct., 1813, distinguished himself at Leipsic, and was made a general of division and count of the empire. In June, 1815, fought at Waterloo; in 1830, by the Revolution, was restored to his peerage and rank in the army; was ambassador to Berlin in 1831, to Vienna in 1841–48; was made senator in 1853; was ambassador to London Dec., 1860, and d. in Paris Sept. 2, 1870.

Flam'borough Head, a promontory on the Yorkshire coast, England. It is formed by a range of steep, almost perpendicular chalk-cliffs from 300 to 450 feet high, and bears on its headland a lighthouse whose revolving light (lat. 54° 7' N., lon. 5' W.) can be seen at a distance of 30 miles. Across the peninsula runs a ditch with ruins of old fortifications, called "Danes' Dyke."

Flamboyant [Fr. "flaming"], a style of Gothic architecture which was exhibited in France after the decline of the art had commenced. It takes its name from the somewhat flame-shaped tracery which is so frequent in this style. It prevailed chiefly in the fifteenth century. The Flamboyant style is marked by great attention to the minute details of ornamentation, and a too general neglect of the total effect. Hence it is regarded as a debased style.

Flame [Lat. *flamma*], a mass of visibly glowing gas; ordinarily, of a gas in process of combustion with air or oxygen. But flame may accompany the combination of any gaseous bodies, provided the action be sufficiently intense to produce luminosity; or it may even result from the intense heating of a gas whose nature is not thereby changed. As a consequence of their high temperature, the gases constituting a flame will have a tendency to rise and form upward currents; this fact, and the circumstance that combustion as well as cooling proceeds from the outside inward, determines the erect and tapering form of undisturbed flames.

Structure of a regular Hydrocarbon (candle, lamp, or gas) *Flame.*—In a candle-flame we readily distinguish four distinct portions, differing both in their aspect and in the nature of the processes producing them: 1. Immediately surrounding the wick there is a dark space of conical shape (No. 1 of figure) filled with the combustible gases formed by the first action of the heat on the fuel (wax, tallow, etc.), together with those flowing in through the base of the flame. The temperature in this dark space is quite low, and it is void of oxygen, so that neither will gunpowder explode nor phosphorus burn in it. 2. Surrounding the base of the dark cone and the lower portion of the luminous part is a cup-shaped zone (No. 2), of a blue tint, faintly luminous, but sharply defined. It results from the sudden and complete combustion of the gases of the dark cone, with a full supply of air (or oxygen) striking them from without. When the natural draught is artificially increased beyond a certain limit, the edges of the blue cup contract, and finally coalesce above, suppressing the luminous part, and forming a short conical blue flame; or if the blowpipe be used, there results an elongated cone, forming part of the "oxidation flame" of blowpipe practice, but itself possessing a slight reducing action. Its temperature is high. 3. Above the dark cone comes the luminous portion of the flame (No. 3), when it exists at all; its extent depending (other things being equal) upon the relative amount of carbon present in the fuel. In a wax, tallow, or coal-gas flame it forms a slender rounded cone with hollow base; while in that of alcohol it appears as a thin paraboloid (inverted cup-shaped cone). Its prominent characteristic is the separation of highly heated and therefore luminous carbon, out of its combinations with hydrogen, by the intense heat of No. 4, the exterior zone of final and complete combustion. The latter, a faintly luminous halo (the "outer veil"), surrounds the flame on all sides, and is its hottest portion. The maximum of temperature is a little *above* the point of the luminous cone, where we also find the highest *oxidizing* power; while just *within* the luminous point high temperature and the presence of free carbon co-operate to produce the most energetic *reducing* action.



Flame.

Luminosity of Flames.—The luminosity of flames varies between wide limits, from the faintly luminous and un

daylight) almost invisible flames of hydrogen, carbonic oxide, or sulphur, to the intense brilliancy of the "Bude light," in which coal gas is burnt with pure oxygen. Frankland has shown that faintly luminous flames may become intensely so when the gases are strongly compressed during combustion. Under ordinary circumstances, however, useful luminosity is dependent upon the presence in the flame of a sufficient (yet not excessive) amount of a highly heated solid; usually carbon, which in ordinary candle, lamp, or gas flames is liberated from the combustible gases by the influence of the high temperature of the exterior portions of the flame, through which no free oxygen can pass inward. But when illuminating gas is, previous to combustion, mixed with air or oxygen sufficient for the complete combustion of all its ingredients, the separation of carbon, and consequent luminosity, will be suppressed, while the temperature is greatly increased. This is the principle upon which the "Bunsen burner" is based, the body of whose flame represents the blue cup (No. 2) or the "oxidation cone" of the blowpipe. By varying the supply of air the flame may thus, at will, be made to exert an oxidizing or a reducing effect—a principle of most important practical application in the management of the reverberatory and gas furnaces used in metallurgical operations, where the flame, urged either by draught or blast, or by both combined, is readily varied in character to suit the requirements of any stage or kind of process.

Feeble luminosity may also be caused by an inadequate amount of carbon in the fuel, or by an excessive supply of carbon, or fuel. In the former case, however high the temperature, sufficient solid carbon is not separated to throw out light; as in the alcohol flame. In the second (as in a turpentine or coal-oil flame in open air), a sufficiency of air cannot find access to the very dense combustible vapor to produce a high temperature. Hence, the carbon is but feebly ignited, and much of it escapes unburnt as smoke or soot. The remedy is to adequately increase the supply of air by means of draught (chimneys) or blast.

The temperature of flames depends primarily upon the nature of the fuel, upon the rapidity and completeness of combustion, and upon the amount of inert gas mixed with the active ingredients. The hottest flame is that of pure hydrogen burning with half its bulk of pure oxygen; but a hydrogen flame burning in air is less hot, because four-fifths of the air is an inert gas (nitrogen), which has also to be heated. Still less hot is the flame of coal gas in air, because it consists in part of carbon, whose combustion generates less heat than does that of hydrogen.

When, in a mixture of combustible gas or vapor with air or oxygen, either of the two is present in great excess over the proportion required for complete combustion, the mixture will either not burn at all, or will burn with a quiet flame. But if neither be in great excess, a flame will instantly fire the entire mass, and an *explosion* ensues. To prevent the flame of the miner's lamp from thus setting fire to explosive mixtures of marsh gas and air formed in coal-mines ("fire-damp"), a fine wire screen, through which flame will not communicate, is made to enclose the lamp flame.

The color of flames depends essentially upon the substances that are vaporized within them, and is very characteristic, especially when observed with the spectroscope. Thus, compounds of sodium (such as common salt) produce a yellow tint; copper, green and blue; calcium (lime), orange red; strontium, crimson ("red fire"); potassium, violet, etc.

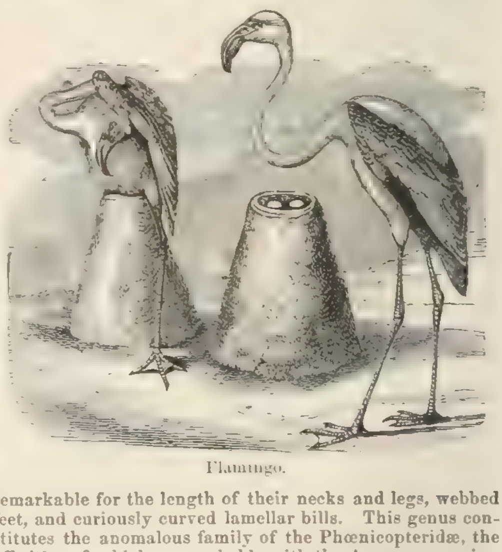
The appearance of flame is sometimes presented by dense masses of small particles, either themselves red hot or strongly illuminated from an outside source. Such is doubtless the nature of the immense sheets of "flame" often reported by unskilled observers as issuing from volcanoes during eruptions; which are in reality but jets and clouds of volcanic ashes and smoke lighted up by the fiery masses in the crater. *True flame* (of hydrogen, sulphur, etc.) is also sometimes emitted from volcanic vents, but much more rarely, and on a comparatively small scale.

E. W. HILGARD.

Fla'men, the name given to a Roman priest, devoted to the service of one deity. They were at first three (established by Numa), but were increased ultimately to fifteen, constituting two distinct classes—viz. (1) the *Flamines majores*, consisting of only three, the *dialis*, *martialis*, and *quirinalis*, consecrated the first to Jupiter, the second to Mars, and the third to the deified Romulus, and selected from the descendants of patricians only; and (2) the twelve *Flamines minores*, who usually were of the plebeian order. The office was for life, but a flamen could forfeit it by neglect of duty, and was liable to removal if an ill-omened event disturbed any of his sacred performances. Their characteristic dress was the *apex*, a cap either conical or close-fitting, having at the top a pointed piece of olive-wood, surrounded at its base by a lock of wool (*filum*, whence, according to Varro and Festus, the word *flamen* was obtained, but by Plutarch derived from *pileum*, "hat"), the *læna* or mantle, and the laurel wreath. The most distinguished of the flamens was the *dialis*, who was required to be the son of parents united in marriage by confarreation. The *flamen dialis* immediately after his appointment, though a minor, was relieved from parental control, and became *sui juris*. He was never required to give oath, had a seat in the senate *ex officio*, and, like the highest officers of state, had the use of the *sella curulis* (or chair of state) and of the *toga prætexta*, the assistance of a lictor, the right of sanctuary for his house, and the high prerogative of procuring pardon or respite for criminals. On the other hand, the *dialis* suffered numerous restrictions and deprivations; as, *e. g.*, he was not allowed to mount, or even to touch, a horse, wear a ring, or to touch a dead body. He was forbidden to sleep out of his own bed for three consecutive nights, to leave the city even for a single night (a rule modified by Augustus and Tiberius), and was obliged to resign and remain single upon the decease of his wife, who assisted him in the performance of some of his sacred functions. She was called *flaminica*, and was subject to restrictions like those by which her husband was fettered. In Rome's earlier days the flamens were nominated by the *comitia curiata* (in the case of the dialis three being designated), but after the enactment of the Lex Domitia (B. C. 104) they were named by the *comitia tributa*; and when thus nominated were received and installed into office by the *pontifex maximus*. (See FESTUS, s. v. *Maximæ dignationis* and *Majores flamines*; RAMSAY, *Manual of Roman Antiquities*, s. v.; SMITH, *Dictionary Greek and Roman Antiquities*, s. v., where the Latin authors are freely referred to.)

J. H. WORMAN.

Flamin'go (*Phœnicopterus*, Linn.), a genus of birds



Flamingo.

remarkable for the length of their necks and legs, webbed feet, and curiously curved lamellar bills. This genus constitutes the anomalous family of the Phœnicopteridæ, the affinities of which are probably with the Anseres, or swimming-birds, though it is still placed by many with the Grallæ, or waders. Several species are known. *Phœnicopterus ruber*, Linn., is met with on the Florida keys; *Phœnicopterus antiquorum*, Tem., occurs on the southern coasts of Europe.

EDWARD C. H. DAY.

Flamin'ian Way [Lat. *Via Flaminia*], the principal northern road which led from ancient Rome. It was laid out from the Flaminian gate of Rome to Ariminum by C. Flaminius the Elder in 220 B. C., during his censorship, and with its subsequent extensions and branches finally reached nearly all the large towns of Northern Italy. Its remains are still visible at various points.

Flamini'nus (TITUS QUINTIUS), a great general of the Romans, b. about 230 B. C., became quæstor in 199 and consul in 198; invaded Epirus, which he subjugated; gained in 197 the great battle of Cynoscephalæ over Philip, the last king of Macedon; proclaimed at the Isthmian Games, in 196, the independence of Greece; overthrew the tyrant Nabis in the Peloponnesus in 195; triumphed in 194; was ambassador to Greece in 192–190; censor in 189; envoy to Prusias of Bithynia 183, designing to arrest Hannibal, who was an exile there. D. about 174 B. C.—His brother, LUCIUS QUINTIUS FLAMININUS, was an able general and admiral, notorious for vice and cruelty.

Flamin'ius (CAIUS), an eminent Roman of plebeian birth, became tribune 232 B. C., and carried an agrarian

law against the strongest opposition; was prætor in 227; as consul in 223 defeated the Insubrian Gauls and triumphed, but was deprived of his office by the senate; was magister equitum to M. Minucius Rufus 221, but both had to resign immediately, on account of the squeaking of a mouse, an evil omen; was one of the censors in 220, and constructed the Flaminian Way and the Flaminian Circus; again consul in 217; marched against Hannibal, and was defeated and slain in the battle of Lake Thrasymene June 23, 217 B. C. Flaminius was a man of singularly bold and decided character, hated by the aristocrats and idolized by the common people. His son, CAIUS FLAMINIUS, was an able general, consul in 187 B. C.

Flammarion (CAMILLE), French astronomer, b. at Montigny le Roi, Haute Marne, Feb. 26, 1842, studied in the imperial observatory from 1858 to 1862, when he became editor of *Cosmos*. In 1865 was appointed scientific editor of the *Siècle;* in 1868 made several balloon ascensions to study the atmosphere at great altitudes. Has written *La Pluralité des Mondes Habités* (1862), *Les Mondes Imaginaires et les Mondes Réels* (1864), *Les Merveilles Célestes* (1865), *Dieu dans la Nature* (1866), *Histoire du Ciel* (1867), *Contemplations Scientifiques* (1868), and *Voyages Aériens* (1868); has some distinction as a popular writer and Spiritualistic lecturer.

Flam'steed (JOHN), first English astronomer royal, b. at Denby, Derbyshire, Aug. 19, 1646; graduated at Cambridge University, taking M. A. there in 1664; early began the study of the stars; was ordained as clergyman, and obtained the living of Bristow, Surrey, in 1684. He had been appointed astronomer royal in 1675, and finished the observatory of Greenwich in 1676. Here he passed his life in observation, determining the position of 2934 stars; erected a mural arc in Sept., 1689; quarrelled with Sir Isaac Newton, but ultimately adopted his philosophy, and d. Dec. 31, 1719. His great work was *Historia Cœlestis Britannicæ,* published in 1725 in 3 vols., the first trustworthy catalogue of the fixed stars.

Flan'ders, formerly the name of the territory comprising the two provinces of Belgium, East and West Flanders, the southern portion of the province of Zealand, in the Netherlands, and the two departments of France, Nord and Ardennes. In the latter part of the ninth century this territory was given by the French king Charles the Bald as a fief to his son-in-law, Baldwin with the Iron Arm, count of *Vlän-dergan,* who gave the country its name, and who by his prudent management laid the foundation of that agricultural, industrial, and commercial prosperity which soon afterwards made it powerful. A spirit of independence and republicanism sprang up with material success, and the relation between the Flemish towns and the counts of Flanders was often very loose. On the marriage of Marguerite of Flanders to Philip the Bold of Burgundy (1384), Flanders became united to Burgundy, and a century later (1477), on the death of Charles the Bold, it passed, together with this country, to the House of Habsburg by the marriage of Mary of Burgundy to the archduke Maximilian. On the abdication of Charles V., in 1556, Flanders and Burgundy came into the possession of the Spanish line of the House of Habsburg with Philip II., but the territory of Flanders was soon considerably diminished, a northern portion of it being transferred to the States General by the Peace of Westphalia (1648), and a southern portion being conquered by Louis XIV., and secured to him by the Peace of Utrecht (1713). The remainder of Flanders fell again, by the Congress of Rastadt (1714), to the Austrian line of the House of Habsburg, but in 1794 it was conquered by the French and incorporated with the French republic, and afterwards with the empire, until the Congress of Vienna (1814) conferred the territory on the kingdom of the Netherlands, to which it remained united till the formation of the kingdom of Belgium in 1831, of which kingdom it forms two provinces—East and West Flanders. But under all these changes Flanders was always rich and prosperous, for it was industrious and enterprising, and it was always independent or fighting for its independence. Flemish influence on commerce and industry, on literature and art, on morals and fashion in Europe, has been very considerable, and to the student who wishes to understand the relation between energy and prosperity, and between prosperity and morals, its history is a rich source of information.

FLANDERS, EAST, province of Belgium, bounded N. by Holland. It has an area of 1146 square miles, with a population of 857,726, or 751 to the square mile; it is the most thickly-peopled region in Europe. Its surface is a low and level plain belonging to the Scheldt basin. Its soil, though in many places sandy, has been made exceedingly fertile by spade cultivation and an excellent system of manuring. Flax and hemp are its most valuable productions; linen, laces, damasks, and bobbinet its most valuable manufactures. Its principal towns are Ghent and Dendermonde.

FLANDERS, WEST, province of Belgium, bounded N. by the North Sea and W. and S. by France. It has an area of 1237 square miles, with a population of 668,976. Its surface is flat, for the most part belonging to the Scheldt basin, but with a range of low, sandy hills along the coast. Its soil is sandy, but well cultivated and fertilized, though not so productive as that of East Flanders. Its principal towns are Bruges and Ostend.

Flanders, post-v. of Long Island, in Southampton tp., Suffolk co., N. Y. Pop. 160.

Flanders (BENJAMIN FRANKLIN), b. at Bristol, N. H., Jan. 26, 1816; graduated at Dartmouth College 1842; went to New Orleans in Jan., 1843; studied law and taught there; edited *The Tropic;* held some municipal and public positions; was forced to flee to the Northern States in Jan., 1862, for Unionism; returned to New Orleans when it was captured by the Union forces; was city treasurer in 1862, and member of Congress from Louisiana from 1863 to 1867; then military governor of the State 1867–68.

Flanders (HENRY), American legislator, b. at Plainfield, N. H., has published *Treatise on Maritime Law* (1852), *Treatise on the Law of Shipping* (1853), *Lives and Times of the Chief Justices of the U. S.* (2 vols., 1855–58), *Memoirs of Cumberland* (1856), *The Principles of Insurance,* etc.

Flandrin (JEAN HIPPOLYTE), b. at Lyons, France, Mar. 23, 1809, was the son of a miniature-painter; studied with Ingres and at Rome; obtained a high rank as an historical and portrait painter, and won numerous medals and distinctions; executed remarkable frescoes and glass-window paintings for many of the principal churches of Paris and other leading cities of France, as well as works for various government buildings. His last great undertaking, the fresco-painting of the Strasburg minster, he did not live to finish. D. at Rome Mar. 21, 1864.—His brothers, AUGUSTE (1804–42) and JEAN PAUL (b. 1811), also attained distinction as painters.

Flan'nel [perhaps allied to the Lat. *velamen,* or the Celtic *gloan,* "wool"], a fabric formerly made of wool alone, and still chiefly made of that fibre; but there are silk-mixed, linen-mixed, cotton-mixed, and all-cotton flannels. Flannels with a cotton warp are called dometts. All-cotton goods, baize-woven and having a dense nap on one side, are called canton or cotton flannels. In general, flannels have a loose-twisted yarn, and hence their superior warmth. There are many varieties—some twilled and others not—from the translucent gauze undershirting to heavy homespun flannels. Choice flannels are used for men's suits and for ladies' opera-cloaks. Many fancy flannels are now printed in colors.

Flash (HENRY LYNDEN), b. in the West Indies in 1837, published a successful volume of poems in 1860. Was educated in Georgetown College, D. C., and in Kentucky, and afterwards removed to Alabama. Has made various contributions to periodical literature.

Flat, a musical character (♭), the effect of which is the lowering of the note to which it is prefixed a minor semitone. On the organ and other keyed instruments each black (or short) key is the *flat* of the white key on the right hand, and also the *sharp* of the white key on the left. But as E and F, B and C, are only a major semitone apart, and have therefore no intervening black key, F♭ and C♭ are produced by striking the white keys E and B, being the next on the left hand respectively. A double flat (♭♭) lowers a flattened note a semitone further, which is effected by playing the white key next below (or on the left side of) the flat. An *accidental* flat is one which affects only a single note, or its repetitions in the same bar, except when the first note of the next bar is a mere prolongation of the preceding one. One or more flats placed at the clef, as B, E, A, D, etc., affect all the notes of similar name in every octave throughout a movement, unless contradicted by a natural (♮).

WILLIAM STAUNTON.

Flat Branch, tp. of Shelby co., Ill. Pop. 989.

Flat'bush, the central town of Kings co., N. Y., is on Long Island, 4 miles S. of Fulton Ferry, Brooklyn. It is a beautiful village, and is one of the wealthiest places in the State in proportion to its size. It contains the county almshouse, nursery, hospital, and lunatic asylum, a fine academy, a fine town-hall, a free public school, a weekly newspaper, four churches, hook-and-ladder and fire companies, and the county military parade-ground, which adjoins Prospect Park, Brooklyn, and covers 40 acres. Flatbush is connected with the Brooklyn ferries by horse-railroads. It is remarkable for the antiquated palatial style of many of its old dwellings. Its people are largely of Dutch descent. Flatbush was the scene of an important

battle (Aug. 27, 1776) between the Americans and the British and Hessian troops. Pop. of tp. 6309.

H. J. EGGLESTON, ED. "KINGS CO. RURAL GAZETTE."

Flat Creek, post-tp. of Barry co., Mo. Pop. 1571.

Flat Creek, tp. of Pettis co., Mo. Pop. 1651.

Flat Creek, tp. of Stone co., Mo. Pop. 595.

Flat Creek, tp. of Buncombe co., N. C. Pop. 1168.

Flat Creek, tp. of Lancaster co., S. C. Pop. 2088.

Flat Creek, tp. of Mecklenburg co., Va. Pop. 2328.

Flat Fish. See PLEURONECTIDÆ.

Flat'head In'dians, properly called **Se'lish,** and named **Hopil'po** by Lewis and Clarke. The name is incorrect, as, unlike the tribes mentioned below, they do not flatten the heads of their infants. By the labors of Father de Smet (see SMET, DE, P. J.) and other Jesuit missionaries they have all become Roman Catholics. They have adopted the dress and habits of white men, and are uniformly peaceful towards the whites. In 1871 they were removed by the U. S. government from their old abode on the Bitter Root River to the Jocko Valley, Mon. Their language is very hard to learn. (See its grammar—*Grammatica Linguæ Selicæ*, by MENGARINI, 1861.) It is affiliated with those of nearly all the tribes of their vicinity, who together constitute the Selish family, none of whom flatten the head. In 1872 the number of Flatheads on the reservation was put at 460, but it is understood that many of the tribe are not on the reservation.

II. The real Flatheads of the Pacific coast are mainly of the now nearly extinct Chinook group of fish-eating tribes. They flatten the skull of the infant, either by binding a board upon the forehead, so as to depress and flatten the top of the head, or by fastening a pad of grass upon the forehead. The operation lasts for several months, but its effects slowly wear away, and by the time manhood is reached the head is of nearly normal shape. It does not appear to affect the intellect. The same custom anciently prevailed among the Chickasaws, Choctaws, the Natchez (who flattened the head vertically), the Caribs, the Toltecs, the ancient Peruvians, and others; but the practice at present appears to be everywhere nearly extinct.

Flathead (or **Selish**) **Lake** lies in Missoula co., Mon., W. of the Rocky Mountains. Its waters flow through Flathead River into the Columbia.

Flathead Pass, in Mon., a gap in the Rocky Mountains; elevation, 6769 feet. Through this the Flatheads, Bannocks, and Shoshones have been accustomed to send hunting-parties eastward, and the eastern tribes to send war-parties westward of the mountains.

Flat'lands, post-tp. of Kings co., N. Y. Pop. 2286.

Flat Lick, tp. of Johnson co., Ill. Pop. 1180.

Flat River, tp. of Person co., N. C. Pop. 958.

Flat Rock, post-tp. of Clay co., Ala. Pop. 945.

Flat Rock, tp. of Randolph co., Ala. Pop. 901.

Flat Rock, tp. of Bartholomew co., Ind. Pop. 1543.

Flat Rock, tp. of Henry co., O. Pop. 1184.

Flat Rock, post-tp. of Kershaw co., S. C. Pop. 3755.

Flat Rock Spring, at Saratoga Springs, N. Y., has saline chalybeate waters much resembling those of the famous High Rock Spring.

Flat'tich (JOHANN FRIEDRICH), b. at Beyhingen, Würtemberg, in 1713; studied at Tübingen, and held several Protestant pastorates, the last at Münchingen (1760–97). He was one of the most famous instructors of South Germany, and had a wide influence in his time. His works on practical education were reprinted in 1856 at Heidelberg. D. at Münchingen in 1797.

Fla'vel (JOHN), English nonconformist clergyman, b. in Worcestershire about 1627, was educated at Oxford, and became rector of Dartmouth in 1656, but was ejected for nonconformity in 1662, and afterwards preached in private houses. His works are highly prized, and are *Husbandry Spiritualized* (1669), *A Saint Indeed* (1673), *Divine Conduct* (1678), *The Touchstone of Sincerity* (1679), *Personal Reformation* (1691), *Remains* (1691), *Exposition of the Assembly's Catechism* (1692), *The Soul of Man* (1698), *Methods of Grace* (1698). His complete *Works* were published in 1820 in 6 vols. D. at Exeter, and was buried June 29, 1691.

Flavia'nus, patriarch of Antioch in the fourth century; in early life was a lay monk, zealous for the faith; and, according to Theodoret, he, with Diodorus, his associate, first devised the choir and introduced the responsive singing of the Psalter. In 381 A. D. he was chosen bishop of Antioch to succeed Meletius, but was not fully acknowledged by all factions until 390. In 387 he interceded with Theodosius the Great for the seditious people of Antioch. He strongly opposed Arianism and the Mersulians, and d. in 404 A. D. Chrysostom was one of his pupils.—Another Flavianus was bishop of Antioch 498–511, when he was deposed and banished to Petra, where he d. in 518 A. D. He is honored as a saint by the Roman Catholic Church.

Flavia'nus, SAINT, became bishop of Constantinople 446 A. D., and was from the first opposed by Theodosius II., the emperor, who favored the Eutychian heresy. Flavianus called a synod which deposed and excommunicated Eutyches (448), but in 449 the emperor convened a council at Ephesus (the robber council), presided over by Dioscurus, bishop of Alexandria, who was the enemy of Flavianus. The latter, who was present, was deposed and ordered to be banished, but was set upon and so beaten by the Egyptian party that he d., 449 A. D.

Fla'vine, a preparation of QUERCITRON BARK (which see, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.).

Fla'vius, the name of many eminent Romans, mostly of the gens Flavia, an ancient plebeian stock, but many of the Flavii who figure in history were undoubtedly not of this gens, and were indeed not even Romans in a strict sense.—CNEIUS FLAVIUS, a Roman jurist who was curule ædile in 303 B. C., was the son of a freedman and secretary to Appius Claudius Cæcus. His publication of the *Jus Flavianum*, embracing the secret rules of judicial procedure, hitherto known only to pontiffs and patricians, caused great indignation, and made him exceedingly popular with the common people.—Vespasian, Constantine the Great, and many other Roman emperors bore the name of Flavius.

Flax. Like the more important cereal grains flax was known throughout the ancient seats of civilization in the East. It is therefore impossible to determine where it originated. It is known throughout the civilized world, and valued as an almost indispensable adjunct of our civilization. Its botanical name is *Linum usitatissimum.* The genus *Linum* contains several species, of which this is the only one of especial value or of commercial importance. The *plant* is an annual of quick growth, and probably a race which originated from a species still indigenous to Southern Europe. It grows from one to three feet high. The leaves are alternate upon the straight slender stem and branches. The flowers, which are in loose terminal panicles, are blue, about an inch in diameter, having a calyx of five sepals, a corolla of five petals, five stamens, and a pistil having five styles. The petals drop within a few hours after the flowers open, and the seed-heads, called *bolls*, form rapidly, becoming finally nearly globular. These consist of ten cells, each containing a flat oval seed of a reddish-brown color, very smooth and glossy. When the plant grows by itself in good soil, it branches freely, blossoms profusely, and yields a proportionately large quantity of seed. When, however, many plants are crowded together, each one grows as a single upright stem, bearing a few blossoms and little fruit at the summit. The valuable portions of the plant are the fibrous coating of the stalk, and the seed. The *stalk* is a woody cylinder, more or less pithy and hollow when dry, and enclosed in a bark consisting of long, strong, silky fibres cemented together by a kind of glue, and encased in an outer bark or skin, which adheres as if glued to the fibre. The *fibre*—when freed from all else, so far as possible, by the processes of rotting, to destroy the glue; breaking, to free it from the woody part of the stalk; scutching, to whip out the small particles of bark and stalk adhering; hatcheling, to straighten it and free it from tangles—is nearly pure bast fibre, is of a light grayish-brown color inclining to green, exceedingly tough, adapted to spinning and weaving, capable of being bleached to snowy whiteness and of taking a variety of colors in dyeing, which it holds faster than cotton, though it does not take readily so many dyes.

The ultimate filaments are hollow, thick-walled, and thus nearly solid cylindrical cells, which are terminated by exceedingly attenuated points. They are semi-transparent, of a silky lustre, and under the microscope the walls of the tube appear like a double line through the centre. These filaments vary in thickness from $\frac{1}{650}$th to $\frac{1}{5000}$th of an inch, according to the measurements of Mr. John Phin, who describes the cells as jointed, apparently like the stalks of the bamboo cane. (See FIBRES.) When the fibre is separated from the bark and wood of the stalk, as above indicated, it appears in market in two principal forms—namely, "dressed flax" and "tow," which are each of several qualities.

The *seed* consists of the embryo or kernel and its outer coverings, principally its reddish-brown shell, which is very mucilaginous, yielding, particularly to hot water, a thick, glairy gum, becoming quite viscid when cold. The kernel is rich in a valuable oil, which possesses the property of "drying" or hardening on exposure to the air to a remarkable degree (see LINSEED OIL), by which process of

drying it gains, instead of losing weight. Powdered flaxseed and powdered oil cake (linseed meal) are much used in medicine and surgery for poultices, epithems, etc., and are useful on account of their long retention of heat and moisture.

FLAX-CULTURE. Flax is a plant of rapid growth, for, being sown in April or May and harvested early in August, it is less than three months in possession of the ground. When raised for seed it makes considerable drafts upon the soil, which should therefore be rich and in fine tilth. As it is almost impossible for manure to be evenly distributed through the soil the first season, it is best to grow it upon land heavily dunged the previous year as for a corn-crop, but dressed the same season with wood-ashes or some other "hand manure" which can be evenly applied and is adapted to the wants of the land. Good wheat-soils are especially favorable to flax. Heavy clays, coarse gravels, light sands, and peaty soils are not so. Moderately stiff soils should be ploughed in autumn, light ones early in the spring. As soon as weeds begin to germinate and grass to grow the land should be thoroughly and evenly ploughed and harrowed. If the weather be not favorable to sow, the harrowing may be repeated, and thus successive crops of weeds killed in the seed leaf. Finally, when the ground is warm in spring, the seed should be sown. The practice in Europe is to sow very early; in this country flax should not be sown until after the oat crop is in—say from the 15th of April to the 1st of May in the Middle States. The quantity of seed sown to the acre depends upon the object for which the crop is raised; if principally for seed, half a bushel to three pecks is used; if for fibre mainly, a bushel to a bushel and a half is employed. It is very important that the sowing should be even, for otherwise the tendency to branch is great, and those plants which are least crowded will grow coarser and larger, ripen their seed unevenly, and cause the crop of lint to be of unequal fineness, and to leave much more of the fibre in the tow than otherwise need be. Flax should be sown as carefully as fine grass-seed, and to enable the sower to handle it more easily it is sometimes soaked a short time in cold water and then rolled in plaster. It should be harrowed in evenly with a light harrow. Some farmers, who raise flax for the lint principally, preferring that no horse should tread upon the land after sowing, brush the seed in with a heavy hand bush harrow, made like a stable broom by inserting short pieces of brush in a hard-wood head five or six feet long. This is drawn over the ground by means of handles attached at right angles, or nearly so, to the brush. It is most important that the flax should get the start of the weeds, and when it is about three or four inches high it should be carefully examined, and if necessary weeded at once—an operation best done in moist weather and by women and children, who go upon the crop without shoes, and work facing the wind, so that the breeze may favor the downtrodden plants to rise again. It is better to let the weeds grow than to weed the crop after the plants are six or eight inches high, or to do this hurriedly, mashing and bruising the plants. After this the crop is "laid by" until pulling-time.

Pulling.—Flax is ready to pull when it changes color decidedly after blooming, becoming of a yellowish or golden-brown color, two-thirds of the bolls being plump and beginning to turn brown, and the leaves having shrivelled and dried upon the lower half of the yellow stalks. Pulling should take place a little earlier than we describe if lint be the principal object, but a little later if the seed pays best. This is done by grasping a handful of stalks in one hand near the tops, and then pulling them with both hands, giving a *steady jerk*, so to speak. This handful is not laid down, but held while other handfuls are pulled, until as much is gathered as can conveniently be grasped; then it is bound after "butting" the roots even. Stalks which fall out and scatter are used for bands. These bundles are set up in long shocks, to become cured thoroughly before stacking. The drying process is greatly shortened if, instead of binding as soon as pulled, the gavels are spread out on the ground, so as to be turned and sunned on both sides before binding.

If the fibre is an important object with the farmer, the flax should be pulled as described, but otherwise it may be mowed with a scythe or cradle, or with a reaper, cutting close as possible to the ground. In using the scythe the swath must be thrown towards the standing flax; thus, the stalks are all left leaning against the flax, and may be gathered and laid in gavels to dry or be bound into sheaves.

Thrashing.—After drying and standing in the stacks, or not, as the case may be, the seed may be thrashed off by a flail or by beating the heads of the sheaves against a block of wood, which easily removes the bolls. On a large scale the seed is most easily removed by holding the bundles spread out, fan-shaped, upon the cylinder of a thrashing-machine, the "concave" being taken off. After this the flax is ready to be subjected to the process called

Retting (rotting).—This is conducted either under water, or upon the grass, where the flax is exposed to the action of the dew and sunshine. In "water-rotting" the flax is subjected in the bundles to the action of *soft* water in pools called "dams." The methods of setting or laying the bundles are various, and the rapidity of the action depends upon the warmth and softness of the water, varying from four to fourteen days. It is more uniform if it does not progress very rapidly. During the whole process it must be kept submerged, being weighted with stones. Waters containing iron or other mineral matters are likely to stain the fibre and to hinder the action. It requires some experience to know exactly when to remove the flax, for a few hours may make a considerable difference in the amount of fibre realized. If too much rotted, the lint will break and tangle, and be lost in the tow. If too little rotted, the fibre will break up with the stalk, and be scutched out with the shives. When the rotting (or retting) has been continued long enough, the woody part of the haulm separates easily and completely from the fibrous bark, which itself is easily divided upon the finger into individual fibres. When, however, the process has gone too far, the fibre is weakened, but this can only be quickly detected by the most experienced. When sufficiently rotted, the flax bundles are lifted from the water, opened, and spread upon the grass until perfectly dry. Then they are rebundled and housed until they can be conveniently subjected to the next process, which is

Breaking.—This is accomplished by machines called flax-breaks, which are variously constructed, but all accomplish the same end—namely, the breaking up of the stalks without doing violence to the fibre. A flax-break in common use and easily constructed consists of several hickory slats hinged at one end upon a form, and fastened at the other end into a heavy wooden head. These slats when let down occupy a horizontal position, and shut in between other similar fixed slats, but do not touch them. By means of a handle attached to the head the movable slats are raised up and down by one hand, while the flax held in the other is thrust in and drawn through, and thus "broken," so that the "shives," or pieces of broken stalk, or "boon," may be whipped or "scutched" out.

Scutching or *swingeing* is the next operation, and one performed both by simple hand-appliances and by more complicated machinery. The essential implements are the scutching-block and the scutching-knife. The former is an upright hard-wood board set in a block or fixed in any convenient place. It has in it a large notch, with one edge horizontal and cut to a sharp edge, the bevel being altogether upon one side. This notch is to receive a handful of flax, which resting upon the sharp wooden edge, hangs over upon one side. The scutching knife is made of hard wood also, and must be nine or ten inches broad and very thin. With this the "hand" of flax is struck sharp blows as it is turned in the notch, the knife being brought down close, parallel with the side of the board. Thus, the fibre is freed from most of its adhering impurities, and in this condition is usually baled and marketed in this country, but before it can be spun much more is necessary. In this condition the lint and the tow remain together, only the coarsest tow being separated from the fibre by the scutching process.

Hatcheling or *heckeling* consists in drawing the hands of flax-fibre through combs of long iron teeth set filling a circle or a square. The instrument is called a "hatchel" or "heckel," and there are usually two hatchels used—one, coarse, for a preliminary operation, the other, fine, for finishing. The hand of flax is hatcheled from the tips to the middle—first one half, and then the other; the tow being left in the teeth of the hatchel, and the teeth being frequently cleaned of the same. The ends accomplished by this process are three—namely, the subdivision of the fibres into their finest filaments, the separation and removal of all broken or short fibres (the tow), and the laying of the lint parallel and untangled. The operation requires considerable skill, and upon it depend to a great extent the value of the result. It will be long before American farmers to any great extent will prepare their flax-fibre for market by the careful dressing practised in Germany, Holland, and Great Britain; but until this is done the value of the crop will be greatly less than it might otherwise be. In general, this crop is and will be cultivated in this country mainly for the seed, the lint being roughly treated and sold for cordage and for coarse fabrics. The amount produced in 1870, according to the U. S. census for that year, was 27,133,034 pounds of flax and 1,730,444 bushels of seed. More than half—namely, 17,880,000 pounds of the lint—was raised in Ohio alone, and the great bulk of the seed was raised in Ohio, Indiana, and Illinois, Ohio

producing more than one third of the entire amount—namely, 632,000 bushels. During the "cotton famine" caused by the late civil war greatly increased interest was manifested in flax-culture, and great efforts were made to treat the fibre so that it could be worked upon cotton machinery; but these efforts resulted in no marked success, and were given up when cotton again became abundant.

M. C. Weld.

Flax, New Zealand, the *Phormium tenax*, a large perennial, liliaceous plant, native of New Zealand, and grown for its fibre, which is exported to some extent, and used as a substitute for hemp, which is inferior to New Zealand flax in strength, but superior in durability. The fibre is obtained from the long and flaglike leaves, which are two to six feet long and one to three inches broad.

Flax, Purging, the *Linum catharticum*, a plant resembling the common flax on a small scale. It is a European annual, and has been considerably used in medicine as a gentle hydragogue cathartic.

Flax′man (John), the most poetical sculptor that England has produced, was b. in the city of York July 6, 1755. He was the second son of John Flaxman and his wife, whose maiden name was Lee. When he was only six months old his father, who had gone to York from London, where he had failed to find sufficient work in his trade of modeller in plaster, returned to the capital, taking his family with him. Cunningham says that the elder son, William, distinguished himself as a carver in wood. The elder Flaxman was a good workman and a good father; his plaster casts were in great favor with artists, and, although not an artist himself, he had sense and perception enough to encourage the early indications of talent in his afterwards famous son. When Flaxman was ten years old his mother died, and soon after the father married a second wife, whose maiden name was Gordon. This lady proved a good mother to her husband's children, and in time gave them a sister, who later in life was a beloved inmate of Flaxman's married household.

Flaxman was born into the world a feeble child, and was brought up with difficulty. For a long time he moved about with the help of crutches, and this weakness kept him much within doors. He loved to sit behind his father's counter in the shop, surrounded by the images of gods and goddesses, where he would amuse himself for hours with his pencil and paper, and where he often saw notable people, artists and literary men, his father's customers, who would sometimes chat with the boy or amuse themselves with looking at his childish attempts at drawing. Roubiliac, the sculptor, was one of these visitors, and Cunningham says that in his day there was a studio-legend that Flaxman had been for some time under the direction of the Frenchman, who had declared he saw no symptoms of talent in him. There could be no foundation for such a legend, because Roubiliac died in 1762, when Flaxman was seven years old. But if Flaxman was spared the injury that so meretricious a sculptor as Roubiliac might have done him, he was not left to grope his way without aid. Another of his father's visitors was the Rev. Henry Mathew, a clergyman of some note in his day, who, though now forgotten, has a substantial claim to our gratitude for his kindness, not only to Flaxman, but to William Blake. Mrs. Mathew was one of the most distinguished of the circle of Blue-stockings whose works and ways fill such a space in the literary and social gossip of the time. Her husband brought young Flaxman to her, a feeble child moving slowly on crutches, but with fine eyes and a beautiful forehead; and in this excellent lady he found a kind and sympathizing friend. She knew how to train and develop his mind, and to encourage his talent without spoiling him. He was eleven years old when he first knew Mrs. Mathew, and he frequently visited her house in the evening to hear her read Homer and Virgil and discourse upon sculpture and poetry. It is said that while Mrs. Mathew read Homer, Flaxman would sit by her side, and as she commented on the pictorial beauty of his poetry, the child would embody such passages as caught his fancy. A Mr. Crutchely, having seen some of these youthful performances (many of which have been preserved), commissioned from him a set of drawings in black chalk. These subjects, six in number, were all drawn from the Greek poets, and they have an interest for us as having been the modest precursors of those illustrations of Homer, Æschylus, and Pindar which were to carry Flaxman's name and fame to every part of Europe and America. At the age of fifteen Flaxman entered the Royal Academy as a student; in 1770 he exhibited a figure of Neptune in wax (this was the era of waxwork); and during the next five years he sent ten pieces to the Academy. Among his early works were his own portrait-bust, quarter size, modelled in his twenty-third year, two statues, *Grecian Comedy* and a *Vestal*, and many portrait-busts of his friends.

Either Mr. Mathew or Stothard had introduced him to Blake, who was two years his junior, but their tastes were so similar that an introduction was hardly needed. It was in the nature of things that a strong friendship should spring up between these two, great alike in art (though with such different greatness) and in force and purity of personal character. Flaxman remained under his father's roof until 1782, when he married, at the age of twenty-seven, Ann Denman, an amiable and accomplished woman with a love of art and literature, and in full sympathy with her husband's tastes and pursuits. She d. in 1820. Flaxman and his wife had no children. In 1787, Flaxman went to Italy, taking his wife with him, and remained there for seven years, living for the greater part of that time in Rome. While in Italy he made for Mrs. Hare Nayler the well-known series of designs in outline for the *Iliad* and *Odyssey;* for the countess Spencer the illustrations to Æschylus, and for Mr. Thomas Hope the illustrations for the *Divina Commedia* of Dante. He was an acute observer, and studied closely the remains of ancient sculpture in Rome, making many memoranda which were afterwards embodied in his *Lecture on Sculpture.* While in Rome he executed several works in marble, but none of them of much importance, if we except the *Cephalus* and *Aurora*, a commission from Mr. Thomas Hope. Shortly after his return to England he made his statue of Lord Mansfield. In 1797 he was elected an associate of the Royal Academy, and in the same year he sent to the exhibition three sketches in bas-relief from the New Testament and the statue for the monument of Sir William Jones. In 1800, being then in his forty-fifth year, Flaxman was elected a member of the Royal Academy, and on this occasion he presented to the Academy a marble group, *Apollo and Marpessa*, in compliance with the rules of the institution, which require from each new member a specimen of his skill. He now produced in rapid succession many of his best works—the monument in memory of the Baring family; the Lushington monument; the monument to the countess Spencer; to Mrs. Tighe, the poetess; with others to the memory of the Tarborough family, to Mr. Edward Balme, and to the Rev. Mr. Clewe. Flaxman was at his best in these religious subjects, for he was in full sympathy with Christianity, and unconsciously expressed his own devout, amiable character in these works, full of tenderness and spiritual feeling, and with a grace sometimes suggesting the Greek, sometimes the early Italian, but, after all, leaving an impression wholly English. His historical-allegorical monuments cannot be so thoroughly enjoyed. Flaxman's genius was not of the heroic type, and though it is not necessary to accept Mr. Ruskin's grunting disparagement of him, yet it is true that his field was a narrow one, and that he blundered when he tried to climb. He was a Fra Angelico born out of due time, and in the dull, mechanical England of his day, instead of Italy, where he would have been at home. Mr. Ruskin says of his *Dante* that "it contains, I think, examples of almost every kind of falsehood and feebleness which it is possible for a trained artist, not base in thought, to commit or admit, both in design and execution." This criticism, though true of the *Dante*, is balanced by no recognition of what is true and lovely in Flaxman's other work, where he was more at home—in the *Homer* especially, and in those simple groups in marble for which Mr. Ruskin can say no more than that they "were always good and interesting." It does not even do justice to the *Dante*, in which—with much that is weak and pretentious, as there is even in Blake, and must, from the nature of the case, be in every one who attempts the task of illustrating Dante—there is some happy and ingenuous design. The world has been kinder to Flaxman than Ruskin would have it, and as his name has long been a dear one to the world of humble lovers of art, it is pleasant to know that in the new birth of art in England, in a time that brings back "the touch of a vanished hand and the sound of a voice that is still," the name of Flaxman is also dear to many of those who have led the van in the new revolution.

Among the statues made by Flaxman were those of Sir Joshua Reynolds, of Sir John Moore, of Pitt, of Joseph Warton, of George Stevens, of the rajah of Tanjore, of the missionary Schwarz, of Lord Cornwallis, and of Warren Hastings. In 1810 the Royal Academy created a professorship of sculpture, and requested Flaxman to fill the chair. "A small premium was offered for six annual lectures," says Cunningham, "and, as money was never his object, he proceeded to fulfil the duties of his office with enthusiasm and knowledge. His first lecture was delivered in 1811." He gave in all ten lectures, and these are the subjects: 1, English sculpture; 2, Egyptian sculpture; 3, Grecian sculpture; 4, Science; 5, Beauty; 6, Composition; 7, Style; 8, Drapery; 9, Ancient art; 10, Modern art. They were published in 1829 in one vol., with 52 plates.

With all his mildness of manner and real gentleness of disposition, Flaxman was capable of noble anger, and ready enough at need to express it. When in Italy he had bluntly expressed to the ambassador of the French, who proudly showed him a medal of Bonaparte, his contempt for the plunderer of Italy and the trampler upon the liberties of France. When the Peace of Amiens once more opened Paris to the English, Flaxman again visited the capital to see the glories of the Louvre, splendid in its stolen peacock plumes. In Paris, David called on him, but the English sculptor drew himself up, held his hands behind his back, and refused the proffered civilities of the friend of Marat.

Besides his *Lectures on Sculpture*, Flaxman produced some minor writings, not perhaps of much importance. A chapter on the character of Romney's works for Hayley's *Life* of Romney is mentioned by Cunningham, and he also contributed to *Rees' Cyclopædia* the articles, "Armor," "Basso-Rilievo," "Beauty," "Bronze," "Bust," "Composition," "Cast," and "Ceres." The articles on "Armor" and "Basso Rilievo" were illustrated by Blake, who also made some slight illustrations, says Gilchrist, for a *Letter* which Flaxman addressed to the committee for raising a monument to commemorate the naval triumphs of Great Britain. In his sixty-sixth year Flaxman modelled for Lord Egremont a statue of the archangel Michael vanquishing Satan, and finished the celebrated *Shield of Achilles*, ordered by Rundell & Bridge, the silversmiths. This is one of the most beautiful and characteristic of his productions; indeed, Flaxman was never happier than when working in bas-relief, for which he had a genius all his own. Cunningham says that "the very way in which he made it was peculiar; he modelled it roughly in clay, had it cast into plaster of Paris, and then finished it for the silver-moulder. It was in this way that he made his chief works; no one could work so felicitously in plaster as himself; it carried a softness and a beauty from his touch which it could derive from no other hand." No doubt this skill was inherited from his father. "A wistful remembrance of the superiority of 'old Flaxman's' casts," says Gilchrist (*Life of Blake*, vol. i. p. 37), "still survives among artists." Besides these two works, Flaxman made in these later days his statues of *Psyche*, the *Pastoral Apollo*, *Michael Angelo*, and *Raphael*, with those of Kemble and Robert Burns.

Flaxman died, after a brief illness, on Dec. 7, 1826. He was buried in the churchyard of St. Giles in the-Fields on Dec. 15th, the president and council of the Royal Academy assisting at his funeral. (His *Life* has been well and sympathetically written by ALLAN CUNNINGHAM in the 3d vol. of his *British Painters, Sculptors, and Architects*, London, 1830. There are also some valuable memoranda in ALEXANDER GILCHRIST'S *Life of William Blake*, London, 1867.) CLARENCE COOK.

Flea, the common name of the insects of the family Pulicidæ, wingless creatures regarded by some as constituting a separate order, Aphaniptera, but more generally considered as degradational forms referable to the Diptera, or two winged insects. They grievously infest the higher animals, the common flea (*Pulex irritans*) attacking man as well as beast, while other species attach themselves to the dog, cat, mole, and various other mammals and birds. The *Sarcopsylla penetrans*, or chigoe, is another flea which seriously troubles man. Most of the fleas are distinguished by great powers of leaping. Many anecdotes are related of fleas trained to perform curious feats which have been often exhibited in public. It is doubtful whether there is any training in the case. The feats which seemingly evince intelligence are probably acts necessitated by the mechanical conditions to which the insect is subjected.

Flea.

Flea'bane [so called from their insecticide powers], a name given to various herbs of the order Compositæ, especially to those of the genus *Erigeron*. The *Erigeron Canadense* and *Philadelphicum* yield strong-smelling, volatile oils which are sometimes used in medicine as diuretics. The allied genera, *Pulicaria* and *Conyza*, are called fleabanes in England. The destructive powers of various composite plants upon insects appear to reach their maximum in *Pyrethrum carneum* and *roseum* of Asia and Europe, the leaves of which are largely used as an ingredient of the Persian insect-powder, so deadly to insect vermin.

Flea Hill, tp. of Cumberland co., N. C. Pop. 1899.

Flea'wort Seed (*Semen psyllii*), the seeds of *Plantago Psyllium*, a kind of plantain of Europe and Barbary. The seeds are mucilaginous, like flaxseed, and are sometimes used for the same purposes in medicine. They are not often brought to America.

Flèche, La, town of France, in the department of Sarthe, on the Loire. It has a military school for the education of the sons of poor officers or distinguished soldiers. Pop. 7077.

Fléchier (ESPRIT), b. at Pernes, France, June 10, 1632; was educated by the Fathers of Christian Doctrine at Avignon; taught rhetoric at Narbonne; went to Paris in 1661, where his talents as a preacher won him great preferments. In 1673 he was admitted to the Academy; in 1685 became bishop of Lavour, and in 1687 was translated to Nîmes, where he was beloved alike by his own Church and by the Huguenots. D. at Montpellier Feb. 16, 1710. His *Oraisons Funèbres*, *Panégyriques des Saints*, and *Lives* of Theodosius the Great and of Ximenes are his principal works.

Fleet [allied to the word *float*]. An assembly of twelve or more vessels takes the name of *fleet*, and is divided into three divisions, of one, two, or three squadrons, each squadron comprising not less than four vessels. (*Parker's Tactics*.) The term fleet implies not only a collection of ships of war of a sovereign state, but is applied as well to a number of merchant-vessels employed in a particular branch of commerce. RAYMOND P. RODGERS.

Fleet Mar'riage. The Fleet prison in London, like Gretna Green in later times, and May Fair and the Savoy at a somewhat earlier date, was long a famous resort for clandestine marriages. Fleet marriages are first mentioned in 1613, and in 1754 were forbidden by statute. The officiators were Church of England clergymen in prison for debt. The most famous Fleet marriage was that of Henry Fox, afterwards Lord Holland, to Georgina Caroline Lennox, daughter of the duke of Richmond. (See J. S. BURN, *History of the Fleet Marriages*, 1834.)

Fleet Prison, or **The Fleet,** in London, was in use before 1200, both as a debtors' and king's bench prison. It was such until 1641, when, on the abolition of the Star Chamber, it became, like the Marshalsea, a debtors' prison. It was burned in 1381 by Wat Tyler, in 1666 at the Great Fire of London, and in 1780 by the Gordon rioters. In 1842 it was abolished by statute, and in 1845 pulled down. It was the scene of many disgraceful abuses.

Fleet'wood (JOHN), D. D., English theologian, published *The Christian Prayer Book* (1772), *The Christian Dictionary* (1773), *Life of Christ, and the Lives of the Apostles, John the Baptist, and the Virgin Mary* (1813), the last often reprinted.

Flem'ing, county in the N. E. of Kentucky, bounded on the W. by the Licking River. Area, about 500 square miles. The E. portion is mountainous, the soil very productive. Cattle, grain, tobacco, and wool are staple products. Cap. Flemingsburg. Pop. 13,398.

Fleming, post-v. and tp. of Cayuga co., N. Y., on the Southern Central R. R. The town lies on Owasco Lake. Pop. 1207.

Fleming (JOHN), Scotch clergyman and naturalist, b. near Bathgate, Linlithgowshire, 1785; preached in Shetland and at Flisk, Fifeshire; appointed to the chair of natural philosophy at King's College, Aberdeen, 1832; resigned the position in 1843, having identified himself with the Free Church, and became professor of natural science in the Free Church College of Edinburgh 1845. D. Nov. 18, 1857. The *Philosophy of Zoology* was published about 1822; *History of British Animals*, in 1842; *Molluscous Animals, including Shellfish*, in 1837.

Fleming (THOMAS), soldier in the Revolution, commanded the troops from Botetourt co., Va., in the battle of Point Pleasant with the Indians, being thrice wounded, and was appointed colonel Mar. 2, 1776. D. Aug., 1776.

Fleming (WILLIAM), b. in 1754, was a citizen of Cumberland co., Va.; educated at William and Mary College; was in the Virginia conventions and the house of burgesses (1775–76), and in the latter year was one of the committee on Independence; became a judge of the general court, and was for a time presiding judge of the court of appeals; was in the U. S. Congress 1779–81. D. Feb. 2, 1824.

Flem'ingsburg, post-v., capital of Fleming co., Ky., 17 miles S. of Maysville, on the C. F. and P. G. R. R., and 4 miles S. of the Maysville and Lexington R. R. It has 2 banks, 2 schools, 1 college, 7 churches, 1 newspaper, 2 large flouring-mills, 2 distilleries, 3 hotels, Masonic and Odd Fellows' Hall, and an artesian well 1700 feet deep. Principal business, raising wheat, corn, tobacco, etc. Pop. 425.

C. H. ASHTON, ED. "FLEMINGSBURG DEMOCRAT."

Flem'ington, post-v., capital of Hunterdon co., N. J., on the Central R. R. of New Jersey, 50 miles from New York. It has 2 newspapers, a national bank, 2 hotels, 4

churches, and a large number of stores and shops. It is in a rich agricultural district, and has an extensive trade with the surrounding country. Pop. 1412.

W. G. CALLIS, ED. "THE HUNTERDON REPUBLICAN."

Flemington, post-tp. of Taylor co., West Va., on the Baltimore and Ohio R. R. It is the seat of West Virginia College and a normal school. Pop. 942.

Flem'ingville, post v. of Owego tp., Tioga co., N. Y., on the Southern Central R. R., 4 miles N. of Owego. Pop. 91.

Flem'ish Language and Literature. With the exception of some slight differences in pronunciation and orthography, the Flemish (or Vlaemisch), language is identical with the Dutch. The difference is a difference of name only, and the true name is "Flemish" or "Vlaemish;" "Dutch" or "Hollandish" did not come into common use until a comparatively late period. Now, Flemish designates the Dutch language as far as it is spoken by the inhabitants of the Belgian provinces of East Flanders, Antwerp, Limburg, West Flanders, and Brabant; and the most interesting feature in its present history is the contest which takes place within the boundaries of the Belgian kingdom between this branch of the Germanic tongue and the Walloon, a French dialect spoken by the inhabitants of the other Belgian provinces, Liège, Hainaut, Namur, and Luxemburg. The division is nearly equal, the Flemish having a numerical superiority of half a million, and the Walloons having politically and socially the advantage of their compatriots. In 1869 there were reported 180,000 Flemish-speaking people in France.

When the Belgian provinces were overrun by the armies of the French republic in 1794, and subsequently united to France by the treaty of Campo Formio, French became not only the official, but gradually also the literary, language of the country. Flemish ceased to be used in newspapers, pamphlets, and works of science and imagination; nay, it even ceased to be the conversational medium of the higher circles of the Flemish population. And, singularly enough, the establishment of the kingdom of the Netherlands in 1815, and the annexation of Belgium to Holland, did not materially alter this course of affairs. The interests of these two countries were so unlike that they were almost foreign to each other, and the partiality of the Dutch government for its Dutch subjects was so marked that a kind of hatred sprung up between the two countries. The Dutch government tried to gain the sympathy of the Flemish population of Belgium by patronizing their native language; but even these attempts at reconciliation were received with suspicion and mistrust, and it was not until after the separation of Belgium from Holland in 1830 that the Flemish movement became an open and acknowledged tendency in the life of its inhabitants. Willems, who at his death (in 1846) stood at the head of this movement, and was one of the most popular men among the Flemings, was twenty years earlier very unpopular among the same men, and on account of the same ideas, simply because these ideas were then espoused by the Dutch government. But after the separation the movement grew rapidly, carried on by men like Willems, Blommaert, Conscience, Van Duyse, Snellaert, Snieders, and Van Ryzwick. In 1860, 76 political newspapers and 31 weekly and monthly periodicals of miscellaneous character were issued in the Flemish language; and the *Nederduitsch Tijdschrift*, commenced in 1862 by Emmanuel Hiel, is the most spirited and elegant periodical in Belgium, and a competent rival of French publications of the same kind. A reconciliation between the Flemings and the Dutch has also taken place; linguistical congresses of scholars and writers from the two countries have been held and attracted much attention; and at present it seems rather questionable whether the strong community of commercial and industrial interests, which in the Belgian kingdom keeps the Flemings and the Walloons together, will be strong enough to conquer the elements of dissension and jealousy which differences in origin and character, in language and ideas, cannot fail to generate.

CLEMENS PETERSEN.

Flem'ming (PAUL), M. D., b. at Hartenstein, Saxony, Oct. 17, 1609; studied medicine at Leipsic, and took his degree at Leyden. In 1633 he joined the legation sent to Russia by the duke of Holstein-Gottorp, and was attached to the Persian embassy 1635–39; married an Esthonian lady, and d. at Hamburg Apr. 2, 1640. He wrote *Geistliche und Weltliche Poemata* (1642), including the fine hymn *In allen meinen Thaten;* also Latin poems, love-songs, and a pastoral called *Margenis*.

Flens'borg, handsome and thriving town of Sleswick, at the W. end of Flensborg Fjord. It has good shipyards, excellent oyster-beds, some tobacco manufacture and spinning, and sugar-refining industry. Pop. 21,325.

Flers, town of France, in the department of Orne. It has considerable linen manufactures. Pop. 10,054.

Flesh [from the Ang.-Saxon], in a narrow sense includes only the muscular tissue of animals, especially of the vertebrates, and in a still narrower popular sense the muscular tissues of fishes, reptiles, and birds are excluded; but as ordinarily used the name applies to all solid animal tissues, excluding the bones. The flesh of animals comprises in this sense not only muscles, but fasciæ, fibrous, adipose, and other tissues, cartilage, nerve-substance, the parenchyma of the viscera, etc.; each of which is described under its alphabetical head. (See MEAT EXTRACT.)

Flesh-Fly, the common name of various insects of the order Diptera, family Muscidæ, of which the best known is the *Sarcophaga carnaria*, the common flesh-fly. The *Musca* (or *Lucilia*) *cæsa*, *Musca* (or *Calliphora*) *vomitoria*, and other species are common to both continents, and deposit their already-hatched larvæ upon fresh meat and decaying animal matter—sometimes on the wounds of soldiers—giving rise to a most disgusting crop of maggots. A single female sometimes deposits 20,000 maggots.

Flesh Juice. See MEAT EXTRACT.

Fletch'all, tp. of Worth co., Mo. Pop. 582.

Fletch'er, post-v. of Brown tp., Miami co., O. P. 306.

Fletcher, tp. and post-v. of Franklin co., Vt., 30 miles N. N. W. of Montpelier. Pop. 865.

Fletcher (ANDREW) **of Saltoun,** Scotch publicist, b. at Saltoun in 1653, opposed the royal court in the Scottish Parliament in 1681, and was forced to retire to Holland. Returned to England in 1683; took part with the duke of Monmouth in 1685; served in Hungary against the Turks in 1686; returned to England with William of Orange in 1688; brought forward the bill of security in the Scotch Parliament in May, 1703; opposed the union in 1706; and d. in London in 1716. His *Political Works* were published in 1737.

Fletcher (BENJAMIN), a soldier of fortune who was governor of the province of New York (1691–98), succeeding Sloughter and preceding the earl of Bellomont. He was a dissolute man, and in New York attempted to establish the Church of England in opposition to the wishes of the people. Was also (1693–95) governor of Pennsylvania by the illegal commission of William and Mary.

Fletcher (JAMES COOLEY), clergyman, traveller, and author, b. at Indianapolis, Ind., in 1823; graduated at Brown University in 1846, studied theology at Princeton Seminary, N. J., then at Paris, France, and in Geneva, Switzerland, marrying there a daughter of Dr. C. Malan. Went in 1851 to Rio de Janeiro, S. A., as chaplain missionary of the American and Foreign Christian Union and the American Seamen's Friend Society. Here he was also secretary of the U. S. legation. Returning to the U. S. in 1854, he again visited Brazil in 1855, and travelled extensively in the empire. Having returned to the U. S., he issued his *Brazil and the Brazilians*, in connection with Rev. D. P. Kidder, D. D.—an illustrated imperial octavo. Has since then again visited Brazil, and the edition of his great work issued in 1868 contains the result of tours made during the years 1862–65. Has written for the *New York Observer*, *Evening Post*, *Journal of Commerce*, etc. In 1869 was appointed U. S. consul to Oporto, Portugal.

Fletcher (JOHN), English dramatist, b. in Northamptonshire in 1576, was educated at Cambridge, and became the friend of Francis Beaumont. D. in London in 1625, of the plague. Was sole author of *The Faithful Shepherdess*, *The Scornful Lady* (1616), *The Spanish Curate*, comedy (1622), *Rule a Wife and Have a Wife*, comedy (1624), etc., besides his share in the long line of plays in which his name is inseparably associated with that of Beaumont.

Fletcher (JOHN WILLIAM), originally **de la Fléchière,** b. at Nyon, Switzerland, Sept. 12, 1729; studied at Geneva; served in the Portuguese and Dutch armies; visited England, and became a minister of the Established Church in 1757, being vicar of Madeley. Wrote in defence of Wesley's Arminianism. The countess of Huntingdon appointed him president of her theological school at Trevecca, Wales, 1768. D. at Madeley Aug. 14, 1785, his principal work being *Checks to Antinomianism*. All his writings were published in 8 vols. He was one of the founders of Methodism, and a man of great industry and piety and of most amiable and saintly character. He was also a keen polemic.

Fletcher (PHINEAS), English poet, b. about 1584, entered Cambridge University in 1600, and was rector of Hilgay, Norfolk, in 1621; d. there about 1660. Wrote various poems—*The Locustæ, or Apollyonists*, a satire against the Jesuits (1627), rare; *Sicelides, a Dramatic Piece* (1631), *Joy in Tribulation* (1632), *The Purple Island, or The Isle of Man*, together with *Piscatoric Eclogues and other*

Poetical Miscellanies (1633), etc. He was a cousin of Fletcher the dramatist, and brother of Giles Fletcher (LOSS 1623), a clergyman, and author of the fine poem *Christ's Victory and Triumph* (1610).

Fletcher RICHARD, LL.D., b. at Cavendish, Vt., Jan. 8, 1788; graduated at Dartmouth College in 1806; studied law with Daniel Webster; was admitted to the bar in 1809; and settled at Salisbury until 1825, when he removed to Boston, Mass. Was member of the Massachusetts legislature; a representative in the U. S. Congress in 1837–39; judge of the Massachusetts supreme court 1848–53; and d. June 21, 1869, at Boston, bequeathing $100,000 to Dartmouth College.

Fletcher (WILLIAM A.), American jurist, b. in Massachusetts; settled in Michigan about 1820; practised law at Detroit; was attorney-general of the Territory; in 1835 chief justice of the supreme court of the State; retired from the bench in 1842, and resumed his practice. The *Revised Statutes of Michigan* were published by him in 1838. D. at Ann Arbor, Mich., 1855.

Fleur de Lis [Fr. for "flower of the lily"], often Anglicised into **Flower de Luce,** the flower of the *Iris sambucina* (order Iridaceæ), a plant native in the south of Europe and cultivated for many centuries in gardens. This flower is famous as the emblem of the French kings, whose arms in later times were azure, three fleurs de lis, or, borne two and one. Many curious legends were related as to the origin of this emblem. The historical fact appears to be that the Frankish kings employed the fleur de lis as a kind of badge long before the proper rise of heraldry. The heraldic fleur de lis is a common bearing upon arms in other countries.

Fleurus, town of Hainaut, Belgium, 7 miles N. of Charleroi. Here Gonsalvo of Córdova was defeated by the dukes of Brunswick and Saxe Weimar Aug. 29, 1622; Waldeck was defeated by Marshal Luxembourg July 1, 1690, and the prince of Coburg, having gained here a virtual victory over Jourdan, June 26, 1794, lost its fruits, and indeed the whole of Belgium, by bad strategy after the fight. The battle of Ligny, 1815, took place a mile or two N. of Fleurus. Pop. 4093.

Fleury (CLAUDE), ABBÉ, French ecclesiastic and historian, b. at Paris Dec. 6, 1640, was advocate to the Parliament of Paris 1658–67, and tutor to the princes Conti in 1672; in 1689–1707 sub-preceptor with Fénelon to the dukes of Burgundy, Anjou, and Berri. Was prior of Argenteuil in 1707, confessor to Louis XV. 1716–22, and d. July 14, 1723. Published *Morality of Christians*, *Ecclesiastical Law*, *Historical Catechism* (1683), etc., but his greatest work is his *Ecclesiastical History* (20 vols., 1691–1723).

Fleury (ÉMILE FÉLIX), French general, b. in Paris Dec. 23, 1815; entered the army in 1837; served eleven campaigns in Algeria; was sub-lieutenant in 1840, captain in 1844, major in July, 1848, and on his return to France a general of brigade Mar. 18, 1856, and general of division Aug. 13, 1863. Was a thorough Napoleonist, and became officer of the Legion of Honor in 1849, grand officer Aug. 13, 1859. Was summoned to the French senate by decree Mar. 15, 1865, was chief equerry to Napoleon III. Dec., 1865, having received the grand cross of St. Anne in 1864. In 1866 was sent on a diplomatic mission to King Victor Emmanuel, and in Sept., 1869, became French ambassador at St. Petersburg. In Sept., 1870, resigned this position, and with his family retired to Switzerland.

Fleury, de (ANDRÉ HERCULE), CARDINAL, b. at Lodève, France, June 22, 1653; studied at the Jesuit College, Paris; was made bishop of Fréjus 1698; in 1715 became preceptor to Louis XV.; in 1721 was admitted to the Academy; in 1726 assumed the position of prime minister of France, and was made a cardinal. His policy was to foster the sciences and arts, to increase the internal prosperity of France, and to reduce the expenses of the government; but his foreign policy lacked vigor. D. at Paris Jan. 29, 1743.

Fleury, de (LOUIS), CHEVALIER and VISCOUNT, French lieutenant-colonel in the American Revolutionary army, having received a captain's commission from Washington; served at Fort Mifflin on the Delaware and at the battle of Brandywine, and was promoted to be lieutenant-colonel Nov. 26, 1777. In the winter of 1777–78 he was sub-inspector under Steuben; June 4, 1778, adjutant-general of Lee's division; in July, 1778, was second in command of a battalion of light infantry in the Rhode Island expedition, and then commanded a battalion of light infantry under Washington. He received the thanks of Congress and a silver medal for gallantry in the storming of Stony Point, July, 1779. Returned to France in 1780 with Rochambeau, becoming one of his officers.

Flexibil'ity [from the Lat. *flecto*, *flexum*, to "bend"], that quality by which certain bodies may be made temporarily or permanently to change their form under the influence of mechanical forces. Thus, a long leaden rod held by one end in a horizontal position is bent downward by its own weight. Flexibility, though not the opposite of brittleness, cannot be predicated of brittle bodies.

Flex'ible Sand'stone, sometimes called **Itacol'umite,** a metamorphic siliceous rock found in the Southern Alleghanies, and especially in Brazil. It occurs in thin layers, which are to a certain degree flexible, but are not elastic. Such sheets may be bent forward and backward hundreds of times without breaking. The cause of this peculiar property of itacolumite has been much discussed. Prof. Wetherell of Philadelphia, after a careful microscopic examination of the granules of quartz which compose this rock, announced that he had discovered that they are elongated and interlocked, each particle working in a kind of joint. This statement has been denied by subsequent observers, but the weight of authority is in favor of its acceptance. Gold and diamonds are frequently found with itacolumite, and it has been thought that the association of the two latter was something more than accidental. No relationship has, however, been proved to exist between them.

J. S. NEWBERRY.

Flex'ure of Beams. A beam or girder is defined by Rankine as "a bar supported at two points, and loaded in a direction perpendicular or oblique to its length." The term *beam* is sometimes, as is the case of a tie or collar beam, used where the strain is in the direction of the beam, but such use is exceptional, and in this article beam and girder will be considered as synonymous. If it is supported at but one point it is called a semi-girder. A beam or girder may be a continuous solid, like a trunk of a tree, or it may be an assemblage of many members united to form an artificial bar. Such girders are variously known as braced girders, frames, and trusses.

The greater portion of the following summary of the laws of the strains in various kinds of beams will be condensed from Stoney's *Theory of Strains in Girders and Similar Structures*, a standard work on the subject; to which book, among many others, reference is made for fuller discussions than are possible in the limits of the present article.

The following mechanical laws are the basis of the theory of strains:

Resolution of Forces. If three forces meet and balance at a common point, three lines parallel to their directions will form a triangle whose sides will be proportional to these forces.

If it is known that three forces balance, and that two of them meet, the line of direction of the third must pass through their point of intersection.

Law of the Lever.—If a weight rests on a beam supported at its two extremities, the part of the weight which is upheld by either support will be to the whole weight as the distance between the weight and the other support is to the distance between the supports. The upward reaction of either support is equal and contrary to the pressure on it.

Equality of Moments.—When any number of forces, acting in the same plane on a rigid body, balance, the sum of the moments of the forces tending to turn it in one direction around any given point is equal to the sum of the moments of those tending to turn it in the opposite direction.

When any number of forces acting in the same plane have a single resultant, the sum of the moments of the forces around a given point is equal to the moment of their resultant.

The moment of a force around a given point is the product of the intensity of the force by its lever-arm, the latter being the perpendicular let fall on it from the given point.

The ordinary girder has an I cross-section, the top and bottom being called *flanges*, and the vertical connection the *web*. Tubular or double-webbed girders are those whose cross-sections are a hollow rectangle or a ring.

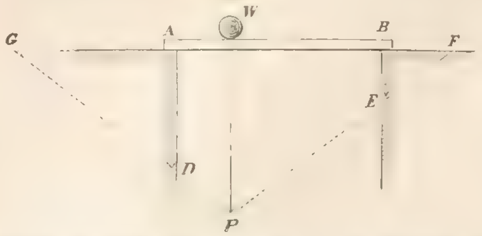
Throughout the discussion that follows the girders are supposed to be without weight, unless the contrary is stated.

The strains that act on material bodies may be divided into two great classes—tensile, tending to pull bodies apart; and compressive, tending to crush them. As a matter of convenience and of clearness these names are generally limited to forces acting in the direction of the axes of bodies, or nearly so. Forces acting at right angles to the axes are termed transverse forces; those that tend to break bodies by twisting are torsional forces, and those that act to make the elementary transverse sections of a body separate from the sections on either side are called shearing forces. The shearing forces on horizontal beams are vertical in direction.

In Fig. 1 the weight W on the beam A B is transmitted

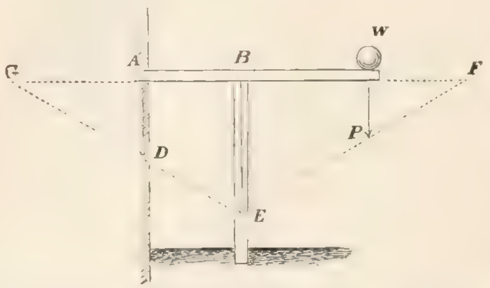
through the beam to the abutments. The nearer abutment

Fig. 1.



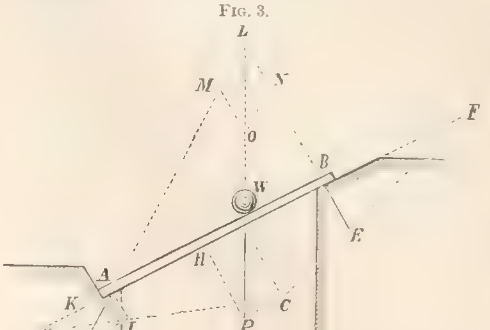
supports the greater part of the load. If we represent the weight by the line W P, abutment A will support the portion equal to A D, and abutment B the portion equal to B E. The amount of the weight on each abutment will be just equal to the upward force that would be required at that abutment to support that end of the beam in case the abutment were removed. The amounts of these weights may be determined graphically by laying off on each side of the point W distances W F and W G, each equal to A B, and connecting F and G with P. If lines parallel to W P be drawn from A and B, the distances intercepted on these lines, when measured by the same scale that was used in laying off W P, will give the amounts of the weight which are borne by each abutment. In all positions of W it is equal to A D + B E. If the weight, as in Fig. 2, be out-

Fig. 2.



side of the points of support, we shall have it acting to depress one end of the beam, while the wall above A will hold down the far end, B being the fulcrum around which the forces act. The masonry above A will exert enough downward pressure to prevent motion. This pressure into the lever-arm A B must equal W into the lever-arm W B. Hence, calling F the force at A, $F \times A\,B = W \times W\,B$; whence $F : W :: W\,B : A\,B$, or as $\frac{1}{A\,B} : \frac{1}{W\,B}$. Thus, as in Fig. 1, the forces at the extremities of the beam are inversely proportional to their distances from the point of support. As the weight and the pressure of the wall above A both act downward, the pressure on B is equal to their sum, or $B\,E = W\,P + A\,D$. The pressures exerted at B may be obtained by laying off $B\,F = A\,W$, and drawing a line from F through P until it meets B E. If B G be also made equal to A W, and G E be drawn, the vertical line A D will give the pressure at A. In this case the pressure at B equals the sum of the other two.

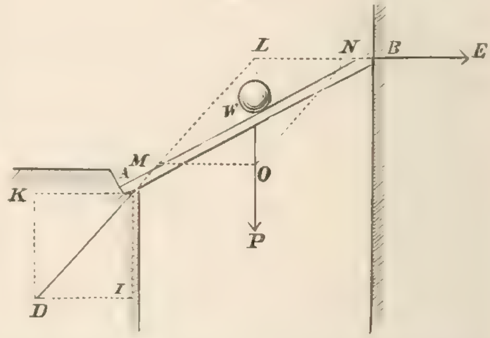
Fig. 3.



If the beam be inclined, as in Fig. 3, the resolution of forces would take place in a similar manner. Resolving the weight W P into its components W H and W C, we find that the former is transmitted directly to A, where it becomes A K, and is resisted by the abutment. Considering only the force W C at right angles to the beam, we find, as in Fig. 2, the two pressures B E and A I. The former is the only pressure on abutment B, but the latter must be combined with the force A K, and there will result a pressure A D on abutment A.

The same result could have been obtained as follows. We know the direction, intensity, and point of application of the weight, and the points of application of the two reactions. We also know the line of direction of the reaction of the right abutment, as it must be perpendicular to the beam. Therefore, drawing B L perpendicular to the beam, and prolonging it until it meets W P prolonged upward, we find L the point of intersection of the three forces. Connecting this with A, we have the direction of the pressure on the left-hand abutment. Laying off $L\,O = W\,P$, and constructing the parallelogram L M O N, we find L N and L M as the pressures on the two abutments. They agree with what we have found by the other method.

Fig. 4.



If, as in Fig. 4, the beam rests against a vertical wall, forming what is generally known as a shed-roof, the direction of the resistance of the right-hand abutment is changed, and there is a corresponding change in the intensities of the developed pressures. In Fig. 3, B E had a vertical component; in this case it has none, but the component A I is equal to the weight W P, showing that the whole weight is transmitted to the left-abutment. The pressure A D is therefore greater than the original weight.

If in the cases above given the weight, instead of being concentrated, were uniformly distributed, the pressures on the abutments would be obtained by replacing the distributed weights by a single weight equal to their sum and located at their centre of gravity.

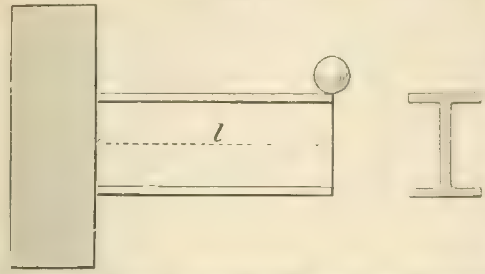
When a weight is placed at the extremity of a semi-girder, it tends to shear or separate the section on which it rests from the one adjoining it. The molecular forces prevent this separation, and the tendency to shear is transmitted to the next section, and thus to the abutment. Thus, a vertical force equal to the weight is transmitted from section to section to the point of support. This strain is called the shearing strain. Its action in solid girders is obscure, but it must act on non-horizontal lines, as it is a well-known mechanical law that vertical forces can only generate strains that are vertical or have vertical components.

When the vertical web of a girder with horizontal flanges is open-work, like latticing, the shearing strain is altogether transmitted through the bracing, the flanges being capable of conveying strains in the direction of their length only; but when the web is continuous, as in a plate girder, it is probable that a small amount of shearing force acts upon the flanges also. If, however, one or both flanges are curved, the whole or a considerable portion of the shearing-strain is conveyed through that part of the flange which is sloped, the amount depending on the angle of inclination. In this case the web has less duty to perform than if the flanges were horizontal, and its sectional area may therefore be reduced. It will also be observed that the diagonal strains developed by the shearing force in a continuous web have horizontal components within the web itself, and, consequently, a continuous web aids the flanges to a certain extent, for those parts of the web which adjoin the flanges share the horizontal strains in the latter; and this flange-action of the web is greater the thicker the web is. When, however, the web is very thin, the total amount of this flange-action of the web is small compared with the strain in the flanges themselves, and may therefore be neglected without introducing any serious error. In the following discussions the web will not be considered except when it is expressly so stated.

In the flanged semi-girder shown in Fig. 5 it may be proved that the horizontal strain of tension in the upper

flange is equal to the horizontal strain of compression in the lower flange: also, that the weight which it is capable

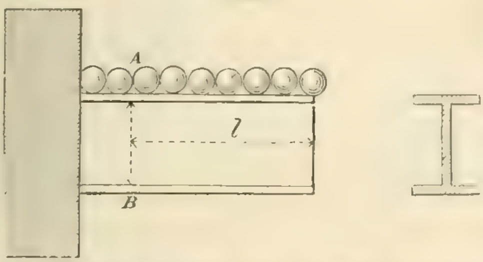
FIG. 5.



of supporting varies directly with its depth and inversely with its length. When both flanges are horizontal the strains per square inch in the flanges are inversely proportional to their areas. It follows from this that to ensure the greatest strength with a given amount of material in a girder with horizontal flanges, the sectional areas of the flanges should be inversely proportional to the maximum strains per square inch which can be permitted in the respective flanges.

The shearing strain is the same at each vertical section, and is equal to the weight at the extremity.

FIG. 6.



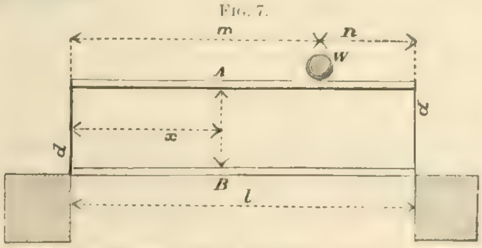
In a flanged semi-girder uniformly loaded we shall find the following expression for the strain in either flange at any section, as A B:

$$F = \frac{w\,l^2}{2d},$$

in which F is the strain, w the weight on each lineal foot, l the length from the end to the assumed section, and d the depth.

The shearing strain at any section of this girder is equal to the weight between it and the outer end: it therefore increases towards the abutment. If the flanges are parallel, all of the shearing strain will pass through the web, and therefore the latter should increase in thickness toward the abutment.

FIG. 7.



In a flanged girder resting on two supports, as in Fig. 7, and supporting a single weight, the horizontal strain in either flange at any section, as A B, will be found by taking the moments of all the forces around A or B. We thus obtain

$$F = \frac{n\,x\,W}{d\,l},$$

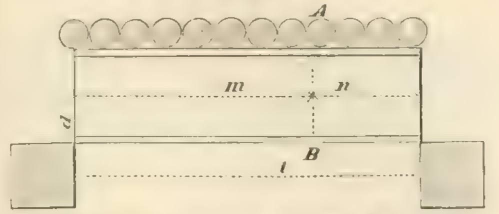
in which F is the strain, x the distance of the section from one of the abutments, and the other letters are explained by the figure. It will be found that the maximum strains at any point of either flange occur when the weight rests on that point. In this case $x = m$, and the strain is

$$F = \frac{m\,n\,W}{d\,l}.$$

If the weight be a moving one, the greatest strain in either flange will be found when the weight is at the middle of the girder. The shearing strain in each segment of the girder is uniform, and is equal to the portion of the weight transmitted to the abutment through that section.

If several weights rest on a girder, the strains should be calculated for each separately, and then added.

FIG. 8.



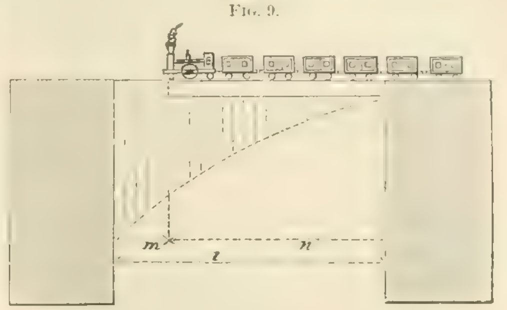
In a uniformly loaded girder, as in Fig. 8, we have

$$F = \frac{m\,n\,w}{2d} = \frac{m\,n\,W}{2dl},$$

the nomenclature being the same as in Fig. 7. W is the total weight on the girder, and therefore it equals wl.

Comparing this value of F with that previously found for a single weight, we find that the strains at any point in the flanges due to a single weight resting on this point are twice as great as would be produced if the same weight had been uniformly distributed. The shearing strain at the middle of a uniformly loaded girder is 0, and at any other point it is equal to the weight on the girder between that point and the middle.

FIG. 9.



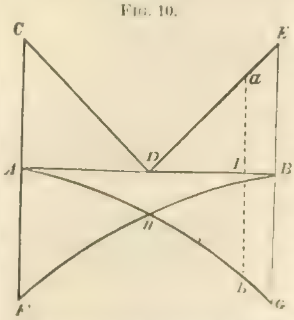
Suppose a girder partly loaded with a uniform train weighing w tons per running foot. Its weight, as in Fig. 9, is wn, and its moment around the right abutment is $wn \times \frac{n}{2} = \frac{wn^2}{2}$. The moment around the right abutment of the pressure on the left abutment (R) is Rl. Hence,

$$Rl = \frac{w\,n^2}{2}.$$

R therefore varies as the square of n. But R is the shearing strain through the segment in front of the train. It therefore varies as the ordinates of the dotted parabola represented in the figure. When the train comes from the left, a similar parabola is generated, whose vertex is at the left end of the girder.

The maximum shearing strains on any girder traversed by a passing load may be found from Fig. 10. The two triangles A C D and D E B represent the shearing strains from the permanent load which is the weight of the structure. The two parabolas F H B and A H G represent the shearing strains from the passing load. At any point I the ordinate ab represents the maximum shearing strain from the permanent and the moving loads.

FIG. 10.



The maximum strains in the flanges will be found when the load covers the whole girder.

Transverse Strain.—In any body under transverse strain the *neutral surface* is that surface at or near the centre of body where compression ceases and extension begins. The *neutral axis* of any cross section is the intersection of this section with the neutral surface. In every girder the horizontal forces in any cross section must balance, otherwise the girder would separate at this place. The *moment of rupture* of any cross section is the sum of the moments of the horizontal forces in that section which tend to produce rupture. It will always be represented by the symbol M.

To calculate the strength of solid rectangular or solid round semi-girders we have the following:

$$W = \frac{a\,d\,S}{l},$$

in which W is the breaking weight, a the area of the cross-section of the girder in square inches, and S a number determined by experiment, and called the coefficient or modulus of rupture. The value of S for different substances can be obtained from tables prepared for this purpose.

The following formulas can readily be deduced:

Semi-girder loaded uniformly........................ $W = \frac{2a\,d\,S}{l}$.

Girder loaded at intermediate point........ $W = \frac{a\,d\,l\,S}{m\,n}$.

Girder loaded at centre.................................. $W = \frac{4a\,d\,S}{l}$.

Girder loaded uniformly................................ $W = \frac{8a\,d\,S}{l}$.

The breaking weights of similar girders, which determine their strengths, are therefore found to vary as their cross-sections.

If the law of uniform elastic reaction holds good in girders subject to transverse strains, the neutral axis of any cross-section will pass through the centre of gravity of the section. Assuming this law to be true, for lack of a more exact assumption, we find the following moments of rupture for various cross-sections. In these expressions M is the moment of rupture, b the breadth, d the depth, r the radius, t the thickness of hollow sections, and f the horizontal strain per square inch on the fibres in the section, whose distance from the neutral axis is c.

Solid rectangle.. $M = \frac{b\,d^3\,f}{12c}$.

Solid square with one diagonal vertical .... $M = \frac{b^4\,f}{12c}$.

(In this case b is the side of the square.)

Solid circle.. $M = \frac{\pi\,f\,r^4}{4c}$.

Circular ring of uniform thickness........................ $M = \frac{\pi\,f\,r^3\,t}{c}$.

Solid ellipse with one axis horizontal.................... $M = \frac{\pi\,b\,f\,d^3}{4c}$.

(b is the horizontal semi-axis, and d the vertical.)

Elliptic ring with one axis horizontal. .... $M = \frac{\pi\,d^2\,f\,t}{4c}(3b + d)$.

(b is the exterior horizontal semi-axis, and d the exterior vertical.)

Flanged girder or rectangular tube, omitting the web.. $M = \frac{a_1 a_2\,d^2\,f}{A\,c}$,

in which a_1 = area of upper flange, a_2 the area of lower flange, d the depth of the web, and $A = a_1 + a_2$.

Flanged girder or rectangular tube, including the web.............. $M = \frac{f}{c}\left\{\left(a_1 + \frac{a_3}{3}\right)h_1^2 + \left(a_2 + \frac{a_4}{3}\right)h_2^2\right\}$,

in which a_3 is the area of the web above the neutral axis, a_4 the area below the neutral axis, and h_1 and h_2 the corresponding heights of the web.

Flanged girder with equal flanges. ....$M = \frac{d^2\,f}{12c}(6a + a')$.

(a = area of either flange, a' = area of web.)

Rectangular tube with equal flanges......... $M = \frac{f}{12c}(b\,d^3 - b_1 d_1^3)$.

(b_1 = internal breadth, d_1 = internal depth.)

Square tube of uniform thickness, with sides or diagonal vertical... $M = \frac{2\,b^3\,f\,t}{3c}$.

Semi-girders Loaded at the Extremity.—To apply these values for the moment of rupture to semi-girders of any of the sections indicated, we have only to substitute in the equation

$$W\,l = M,$$

the particular value of M given above. To get breaking weights, substitute for f the breaking strain per square inch of the particular substance, and for c the distance from the neutral surface or centre of gravity to the outermost fibres.

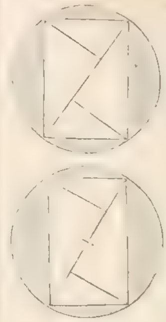
The following facts may be easily deduced:

A solid square semi-girder is 1.4 stronger when its sides are vertical than when its diagonal is.

To cut a rectangular girder of the maximum strength out of a round log, draw a diameter and divide it into three equal parts. At one of the points of division erect a perpendicular. From the point at which it cuts the circumference draw lines to each end of the diameter, and they will be the sides of the cross-section of the required girder. According to Humber, the stiffest solid rectangular girder that can be cut out of a cylinder is obtained by dividing a diameter into four parts and proceeding as before. The strength of a solid square girder is 1.7 times that of the inscribed cylinder.

The centre of a cylindrical girder may be removed without seriously diminishing its strength, and therefore it is more economical to make such girders hollow. It may also be shown that the transverse strength of a hollow cylinder is to that of a solid cylinder of the same weight approximately as the diameter of the former is to the radius of the latter.

Fig. 11.



A square tube of uniform thickness, with its sides vertical, is 1.4 times stronger than when its diagonal is vertical. Square and round tubes of equal weight are about equally strong when the square tube is strained parallel to its sides. Round tubes, however, should be preferred wherever the strain is liable to come from various directions, as square tubes are much reduced in strength when strained in the direction of the diagonals.

A continuous web in a girder with flanges of equal area does theoretically as much duty in aid of the flanges as if one-sixth of the web were added to each flange and the web were made of bracing.

Semi-girders Loaded Uniformly.—The breaking weights for uniform loads may be obtained, as for single loads, by using the equation

$$\frac{W}{2} \times l = \frac{w\,l^2}{2} = M,$$

in which W is the total weight on the girder, and w is the weight on each unit of length.

Girder Supported at Both Ends, and Loaded at Intermediate Point.—Let x = the distance of any transverse section from the end of the girder which is farthest from the weight.

f = the strain per square inch on the extreme fibres at top or bottom.

Also let m and n be the two segments into which the weight divides the girder, b the breadth, d the depth, r the radius, t the thickness; and we obtain the following:

Solid rectangular girders.. $W = \frac{f\,b\,d^2\,l}{6\,n\,x}$.

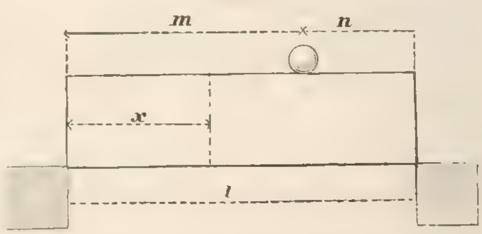
Solid round girders.. $W = \frac{\pi\,f\,l\,r^3}{4\,n\,x}$.

Hollow round girders of uniform thickness........... $W = \frac{\pi\,f\,l\,r^2\,t}{n\,x}$.

Flanged girders or rectangular tube, including web,

$$W = \frac{f\,l}{c\,n\,x}\left\{\left(a_1 + \frac{a_3}{3}\right)h_1^2 + \left(a_3 + \frac{a_4}{3}\right)h_2^2\right\}.$$

Fig. 12.



In the last formula all the terms are the same that were used before in the similar case of a semi girder.

Girders Supported at Both Ends, and Loaded Uniformly.—For girders loaded uniformly we have the general equation

$$W = \frac{2\,l}{m\,n} \times M,$$

m and n being the two segments of the girder. To get the breaking weights of such girders we have only to substitute for M its value depending on the form of cross-section. We therefore readily deduce—

Solid rectangular girders.. $W = \frac{f\,b\,d^2\,l}{3\,m\,n}$.

Solid round girders.. $W = \frac{\pi\,f\,l\,r^3}{2\,m\,n}$.

Hollow round girders, uniform thickness .... $W = \frac{2\,\pi\,f\,r^2\,t\,l}{m\,n}$.

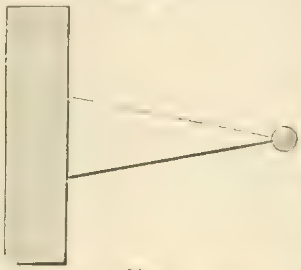
Flanged girders or rectangular tubes including web,

$$W = \frac{2\,f\,l}{c\,m\,n}\left\{\left(a_1 + \frac{a_3}{3}\right)h_1^2 + \left(a_2 + \frac{a_4}{3}\right)h_2^2\right\}.$$

Uniform Strength.—A girder is said to have uniform strength when one part is as apt to break as another. The construction of girders thus proportioned is evidently the most economical use of a given amount of material.

From the formulas already given the following forms for uniform strength can readily be deduced:

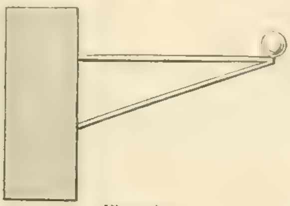
FIG. 13.



Plan.

Flanged semi-girder of uniform depth, loaded with a weight at the outer end; its plan will be a triangle with the weight at its apex.

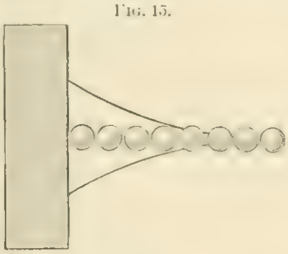
FIG. 14.



Elevation.

Flanged semi-girder of uniform width, loaded with a weight at the outer end; its elevation will be a triangle with the weight at its apex. The strain in the inclined flange will exceed that in the horizontal one in the ratio of their respective lengths.

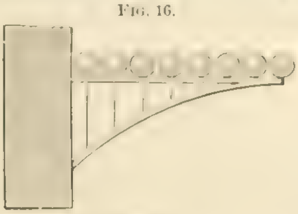
FIG. 15.



Plan.

Symmetrical flanged semi-girder of uniform depth and uniformly loaded; its plan will be bounded by two parabolas, with a common vertex at the outer end of the girder, and their axes at right angles to that of the girder.

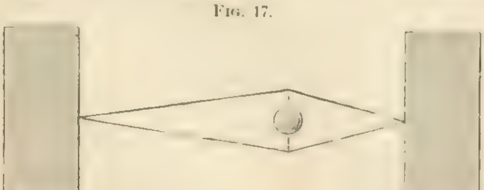
FIG. 16.



Elevation.

Flanged semi girder of uniform width and uniformly loaded; its lower flange will be a parabola, with its vertex at the outer end of the girder, and its axis a vertical line through the same point.

FIG. 17.



Plan.

Flanged girder of uniform depth, supporting a single fixed weight; its plan will be two triangles having a common base under the weight.

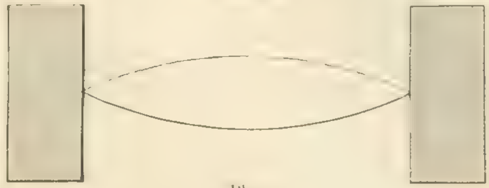
Flanged girder of uniform width, supporting a single

FIG. 18.

Elevation.

fixed weight; its elevation will be a triangle, with its apex down and immediately under the weight.

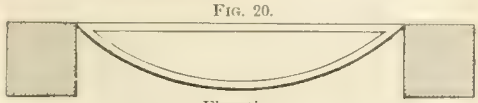
FIG. 19.



Plan.

Flanged girder of uniform depth, supporting a single *moving* weight; its plan will be two parabolas, with their vertices at the middle of the span, and their concavities turned toward each other.

FIG. 20.



Elevation.

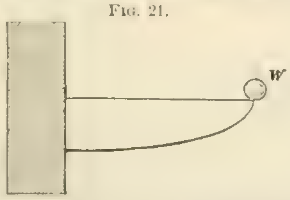
Flanged girder of uniform width, supporting a single *moving* weight; its elevation will be a parabola, with its axis vertical and at the middle of the span.

Flanged girder of uniform depth and uniformly loaded; same plan as Fig. 19.

Flanged girder of uniform width and uniformly loaded; same elevation as Fig. 20.

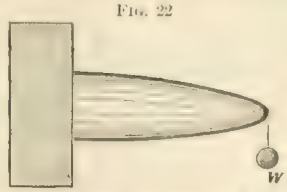
Solid rectangular semi-girder of uniform depth, supporting a weight at the outer end; same plan as Fig. 13.

FIG. 21.



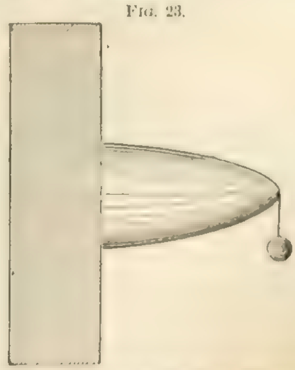
Solid rectangular semi-girder of uniform width, supporting a weight at the outer end; its elevation will be a parabola, with its vertex at the outer end and its axis horizontal.

FIG. 22



Solid round semi girder, supporting a single weight at its outer end; it will be a solid of revolution formed by revolving a cubic parabola around a horizontal axis. (Equation of cubic parabola $y = ax^3$.)

FIG. 23.

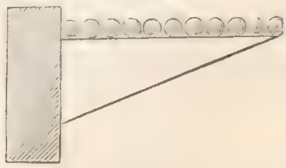


Hollow round semi girder of uniform thickness, support-

ing a single weight at its outer end: it will be a hollow solid of revolution formed by revolving a parabola around a horizontal axis.

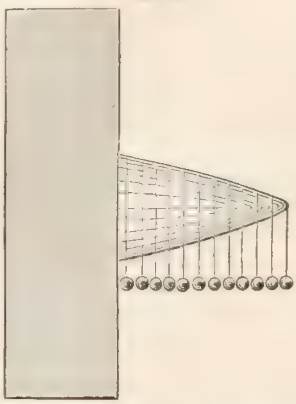
Solid rectangular semi-girder of uniform depth and uniformly loaded; same plan as Fig. 15.

FIG. 24.



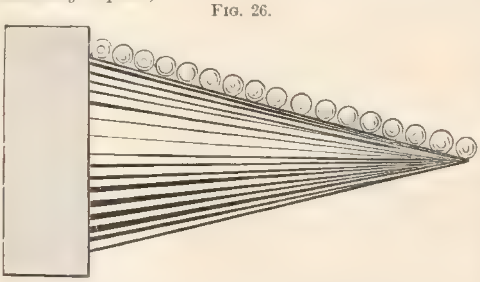
Solid rectangular semi-girder of uniform width and uniformly loaded; its elevation will be a triangle, with its apex at the outer end.

FIG. 25.



Solid round semi girder uniformly loaded; it will be a solid of revolution formed by revolving a semi-cubic parabola around a horizontal axis. (Equation of semi-cubic parabola $y^2 = p^2x^3$.)

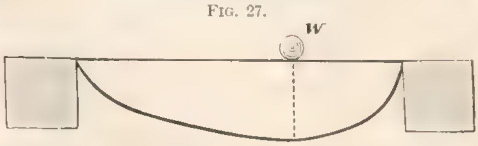
FIG. 26.



Hollow round semi-girder of uniform thickness and uniformly loaded; it will be a hollow cone with horizontal axis.

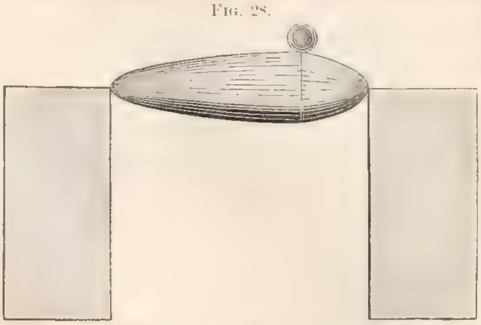
Solid rectangular girder of uniform depth, supporting a single fixed weight; its plan will be the same as Fig. 17.

FIG. 27.



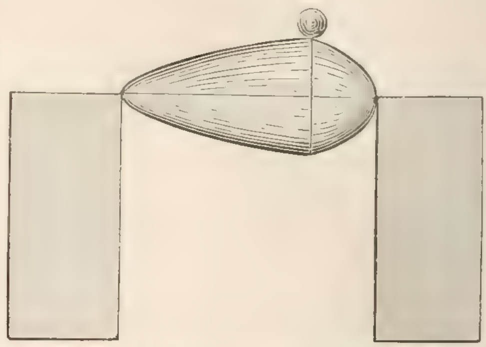
Solid rectangular girder of uniform width, supporting a single fixed weight; its elevation will be bounded on the under side by two parabolas, having their vertices at either end of the girder and their axes horizontal.

FIG. 28.



Solid round girder, supporting a single fixed weight; it will be a solid of revolution formed by revolving around their common axis two cubic parabolas, with vertices at the points of support. The solid will be in the shape of a spindle.

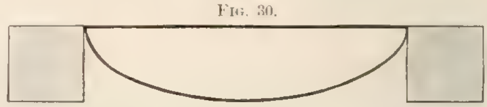
FIG. 29.



Hollow round girder of uniform thickness, supporting a single fixed weight; it will be a hollow solid of revolution formed by revolving around their common axis two parabolas, with vertices at the points of support.

Solid rectangular girder of uniform depth, supporting a single *moving* weight; same plan as Fig. 19.

FIG. 30.



Solid rectangular girder of uniform width, supporting a single *moving* weight; its elevation will be bounded on the under side by a semi-ellipse, with vertices at the points of support, and the top of the girder as one of its axes.

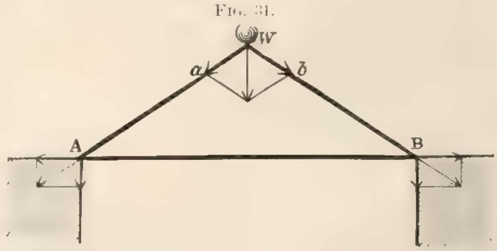
Solid rectangular girder of uniform depth and uniformly loaded; same as Fig. 19.

Solid rectangular girder of uniform width and uniformly loaded; same as Fig. 20.

Theory and practice do not agree very well in the matter of the strength of girders, and the formulas given for solid girders give results much smaller than the actual fact.

This is probably due to the fact that the neutral axis does not pass through the centre of gravity, as has been assumed. Mr. Hodgkinson concluded, from his experiments on a cast-iron girder, that the neutral axis was at a distance from the compressed side equal to from one-fifth to one-sixth the depth. Similar results were found by Barlow in experimenting upon the strength of timber. The whole subject is not yet well understood. It is safe, however, to conclude that the tensile and compressive strength of materials cannot be determined with accuracy from experiments on transverse strains.

FIG. 31.



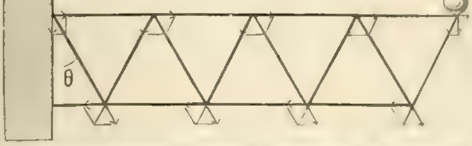
The primary object of bracing is to change transverse strains into longitudinal ones. The best bracing is made up of triangles, as they are the most stable of geometrical figures, having the least tendency to change shape under pressures at the apexes. In the frame represented in Fig. 31 the weight is resolved into two components, *W a* and *W b*, which go to the respective abutments. Here they are resolved into horizontal and vertical components, the former of which balance through the tie-beam A B, and the others, each of which is equal to half of *W*, press vertically on the supports.

The following are the technical terms used in bridge-building: The top of a bridge truss is variously called the top chord, the top, the boom, and the upper flange. The first name is generally used in the U. S. Similarly, the bottom of a bridge is known as the bottom chord, the bottom, and the bottom flange. The intermediate members

are known as the bracing or the web. Braces under tension are called ties; those under compression, struts. Vertical struts are generally called posts. The intersection of a brace with a chord or flange is called an apex. The distance between two adjacent apexes is called a panel or bay. When the moving load is carried on the top of a bridge the latter is called a deck or undergrade bridge; when carried on the bottom, a through or overgrade bridge. As a matter of convenience, tensile strains are generally marked *minus* (—), and compressive strains *plus* (+).

The strain on any member from different weights is the algebraic sum of the strains from each weight. The same member may sometimes be extended and sometimes be compressed, but it can only sustain one kind of a strain at a time. A uniformly distributed load is assumed, for convenience of calculation, to be concentrated at the apexes, each apex supporting a weight equal to that on the adjacent half panels.

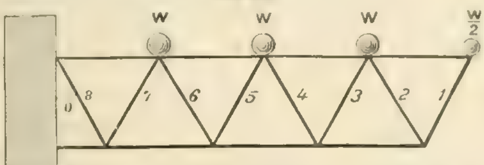
FIG. 32.



The accompanying diagram represents the effect of a single weight at the extremity of a braced semi-girder, showing how the weight is transmitted through the braces in succession to the abutment. It will be seen that the strains are equal on all the braces, but that while the strain on the outermost brace is compressive, that on the second is tensile, that on the third compressive, etc., alternating thus to the abutment. All the strains in the top chord are tensile, and they increase in amount from the weight to the abutment, each brace bringing up a new tensile strain, which is added to that previously developed. The least tension is in the segment nearest the weight, and the greatest in that adjoining the abutment. In the bottom chord the strains are compressive, increasing in amount towards the abutment.

Designating the angle of each brace with the vertical by θ, we find that the strain on each brace is W sec. θ. The strain on the outermost segment of the top chord is W tan. θ, while the increment of strain from each brace except the last is $2 \times W$ tan. θ. The increment from the last is W tan. θ. The compressive strain on the bottom chord from each brace is $2\ W$ tan. θ. The sum of the tensile strains on the top chord, which is the strain on the segment nearest the abutment, is $8\ W$ tan. θ, and the compressive strain on the corresponding segment of the bottom chord is likewise $8\ W$ tan. θ.

FIG. 33.



In a semi girder uniformly loaded, as in Fig. 33, each weight will be transmitted to the abutment, as in Fig. 32. The outermost weight passes through all the braces, the next through all but the two outer, and so on to the abutment. The sum of the strains on any brace is equal to the sum of the strains from each weight considered separately. Calling this sum Σ, we have the following:

$$\Sigma = n\ W \text{ sec. } \theta\,;$$

in which n is the number of weights that pass through the brace. For instance, one full weight and a half of a weight pass through 3 and 4. Therefore, for these two $n = 1\frac{1}{2}$. By summation of the strains in each chord we find the following for any panel of the loaded chord:

$$F = \left\{ m\,(m-1) + \tfrac{1}{2} \right\}\ W \text{ tan. } \theta\,;$$

and for any panel of the unloaded chord,

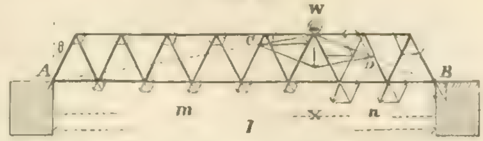
$$F = m^2\ W \text{ tan. } \theta,$$

in which F is the strain on the panel, and m is the number of the panel from the outer end.

The chief practical use of the calculations on semi-girders is in the construction of drawbridges.

If the semi girders thus far examined had been lattice trusses, in which each brace is intersected by one or more others, it would only be necessary to make separate calculations for the braces of each system, taking account only of the weight on the apexes of that system, and to add together all the strains on the chords.

FIG. 34.



In the girder or truss shown in Fig. 34 we know, on the principle of the lever, that the resolution of the weight will take place on the lines W A and W B. The course of W C, the component that goes to A, may readily be traced, as also that of W D, that goes to B. The direction in which the forces act shows whether they are tensile or compressive. It will be seen at a glance that while in the semi-girder the top chord was in tension and the bottom chord in compression, the reverse holds in the full girder or truss.

Calling θ the angle of inclination to the vertical, and m and n the two segments, we have

Strain in each diagonal in left segment . . . . . . $\Sigma = \frac{m}{l}\ W \text{ sec. } \theta.$

Strain in each diagonal in right segment . . . . $\Sigma = \frac{n}{l}\ W \text{ sec. } \theta.$

The diagonals which meet at the weight are under the same kind of strain (in this case compression). Those that meet at any other apex are under opposite strains.

If x represents the number of apexes (both chords included) between any panel and the abutment of the segment to which it belongs, we shall have the following:

Panel in right segment (x measured from right abutment),

$$F = \frac{mx}{l}\ W \text{ tan. } \theta.$$

Panel in left segment (x measured from left abutment),

$$F = \frac{nx}{l}\ W \text{ tan. } \theta.$$

The maximum strains will be found under the weight.

Moving Load.—As the load changes its position the strains in the braces vary, changing from tension to compression, and *vice versâ*, as it passes each apex. If the upper chord supports the load, the maximum compression in any brace will occur when the weight is passing its upper extremity, and the maximum tension when passing the adjoining apex at that side to which the brace slopes. If the lower chord supports the load, the maximum tensile strain in any brace occurs when the weight is passing its lower end, and the maximum compressive strain when passing the adjoining apex on that side to which the brace slopes upward. The maximum strain in any panel of the unloaded chord occurs when the moving load is in the vertical line passing through that panel. The maximum strain in any panel of the loaded chord occurs when the passing load rests on the adjoining apex at the same side as the centre. If a single load traverses a lattice truss, only one system of triangulation will be strained at a time.

FIG. 35.

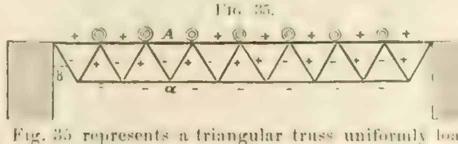


Fig. 35 represents a triangular truss uniformly loaded. The weights on the left of the central line are transmitted to the left abutment, and those on the right to the right abutment, half of the central weight going to one abutment and half to the other. The strains in the diagonals therefore increase toward the abutments, and those in the chords increase toward the centre. The character of the strains on each member is indicated by the sign + for compression, and — for tension.

Strain on a brace, $\Sigma = n\ W$ sec. θ; n representing the number of weights between any diagonal and *the centre*. Any two diagonals equally distant from the centre sustain all the intermediate load, on the principle of the *counter balancing of equal weights similarly situated on symmetrical trusses*. The strains on the chord panels are obtained from the law that *the increment of strain developed at any apex is equal to the algebraic sum of the horizontal components of the strains in the intersecting braces*. The total strains on any panel are obtained by properly summing up the increments of strain from the braces. The easiest way to do this is by means of a diagram, the details of whose construction may be found in Stoney *On Strains*. They may also be found by forming a table of the strains which each weight would produce if acting separately, and obtaining their algebraic sum. It is well in complicated trusses to

check results by calculating the strains in one or more panels on the principle of moments. For instance, in Fig. 35, taking moments around a, the moment of the strain in panel A, acting with a lever-arm equal to the depth of the truss, will be equal to the moment of the reaction of the left abutment (whose lever-arm is two panels and a half), diminished by the moments of the first two weights (whose lever-arms are a panel and a half, and half a panel respectively). In this equation all the quantities are known except the strain in A, which is easily deduced. The moments of the forces at a do not enter the equation, as their lever-arms are zero. It is easy to show that when two diagonals meet at a loaded apex the strain in the one more remote from the centre is the greater by W sec. θ; also, that the strains in two diagonals that intersect at an unloaded apex are equal in amount, but opposite in character.

All bridges must be calculated as always sustaining a permanent or dead load, which is the weight of the structure, and as also sustaining a moving or live load, gradually advancing from one end and gradually passing off at the other. Each member of the truss must be capable of sustaining with the prescribed degree of safety the greatest strain which can come on it from any combination of the two loads. As the effect of the moving load is to cause strains on the braces that sometimes are similar in kind to those caused by the permanent load, and sometimes are opposite, the best method of calculation is to determine the permanent strains due to the weight of the structure, and then to take each weight separately, and determine the strain caused by it on each one of the diagonals. The sum of all of these strains will give the maximum strain due to the moving load. On all but the diagonals of the extreme panels there will be two kinds of strain. By adding to the permanent strains the temporary ones of the same kind, we determine the maximum degree of this class of strains. When the permanent strains are less than the temporary ones of opposite kind, we subtract them, and thus obtain the maximum degree of the latter kind of strain. If the permanent strains are the greater, the brace will only be subjected to one class of strains, the temporary strain being insufficient to reverse the permanent one.

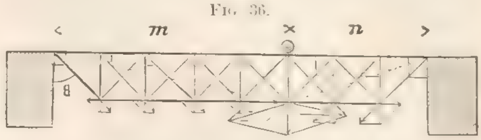
The greatest strains in the chords are found when the whole bridge sustains the maximum load that can come on it.

The maximum strains on the braces may be expressed by equations, but they are too complicated to find a place here.

Lattice Bridges.—The strains in lattice bridges may be calculated as in other bridges, provided care is taken to keep the systems of triangulation separate, and to get the strains on the diagonals only from the weights that act on the system to which they belong. As the greatest strains in the chords occur when the whole bridge is covered, they are easily found by a proper summation of the increments of strain brought up by the diagonals. The method of tabulating the strains due to each weight is the simplest and most satisfactory. In lattice bridges, as usually built, the end pillars must be made capable of safely resisting the transverse strains brought upon them by the end diagonals. A better method of construction is to change the angles of these diagonals, and to bring their lower ends to the end of the bottom chord.

There is no theoretic advantage in lattice trusses, but there is a practical advantage in the support that is given to braces under compression by those that intersect them. However, this form of truss is not in favor in the U. S.

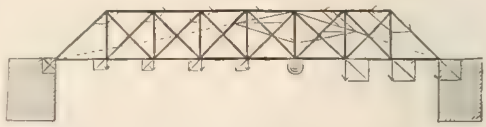
FIG. 36.



In the truss represented in Fig. 36 the bracing is composed of diagonals and of vertical posts under compression. As $\frac{n}{l} W$ goes to the left abutment and $\frac{m}{l} W$ to the right, the strains on the posts will be the shearing strains, and will be $\frac{n}{l} W$ in the left segment, and $\frac{m}{l} W$ in the right segment. The method of transmittal is clearly indicated in the diagram. It will be observed that in the case represented the only braces under strain are those that are parallel in their respective segments to the two that meet at the apex under the weight. The strains in these diagonals are equal in each segment, being obtained by multiplying the shearing strains by sec. θ. The increments of strain in the chords at each apex are $\frac{n}{l} W$ tan. θ in the left segment, and $\frac{m}{l} W$ tan. θ in the right.

In this truss the loads are at once transferred by the posts to the bottom chord, whence they pass up the diagonals to the next posts, and so forth. The determination of the strains under a permanent load and under a rolling load may be made as heretofore indicated. When this truss is uniformly loaded, the only braces under strain are those in each half truss that incline upward toward the nearest abutment. The strain on each of these braces is $n W$ sec. θ, and the increment of strain at each apex equals $n W$ tan. θ, n being the number of weights between any brace and the middle of the truss. The other braces are strained when the truss is loaded unequally. The strain on each post is $n W$. In this truss there are no members under opposite strains at different times. All the posts sustain compression only, and all the braces tension only.

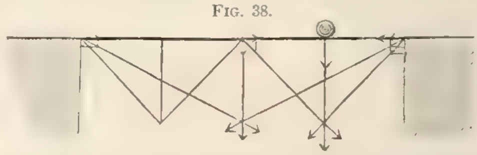
FIG. 37.



There is another form of this truss in which the posts are vertical ties sustaining tension, and the braces are inclined struts under compression. The methods of calculation, however, are not changed, nor are the results changed in magnitude, the only difference being that the strains in the bracing are different in character. This truss is less economical than the other, since the cross-section of a tie does not change, whatever be its length, while an increase in the length of a strut compels an enlargement of its cross-section. It is therefore more economical to make the longer braces ties, and the shorter ones struts.

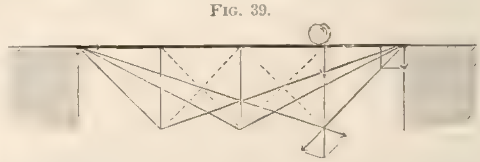
Lattice Bridges with Vertical Posts.—In these bridges calculation is at fault if the braces are made to act as ties or struts at will. They should either be designed to act as ties only, or the posts should be omitted.

FIG. 38.



In the form of bridge truss shown in Fig. 38, known from its inventor as the "Fink suspension truss," the transmission of a single weight is indicated by the diagram. There is no bottom chord, and as all the weights ultimately reach the ends of the top chord, the strain in this is uniform throughout. The posts are all under compression and the ties under tension. This truss is very well adapted to preserving its form under all changes of temperature. It is better adapted to use as a deck than as a through bridge.

FIG. 39.



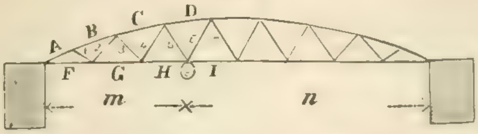
The truss shown in Fig. 39 is known from its inventor as the "Bollman." In it the resolution of strains is exceeding simple. Each post rests on a pair of suspending rods, which immediately resolve the weight into its components, and carry the latter directly to the ends of the top chord. The strain on the latter is therefore uniform throughout. Strictly, it can hardly be called a truss, as each suspending system is entirely independent of the others, the only common member being the top chord. Experience has shown that the panel ties, indicated by dotted lines, are necessary to the stability of the combination. Their only apparent office is to prevent flexure in the top chord. This system is not as economical as those previously indicated.

There are many other forms of truss, which lack of space compels us to omit. Those specially adapted to roofs will be found under that head.

Bowstring Girders.—This is a common form of bridge, which differs somewhat from those previously given. Owing to the lack of parallelism in the chords the strains on the braces are not susceptible of representation by simple formulas. The strains may be calculated by moments, or by

resolving the known strains at either abutment into their components along the different members, thus gradually

FIG. 40.

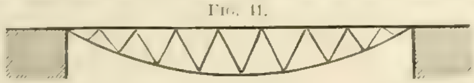


working towards the middle. The pressure on the left abutment, from the weight W, is

$$\frac{m}{m+n} W,$$

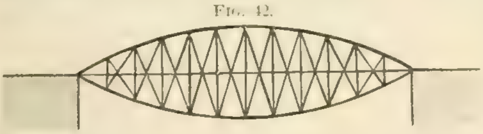
and its direction is vertically downward. As it is the resultant of the strains in A and F, the two latter may be found by a parallelogram of forces. The strain in A is the resultant of that in B and brace 1; these two can therefore be found. The strain in brace 1 is the resultant of the strain in brace 2 and the increment of strain in panel G; these may therefore be found. The total strain in G is this increment increased by the strain in F. The strain which generated the strains in B and brace 2 (which may be found from them) is the resultant of the strains in panel C and brace 3, both of which can thus be found. By this method all the strains due to this weight may be found, and their values may be determined by the scale. Proceeding in a similar manner for every other weight on the girder, and tabulating and properly combining the results, we can find the maximum strains on each member. It will be found that the strains on the chords are nearly uniform throughout, but the strains in the braces increase towards the centre of the girder, the reverse of what takes place in the truss with parallel chords. The strains on the braces are all tensile, except that small compressive strains may come on the middle braces. But these will not appear in large girders, whose permanent weight is very much greater than the passing load. It is a practical objection to this form of truss that it is not well adapted to receive top lateral bracing near its extremities. After calculating the strains by diagram, they should be verified by calculating some of the chord strains by moments. As the weight of the upper

FIG. 41.



chord or arch does not rest on the lower chord, it is more accurate to omit it from the permanent load, and to calculate its effect separately as an arch with a tie.

FIG. 42.



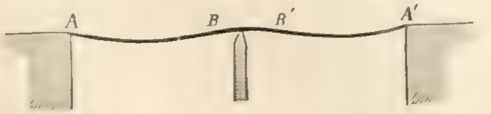
The method of calculation indicated applies equally well to fish-bellied girders, as Fig. 41, or lenticular girders, such as Fig. 42, which is the style of truss used for the Saltash bridge.

Camber and Deflection.—Bridges are generally built with a slight camber or upward arching, so that when they are in use, and all the parts have got exactly fitted to their places, the chords will be horizontal. In the central span of the Boyne lattice bridge, which is 267 feet between centres of piers, the camber at the centre during construction was $3\frac{1}{2}$ inches. When the false work was removed this was reduced to $1\frac{1}{2}$ inches, and finally, after four months' use, it was found to be less than 1 inch. The deflection of a bridge under a load is almost entirely due to the shortening of the upper flange and the lengthening of the lower one, and is practically unaffected by the kind of bracing. A lattice bridge and a plate girder should deflect equally. At the opening of the Newport and Cincinnati railroad and highway bridge, whose channel span is 420 feet in length—being the longest truss in America—the deflection at the middle under a weight of five locomotives coupled together was $1\frac{9}{16}$ inches. The object of giving a bridge a camber is rather for the sake of appearance than from necessity. Unless a bridge deflects so much as to change the vertical pressure on the abutments into an oblique one, there is no appreciable diminution of strength.

Continuous Girders.—A girder or truss is called continuous when it has one or more intermediate supports between its extremities.

When a loaded girder is balanced on a single pier at or near its centre the upper chord is subject to tension and the lower one to compression, and the girder becomes curved, with its convex side uppermost, being in fact, two semi-girders connected together. If, however, the pier be removed, and the girder be supported at its extremities, the

FIG. 43.



strains in the chords are reversed, the upper one being compressed and the lower one extended, and the girder becomes convex on its lower side. If, while in the last position, the central pier be replaced so as to form two spans, the girder becomes continuous, and partakes of the nature of both of the previous cases. Each chord is compressed in some places and extended in others, and becomes a waved line.

The girder may be conceived to be divided into three segments. The central segment B B′ is the union of two semi-girders which balance on the central pier. The segments A B and B′ A′ are two girders, supported at one end by the central segment, and at the other by the abutments. The central segment therefore sustains at each extremity half the weight of an end segment, besides its own proper load. The points B and B′, where the curvature changes, are called the *points of inflection*. At these points the strains in the chords change their character, the strains at the points themselves being zero. The chords therefore might be severed at these points without danger. The connections would be maintained by the bracing.

The positions of the points of inflection are changed by the moving load, as the effect of this load is to increase the deflection of the segment which it covers. The effect of a load on A B is to bring B nearer to the central pier, and to carry B′ farther from it. As this is the maximum length of A B, its strains must be calculated for that length. The same thing would hold for A′ B′ when the train came from the other direction. The central segment B B′ becomes of its maximum length when the whole girder is uniformly loaded, and the points of inflection must be determined for this length also. If the strengths of the chords be calculated for the conditions that give the maximum length of the segments, they will evidently be strong enough for any other cases. The maximum strains in the braces occur before the moving load has covered the first segment, and therefore when the point of inflection is nearer the abutment than it subsequently becomes. The point of inflection must therefore be determined when each brace has its maximum strain.

The greatest pressure on any abutment is half the load on the adjacent segment when the latter has its maximum length. The greatest pressure on the central pier is equal to the load on the central segment when of maximum length, increased by the sum of the synchronous pressures on the two abutments.

The easiest way to determine in advance the points of inflection in a girder is to find them by trial on a small pine model. In practice, the point of inflection may be fixed at any assumed point of the top chord by severing the chord at that point, and slightly lowering the outer end of the segment that rests on the abutment until the severed ends just separate. The point of inflection in the lower chord will be very nearly vertical under that in the upper chord. The point of inflection in the adjoining span can be found from the known strains in the chords over the central pier. The operation of severing one of the chords was tried at the Boyne viaduct, and proved successful.

In a continuous girder of three spans the maximum strains in the chords are as follows: in the side span when both side spans are covered by the moving load, and the centre span is free; in the centre span when it alone is covered; over either pier when the passing load covers the centre span and the adjacent side span, leaving the farther side span uncovered.

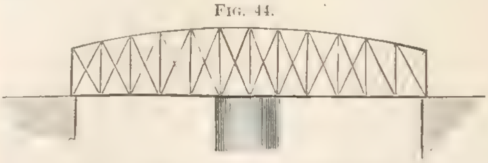
When a continuous girder supports a permanent load the strains in the bracing are not affected by points of inflection, but only the strains in the chords. The advantage of continuity arises from two causes: first, from the smaller amount of material in the chords; secondly, from the removal of a certain portion of their weight from the central part of each span to a position nearer the piers. The latter is but a trifling advantage in continuous girders of moderate spans (say under 150 feet) which support passing loads, for the part so removed forms but a small proportion of the total weight. In the case of a fixed load, however, the saving from this cause is considerable; but when acted upon by a moving load the advantages of continuity are liable to be overrated, especially in girders of small spans, for it will be evident, on a little reflection,

that when the points of inflection move under the influence of the passing load, a greater amount of material is required than if their position remained stationary; and this, moreover, introduces the necessity of providing for both tension and compression in those parts of the chords which lie within the range of the points of inflection; this latter objection is perhaps of little consequence when wrought iron is used.

A subsidence of any of the points of support of a continuous girder will cause a change of strain, whose amount it is quite impossible to foresee, and which may seriously injure the structure, or perhaps render it dangerous. Hence, continuous girders should be avoided when the foundations of the piers are insecure. In bridges of large span, where the permanent load constitutes a large portion of the whole weight, the advantage of continuity is very considerable.

Girder with Fixed Ends.—If a uniformly loaded girder of uniform section is built into a wall so that its ends are rigidly held—as, for instance, the lintel of a door—the strain in the flanges at the centre will be one-third of what it would be if the ends of the girder were merely resting on the walls, and it will be just half of the strains in the flanges at the ends.

FIG. 44.



Drawbridges.—The usual type of drawbridge in the U. S. is the one shown in Fig. 44. The truss is symmetrical, and rests on a turn-table on the central or pivot pier. Two equal openings are provided when the draw is turned. The strains on such a drawbridge are very different when it is shut from what they are when it is open. When the draw is shut, the truss is a continuous one of two spans, and liable to be acted upon by the moving load. When the draw is swung open, the moving load cannot come on it, and it consists of two semi-girders or cantilevers, connected together over the pivot pier. In the first case the top chord is under tension for a certain distance over the pivot pier, and under compression throughout the rest of its length. The reverse holds for the bottom chord. The positions of the points of inflection and the strains must be found as indicated for continuous girders. In the second case the top is in tension and the bottom is in compression. It is therefore necessary to make these chords so that they will be able to resist both kinds of strain.

The practice among the most successful American bridge-builders in planning drawbridges is to consider the permanent load as at all times supported by the pivot pier, whether the draw be open or shut. The rolling load only comes on when the draw is shut, and it is provided for by considering the draw as a continuous girder on three supports. The depth of drawbridges is generally made greater over the pivot pier than at the ends. This gives an increase of depth where it is needed, while the truss is kept shallow at the ends, where any increase of weight beyond what is absolutely needful is injurious, as increasing the strains when the draw is open. Drawbridges are turned by gearing on the circumference of the pivot pier worked by hand or by steam. The drawbridge over the Mississippi at Louisiana, Mo., gives two clear openings on each side of 200 feet.

Counter-bracing.—Braces are so placed as to carry weights from the centre towards the abutments. Tie-braces, therefore, have their feet nearest the centre of the truss, and strut-braces have their heads nearest the same point, so that when the weight has passed through either it is one or more panels on its journey to the proper abutment. When loads are uniformly or symmetrically distributed, they go undivided to the nearest abutment, and there is no need of counter-braces. When a load is not uniformly distributed, a portion of it must cross the centre, and go to the farther abutment. Counter-braces are those whose feet if they are ties, or whose heads if they are struts, are farthest from the centre, and their office is to carry to the farther abutment portions of the unbalanced weights which must cross the centre. Some engineers use them only in those parts of the truss where the temporary strains from the moving load exceed the permanent strains from the weight of the bridge, and are opposite in kind. Others use them throughout the truss. The former is the more general practice.

Angle of Economy.—Mr. Stoney concludes that in isosceles bracing the best angle for the braces, in order that they may transmit strains to the supports with the least amount of material, is 45°. He also concludes that when vertical posts are used the best angle for the bracing is about 55° with the vertical. The writer (see *Iron Truss Bridges for Railroads*) concludes that for a series of strut-braces the angle with the vertical should be about 40°, and that for a series of tie-braces the angle should be 45°.

Arched Bridges.—The graphic method of calculating the strains in braced arches has been indicated as the easiest. In the first printed report of the Illinois and St. Louis Bridge Company, dated May, 1868, is given in full the analytical method used in calculating the arches of their great bridge, to which reference is made. It will only be necessary to state here that their arches were assumed to be circular with the ends fixed. At the close of this article will be found a diagram of the strains on one of the side spans of this bridge.

Tubular Bridges.—The first tubular bridge was that known as the Britannia, and its dimensions were determined by experiment on a model 78 feet in length, or about one-sixth the length of the greatest span. The following formula for the breaking weight was deduced from the experiment:

$$W = C \times \frac{Ad}{l},$$

in which W is the breaking weight in tons, A the square inches of metal in the cross-section, d the depth in inches, l the length in inches, and C a constant which for rectangular tubes was found to be 21.5.

Both top and bottom of the Britannia bridge are cellular. This form, however, is not now considered the best distribution of metal. It is believed that if the metal in the top cells were concentrated into a pile of plates at the centre of the cell, more strength would be secured, and the danger of corrosion would more readily be provided for. In later bridges the bottom has always been made without cells. The strains in the top or bottom flanges can be obtained from the formulas already given for flanged girders. The strains in the web are only the shearing strains, and the minimum thickness of the web can be found by dividing the greatest shearing strain by the greatest permissible strain per square inch. The web is always strengthened by vertical angle-irons. The general opinion among American engineers is that the day of tubular bridges has passed away, and that they are in every way inferior to open-work truss bridges.

Depth of Truss.—The strains in the bracing are independent of the depth of the truss, but those in the chords vary inversely as the depth. Therefore, within certain limits it is economical to make trusses deep, as the strains on the chords—and therefore their dimensions—are diminished, while the amount of material in the bracing is only increased by the increase in length of each brace. The following table, taken from Vose's *Manual for Railroad Engineers*, shows the usual practice in the U. S.:

Span, in feet	Depth of truss, in feet	Ratio
100	17	$\frac{1}{6}$
150	21	$\frac{1}{7}$
200	25	$\frac{1}{8}$
250	28	$\frac{1}{9}$
300	30	$\frac{1}{10}$
400	40	$\frac{1}{10}$

Rolling Load on Bridges.—The magnitude of the rolling or live load which should be safely carried by bridges is differently estimated in different countries. According to Mr. James Laurie, C. E., the English authorities assume $1\frac{1}{2}$ tons per running foot for each track on short railroad bridges, and 1 ton on longer ones. He states that in France a *dead load* of $1\frac{1}{2}$ tons per running foot is used in testing railroad bridges of less span than $66\frac{1}{2}$ feet, and $1\frac{1}{5}$ tons, which is sometimes reduced to $1\frac{1}{20}$ tons, for bridges of longer span. They are also tested by running trains on at various speeds. In this country the Pennsylvania and the Baltimore and Ohio R. Rs. have adopted a rolling load for all bridges of $1\frac{1}{2}$ tons per track per running foot. The shorter the span the greater should be the assumed rolling load, on account of the greater relative length of bridge that will be covered by the locomotive. A span of 5 feet, as a cattle-guard, may have to sustain from one pair of locomotive drivers a load of 10 tons on its middle point, which is a rolling load of 2 tons per foot of its length. In proportioning highway bridges it is safe to assume a load of 80 pounds per square foot of surface, although, according to Trautwine, the French laws assume a maximum load of only 42 pounds per square foot. Experiment has shown that with picked men it is possible to get a load of 120 pounds per square foot, but such loading can scarcely occur in practice. Allowance must be made in highway bridges for heavy concentrated loads, depending

on the locality. The London bridges are sometimes traversed by loads as great as 34 tons on four or six wheels.

Factor of Safety.—The usual formulas for strength of materials give the weights under which they will just break. In designing bridges the maximum strains on the members are multiplied by some number, usually 5 or 6, and the members are then proportioned so that they will just break under the augmented strains. This multiplier is called the *factor of safety.*

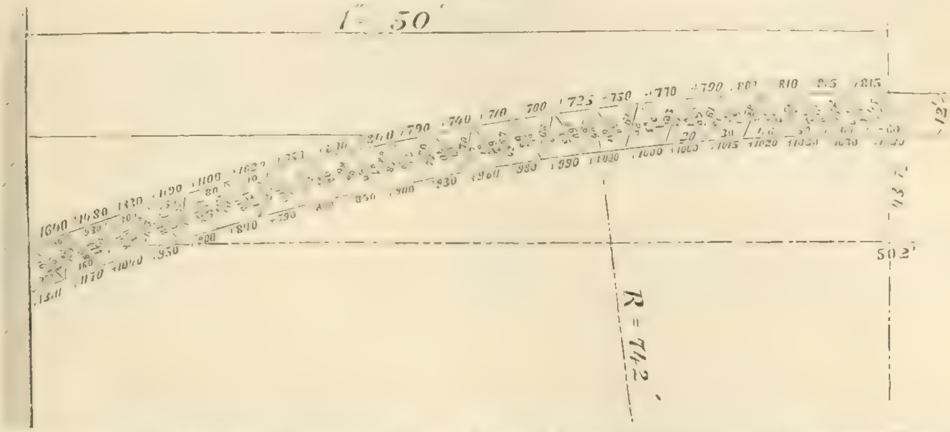
Designing of Bridge Trusses. The work of designing bridge trusses consists of two distinct parts. The first thing to be done is to determine the length of the span, and next the kind of truss to be used, and its depth. Then the strains on all the members must be calculated, assuming an approximate weight of bridge. The calculations are the same whether the bridge is to be of wood or of iron, the only difference being that the bridge weight will vary according to the material used. After the first determination of strains the sizes of the different members can be settled, and a more exact determination of the bridge weight can be made. The strains being known in character and magnitude, it is a problem in mechanical engineering to design suitable members to meet these strains.

Strain Sheets.—The following diagrams of various styles of bridges in use in the U. S. have been kindly furnished by the builders. On each member is placed the maximum strain in tons which it is expected to sustain. Compressive strains are marked + and tensile strains —.

FIXED BRIDGES.

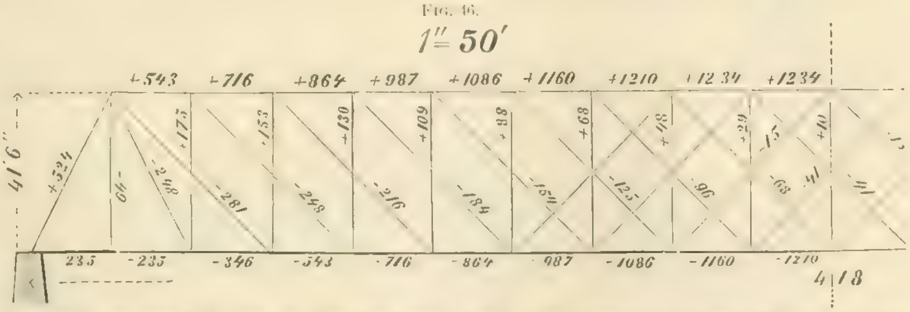
Bridge over the Mississippi at St. Louis, Messrs. Eads, Flad & Pfeifer, engineers.—This bridge is composed of four arched trusses, and carries a double track railway tangent to its lower chord at the middle, and a wide highway 26 feet above. On a single arch the assumed permanent load is 1 ton per lineal foot, and the rolling load 0.8 ton. (Fig. 45 shows a side span.)

FIG. 45.



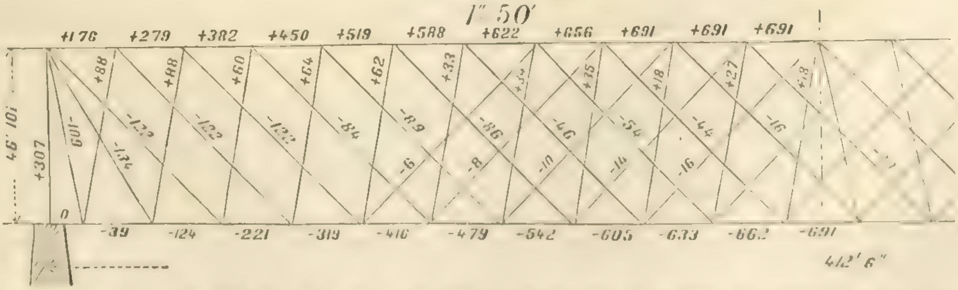
Bridge over the Ohio at Cincinnati, built by the Keystone Bridge Company, J. H. Linville, president. This bridge carries a single track railway on a level with its bottom chord, and outside of each truss is a highway sustained by cantilever beams suspended below the trusses. The permanent load of the bridge is 2½ tons per lineal foot, and the rolling load is taken at 1½ tons for the railway, and ¾ of a ton for the highway, making a total rolling load of 2¼ tons. Each truss supports one half of these weights. (Fig. 46 shows channel span.)

FIG. 46.



Bridge designed by McNairy, Claflin & Co.—This bridge is on the plan invented by the late S. S. Post. The assumed permanent load is 1.8 tons per foot, and the moving load 1¼ tons per foot. (See Fig. 47.)

FIG. 47.



Bridge over the Ohio at Louisville, Messrs. Fink & Vaughn, engineers.—This bridge is a Fink triangular truss, and it carries a single track railway, with sidewalks for foot passengers. The permanent load on this span is 2 tons per lineal foot, and the moving load 1.3 tons. (Fig. 48 shows Indiana channel-span.)

Bridge over the Missouri at Leavenworth, built by the American Bridge Co., L. B. Boomer, president.—This is a Post bridge, and is designed for a single track railroad, besides being used for highway traffic when not occupied by cars. The permanent load on this span is 1.6 tons per lineal foot, and the moving load is assumed as 1.5 tons for two panels, 1.25 tons for the next two panels, and 1.12 tons for the remainder of the bridge. (See Fig. 49.)

Bridge over the Missouri at St. Charles, built by the Bal-

FIG. 48

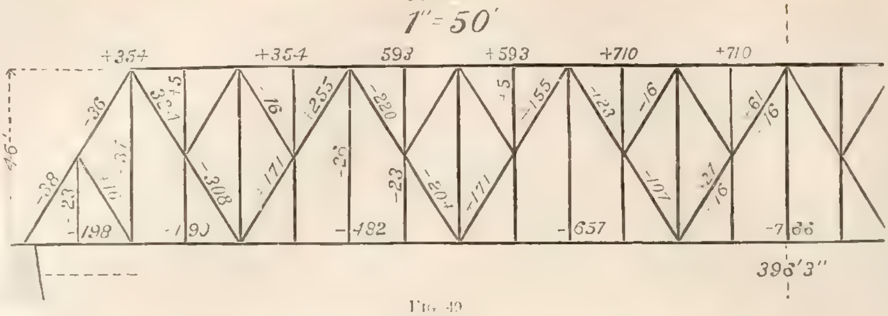
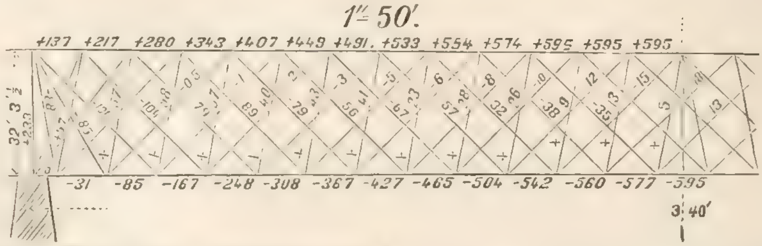
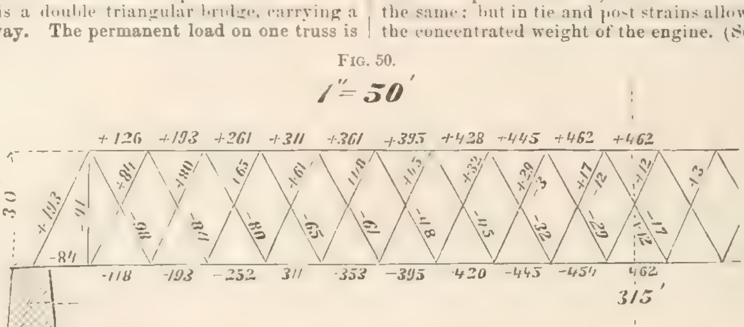


FIG. 49



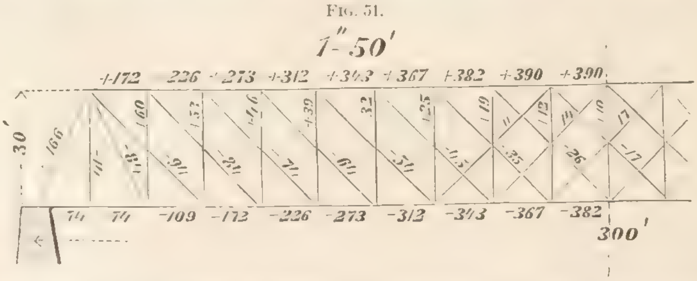
timore Bridge Co., C. Shaler Smith, president and chief engineer.—This is a double triangular bridge, carrying a single-track railway. The permanent load on one truss is 1.12 tons per lineal foot, and the assumed rolling load is the same; but in tie and post strains allowance is made for the concentrated weight of the engine. (See Fig. 50.)

FIG. 50.



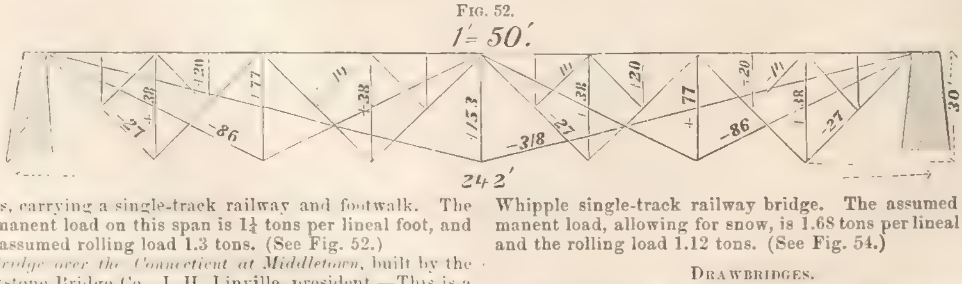
Bridge designed by the Detroit Bridge Co., W. S. Pope, president and engineer.—This is a Whipple bridge, designed for a single-track railway. The assumed permanent load of bridge is 1.05 tons per lineal foot, and the assumed rolling load is 1.3 tons per foot on 100 lineal feet, and 0.90 ton on the rest of the bridge. (See Fig. 51.)

FIG. 51.



Bridge over the Ohio at Louisville, minor span, Messrs. Fink & Vaughn, engineers.—This is a Fink suspension truss, carrying a single-track railway and footwalk. The permanent load on this span is $1\frac{1}{4}$ tons per lineal foot, and the assumed rolling load 1.3 tons. (See Fig. 52.)

FIG. 52.



Bridge over the Connecticut at Middletown, built by the Keystone Bridge Co., J. H. Linville, president.—This is a single-track railway bridge, and may be called a long-panel lattice bridge, or a triangular bridge of four systems of triangulation. The permanent load is 0.8 ton per lineal foot, and the assumed rolling load 2 tons per foot. (See Fig. 53.)

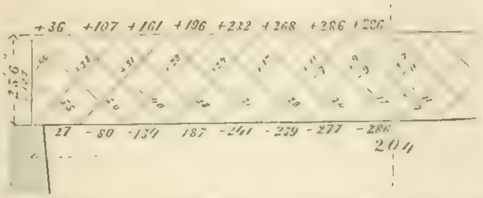
Bridge over the Connecticut at Windsor Locks, Messrs. James Laurie and Theodore G. Ellis, engineers.—This is a Whipple single-track railway bridge. The assumed permanent load, allowing for snow, is 1.68 tons per lineal foot, and the rolling load 1.12 tons. (See Fig. 54.)

DRAWBRIDGES.

Drawbridge over the Mississippi at Rock Island, built by the Baltimore Bridge Co., C. Shaler Smith, president and chief engineer.—This drawbridge is a reversed Whipple, carrying a highway on its lower chord, and a single-track railway halfway between the two chords. The permanent load is 1.85 tons per lineal foot, and the rolling load $2\frac{1}{2}$ tons per foot. (See Fig. 55.)

FIG. 53.

1″ = 50′



Drawbridge over the Missouri at Boonville, built by the American Bridge Co., Messrs. Hemberle & Coolidge, engineers.—This is a Post drawbridge for a single-track railway. The permanent load is one ton per lineal foot, and the rolling load $1\frac{1}{4}$ tons per foot. (See Fig. 56.)

Drawbridge designed by the Detroit Bridge Co., Willard S. Pope, president and chief engineer.—This is a modified Whipple drawbridge for a single-track railway. The permanent load is 0.95 ton per lineal foot, and the assumed rolling load is $1\frac{1}{4}$ tons per foot. (See Fig. 57.)

Drawbridge designed by McNairy, Claflin & Co.—This is a Post drawbridge, carrying a single-track railway. The permanent load is 0.75 ton per lineal foot, and the assumed rolling load is 1.5 tons per foot. (See Fig. 58.)

Drawbridge over White River, near Jacksonport, Ark., **built by the Baltimore Bridge Co., C. Shaler Smith, president and chief engineer.**—This drawbridge is composed of **two Pratt trusses, with independent suspension system for** sustaining the cantilevers when the draw is open. The bottom chords are stiffened with Phoenix columns, so as to resist the compressive strains generated when the draw is open. The suspension rods pass over a tower which is hinged at *a, a*, so as not to interfere with the contraction of the top chord. Therefore in this drawbridge the girder is not continuous. The permanent load is $\frac{1}{4}$ ton per lineal foot, and the assumed rolling load is 1.12 tons per foot. (See Fig. 59.)

Drawbridge over the Cumberland at Clarksville, Albert Fink and L. W. Vaughn, engineers.—This is a Warren girder, or triangular drawbridge for a single track railway.

FIG. 54.

1″ = 25′

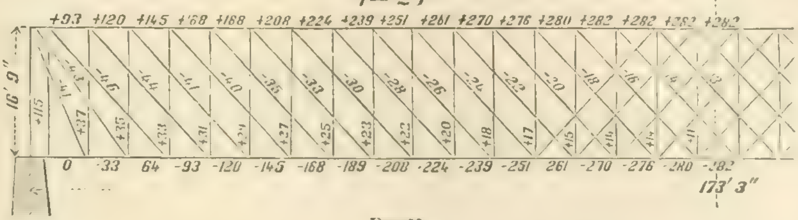


FIG. 55.

1″ = 50′

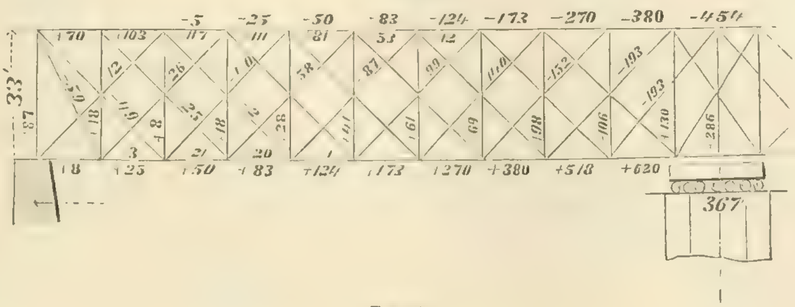


FIG. 56.

1″ = 50′

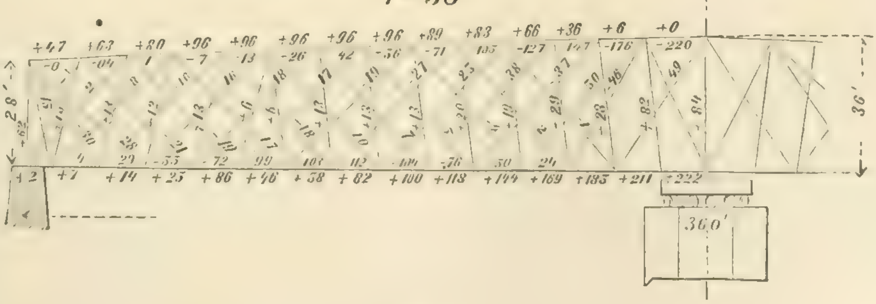


FIG. 57.

1″ = 50′

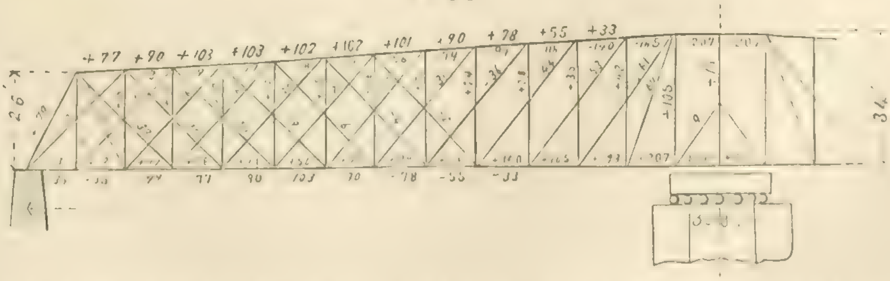


Fig. 58.

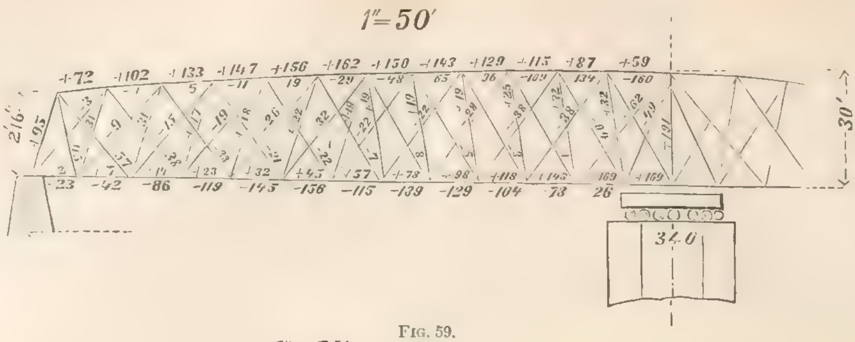


Fig. 59.

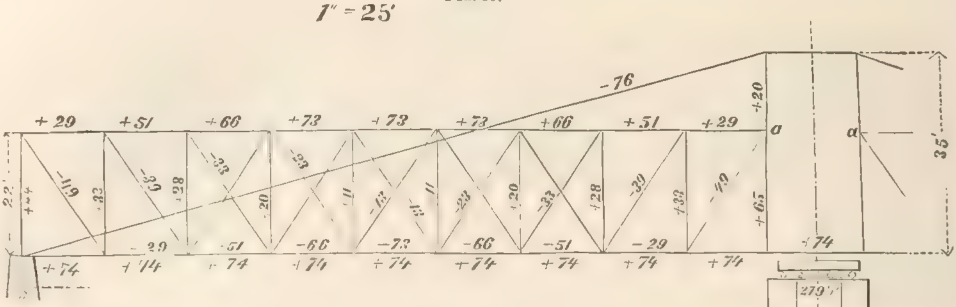
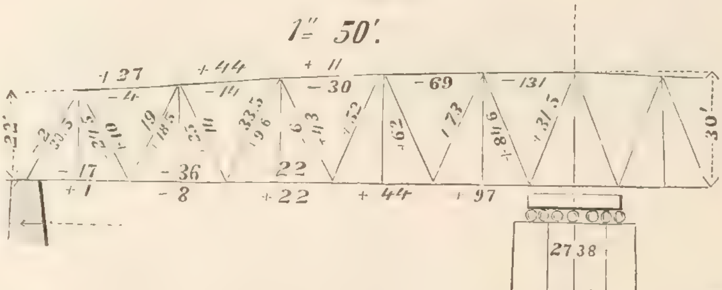


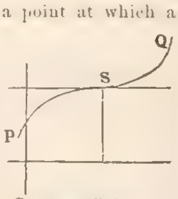
Fig. 60.



The permanent load is 0.55 ton per lineal foot, and the rolling load 1.12 tons per foot. (See Fig. 60.)

(For further information reference is made to the following publications: *Long span Railway Bridges*, Baker; *Theory of Bridge Construction*, Haupt; *Cast and Wrought Iron Bridge Construction*, Humber; *Iron Truss Bridges for Railroads*, Merrill; *Civil Engineering*, Rankine; *Strains on Structures of Ironwork*, Shields; *Strength of Bridges and Roofs*, Shreve; *Theory of Strains*, Stoney; *Engineer's Pocket-Book*, Trautwine; *Wrought Iron Bridges and Roofs*, Unwin; *Manual for Railroad Engineers*, Vose; *Mechanics of Engineering*, Weisbach. See also engineer's reports on the Britannia, Victoria, St. Louis, Kansas City, and Quincy bridges.) W. E. Merrill.

Flexure, Point of Contrary, a point at which a curve from being concave in a given direction becomes convex, or the reverse. Thus, S is a point of contrary flexure (or a point of inflection) of the curve P S Q, because at this point the curve ceases to be concave downward, and becomes convex downward—that is, concave upward. When a curve is concave downward, the differential of the ordinate decreases algebraically as the abscissa increases; the second differential of the ordinate is therefore *negative*. When the curve is convex downward, the differential of the ordinate is an increasing function of the abscissa, and consequently the second differential of the ordinate is *positive*. Hence, at a point of inflection the second differential must change sign, which it can only do by reducing either to 0, or to ∞—. At a point of inflection the *radius of curvature* of the curve changes sign—. At such a point the radius of curvature is usually equal to infinity—that is, for an infinitesimal distance the curve may be regarded as a straight line. W. G. Peck.



Contrary Point of Flexure.

Flied'ner (Rev. Theodor), D. D., one of the most successful Christian philanthropists of the century, and founder of the institution of Protestant deaconesses, was b. Jan. 21, 1800, the son of a clergyman at Eppstein near Wiesbaden, and d. at Kaiserswerth, the scene of his labors, Oct. 4, 1864. He was a plain, unpretending German pastor of great working power, indefatigable zeal, fervent piety, and rare talent of organization. Left an orphan at the age of thirteen, he studied at Giessen, Göttingen, and Herborn, was for one year tutor in a family at Cologne, and began to doubt his fitness for the ministry when he received and accepted in Nov., 1821, what he considered a providential call, with the promise of a salary of 180 Prussian dollars, from a small Protestant colony at Kaiserswerth, a Roman Catholic town of 1800 inhabitants on the Lower Rhine, below Düsseldorf. He walked there to save expense to the poor congregation. Four weeks after he had entered upon his duties the silk-factory of Preyer & Peterson, which furnished the chief support to his parishioners, failed. But this failure proved his success. It led him to undertake, in the spring of 1822, a collecting-tour to keep the struggling congregation alive. At first he was shy and discouraged, but a brother pastor, Döring of Elberfeld, told him that he needed only three requisites, "patience, impudence, and a ready tongue," and introduced him to a Mr. Frowein, who gave him 40 thalers. By the end of the same week Fliedner could return with 1200 thalers. This was only the beginning of much greater things. By experience and perseverance he became one of the greatest beggars in the service of Christ. The same year (June 1, 1823) he made a tour to Holland and England, which not only resulted in a permanent endowment of his congregation, but suggested to him the idea of his benevolent institutions. "In both these Protestant countries," he tells us himself, "I became acquainted with a multitude of charitable institutions for the benefit both of body and soul; I saw schools and other educational organizations, almshouses,

orphanages, hospitals, prisons and societies for the reformation of prisoners, Bible and missionary societies, etc. etc.; and at the same time I observed that it was a living faith in Christ which had called almost every one of these institutions and societies into life, and still preserved them in activity. This evidence of the practical power and fertility of such a principle had a most powerful influence in strengthening my own faith." The practical Christianity and philanthropy of Holland and England inspired Fliedner to similar zeal, and he repaid the debt by the happy influence which his deaconesses' establishment exerted upon England and other countries. Many a visit to Kaiserswerth since that time has been an inspiration to noble deeds of charity.

Fliedner made two more journeys—to Holland, England, and Scotland (in 1832 and 1853), in the interest no more of his congregation, but of his institutions. He also visited the U. S. in 1849. Twice he travelled to the East—in 1851, to aid Bishop Gobat in founding a house of deaconesses in Jerusalem, and again in 1857, when he was, however, too feeble to proceed farther than Jaffa.

In his work he was powerfully aided by both his first and second wife, who seemed predestinated for him, and had the charge of his institutions at home while he was promoting their interest abroad. "Twice," said he, "have I experienced that in seeking some one for the service of the Lord, I have found the best blessing for myself." King Frederick William IV. of Prussia and his queen Elizabeth took the most cordial interest in his labors for the sick and poor, granted him several audiences, furnished him liberally with means, and founded a Christian hospital with deaconesses at Berlin (Bethany) after the model of Kaiserswerth.

Fliedner's Institutions.—In the parsonage garden at Kaiserswerth there still stands the little summer-house, with one room of ten feet square and an attic over it, which was the first asylum for released female prisoners and the humble cradle of all Fliedner's institutions.

The most important of these is the institution of *Evangelical Deaconesses*, founded in 1836. It was intended to be, and is in some sense, a revival of the apostolic office of deaconesses, which continued in the Church for several centuries, but it resembles more the active sisterhoods of the Roman Church, and may be regarded as a Protestant counterpart of the Sisters of Charity, divested of all ascetic and monastic features. The apostolic deaconesses, such as Phœbe, were congregational officers, and visited the sick and the poor at their homes. The Kaiserswerth deaconesses may also be employed for parochial activity (*Gemeindepflege*), but they are usually connected with hospitals, orphan asylums, prisons, and other public institutions. The immense usefulness of regularly trained nurses is apparent in every large city at all times, and more especially in times of war and raging epidemics. This was strikingly illustrated by experience in the Crimean war (1856), which first popularized the institution in England through the labors of Miss Florence Nightingale; in the Sleswick-Holstein war (1864), the Prussian-Austrian war (1866), the Franco-German war (1870), as well as in our own civil war (1861-65).

The ordinary government of the mother institution is in the hands of the principal chaplain or superintendent. The sisters have a vote in the election of the head-sisters or matrons and in the admission of new deaconesses. Applicants must be from 18 to 40 years of age, of sound health, Christian character, and good elementary and domestic training; they must furnish a narrative of their previous life, and give the motives which induce them to devote themselves to this life. They must undergo a probation from six months to three years, according to circumstances. After this they are either dismissed or consecrated to the work. They take no vows, but engage themselves to the institution for five years, at the end of which they are at liberty to leave or to renew their engagement; but they can leave at any time and marry by giving three months' previous notice. They wear a simple, cheerful, and convenient blue dress and apron, with a white cap and collar, and receive, besides free living, twenty-five dollars a year as pocket money; when sick or disabled they are supported by the institution, unless they have sufficient means of their own. They are divided into two classes—nursing sisters (*Pflegeschwestern*) and teaching sisters (*Lehrschwestern*). The former attend to the care of the sick, the poor, the children, and the prisoners and fallen women (*Krankenpflege, Armenpflege, Kinderpflege, Gefangenen- und Magdalenenpflege*); the latter train probationers for the office of deaconess, teach orphans, conduct infant schools and higher schools for girls.

With the House of Deaconesses at Kaiserswerth are connected a hospital, an infant school, an orphan home, an asylum for insane females. In 1850 more than sixty Kaiserswerth deaconesses were at work in different places. At the time of Fliedner's death the number of deaconesses exceeded 400, in 1866 it amounted to 490, in 1873 to 547 (including 144 probationers). Many clergymen also applied to Fliedner for parish deaconesses, who labor under the direction of the pastor and congregation. In the Austro-Prussian war of 1866 the various "deaconess houses" of Germany furnished 284 nurses to the military hospitals, besides receiving a large number of sick and wounded into their own establishments; and of these nurses, 46 were from Kaiserswerth. The Mother House fulfils the mission of a large normal school for the training of women to the care of the poor and suffering, and has given rise to many similar institutions in Germany and other lands. There Florence Nightingale was inspired for her noble mission in the Crimean war, and Dr. Passavant for the establishment of a Christian hospital in Pittsburg. Institutions of deaconesses and Christian hospitals have since been founded, mostly, though by no means exclusively, after the model, and with more or less co-operation, of Kaiserswerth—at Paris (founded by Rev. Vermeil and Rev. Valette, 1841), at Strasburg (1842), at Echallens in the Canton de Vaud (1843), at Dresden (1844), at Berlin (1847), at Pittsburg (1849), at Riehen near Bâle (1852), at Neudettelsau and Stuttgart (1856), at Zürich (1858), at Hamburg (1859), at London (1861), at Copenhagen (1862), at Constantinople (1852), at Alexandria (1857), at Smyrna (1853), at Jerusalem (1851), at Brooklyn, N. Y. (1874). In the year 1873 there were 34 houses of Protestant deaconesses, with more than 1700 sisters.

Literature.—FLIEDNER: *Collectenreise nach Holland*, Essen, 1831, 2 vols.; *Buch der Märtyrer der evangel. Kirche*, 1852 *seq.*, with a supplement, in 3 vols.; *Kurze Geschichte der Entstehung der ersten evang. Liebesanstalten zu Kaiserswerth (des Asyls, der Diakonissen-Mutter Hauses und des Hospitals)*, 1856; JUL. DISSELHOFF (Fliedner's successor): *Nachricht über das Diakonissenwerk in der christlichen Kirche . . . und über die Diakonissen Anstalt zu Kaiserswerth*, 5th ed. 1867; CATHERINE WINKWORTH: *Life of Pastor Fliedner of Kaiserswerth*, translated from the German (which first appeared in the *Kaiserswerth Almanac* for 1866), London, 1867; MISS FLORENCE NIGHTINGALE: *Account of the Institution for Deaconesses*, London, 1851; DEAN HOWSON (of Chester): *Deaconesses*, London, 1862; W. F. STEVENSON: *Praying and Working*, 1862, republished in New York; J. M. LUDLOW: *Woman's Work in the Church*, London, 1866; also the annual reports and other periodical publications of Kaiserswerth.

PHILIP SCHAFF.

Flin'ders (MATTHEW), English navigator, b. in Lincolnshire in 1760; went to New Holland in 1795, and with Bass discovered Bass's Straits in 1798. Exploring the southern coast of Australia, he discovered the Gulfs of Spencer and St. Vincent. Putting in at the Isle of France, he was held prisoner by the French there from 1803 to 1810, but was released, and d. in England July 19, 1814. Published *Voyage to Terra Australis* in 1814.

Flinn, tp. of Lawrence co., Ind. Pop. 967.

Flint, a variety of quartz, massive, dull-colored, and dark, with translucent edges, found especially in nodules in chalk-beds, and on microscopic examination found to consist largely of the fossil frustules of diatoms, the spiculæ of sponges, and the like. Its nodules frequently enclose a large fossil. Specific gravity, 2.6. In pre-historic times it was extensively used as the material for knives, arrowheads, and other weapons, its peculiar conchoidal fracture and sharp edges fitting it well for such uses. Its use for striking fire with steel and tinder is a thing of the past, as is its employment for a similar use in firearms. Flint is employed in making some kinds of glass, and ground flints are an ingredient of porcelain-ware. Flint is in some places used as a building stone. In the U. S. the hornstones of the palæozoic limestone strata pass into flint, and have been shown to be of precisely similar origin to the true cretaceous flint.

Flint, tp. of Benton co., Ark. Pop. 1701.

Flint, post-tp. of Pike co., Ill. Pop. 403.

Flint, city and tp., capital of Genesee co., Mich., at the junction of the Chicago and Lake Huron and the Flint and Père Marquette R. Rs., 60 miles N. W. of Detroit. The Michigan Institution for the Deaf, the Dumb, and the Blind is located here. It has 2 national banks, 3 weekly newspapers, a city hall, a court-house, a large union school-house, 7 churches, 11 steam saw-mills (manufacturing about 50,000,000 feet of lumber annually), and a ladies' library association. City pop. 5386; tp. additional, 2142.

R. W. JENNY, ED. "GENESEE DEMOCRAT."

Flint (ABEL), D. D., b. at Windham, Conn., Aug. 6, 1765; graduated at Yale College 1785; was tutor at Brown University 1786-90, and was ordained minister of the Sec-

ond Congregational church in Hartford, Conn., Apr. 20, 1791. D. Mar. 7, 1825. Published *Geometry and Trigonometry, with a Treatise on Surveying* (1806), and translated sermons of Massillon and Bourdaloue.

Flint (Austin), M. D., a distinguished author, professor in several medical colleges, etc., b. in Petersham, Mass., Oct. 20, 1812; graduated in the medical department of Harvard University 1833; was one of the founders of the Buffalo Medical College, and professor of theory and practice in it from 1847 to 1853. Also established the Buffalo *Medical Journal*. In 1844 was called to the Rush Medical College in Chicago. Occupied for four years the chair of theory and practice in the medical department of the University of Louisville, and for three winters (1858–61) was professor of clinical medicine in the New Orleans School of Medicine. He removed to New York City in 1859, was made one of the attending physicians to Bellevue Hospital, and appointed to the chair of principles and practice of medicine and clinical medicine in the Bellevue Hospital Medical College, a position he now holds. Also for a brief time filled a professorship in the school of the Long Island Medical College Hospital. Dr. Flint is the author of several standard works in the profession. In 1852 he published clinical reports *On Continued Fever; Chronic Pleurisy* in 1853; *Dysentery*, 1853; *Physical Exploration in the Diagnosis of Disease of the Respiratory Organs*, 1856; *Diseases of the Heart*, 1859–70; *Principles and Practice of Medicine*, 1866. Some of these works have passed through several editions. Paul F. Eve.

Flint (Austin, Jr.), M. D., son of the preceding, b. at Northampton, Mass., Mar. 28, 1836; studied medicine 1854–56 at the University of Louisville, Ky., and graduated 1857 at the Jefferson Medical College, Philadelphia; was editor of the Buffalo *Medical Journal*, and professor of physiology and microscopical anatomy in the University of Buffalo 1858–59; became professor of physiology in the New York Medical College 1859, and in New Orleans Medical School 1860; studied in Europe under Bernard and Robin, and in 1861 became professor of physiology and microscopical anatomy in Bellevue Hospital; has held the chair of physiology in Long Island College Hospital; author of *The Physiology of Man* (5 vols., 1866 *seq.*), *Manual of Chemical Examination of Urine* (1870), and *New Excretory Function of the Liver* (1869), which received a prize from the French Academy of Sciences. His last appointment is that of surgeon-general of New York State, by its governor.

Flint (Charles Lewis), b. at Middleton, Mass., May 8, 1824; graduated at Harvard University in 1849; studied law, but in 1852 became secretary of the State Board of Agriculture of Massachusetts, a position which he still holds (1874). Besides full and valuable annual reports, he has published *The Agriculture of Massachusetts* (3 vols., 1853-54), *Grasses and Forage Plants* (1857), *Milch Cows and Dairy Farming* (1859), Harris's *Insects Injurious to Vegetation*, and, with G. B. Emerson, *Manual of Agriculture*, a text-book for schools.

Flint (Henry), b. at Dorchester, Mass., 1675; graduated at Harvard University in 1693; was tutor in Harvard College, Mass., 1705–54, and d. Feb. 13, 1760. In 1700 was made a fellow of Harvard University. A volume of twenty of his sermons was published in 1739.

Flint (Henry M.), American writer in the New York *World* over the signature of "Druid," wrote also *Life of Stephen A. Douglas, Mexico under Maximilian, History and Statistics of the Railroads of the U. S.*, and d. at Camden, N. J., Dec. 12, 1868.

Flint (Jacob), American clergyman, b. at Reading, Mass., Aug. 7, 1768; graduated at Harvard University 1794, and was ordained, June 10, 1798, as minister at Cohasset, Mass. Published a history of that town in *Massachusetts Historical Collections*, etc., and d. Oct. 11, 1835.

Flint (Joshua Barker), M. D., b. at Cohasset, Mass., Oct. 13, 1801; graduated at Harvard University in 1820; practised in Boston from 1825 to 1837; was professor of surgery in the Louisville (Ky.) Medical Institute from 1837 to 1849, and from 1849 to his death at Louisville, Mar. 19, 1864, had the same chair at the Kentucky School of Medicine in that city. Was for several years a member of the Massachusetts legislature.

Flint (Micah P.), b. at Lunenburg, Mass., in 1807; studied law, and was admitted to the bar in Alexandria, Miss. In 1826 he published at Boston *The Hunter, and Other Poems*, contributed freely to the *Western Review*, and d. in 1830. A son of Rev. Timothy Flint.

Flint (Timothy), b. at Reading, Mass., July 11, 1780; graduated at Harvard University in 1800; was a Congregational minister at Lunenburg, Mass., from 1802 to 1814. In Sept., 1815, went as missionary to the Mississippi Valley, and was afterwards farmer and teacher at Cincinnati, O., and on the banks of the Red River in Louisiana. Returned to Massachusetts in 1825, and turned his attention to literature. In 1833, at New York, edited the *Knickerbocker;* in 1827–30 edited *The Western Monthly Magazine*. Returned to New England 1840 from the South-west. Mr. Flint published *Geography and History of the Western States in the Mississippi Valley* (1828), besides various novels, *Lectures on Natural History*, etc.; had considerable fame as a chemist and was one of the most active and noteworthy of the American *littérateurs* of his time. D. at Salem, Mass., Aug. 16, 1840.

Flint Glass, one of the varieties of glass which contain a large percentage of lead. Powdered flint was formerly used in the manufacture, whence the name. The best of white sand (51 parts), a tolerably pure carbonate of potash (16 parts), minium or litharge (28 parts), and saltpetre ($4\frac{3}{4}$ parts) are used as principal ingredients; a little manganese, arsenic, baryta, and lime are added to correct any discoloration. Flint glass is used largely in the manufacture of achromatic lenses, and grades inferior to the very finest are used in making bottles, table-ware, and other glass goods, either blown or moulded. (See Glass.)

Flint Hill, tp. of Coosa co., Ala. Pop. 637.

Flint Implements, a name used to designate the tools made of stone, chiefly of flint, used by savages who have no knowledge of metals. If we assume that man's original condition was a savage one (which is by no means universally conceded to be true), it is probable that his clothing and utensils have been the result of a long series of discoveries and inventions, which have been the means of a series of advancing steps towards civilization. It is certain that very early races, like modern savages, fabricated their implements from stone, and chiefly from flint, and that at a later stage bronze, and at a still later stage iron utensils were employed. The period during which any people have employed stone implements only may be termed the *stone age*. The pre-historic Stone Age has been subdivided into, first, the time when only the rough flints or flakes of stone were used, or the *Palæolithic;* and, second, the time when the edges of the knives were sharpened and the surfaces polished, or the *Neolithic*.

The more common flint implements are known as *celts*, from the Welsh *cellt*, a "flint." They are the more common hatchets, adzes, or chisels of stone, and are of three sorts: first, those which have been simply chipped out in a more or less careful manner; second, those which, after being fashioned by chipping, have been ground at the edges; and third, those which have been smoothed over the whole surface. The implements are hatchets, adzes, chisels, gouges, picks, perforated axes, hammers, mining-tools, pestles, grindstones, whetstones, saws, scrapers, awls, drills, knives, daggers, lance or spear heads, javelins, arrow-heads, flaking-tools, sling-stones, balls, slick-stones, sinkers, weights, disks, cups, spindle-whorls, and personal ornaments.

The presence of manufactured celts is sufficient evidence of the existence of man in the absence of his bones. As the flints have been found in connection with the remains of extinct animals, some have supposed that in palæolithic times man was contemporary with the woolly elephant and rhinoceros, cave lion, cave bear, cave hyæna, hippopotamus, and others. In the neolithic period the animals were chiefly those of existing races, the ones just mentioned having disappeared. C. H. Hitchcock.

Flint River rises in Clayton co., Ga., and flows first in a S. S. E. and then in a S. S. W. course to the S. W. corner of the State, where, joining the Chattahoochee, it forms the Appalachicola River. It is 300 miles long, and navigable during high water to Albany by light-draught steamers, and at all times by larger steamers to Bainbridge, 50 miles from its mouth.

Flint River, in Michigan, rises in Lapeer co., flows 100 miles W. and N. W., and falls into the Shiawasee, an affluent of the Saginaw. Its lower part is navigable.

Flint River, tp. of Des Moines co., Ia. Pop. 1278.

Flint'shire, maritime county of North Wales, England, situated between the Irish Sea and the river Dee. Its area is 289 square miles; pop. 76,245. The coast is low and sandy, except along the estuary of the Dee. Parallel with the Dee runs a range of hills, rising in Garrey to 825 feet. The plains and the vales are fertile, and produce wheat, oats, and barley. The hills yield coal and ores of iron, zinc, copper, silver, and especially lead; one-fourth of the lead produced in Great Britain is supplied by Flintshire. Cotton is the main manufacture. Flintshire sends two members to Parliament, one for the county and one for the district of Flint. Flint, Mold, St. Asaph's, and Hawarden are the chief towns.

Flint'stone, post-tp. of Alleghany co., Md. Pop. 1284.

Flip'pen Bar'ren, tp. of Marion co., Ark. Pop. 350.

Float'ing Bat'teries, a name given to the heavier and more cumbrous class of iron-clad or shot-proof vessels. In the great siege of Gibraltar 1779–83 the assailants employed them, but without success. At Kinburn in 1854 they were used with advantage against the Russians, but at present they are built almost exclusively for defensive purposes.

Floating Islands are either artificial or natural. To the former class belong the *chinampas* of the Mexican lakes, which were observed by Cortez, and some of which still exist. They are formed by placing the lake mud upon floats or rafts of wicker work covered with *tule* reeds. In the lakes around Cashmere there are floating gardens made by placing lake mud upon large strips of marsh turf. The object of this process is to escape the floods which frequently destroy the crops in the lowlands of that region.

Natural floating islands are found in many lakes. They frequently consist of considerable pieces of marsh turf held together by willow roots and the like, and torn from their soft muddy beds by inundations or swift currents. Some of these, anchored by long roots, rise and fall with the water. Some are buoyed up, apparently by bubbles of marsh gas beneath the surface. Several floating islands in Europe are large enough to serve as pastures. Floating islands occur in many American lakes which are being filled by the growth of vegetation and the formation of peat. A typical example of these may be seen in Lake Menomenauk on the line between Massachusetts and New Hampshire. This island has an area of about 5 acres, and is covered with small trees from 5 to 25 feet in height. It was formerly in Winchendon, Mass., but has now floated 2 miles up the lake, and into New Hampshire. In the great flood of 1874 several islands or natural rafts from the Mississippi were observed floating out to sea, bearing a freight of living animals, birds, and reptiles. Similar floats, with living trees, have been seen over 100 miles from the mouth of the Ganges in time of flood. Doubtless both plants and animals have had their habitats widely extended in this way.

Floating Warehouses have been constructed, chiefly in French ports. They are designed for the reception of gunpowder, nitro-glycerine, petroleum, and other unusually dangerous wares. They are anchored in places which are remote from quays, shipping anchorages, or buildings, and are thus not only less liable to be fired, but in case of their explosion will do comparatively little damage to other property.

Flobecq, town of Belgium, in the province of Hainaut, has distilleries, weaving and spinning factories, and corn and oil mills. Pop. 5258.

Flodden Field, the last point of the Cheviots, the place where King James IV. of Scotland, after crossing the Border on Aug. 22, 1513, with an army of over 30,000 men, took up his position, and where, on Sept. 9, the bloody battle was fought in which the king was killed and the Scottish army destroyed.

Flodoard, or **Frodoard,** canon of Rheims, b. at Épernay 894 A. D., opposed the intrusions of the civil power into the affairs of the Church, and was imprisoned therefor; author of French annals (*Chronicon*, 919–966); a history of the Rhemish Church; the *Triumphus Christi*, a metrical work, etc. He became an abbot, and d. Mar. 28, 966. His *Chronicon* is a work of much value to the historian. Large portions of his writings are extant, and have been printed.

Floetz, a German term formerly applied to the stratified or sedimentary rocks.

Flog'ging, the infliction of stripes or blows of the whip or scourge, especially when directed by a court of justice or other public authority. Corporal punishment has from the earliest ages been inflicted as a recompense for various offences. In the form of the bastinado it is still extensively employed in the East. In ancient Rome scourging might not be administered to a citizen, for it was looked upon as giving the deepest dishonor to its victim. It was, however, frequently employed as a punishment for those who were not citizens, and was administered with a rod. In modern Europe it is not quite extinct. Its severest form is by the knout in Russia, where it is much less frequent and severe than it formerly was. In Great Britain it exists as a means of prison discipline, as well as a regular punishment in the army and navy. In the U. S. army and navy it has been abolished, as well as in most of the States, Delaware being (1874) a noteworthy exception. Flogging in the public schools is perhaps not unknown in the regions remote from the influence of the progressive spirit of the time, but the mild forms of corporal punishment usually employed in our schools do not deserve so harsh a name as flogging.

Flood, tp. of Darlington co., S. C. Pop. 862.

Flood (Rt. Hon. HENRY), an Irish orator, b. 1732, was educated at Dublin and Oxford; first entered the Irish Parliament in 1759; was sworn of the privy council for Great Britain as well as for Ireland in 1775; was vice-treasurer of Ireland 1775–81; and entered the British Parliament in 1783. His speeches are noteworthy for their fine style and logical method. He was an eloquent advocate of reform for Ireland, but the purity of his motives has been questioned. Author of some poems and a vol. of *Speeches*, 1787. D. Dec. 2, 1791. (See his *Life and Correspondence*, by W. FLOOD, 1838.)

Flood-plain, a plateau which borders many streams above their general water-level, but which is covered by their periodical or occasional floods. The flood-plain is swept by, and often covered with, deposits from the turbid waters of freshets. Thus, it is built up to and maintained at a nearly uniform height. When left beyond the reach of the stream by the cutting down of its bed, the flood-plain becomes a terrace. J. S. NEWBERRY.

Floor, the lower surface of any room in a building, or the upper surface of the structure which separates one story of a building from another. Floors are usually horizontal, but are sometimes inclined, or so curved as to present an upward concavity, especially in public halls and theatres. Floors are variously supported according to the purpose of their construction. Ordinarily, the floor-boards are laid upon simple joists, which are stiffened by struts, the ceiling of the room below being applied to the lower edges of the same joists. For deadening the sounds which may pass through floors, sometimes a double series of joists, or even a more complicated system of carpenter-work, is used. Floors are best made of narrow boards, the timber of the long-leaved Southern pine being a favorite material. A handsome floor may be made by alternate strips of pine and black walnut. Such floors are usually kept oiled or waxed with beeswax, and should be often rubbed and polished. Parqueterie, veneers, wood-carpeting, encaustic tiles, and even mosaics, are sometimes seen upon floors, but less frequently in this country than in Europe. Here the cheapness and excellence of carpets are such that persons in very moderate circumstances can afford to buy good carpets, which not only may be tastefully and artistically designed, but are conducive to health and comfort. The floors of warehouses for heavy goods require special constructions, such as trusses or arches, for their support.

Floor-cloth is composed of oil-painted canvas, both sides being painted with one or more coats, and afterward printed on one side with designs in colors. Floor-cloths are usually printed by hand by the old method of block-printing. The compounds linoleum, kamptulicon, and the like are substitutes for common floor-cloths, and are made by patented processes. India-rubber is an ingredient of some of these, and they are often stiller under foot, and warmer, but less durable than good oil-cloth.

Flo'ra was early worshipped among the Romans as the goddess of flowers and of spring, and was identified with the Grecian Chloris. A temple was vowed to her by Tatius, and a flamen appointed to serve at her altar. Her temple was situated near the Circus Maximus, and an annual festival was held in her honor between the 28th of April and the 3d of May, when every licentious extravagance was indulged in by the populace. She was represented bearing the cornucopia filled with flowers. A late tradition says that she was a wealthy courtesan who bequeathed her riches to the city on condition that she should be worshipped.

In botany, the term *flora* is applied to the collective vegetation of a country or district, and has been extended in its significance so as to include the fossil forms of plant-life found in any geological formation. The name is to botany what *fauna* is to zoology. It is applied also to a work which enumerates and describes the plants of any particular country. A *flora* would include only such plants as were indigenous to the region, or such adventitious ones as had become completely naturalized. The author sometimes endeavors to present his flora in such a way that it may be not merely a list of plants of the specified region, but an indication also of their geographical distribution, habits, and utility. In writing the name of such a work the term *flora* is followed by an adjective expressing the country included, as *Flora Americana*, *Flora Lapponica*, etc. W. W. BAILEY.

Flora, tp. of Boone co., Ill. Pop. 1273.

Flora, post v. of Clay co., Ill., 94 miles E. of St. Louis, Mo., at the crossing of the Ohio and Mississippi and the Springfield and Illinois South-eastern R. Rs. It has 6 churches, is the place of the district fair, contains about 30

stores and shops, 1 national and 1 savings bank, 2 flouring mills, 1 weekly newspaper, and 2 monthly magazines. Pop. 1339. M. L. Wilson, Pub.
"Southern Ill. Journal" and "Monthly Letter-Box."

Flora, tp. of Renville co., Minn. Pop. 269.

Flora Falls, a beautiful cascade and post-v. of Stony Point tp., Rockland co., N. Y., on Flora Creek, which has worn a ravine in the sandstone for 100 feet.

Floréal (the "flowery"), the eighth month in the republican calendar of France, which from Nov. 24, 1793, to Sept. 9, 1805, was used in place of the Gregorian. Floréal began Apr. 19–22, and ended May 18–21.

Flore, Order of [so called from *Floris* (a place near Cosenza), the seat of the first abbey], a branch of the Cistercians, including convents of nuns as well as those of monks. It was founded by Joachim of Floris in 1189, and being suspected of maintaining the heresies of its founder, it never flourished. In 1505 most of its convents joined the Cistercians and other orders.

Flor'ence [It. *Firenze*], province of Italy, comprises an area of 2144 square miles, with a population of 766,824. It is one of the most productive provinces of the country; wheat, wine, and silk are extensively produced.

Florence [It. *Firenze*, with the epithet *La Bella*], a city of Italy, is situated in lat. 43° 46′ 36″ N. and lon. 11° 15′ 30″ E., in the beautiful valley of the Arno, mostly on the northern bank. Pop. in 1871, 167,093. It is one of the most beautiful and interesting cities of Italy, and a principal seat of art and science. Great and splendid even in former times, it made great progress in size and beauty, as the capital of the new kingdom, from 1865 to July 1, 1871. The inner part of the city was formerly surrounded by a wall, but gardens, palaces and monasteries cover the neighboring hills. During the recent expansion of the city the wall was thrown down on the eastern side, and here a new city arose, in the midst of which is situated the beautiful Piazza d'Azeglio. The inner part of the city has been made brighter by the construction of new and wider streets, and new and beautiful palaces are added to the great number of old and celebrated monuments. The Arno, dammed up to 100 paces breadth, is provided with quays, called *Lungarno*, and six bridges connect the different parts of the city with each other. These bridges and quays, with the Via della Scala and Via Maggio, form the liveliest parts of the city, and more than twenty public squares, surrounded by beautiful buildings, adorn it. Among these public squares the most remarkable is the Piazza del Granduca, now called the Piazza della Signoria, which is very rich in works of art. It contains the great fountain, adorned with twelve bronze statues by Gian of Bologna; the beautiful equestrian statue in bronze of Cosimo I., by the same artist; the colossal Neptune and the Tritons of marble by Ammanato; and the statue of Hercules by Bandinelli. The old palaces stand, generally, among common houses in narrow streets, and their heavy and massy architecture gives them a gloomy character. In the Middle Ages they served as strongholds. They were built of large blocks of freestone, with battlements, and often with towers, but without any exterior embellishments. They are now, moreover, blackened by age. In the interior they contain courtyards, with arcades from which stairs lead into the halls. One of the most interesting palaces is the Palazzo Vecchio, or Palazzo della Signoria, at one time the seat of the Florentine magistrature, and from 1865 to 1871 of the Italian Parliament. The Palazzo Pitti, built by Brunelleschi, and the residence of Victor Emmanuel while in Florence, is one of the most magnificent palaces which exists. It contains the Galleria Pitti, the finest collection of pictures in the world, and the Pitti and Uffizi collections are now connected by a long gallery, passing over the Ponte Vecchio.

Remarkable among the ecclesiastical buildings is the cathedral, 555 feet long, 340 feet broad. Arnolfo da Colle commenced the building, and continued it until 1310; Giotto succeeded him, and Brunelleschi finished it in 1436. The marble covering of the cathedral is rich and varied; especially is that of the campanile delicate and fine in color. Very interesting is the construction of the vaults of the baptistery of San Giovanni, belonging to the cathedral and situated to the west; and widely known are the three doors of bronze, especially that of the eastern gate by Ghiberti. The church of Santa Croce, commenced in 1294 by Arnolfo di Cambio, 371 feet long and 113 feet broad, has eleven chapels, and contains the tombs of Michael Angelo, Alfieri, and Machiavelli, and a monument of Dante. A most interesting building is the Loggia dei Lanzi, a hall commenced in 1376, and finished by Benci di Cione and Simone di Francesco Falenti after a plan by Orcagna. It contains masterpieces of marble and bronze—the Vestals, the Centaur, Ajax with the corpse of Patroclus. Between the Loggia dei Lanzi and the Palazzo Vecchio is situated the Palazzo degli Uffizi, containing the world-famous collections of statuary in marble and bronze (the group of Niobe and the Medicean Venus), of cameos, pictures (*Venus* by Titian, the *Holy Family* by Michael Angelo), and crayons.

Florence has two forts, but is not regularly fortified. The industry of the city, formerly flourishing, is remarkable now only in works of art, mosaic, and jewelry; its manufactures of silk, velvet, and woollen have decreased very much.

Florence, originally a Roman colony in Etruria, was a flourishing city at the time of Christ. Under Totila it was destroyed, but rebuilt under Charlemagne. The German emperors, especially Otho the Great, favored the city in many ways; and as its position was of much consequence in military respects, many knights settled here, and early the nobles held the ascendency. Parties fought in Florence as in other cities; nevertheless, in the ninth and tenth centuries it became a centre of civilization, and increased its political importance by conquering the neighboring cities and towns. In the beginning of the twelfth century it threw off the authority of the German emperors and established a republic, and in 1198 it headed the union of the Tuscan cities against Philip of Suabia. In the beginning of the thirteenth century Florence was governed by a podestà, who, however, held the supreme authority only in matters of justice; the administration and the political power depended on six consuls and a municipal council of 100 citizens. The republic had an oligarchical character, but although it was convulsed by the civil wars between the Guelphs and the Ghibellines, the city still increased in power. In 1078 the enlargement of the city made a second wall necessary, and between 1284 and 1327 the third wall, the present one, was built. In 1222, Florence conquered Pisa, and gained great commercial advantages; in 1332 it conquered Pistoja, in 1333 Massa, and soon it ruled over the whole of Tuscany. The authority of the nobility began to decrease; the citizens acquired ascendency, and in 1378 the democracy gained a decided victory, Salvestro de Medici, a plain citizen, becoming gonfaloniere. It was, however, Giovanni de Medici, the banker of the pope and a man of immense wealth, who founded the house. At his death in 1428 he left two sons, Cosimo and Lorenzo, from the latter of whom the dukes of the sixteenth century descended. Cosimo acquired great fame during the Council of Florence in 1439, and his grandson, Lorenzo the Magnificent, added still more to the splendor of the house. In 1478 the conspiracy of the Pazzi against the Medici failed, and in 1492, Pietro succeeded his father Lorenzo as gonfaloniere. Pietro, however, was expelled, and Savonarola established a kind of theocracy, but was burnt as a heretic in 1498. By the victory of Alessandro of Medici (Aug. 12, 1530) the republic was finally overthrown, and (July 29, 1531) Alessandro was declared duke of Florence. He was killed in 1539, but his son succeeded as grand duke. After the death of the last Medicean grand duke the government of Tuscany, whose capital Florence was, fell to Francis, duke of Lorraine, later an emperor of Germany. His descendants were expelled by the French in 1799. In 1801, Tuscany became a part of the kingdom of Etruria under Louis of Parma. In 1808 it came under the sway of France. In 1814 the grand duke Ferdinand III. once more took possession of the country, but in 1859 his son, Ferdinand IV., had to abdicate, and May 22, 1860, Tuscany was incorporated into the kingdom of Italy, and Florence was the capital of the kingdom until in 1871 this dignity was conferred on Rome. A. Niemann.

Florence, a post-v. and tp., capital of Lauderdale co., Ala., is at the head of navigation on the N. bank of the Tennessee River and on a branch of the Memphis and Charleston R. R. It contains the State normal school and a flourishing female college, has 2 weekly newspapers, 3 churches; also 2 churches and a school for colored people, 1 hotel, and the usual number of shops and stores. There are 2 cotton-factories located near Florence. Principal business, farming. Pop. of v. 2003; of tp. 2528. Jones & Powers, Eds. of "Times & Journal."

Florence, post-v. of Pima co., Ara., on the Gila, 60 miles N. of Tucson.

Florence, post-v. of Idaho co., Id., in Florence Basin. It is believed to be the highest town in the U. S. It is 11,100 feet above the sea-level. Florence Mountain, on which it stands, is over 13,000 feet high. Florence has very productive gold-mines.

Florence, tp. of Stephenson co., Ill. Pop. 1185.

Florence, tp. of Will co., Ill. Pop. 875.

Florence, tp. and post-v. of Benton co., Ia., on the

Chicago and North-western R. R., 15 miles W. by S. of Cedar Rapids. Pop. of v. 315; of tp. 1290.

Florence, city of Marion co., Kan., at the junction of the Cottonwood River and Doyle Creek, on the Atchison Topeka and Santa Fé R. R. It has good school advantages, usual religious denominations represented, a stone quarry, a bank, and a grist-mill. Pop. about 500.

E. W. HOCH, LATE ED. "PIONEER."

Florence, post-v. of Boone co., Ky. Pop. 374.

Florence, thriving post-v. of Northampton tp., Hampshire co., Mass., on the New Haven and Northampton R. R., 3 miles N. W. from the village of Northampton, with which it is connected by a street railroad. It has manufactures of sewing-machines, cotton, silk, woollen, and other goods, and has excellent social and educational advantages. (See NORTHAMPTON.)

Florence, post-tp. of St. Joseph co., Mich. Pop. 970.

Florence, tp. of Goodhue co., Minn., on Lake Pepin. Pop. 760.

Florence, post-v. of Haw Creek tp., Morgan co., Mo. Pop. 53.

Florence, tp. and post-v. of Douglas co., Neb., on the Omaha and North-western R. R. and on the Missouri River, 5 miles by rail and 15 miles by steamer above Omaha. Pop. of tp., 395.

Florence, post-v. and tp. of Oneida co., N. Y. P. 2299.

Florence, post-tp. of Erie co., O. Pop. 1341.

Florence, tp. of Williams co., O. Pop. 1678.

Florence, post-v. of Darlington co., S. C., at the junction of the North-eastern, the Cheraw and Darlington, and the Wilmington Columbia and Augusta R. Rs., 102 miles N. of Charleston. It has grown remarkably since 1860, when its site was a pine forest. It has railroad shops, some 30 stores, a mill, machine and other shops, 8 churches, 2 fire-engine companies, a weekly newspaper, a large trade in cotton and in other goods, and a hotel which cost $25,000. WM. LITTLE, ED. "PIONEER."

Florence (THOMAS B.), American Congressman, b. in Philadelphia, Pa., Jan. 26, 1812, published and edited a Democratic newspaper there for several years; was for nine years secretary of the board of controllers of public schools in Philadelphia, and was a Representative from Pennsylvania in Congress from 1850 to 1859. Established the *National Democratic Review*, edited the *Constitutional Union* in Washington, D. C., and was in the national union convention at Philadelphia in 1866. D. July 3, 1875.

Florence, Council of (1439–42 A. D.). This was not a separate council, but, along with that of Ferrara, only the continuation of the Council of Bâle, the seventeenth of the twenty œcumenical councils acknowledged by the Church of Rome. The Council of Bâle was opened Dec. 14, 1431. Called in the interest of reform, the attendance at first was small, the pope, Eugenius IV., being hostile. In 1434 a reconciliation was brought about, and the pope took the direction of affairs into his own hands. On Jan. 8, 1438, the council was transferred to Ferrara, and in Jan., 1439, to Florence, where its sessions continued at intervals until 1442. But its interest culminated in the summer of 1439, when the reunion of the Greek and Latin churches was thought to have been accomplished. More than 500 Greeks, including the Greek emperor and the patriarch of Constantinople, were in attendance, having joined the council at Ferrara. Four points were under discussion: 1, the Filioque of the Latin Creed; 2, the use of unleavened bread in the Eucharist; 3, purgatory; 4, the papal supremacy. The first three points were settled by compromise; the fourth by the submission of the Greeks. But the impulse to this settlement was imperial, the Greeks desiring Occidental assistance in beating back the Turks. The "reconciliation" had no roots in the hearts of the people, and in 1443 the patriarchs of Alexandria, Antioch, and Jerusalem united in denouncing the Council of Florence. Meanwhile, the remnant of the council summoned by Eugenius IV. continued to sit at Bâle; in 1440 elected an antipope (Felix V.), who resigned in 1449; removed to Lausanne July 24, 1448, and dissolved Apr. 25, 1449. (See MANSI'S *Councils*, vol. XXIX.; HARDUIN'S *Councils*, vols. viii. and ix.; and HEFELE'S *Conciliengeschichte*, vol. vii., part 2, 1874.) R. D. HITCHCOCK.

Flor'entine Acad'emy (*Accademia Fiorentina*), a learned association of Florence, was founded in 1540. With it the Accademia della Crusca was finally united.

Flor'entine Work, or **Pie'tra Du'ra** [It. for "hard stone"], a beautiful kind of ornamental work composed of black (or less frequently white) marble inlaid with brilliantly colored stones. Florence is the most famous seat of this industry, or rather art, but the Russians excel the Italians. The workmen of Agra and Delhi in India anciently produced fine work of this kind, but there is reason to think it in part (at least) the work of Italian artists.

Floren'tius, the name of several men eminent in history and in letters. Among them are FLORENCE (Florentius) OF WORCESTER, a learned monk who d. in 1118; author of a Latin chronicle, the first written in England after the Norman Conquest.—FLORENTIUS RADEWIJNS, b. at Leerdam in the Low Countries in 1350; was educated at Prague; succeeded Gerhard Groot as director of the Brethren of the Common Life. D. 1400. (See his *Life*, by Thomas à Kempis.)—Another FLORENTIUS (*François Florent*) was a Burgundian jurist, who d. Oct. 29, 1650; author of *Dissertations* on the canon law (1632) and *Disputations* regarding consanguineous marriages (1636).

Flo'res, the westernmost island of the Azores, in the Atlantic Ocean, in lat. 39° 25′ N. and lon. 31° 12′ W. Its name was given it by the Portuguese in allusion to the flowers with which it is covered. Pop. 10,522. Chief town, Santa Cruz.

Flores, an island of the Malay Archipelago, and the largest of the chain that extends from Java to Timor. Its length is 200 miles, its breadth about 35 miles. It is hilly, with some lofty volcanic peaks on its S. side. It exports sandal-wood, beeswax, and horses. The native inhabitants are Negrillos. On the coast are settlements of Malays.

Flo'resville, post-v., cap. of Wilson co., Tex.

Flo'reyville, Miss. See ROSEDALE, Miss.

Flo'rian, SAINT, patron saint of Poland, was a Roman soldier, b. in Noricum of Christian parentage, and drowned in the river Enns in Austria during the Diocletian persecution, on account of his voluntary confession of the Christian faith. He was buried where now stands the magnificent Augustinian abbey of St. Florian, 3 miles S. W. of Enns, but his relics were translated to Rome, whence in 1183 they were taken to Cracow. In legendary lore he is honored as the extinguisher of conflagrations. He is commemorated on Mar. 4th.

Florian, de (JEAN PIERRE **Claris**), b. at the Château de Florian, in Gard, France, Mar. 6, 1755; entered the service of the duke of Penthièvre; was patronized by Voltaire, and attained fame as a writer of fables, romances, comedies, and pastoral poems; was imprisoned in Paris by the republicans, and d. at Sceaux Sept. 13, 1794. Some of his plays still keep the stage, but his romances *Galatée* and *Estelle*, his *Fables*, and the translation of *Don Quixote* are his best works.

Flor'iculture [Lat. *flos*, *floris*, a "flower," and *cultura*, "attention"], the cultivation of flowers, whether pursued for profit or for enjoyment. Not only for the supply called for by the flower-markets of all large cities, but to satisfy an important commercial demand—that for artificial perfumes—has floriculture become an industrial pursuit. Thus, rose-culture in India, Persia, Turkey, and France, and in the latter country the production of violets, jessamine, orange-flowers, tuberoses, heliotropes, jonquils, etc., are found very profitable, and are conducted on a large scale. In ancient Athens, as well as in aboriginal Mexico—the one the most refined of cities, the other a scarcely more than barbarian town—there were famous flower-markets. Even among the rudest savages the love of flowers is not unknown. India, Japan, and especially China, have done much for the development of garden-flowers, which are indeed almost as much the product of art as of nature. But, though often monstrosities to the eye of the botanist, hardly any objects in the world are more beautiful or more replete with fine æsthetic and moral influences than garden-flowers. Says Solon Robinson (*Facts for Farmers*, p. 400), "We are just as well satisfied of the beneficial moral effect of flower-cultivation as we are that the effect of their beauty upon the senses of nearly all beholders is pleasing. . . . A love of flowers is a love of the beautiful; a love of the beautiful is a love of the good. . . . There is no spot on the farm that grows such a paying crop as the little parterre . . . devoted to the cultivation of flowers. If it does not pay in golden coin, it does in all that makes life worth staying here for." Parlor and green-house floriculture, the Wardian case, and the flower border each require special skill, to be acquired by experience and the study of works specially devoted to the subject. In the U. S. floriculture for profit is carried on in the vicinity of all considerable towns to some extent, but the flower-markets of New York and New Orleans have long been the most celebrated. The cultivation of flowers for market is an important industry in those parts of New Jersey near New York, but the U. S. census does not publish separate statistics for this branch of gardening. Throughout the year the New York flower-markets receive ample supplies, principally from New Jersey, and the number of kinds of flowers supplied, even in the coldest months, is very great.

Flor'ida, the most southern of the States of the Ameri-

can Union, lying between the parallels of lat. 24° 30′ and 31° N., and between the meridians of lon. 79° 48′ and 87° 38′ W. from Greenwich. The peninsula of Florida forms the eastern barrier or boundary separating the Gulf of Mexico from the Atlantic Ocean. It is bounded N. by Georgia and Alabama; E. by the Atlantic Ocean; S. by the Gulf of Mexico and the channel between Florida and Cuba, which forms one of the outlets of the Gulf of Mexico; W. by the Gulf of Mexico and the Perdido River, which separates it from the Gulf portion of Alabama. Its area is estimated at 59,268 square miles, or 37,931,520 acres, but this is only an approximation, as its surface has never been accurately surveyed. The peninsular portion of the State is about 375 miles long, with an average breadth of about 90 miles. Negotiations have been commenced between Alabama and Florida for the purchase by the former of the seven counties lying between the Chattahoochee and Perdido rivers, thus giving Alabama her entire southern coastline on the Gulf. This may eventually be done, but as yet very little progress has been made in the negotiations.

Face of the Country, Coast-Line, Rivers, Lakes, etc.—The State has a coast-line of more than 1150 miles, indented with a large number of spacious bays, harbors, and estuaries, affording great advantages for the development of trade and safe and convenient retreats for vessels exposed to the violent gales which occasionally rage off this coast. On the Gulf coast the principal harbors are Pensacola, Appalachicola, St. Mark's, Cedar Keys, Tampa, Charlotte, and Key West; and on the Atlantic, St. Augustine, Fernandina, Port Orange, and Jacksonville on the St. John's River.

The principal rivers are the Appalachicola, which farther N. takes the name of Chattahoochee from its principal affluent; the Ocklockonnee, the Perdido, the Suwanee, St. Mary's, and St. John's. The last-named river, with its branches, furnishes nearly 1000 miles of river navigation, and for 150 miles from its mouth is 2 miles wide. It is a somewhat sluggish stream, and for more than 200 miles runs nearly parallel with the Atlantic. The Wethlacoochee, which discharges its waters into the Gulf, is a very considerable stream, as are also Peace Creek, which falls into Charlotte Harbor, and the Caloosahatchie River, which falls into the Gulf still farther S. Kissimee River, which connects several of the smaller lakes with Lake Okeechobee, is a navigable stream.

The largest bays are on the Gulf coast. Prominent among these are Perdido, Pensacola, Escambia, Choctawhatchee, St. Andrew's, Alligator, Appalachee, Deadman's, Horseshoe, Wacasse, St. Joseph's, Tampa, Hillsboro', Sarasota, San Carlos, Costigo, Charlotte Harbor, Caximbus, Gallivans, Bahia, Ponce de Leon, White Water, and Florida bays; while on the Atlantic, near the southern extremity of the peninsula, is Bay Biscayne. The coast has also a number of sounds, those on the Gulf being St. Rosa Sound—uniting Pensacola and Choctawhatchee bays—St. George's Sound, and on the Atlantic coast, Barnes and St. Lucie's sounds.

Florida abounds in lakes. Okeechobee, the largest, has not been fully explored, but is said to extend over an area of more than 650 square miles. The largest of the other lakes are Abapopka, Istokpoga, Orange Lake, Kissimee, Cypress, Lake George, Lake Lamona, Lake Washington, Tohopokaliga, Alligator, Dunn's Lake, Lake Harris, Lake Griffin, Lake Trati-Apopka, Lake Jessup, Lake Monroe, Santa Fé Lake, etc.

Not the least striking geographical feature of Florida is the Everglades, which occupy a portion of the lower part of the peninsula. This delta-like expansion consists of numerous streams, which in a wet season form a continuous though mostly shallow sheet of water, and forms the marshy outlet of Lake Okeechobee, extending to the Gulf of Mexico in a south-westerly direction. It is nearly 90 miles in length, and from 30 to 50 in width, comprising an estimated area of 3600 square miles, or 2,204,000 acres. The Everglades, when partially inundated, resemble an immense lake studded with a vast number of islands, varying from a fraction of an acre to hundreds of acres in extent. These islands have a very rich soil, and when reclaimed are well adapted to the growth of plantains and bananas, but in their wild state are generally covered with dense thickets of shrubbery and vines, and occasionally with pines and palmettos. N. of the Everglades the country is generally level, the most elevated point in the central portion of the peninsula being considerably less than 200 feet above the level of the sea; from this point the surface slopes gradually towards the coast on either side. Between the Suwanee and the Appalachicola the surface is more elevated, and occasionally diversified with hills; W. of the Appalachicola the surface is generally level.

Florida has many beautiful springs, some of immense size, and strongly impregnated with sulphur and lime. Good water may be found in almost any section at the depth of from 15 to 20 feet.

S. of the mainland, and extending from Cape Florida on the peninsula, a series of islands, sandbanks, reefs or keys, attached and belonging to the State of Florida, extend south-westward a distance of 220 miles in a curve, terminating in a cluster of sandbanks and rocks known as Tortugas. These keys are separated from the mainland by Florida Bay, Bay Biscayne, Carp's and Barnes sounds. S. of this series of keys, with a navigable channel intervening, lies the Florida Reef, being a long, narrow coral reef, here constituting the left bank of the Gulf Stream. Key Largo is the longest and Key West the most important of these keys. On the latter the city of Key West is located, one of the largest cities in the State, and an important naval station.

Geology and Mineralogy.—The whole State belongs to the alluvial and diluvial formations. It is often spoken of as an immense sand-bar; this is not true. The diluvial portion of the State, the interior and highest portion of the peninsula, consists for the most part of clay intermingled with a calcareous formation. The coral-beds, some of them of great age, underlie most of the State, where, as in all the swampy and low-lying portions, as well as in the alluvium which prevails for perhaps 25 or 30 miles on either coast, the covering of these coral-beds is a deposit from the ocean or the Gulf, and has been so much fertilized by the decay of its luxurious vegetation, that it is uncommonly fertile. On much of the land the live-oak and other oaks, pines, and hickory grow luxuriantly. But few valuable minerals have thus far been brought to light in the State, and it is hardly probable that any considerable number will be found, for alluvial and diluvial lands are not often rich in them. Ochre, amethyst, pit-coal, topaz, agate, carnelian, chalcedony, iron ore, calcareous limestone, silicified shells, and corals are found in limited quantities along the coasts and in the interior. The *coquina* of Florida, a shell-conglomerate, affords a fine building material. The beauty of the sea-shells of the Floridian coast, and especially along the keys around the southern extremity of the peninsula, has been often remarked.

Soil and Vegetation.—The soil of Florida is generally a light, sandy loam, with a substratum of clay, and sometimes intermixed with the latter. It is of all qualities, from the dry sand of the pine barrens to the fertile hummocks and bottom-lands, and in the marshes are inexhaustible vegetable deposits which make most excellent fertilizers. The pine barrens, the poorest lands in the State, although apparently worthless for agricultural purposes, are, in reality, very productive when properly cultivated, experience having proved that they are eminently adapted to market-gardening. In the order of productiveness the swamp lands rank first, the low hummocks second, the high hummocks third, and the pine, oak, and hickory lands fourth. The swamp lands are of comparatively recent formation, and are still receiving additions to their surface. In the cultivation of these lands ditching is indispensable, but they are intrinsically the most valuable lands in the State, being as fertile as the hummocks, and much more durable. They are especially adapted to the cultivation of the sugar-cane, and crops of four hogsheads of sugar per acre are not uncommon. The low hummocks require some ditching, and are also suitable to the cultivation of cane. Of the adaptability of the high hummocks for general cultivation mention has already been made. Nearly all the grains and fruits of the temperate zone may be raised in the northern part of the State; the eastern and central portions of the peninsula produce the various semi-tropical fruits in abun-

dance: and in that portion of the State S. of the line of frosts the fruits of the tropics may be cultivated without difficulty. Every section of the State is adapted to the growth of Indian corn. On the rich bottom-lands the average crop is 55 bushels to the acre. The short staple (or upland) and the long staple (or sea island) cotton are both cultivated, the former being usually grown in the western part of the State, and the latter in the eastern. The yield of the short staple is from 200 to 300 pounds per acre on ordinary soils, but with good care, upon rich land, 500 pounds may be produced. Under favorable circumstances from 300 to 400 pounds of the long staple can be grown upon an acre. The soil and climate of Florida are eminently adapted to the growth of sugar-cane, and its culture is increasing, since it has been discovered that a large capital is not necessary to success in its culture, and that a number of proprietors cultivating small areas have received as great profit from the cane as could be derived from any other product. In Volusia county one field of ten acres produced at the rate of 1500 pounds of sugar and 300 gallons of molasses to the acre. The ordinary yield of sugar per acre in Florida is nearly twice that of Louisiana, and the cultivation much easier. Below the frost-line on the peninsula the sugar-cane reaches perfection, which it cannot in Louisiana or elsewhere in the U. S. Cuba tobacco was grown in some parts of the State before the war, and its cultivation is again becoming common. The average yield of this plant is 700 pounds per acre. Sweet potatoes produce abundantly in all parts of the State, yielding from 100 to 300 bushels per acre, and next to Indian corn form the principal article of vegetable food of the masses. Irish potatoes, although not so productive as in the North, may yet be made an exceedingly profitable crop, as they may be planted in January and ripen in May, when they are shipped at a small expense to Northern markets and sold for good prices.

A large area of the lowlands is well adapted to the culture of rice, the average yield being 40 bushels to the acre. During the British occupation indigo was the main staple, but it is not at present cultivated. The plant now grows wild in many parts of the State. Sisal hemp, introduced from Yucatan, has proved a great success. It may be grown anywhere S. of the frost-line, and with very little care a ton of cleaned hemp can be made to the acre, worth $300 per ton. Coffee has been successfully grown in the southern portion of the peninsula. The pea-nut (or ground pea) produces abundant crops. The *Zamia integrifolia*, a wild arrow-root, yielding a nutritious starch, grows in the S. part of the State. Wheat has been raised in Northern Florida, but is an uncertain crop. Rye and oats are cultivated to some extent, but chiefly for forage. All varieties of hemp grow luxuriantly, and may be cultivated with assurance of remunerative return.

Almost every description of garden vegetables found in the markets of this country can be raised here with great success. Owing to the fact that the season is from four to six weeks earlier than any other part of the Atlantic coast, many vegetables, including tomatoes, peas, beans, cucumbers, potatoes, melons, cabbage, and beets, are shipped to Northern ports at great profit; and with the establishment of direct lines of steamers between the ports of the State and the principal Northern ports, thus avoiding the delays and injury of transshipment at Savannah or Charleston, the gardeners of Eastern Florida are enabled to place vegetables in the Northern markets in good condition long in advance of those of other localities.

In this genial climate all the semi-tropical fruits, such as the orange, lemon, lime, olive, fig, citron, pineapple, banana, guava, and the palm, are produced in as great perfection as in the more tropical climate of Brazil and the West Indies, and with far less attention and greater immunity from injury by insects or vicissitudes of climate than the common fruits of Northern orchards. The oranges are especially celebrated for their superior flavor. It is not known whether this fruit is indigenous, but it is now found growing wild in almost every section of the State. A large number of orange groves have been established within the past few years, and the exportation of the fruit has already become one of the most important branches of trade. The groves are established by transplanting the wild orange trees during the winter, and budding them in the summer with the sweet orange. Raised from the seed, the orange begins to bear in from seven to ten years, but the budded trees generally produce fruit in three or four years. The yield of single trees varies from 100 to 10,000 oranges, according to age, situation, and treatment. One hundred trees are planted to the acre, and as the fruit can be sold on the trees at $15 to $20 per thousand, enormous profits can be derived from a small area of land. The lemons of Florida are far superior to those of Sicily, Italy, or Spain. The lemon, lime, citron, and shaddock are propagated in the same manner as the orange; all of them in greater perfection than in other countries. The pineapple is grown, with slight protection in winter, as far N. as St. Augustine, but 100 miles S. of this point they are produced in great perfection, frequently weighing nine or ten pounds each. The guava, another tropical fruit, trained in bush form, is attracting much attention, and its cultivation is beginning to be largely undertaken. The banana may be successfully cultivated as far N. as Fernandina, and where once established a plantation of this fruit needs no renewal, and 1 acre will produce as much food as 45 acres of potatoes. Figs, pomegranates, oranges, and various kinds of berries are produced in abundance. S. of lat. 28° N. the date-palm is grown with great success. Apples and pears have not been so successful. The peach, the nectarine, and the plum do well, and are less subject to disease and injury from insects than in the North. The grape grows luxuriantly, and is found wild in many parts of the State. The black and white Hamburg, Muscat, and other foreign varieties reach the greatest perfection. The scuppernong is most generally cultivated, and makes excellent wine. The sugar-apple, alligator-pear, plantain, and cocoanut are strictly tropical fruits, but they may all be raised without difficulty in the southern portion of the peninsula. Ginger, cinnamon, pepper, pimento, cloves, and the other tropical spices are all successfully cultivated in Southern Florida.

In the growth and variety of its forest trees Florida has few rivals on the Atlantic slope. The live-oak, the most valuable timber for shipbuilding, is abundant here; indeed, the peninsula may be considered its original home. Various other species of oak, the swamp cypress, the yellow pine, and other choice varieties and species of the pine, hickory, magnolia, the great dogwood, and the bay-laurel are abundant here. The castor-oil bean (*Ricinus palma Christi*), elsewhere a graceful annual shrub, here becomes a majestic perennial tree. Satin-wood and lignumvitæ abound on the keys and islands, as well as many of the West India forest trees, including mahogany, various palmettos, Jamaica kino, several mangroves, the deadly manchineel, the torch-wood, the canella, and a curious parasitic tree incorrectly called India-rubber (*Clusia flava*).

Zoology.—Of the mammals there are few very formidable wild animals. The bear—the brown or black bear of the Southern States—is somewhat numerous. There are probably a few wolves, though this has been doubted. The opossum, the raccoon, the woodchuck or ground-hog, and various species of rats, mice, and bats, are common in Middle and South Florida. There are one or two species of deer, and rabbits, squirrels, etc. abound. The alligator, often of large size, is found in great numbers on the St. John's River, Suwanee, Appalachicola, and Perdido, as well as in all the larger lakes, and is abundant in Lake Okeechobee and the Everglades. There is a true crocodile in South Florida, and the manatee or sea-cow is still found in the sounds and bays. Shad of fair quality are found in the larger rivers early in the season, and immense quantities of mullet, bass, sheepshead, lake-trout, and other varieties of fish suitable for the table are taken. Turtles are very plenty on all the keys, and the green turtle, the delight of epicures, is supplied largely from this region. Other species of turtles are common, and various species of cuttle-fish, some of them of gigantic size, are found along the coast. Sharks are plentiful also, especially on the southern coasts. Wild-turkeys, many species of ducks, and other swimmers and waders, hawks, kites, eagles, vultures (the king vulture, hardly inferior in size to the condor, and heretofore supposed to be peculiar to Mexico, has recently been seen here), and owls are abundant throughout the peninsula. Of smaller birds there is an immense variety, though the major part (excepting always the mocking-bird) are more remarkable for their plumage than their song. In the lowlands and the swampy or marshy regions the insect pests are numerous at certain seasons, sand-flies, mosquitoes, black-flies, etc. being plentiful enough; but there are extensive districts in the State where these are not abundant, and some where they are not known.

Climate.—Though in the latitude of Northern Mexico, the Desert of Sahara, Central Arabia, Northern Hindostan, Northern Burmah, and Southern China, the climate of Florida, tempered by the Atlantic breezes on one side and those of the Gulf on the other, is far more temperate and equable than that of any of those countries. The Spanish records at St. Augustine show that for 100 years the mean temperature of the winter months averaged a little over 60° F., and of the summer months 86°. The extremes of the year, taking the peninsula together, are about 35° as the coldest and 95° as the hottest temperature, and neither extreme is reached more than twice or three times in the year. The summer may be said to last seven or eight months, and during the whole period there are very few uncomfortably hot days, the sea-breezes tempering the air, and the nights

are uniformly cool. The rainy season extends over three or four months, but there are only more frequent showers, and sometimes heavy and drenching rains, but seldom of more than four hours' duration. Occasionally there are long droughts in some sections, and excessive rain in others.

The following table, made up from the army meteorological record in regard to three points, and from private observations in regard to the other four, gives the mean temperature of each month at most of the points named for twenty years, and the rainfall of most for 1871–72:

Places.	Latitude.	Mean temperature, January.	Mean temperature, February.	Mean temperature, March.	Mean temperature, April.	Mean temperature, May.	Mean temperature, June.	Mean temperature, July.	Mean temperature, August.	Mean temperature, September.	Mean temperature, October.	Mean temperature, November.	Mean temperature, December.	Mean temperature, yearly average.	Yearly rainfall in 1871 and 1872.
St. Augustine.	29° 53′	57.03	59.94	63.34	68.78	73.50	79.36	80.90	80.56	78.60	71.88	64.12	57.26	69.61	47.86
Tampa Bay.........	27° 56′	61.53	63.54	67.72	71.82	76.64	70.46	80.72	80.43	78.28	74.02	66.94	61.99	71.92	33.17
Key West...........	24° 36′	66.68	68.88	72.88	75.38	79.10	81.63	83.00	82.90	81.92	78.11	74.66	71.03	76.51	36.49
Jacksonville........	30° 15′	59.38	55.50	61.20	67.20	75.70	79.20	84.10	84.40	77.20	73.00	62.70	53.30	69.60	53.95
Fort Dallas..........	25° 45′	66.40	66.60	70.40	75.60	77.00	80.50	82.10	81.80	79.60	77.90	71.30	66.80	74.80	32.97
Fort Meyers, or Punta Rassa	27°	63.40	68.00	72.20	73.80	80.10	81.20	82.90	83.10	81.70	77.70	71.50	64.70	75.00	40.87
Lake City, 1871....	30° 06′	49.00	53.50	57.60	71.60	78.10	79.30	81.20	79.40	76.50	71.00	63.00	53.00	67.80	47.12

Area and Disposition of Public Lands.—Of the 37,931,520 acres forming the estimated area of the State, 28,092,489 acres had been surveyed up to June 30, 1872, and 9,839,111 acres were still unsurveyed. Of the 28,000,000 acres of surveyed land, there had been sold, at that date, 1,832,431 acres; entered under the homestead law, 389,147; granted for military services, 465,942; officially approved under railroad grants, 1,760,468; approved as swamp lands given to the State, 10,901,207 (of these lands, which are sold by the State at 70 cents per acre, 6,617,177 acres remained unsold July 1, 1873); granted for internal improvements, 500,000 acres; granted for schools and universities, 1,000,663; granted to individuals and companies, 52,114; granted for deaf and dumb asylums, 20,924; and confirmed private land-claims, 3,784,303; making in all 20,669,061 acres disposed of. Including the unsurveyed portion of the State, there are 17,262,459 of public government lands now for sale. Included in this area, however, are the numerous lakes in the State. Besides these there are 6,617,177 acres of the swamp lands for sale by the State at 70 cents per acre. In 1870 there were only 2,373,541 acres of the entire area of the State in farms, and of these only 736,172 acres of improved lands. In the four years which have since elapsed it is believed that the amount of farming lands has more than doubled, and that the improved lands now exceed 2,000,000 acres. The average size of farms in 1870 was 232 acres; the value of farms, $9,947,920, and of farming machinery, etc., $505,074.

Agricultural Products.—In 1870 the value of all farming products, including betterments and addition to stock, was $8,909,746; of animals slaughtered, $520,966; of home manufactures, $131,693; of forest products, $7965 (this must have been exclusive of live-oak timber, lumber, and woods for cabinet use); of market-garden products, $31,983; of orchard products, $53,639; the amount of wages paid to farm-hands during the year, including the value of board, was $1,537,060. Wheat is not grown in any appreciable quantity in Florida, and in 1870 only 545 bushels of rye were reported; of Indian corn, 2,225,056 bushels were reported that year; of oats, 114,204 bushels; of barley, 12 bushels. The number of horses in the State in 1870 was 14,451; of mules, 8835; of neat cattle, 453,451; of sheep, 26,599; and of swine, 158,908. The value of all the live-stock in the State was put down at $5,212,157. Of other agricultural products, there were 39,789 bales of cotton, partly of long staple or sea-island; 37,562 pounds of wool; 17 bales of hay; 401,687 pounds of rice; 157,405 pounds of tobacco; 952 hogsheads of cane-sugar, and 344,339 gallons of cane-molasses; 10,218 bushels of Irish potatoes, and 789,456 bushels of sweet potatoes; 64,846 bushels of peas and beans; 12,049 pounds of beeswax, and 395,278 pounds of honey; 19,479 gallons of domestic wine; 100,989 pounds of butter; 25 pounds of cheese; 3002 gallons of milk sold.

Of many of these products we have no statistics later than 1870, but of some we have approximate reports. There can be no doubt that there is a great advance in the amount of orchard products; the culture of the orange and lemon has become very popular, and is constantly increasing. This is said to be the most profitable fruit to cultivate in the U. S. Nearly 3,000,000 orange trees have been planted since 1870, and most of these will be in bearing by or before 1875. These will add millions to the value of orchard products in the State. The grape, olive, fig, and guava are being cultivated also for market. A beginning has been made also in marketing early and very late peaches, bananas, pineapples, cocoanuts, limes, pomegranates, etc. The cotton production had increased to 47,125 bales in 1872, and in 1873 was estimated at 45,590 bales. The crop of Indian corn in 1873 was somewhat in advance of that of the census year, reaching, in round numbers, 2,320,000 bushels. The crop of Irish potatoes in 1873 was estimated at 13,000 bushels, and of sweet potatoes at 1,037,000 bushels. The production of cane-sugar and molasses is increasing every year; and though the cane was injured by severe storms in 1873, the yield was about 1300 hogsheads of sugar and nearly 500,000 gallons of molasses. Florida is the only State in the Union in which the sugar-cane tassels. The tobacco crop (Cuban tobacco is raised exclusively in Florida) is also constantly increasing, and exceeded 200,000 pounds in 1873. The agriculture of the State is unquestionably improving rapidly. The cattle of Florida are small, hardy, and make tender and juicy beef, but are not of much value as milk-producers. There is room for great improvement in crossing them with some of the larger breeds. Some portions of the State afford fine pasturage, but much of the grass is sour, coarse, and wiry. The State abounds in materials for efficient fertilization. There are extensive beds of marl, a rich muck from all the lakes, and establishments for the manufacture of fish-guano and kelp waste on the coast.

Industry, Manufactures, etc.—Florida has not hitherto been largely engaged in manufactures. The census of 1870 reports 659 establishments, driven by 126 steam-engines and 79 water-wheels, employing 2749 hands, all but 79 of them men; using a capital of $1,679,930; paying wages annually to the amount of $989,592; using materials valued at $2,330,873; and yielding a product of $4,685,403. While it is probable that these figures, as in most of the States, materially understated the amount of the manufacturing industry of the State, it is certain that it has greatly increased within the past four years. The manufacture of pine lumber and spars alone now employs a capital of $8,000,000, and yields an annual product exceeding $5,000,000. The preparation of live-oak timber for shipbuilding purposes is another large and important industry, and the various choice woods for cabinet and ornamental purposes found in the southern portion of the peninsula are also being prepared for market in considerable quantities. Naval stores, turpentine, rosin, pitch, and tar, are now manufactured in large quantities from the vast pine forests of the State. In 1871, 1872, and 1873 large tracts were sold, and numerous turpentine distilleries erected for this manufacture. Flouring and grist-mills (mostly occupied with the grinding of Indian corn) employ now a capital of about $200,000, and produce meal, etc. to the amount of about $825,000. The various manufactures connected with the trades of carpentering and building employ a capital of about $125,000, and turn out products valued at nearly $1,000,000. The manufacture of cigars from the excellent Cuban tobacco grown in Florida, as well as from that brought from the neighboring island of Cuba, has kept pace with the increasing production of tobacco. It now employs over $500,000 of capital, mainly in Key West and its vicinity, about 1000 hands, and produces cigars to the value of nearly $1,500,000. The sponge-fisheries of this region are another considerable branch of industry, sending to market from $125,000 to $150,000 worth of sponges annually. The fisheries of the southern portion of Florida form another important industry. Not only are immense quantities of fish shipped from these keys and the coast to Havana, Norfolk, Baltimore, and New York, but great numbers of green turtle are also forwarded. Salt is manufactured by solar evaporation from sea and lagoon waters at various points. Cotton-seed oil is another product. The other branches of manufacture employ small capital, and are not largely productive.

Railroads and Canals.—The railroads of Florida are—1. The Jacksonville Pensacola and Mobile Railway, 209 miles in length, from Jacksonville on the St. John's River to Chat-

tahoochee Landing on the Chattahoochee River, near its junction with the Appalachicola. This railway passes through Tallahassee, and a branch 21 miles in length connects that city with St. Mark's at the head of Appalachee Bay. Another branch road, 48 miles in length, from Live Oak to Lawton in Georgia, connects this railway with the Atlantic and Gulf Railway and with the whole system of Georgia railways. 2. The Atlantic Gulf and West India Transit Company's Railway (late Florida Railway), 157 miles in length, extending from Fernandina at the mouth of St. Mary's River on the Atlantic to Cedar Keys on the Gulf. 3. The St. John's Railway, from St. Augustine to Tocoi on the St. John's River, a distance of 15 miles. 4. The Pensacola and Louisville R. R., running from Pensacola to Pollard, Ala. There are short railroads running from Pensacola, Ellaville, etc. into the forests to supply timber for the mills. Two other railways have been projected—one, the Great Southern R. R., from Jacksonville, along the St. John's River and the chain of lakes, passing Lake Okeechobee on the E. side, and passing from one key to another till it reaches Key West. This line would be 600 miles or more in length, and though the grades are easy it would not find sufficient business to pay for its construction, as for one-third of the distance it must be built on expensive piling. The other is an extension of the road from Cedar Keys along the Gulf shore to Fort Poinsett at Cape Sable; though not so long as the other, it is liable to the same objections.

There have been numerous canal projects, most of them having in view the shortening the distance between New Orleans and the other cities of the Gulf and the Atlantic coasts. Most of these have fallen through for want of interest on the part of those who would be most benefited by them; but a recently proposed route, in connection with the grand and practicable scheme of sheltered and protected navigation inside the line of islands and sandbars, from New Orleans to Charleston, and perhaps to Norfolk, merits notice. The projectors of this route propose to cut a canal from Appalachee Bay, just below St. Mark's, to the Suwanee River at about the parallel of 30° 12′, and then to improve the navigation of that river to admit of the passage of first-class Mississippi steamers to the great bend of the river, lon. 82° 40′ W., and thence to cut another canal through Okeefenokee Swamp to the St. Mary's River. Another canal, already in progress, extends from the Upper St. John's River, probably in the vicinity of Orlando and Lake Washington, to Indian River, an estuary along the coast, a distance of 6 miles, and then extends Indian River through Lake Worth to Biscayne or Miami, in lat. 25° 45′. The whole amount of cutting will not exceed 25 miles, and only one lock will be required.

Telegraphs.—The Atlantic coast-line of the Western Union Company extends to Key West, from which point an ocean cable is laid to Havana, and connects there with the Gulf cable and the Brazilian cable. Another company owns lines in the W. part of the State.

Finances.—According to the census of 1870, the total assessed valuation of Florida in that year in real and personal estate was $32,480,843, of which $20,197,691 was real estate, and $12,283,152 personal. The true valuation, according to the estimates of the U. S. marshal, was $44,163,655. The valuation for purposes of taxation in 1873 a little exceeded $30,000,000, but in this valuation many vested interests are not included; and as every man makes his own valuation for this purpose, it does not represent the property of the State at anything like its true value. The receipts of the State treasury for the year ending Dec. 31, 1873, from the collection of taxes and licenses applicable to general State expenses, were $320,836.66, and the expenditures, excluding the borrowed money and interest on 1871 bonds, were $314,817.11. Of this, $246,711.65 were for the regular expenses of 1873, and $68,105.46 were used in payment of expenses incurred previous to 1873, including debt due lunatic asylum, bank note company, etc. This was the first year since reconstruction (1867) in which the receipts had not fallen below the expenditures. The aggregate amount of the deficiencies of the six years and two months ending Jan. 1, 1873, was $349,593.97.

The following statement of the comptroller exhibits the indebtedness of the State as it stood Jan. 1, 1874:

Total debt and interest, to be exchanged for the bonds of 1873	$490,937.75
Bonds of 1871	350,000.00
Bonds of 1873 sold and delivered	265,000.00
Bonds of 1873 sold, but not delivered and held to obtain funds to pay for 21 hypothecated bonds of 1868	15,000.00
Bonds of 1873 exchanged for 18 bonds of 1868, with accumulated interest	20,000.00
Bonded debt due school fund	190,752.63
Bonded debt due seminary fund	71,292.45
	$1,402,982.83

Brought forward	$1,402,982.83
Deduct amount of bonds in sinking fund for payment of bonds of 1871	8,700.00
	$1,394,282.83
Add interest due Jan. 1, 1874, to school and seminary funds	9,960.01
Add interest due Jan. 1, 1874, upon the bonds of 1871	29,575.00
Add interest due Jan. 1, 1874, upon bonds of 1873	12,660.00
Total bonded debt and interest due thereon to Jan. 1, 1874	$1,446,477.84
Less money in the treasury, applicable to payment of interest of 1871 and 1873 bonds	16,254.36
Total bonded debt and interest less cash in treasury, applicable in payment of interest	$1,430,223.48

Aside from this debt, the State has issued to the Jacksonville, Pensacola and Mobile Railway Company bonds to the amount of $4,000,000, but for these it has a statutory lien upon the road, and negotiations are now in progress by which it is expected that bondholders will take the lien on the road and the bonds of the company in lieu of the State bonds. These bonds are largely held in Holland.

Commerce.—The commerce of Florida is large in proportion to her population. Fernandina, St. Augustine, Jacksonville, Port Orange, and Biscayne are all considerable ports on the Atlantic shore; Key West, at the southern extremity, has a very large commerce with the Atlantic ports, New Orleans and Mobile, and the West Indian ports; and on the Gulf coast, Pensacola, Appalachicola, St. Mark's, Cedar Keys, Tampa, and Punta Rassa are important seaports, with a constantly increasing commerce. Of course, by far the greater part of the commerce of the Floridian ports is with other ports of the U. S., and its amount cannot be ascertained; but the foreign commerce of the ports of Fernandina, Key West, and Pensacola is also of considerable magnitude. For the year ending Dec. 31, 1873, the imports into the ports of Florida were $512,815; the domestic exports, $3,742,548, and the foreign exports, $1102. This was aside from the large amount of fruits, fish, turtles, lumber, etc. indirectly exported through New York, Baltimore, Mobile, and New Orleans. Of the coast-trade, the commodities shipped from the port of Key West alone to New York and New Orleans amount in the aggregate to more than $4,000,000; while the ship-timber, spars, and yellow-pine lumber shipped from Pensacola amount to nearly as much more.

Banks, Savings Banks, Trust Companies, etc.—There were in 1873 in Florida no national banks or State banks having circulation; two savings banks, branches of the Freedmen's Saving and Trust Company, and four other private banking-houses—three at Jacksonville and one at Fernandina. There were not in 1873 any fire, marine, life, or accident insurance companies reported in the State.

Population.—The organization of Florida as a Territory was authorized by act of Congress in 1819, but as possession was not given to the U. S. by the Spanish government until July, 1821, it was not actually organized until after that time. The first census of the Territory was taken in 1830, and at that time it had 34,730 inhabitants, of whom 18,385 were whites, 844 free colored, 15,501 slaves, and an indefinite number of Indians. In 1840 there were 54,477, of whom 27,943 were whites, 817 free colored, 25,717 slaves. In 1850 the number of inhabitants was 87,445, of whom 47,203 were whites, 932 free colored, 39,310 slaves; there were probably at this time 600 or 700 Indians not enumerated. In 1860 the population was 140,424, of whom 77,746 were whites, 932 free colored, and 61,745 slaves, with 500 to 600 Indians not enumerated. In 1870 the true population was 188,248, of whom 96,057 were whites, 91,689 free colored, and 502 Indians. The density of the population at the periods of the different enumerations has been—in 1830, 0.58 inhabitants to a square mile; in 1840, 0.92 to a square mile; in 1850, 1.48 to a square mile; in 1860, 2.65 to a square mile; in 1870, 3.17 to a square mile. Of the present population, excluding the Indians, 94,548 are males and 93,200 females; 32,873 males and 31,024 females are of school age (between 5 and 18 years); 34,529 males are of military age (between 18 and 45); 39,907 males are above 21 years of age, and of these 38,854 are citizens. Of the present population, 182,781 (91,573 males and 91,208 females) are natives of the U. S., while 4967 (2975 males and 1992 females) are of foreign birth. Of the whites, 91,395 (46,136 males and 45,259 females) were natives, and 4662 (2817 males and 1845 females) were of foreign birth; of the colored race, 91,689 in number (45,594 males and 46,095 females), 91,384 (45,436 males and 45,948 females) were natives, and 305 (158 males and 147 females) were of foreign birth. Of the colored race, 80,338 (40,151 males and 40,187 females) were blacks, and 11,351 (5443 males and 5908 females) mulattoes. Of the blacks 223, and of the mulattoes 82, were of foreign birth.

Education.—In 1870, 12,778 (all but 21 of American birth) were reported as attending school in some portion

of the year; of these there were 4195 white males and 4059 white females; 2241 colored males and 2283 colored females; 66,238 persons of ten years and over could not read, and 71,803 (all natives except 568) could not write; 18,904 of these were whites (10,141 of them females), 52,094 (26,941 of them females) were colored. In 1870 there were 377 schools of all classes in the State, taught by 482 teachers (254 males, 228 females). In the schools 14,670 pupils were represented to have been taught during some portion of the year; of these, 6788 were males and 7882 females; the income of these schools was $154,569, of which $6750 was from endowments, $73,642 from taxation and public funds, and $74,177 from other sources, including tuition, and in Florida the Peabody fund. Of these 377 schools, 226, taught by 265 teachers (169 males and 96 females), were public schools, having 10,132 pupils (4674 males and 5458 females). These schools had an income of $76,389; $61,552 of it from taxation and the public funds. There were 10 classical, professional, or technical schools, with 32 teachers (16 male and 16 female) and 580 students (318 males and 262 females), and having an income of $11,005, of which $2100 was from endowment, $4870 from taxation and public funds, and $4035 from tuition and other sources. There were also 141 other private schools, part of them boarding-schools, with 185 teachers (69 males and 116 females) and 3958 pupils (1796 males and 2162 females). These schools had an income of $67,115, of which $59,305 was from tuition. Of the schools in the State, 2 were normal schools, 4 high schools, 5 graded common, and 215 ungraded common; there were 10 academies, no colleges, 135 day and boarding schools, and 6 parochial and charity schools. The amount expended for public schools in the State in 1873 was stated at $107,723.93.

Constitutional one-mill tax from the counties	$80,000.00
Private contributions	10,000.00
Peabody fund	8,800.00
Interest on school fund, $14,873.23, issued in warrants which sold at 60 cents	8,923.93
	$107,723.93

There is no college or university in the State, but the legislature chartered in 1871 an agricultural college, and the land-scrip, 90,000 acres, was granted to it, and sold for $80,000; the trustees have advertised for propositions for a site for the college. There are no professional or scientific schools as yet established in the State.

There were 75 public libraries reported in the census of 1870, having 25,374 volumes, of which the State library at Tallahassee, with 7000 volumes, and 5 court or law libraries, with 4182 volumes, were the only ones of considerable size; and 178 private libraries, with 87,554 volumes.

There were in the State 23 newspapers and periodicals in 1870, having an aggregate circulation of 10,545 copies, and an aggregate annual issue of 649,220 copies. There were at that time 2 tri-weeklies, with a circulation of 820 copies; 1 semi-weekly, with 300 circulation; and 20 weeklies, with 9425 circulation. In 1872 there were 1 daily, 1 tri-weekly, 1 semi-weekly, 21 weeklies, and 1 monthly, and the circulation had increased about 2500 copies.

Churches.—In 1870 there were 420 church organizations of all denominations, with 390 church edifices, 78,920 sittings, and church property valued at $426,520. Of these, there were reported 127 regular Baptist churches, 123 church edifices, 21,100 sittings, $53,460 of property. At the close of 1873 there were reported 251 Baptist churches, 165 ministers, and 17,004 members; 100 Sunday-schools, with 5910 teachers and scholars. In 1870 there were 17 Protestant Episcopal churches, 13 church edifices, 4600 sittings, $71,100 of property; there were in 1873 but 9 churches, 10 clergymen (9 officiating), 816 communicants, 1045 Sunday-school teachers and scholars, and contributions to the amount of $8823. In 1870 the census reported 235 Methodist churches, 215 church edifices, 42,600 sittings, and $140,700 of church property. These statistics, which refer to the Methodist Episcopal Church South, have doubtless increased somewhat, especially in the value of church property. There was in 1870 one Mormon congregation, with one church edifice, 50 sittings, and $150 of property. Of Presbyterians (Presbyterian Church South) in 1870 there were 29 churches, 29 church edifices, 6620 sittings, $70,310 of church property. The later returns give but twenty ministers of the Presbyterian Church, South residing in Florida, but probably some of them may have, like other clergymen in the South, more than one charge. In 1870 there were reported 10 Roman Catholic organizations, and 9 church edifices, 3950 sittings, $90,800 of church property. In 1873 there were 12 congregations, 19 churches and chapels, 39 missions, and 15 clergymen. The Catholic population is stated at 10,000.

Constitution, Courts, Representation in Congress, etc.—The State is now organized under the constitution of 1868, the third adopted by the State since its first admission to the Union in 1845, and the one under which it was admitted anew to representation in Congress in June, 1868. This constitution provides that slavery shall not exist in the State; that there shall be no civil or political distinction on account of race, color, or previous condition of servitude; and that the State shall ever remain a member of the American Union, the people thereof a part of the American nation, and any attempt, from whatever source or upon whatever pretence, to dissolve said Union or to sever said nation, shall be resisted with the whole power of the State. The governor and lieutenant-governor are chosen by the qualified electors of the State* at the time and places of voting for members of the legislature, and hold office for four years. The secretary of state, treasurer, comptroller, attorney-general, superintendent of public instruction, commissioner of immigration, and adjutant-general are appointed by the governor and confirmed by the senate, and hold their offices the same time as the governor, or until their successors shall be qualified.

The senators, 24 in number, are chosen for four years, and the members of assembly, 53 in number, for two years. The sessions of the legislature are annual, and begin regularly on the Tuesday after the first Monday in January. The session lasts 60 days. The pay of members of both houses is $500 per year, and a mileage allowance of ten cents per mile. Educational qualifications are to be prescribed for electors after 1880. The judicial power of the State is vested in a supreme court, circuit courts, county courts, and justices of the peace. The supreme court consists of a chief-justice and two associate justices, who hold their offices for life or during good behavior. They are appointed by the governor and confirmed by the senate. The clerk of the supreme court, appointed by the justices, is also librarian of the supreme court library. There are seven circuit judges, appointed by the governor and confirmed by the senate, who hold their office for eight years. They hold two courts a year, each in his own circuit. These circuit courts are courts of original jurisdiction. There is a county court in each county. The county court judges, who are also appointed by the governor and confirmed by the senate, hold office for four years. They may be reappointed. The superintendent of public instruction, secretary of state, and attorney-general constitute the board of education. Florida has a State penitentiary at Chattahoochee.

Under the new apportionment since the census of 1870, Florida has two representatives in Congress, both elected at large. There are, of course, two U. S. Senators.

Counties.—There are 39 counties in the State, having the annexed population respectively in 1850, 1860, and 1870:

Counties.	Pop in 1850.	Pop in 1860.	Pop in 1870.	Counties	Pop in 1850	Pop in 1860.	Pop in 1870.	Counties.	Pop. in 1850.	Pop in 1860.	Pop in 1870
Alachua	2,524	8,232	17,328	Hernando	926	1,200	2,938	Nassau	2,164	3,644	4,247
Baker	New	county.	1,325	called Benton, 1850.				Orange	466	987	2,195
Bradford	New	county.	3,671	Hillsboro'	2,377	2,981	3,216	Polk	New	county.	3,169
Brevard	......	246	1,216	Holmes	1,205	1,386	1,572	Putnam	687	2,712	3,821
Calhoun	1,377	1,446	998	Jackson	6,639	10,209	9,528	Santa Rosa	2,883	5,480	3,312
Clay	......	1,914	2,098	Jefferson	7,718	9,876	13,398	St. John's	2,525	3,038	2,618
Columbia	4,808	4,646	7,335	Lafayette	......	2,068	1,783	Sumter	......	1,549	2,952
Dade	159	83	85	Leon	11,442	12,343	15,236	Suwanee	......	2,303	3,556
Duval	4,539	5,074	11,921	Levy	465	1,781	2,018	Taylor	......	1,384	1,453
Escambia	4,351	5,768	7,817	Liberty	......	1,457	1,050	Volusia	......	1,158	1,723
Franklin	1,561	1,904	1,256	Madison	5,490	7,779	11,121	Wakulla	1,955	2,839	2,506
Gadsden	8,784	9,396	9,802	Manatee	......	854	1,931	Walton	1,817	3,037	3,041
Hamilton	2,511	4,154	5,749	Marion	3,338	8,609	10,804	Washington	1,950	2,154	2,302
				Monroe	2,645	2,913	5,657				

* "Every male person of the age of twenty-one years and upward, of whatever race, color, nationality, or previous condition, who shall at the time of offering to vote be a citizen of the U. S., or who shall have declared his intention to become such in conformity to the laws of the U. S., and who shall have resided in Florida for one year, and in the county for six months, next preceding the election at which he shall offer to vote, shall in such county be deemed a qualified elector at all elections under this constitution."—*Constitution of 1868.*

Principal Towns.—Jacksonville, on the St. John's River, in Duval co., is the largest city in the State. In 1870 it had 6912 inhabitants, and is supposed now to have about 8500. It is the great resort of invalids from the North. Many of them, however, pass on to higher points on the St. John's River. The only other towns or cities having over 5000 inhabitants are Key West in Monroe co. and Pensacola in Escambia co., which, with its suburb, Warrington, is the site of the U. S. navy yard. Tallahassee, in Leon co., the capital of the State, has about 2500 inhabitants (2023 in 1870), and Fernandina in Nassau co. (1722 in 1870) and St. Augustine in St. John's co. (1717 in 1870), the oldest settlement in the U. S., have nearly as large a population. Of towns of from 1000 to 2000 inhabitants the principal are Appalachicola in Franklin co., Monticello in Jefferson co., and Milton in Santa Rosa co. Lake City in Columbia co., Pilatka in Putnam. Ocala, Cerro Gordo, Cedar Keys, and Tampa are also thriving towns.

History.—Florida was probably discovered by Columbus or some of his lieutenants before the commencement of the sixteenth century; but Ponce de Leon, who landed at St. Augustine in 1512, is the first European who is known to have landed on its shores. He landed on Palm Sunday (the *Pascua Florida*, or Feast of Flowers, of the Catholic Church), and the name of the peninsula, Florida—a name extended by the Spaniards to a region of indefinite extent northward and westward—is said by some writers to have been bestowed upon it from this cause, while others attribute it, with perhaps more probability, to the profusion of wild flowers found on its broad savannas. Ponce de Leon hoped to find in this beautiful land the fabled fountain of perpetual youth, but after a long and wearisome quest he returned unsatisfied. Four years later he visited it again in search of gold, but was driven away by the stalwart Indians of the peninsula. In 1520, Vasquez, another Spaniard, landed with some troops at St. Augustine, but his expedition came to naught; nor were those of the Florentine Verazzani in 1523, and the Spaniard De Geray in 1524, more successful. In 1526, Pamphilo de Narvaez obtained from Charles V. a grant of all the lands from Cape Florida to Rio Panuco, and in 1528 landed at Appalachee with an army of 440 men; but he was vigorously resisted by the Indians, and at last perished, with most of his troops, by shipwreck near the Panuco. In 1539 a wiser explorer, Fernando de Soto, penetrated into the interior of Florida, and after numerous adventures and a greater measure of success in winning the confidence of the Indian tribes than any of his predecessors had realized, penetrated to the Mississippi, and died there in 1542. Having thus explored a considerable portion of Florida, though they had not established any colony there, the Spanish government claimed it as their rightful territory. In the year 1562, the brave Admiral de Coligny, desirous to rescue his Huguenot followers from the cruel persecutions to which they were subjected in France, made preparations to send them to America, and in the winter of 1563–64 a company of them under Laudonnière were landed on the coast below St. Augustine, and had just established themselves on their new territory, when, early in 1565, the Spanish freebooter Don Pedro Menendez pounced upon them, murdered nearly the whole of them, and hanged them on the trees in the vicinity, with an inscription over their heads, that they were killed "not as Frenchmen, but as heretics" and enemies of God. Leaving a garrison there, Menendez proceeded to the present site of St. Augustine, and there founded the first permanent settlement on the peninsula. The situation was admirably chosen. His raid on the innocent Frenchmen did not, however, long pass unrevenged. Dominique de Gourgues, a French adventurer, a man of great bravery, at the head of a few volunteers landed at the site of the former French colony, seized the garrison which Menendez had left there, and hanging them on the same trees on which the bodies of his unfortunate countrymen had been suspended, put an inscription over their heads, that they were hung "not because they were Spaniards, but because they were traitors, cut-throats, and murderers." The Spanish colony at St. Augustine, defended by a strong fort, increased, and other colonies on the E. coast were established. In 1586 it was captured by Sir Francis Drake, but was probably soon restored to the Spaniards, and for nearly a century later, though it had become a somewhat important Spanish settlement, and its great cathedral indicated the strength of the Catholic power there, yet it made no figure in history. The buccaneers visited it repeatedly, and sometimes exacted a heavy reward for its ransom from destruction, but it had no part in the great movements of European powers on this continent. In 1682 the Frenchman La Salle established some colonies in what was then West Florida, but now Louisiana or Mississippi, and in 1696 the French settled at Pensacola. From 1702 to 1710 the English colonies of South Carolina and Georgia repeatedly attacked St. Augustine, which it was alleged had become a rendezvous of freebooters. In the wars which followed some years later in the eighteenth century between Great Britain and Spain, Cuba was captured by the English, and in 1763 Florida was ceded by Spain to Great Britain in exchange for the "Queen of the Antilles." Emigration to Florida followed this cession almost immediately, and was becoming considerably extensive when by the treaty of 1783 the country was re-ceded to Spain. During the Revolutionary war numerous privateers were fitted out on the Florida coasts, and greatly harassed the people of Georgia and South Carolina. In 1778 the British general Prevost marched from Florida upon Savannah and other towns of Georgia, and captured them. The citizens of the Southern States were greatly annoyed by frequent incursions and raids from Florida, and when Louisiana was ceded to the U. S. in 1803, the terms of the treaty gave the U. S. government a claim to the lands lying W. of the Perdido River, then known as a part of West Florida, and it was accordingly occupied by military posts in 1811. During the war of 1812, a British expedition having been fitted out from Pensacola, Gen. Jackson marched upon that town and captured it. In 1818 it was again captured by Jackson, as was also Fort St. Mark at the head of Appalachee Bay, but both were subsequently restored to Spain. In 1819 the U. S. government entered into negotiations with Spain for the purchase of Florida, and the treaty having been ratified by both parties, in July, 1821, the sovereignty was formally transferred to the U. S. An organizing act had been previously passed, but the Territory was not fully organized until 1822. Immigration into the Territory commenced almost immediately, but the Seminoles, a warlike and ferocious race of Indians, occupied most of the best lands, and fiercely resisted the progress of the immigrants. In 1835, open war commenced between the Seminoles and the settlers, and the U. S. government commenced a costly warfare which continued for seven years. The Seminoles, though comparatively few in numbers, yet occupied positions almost impenetrable, and in a climate which was deadly to the whites. At length, after great expense and the loss of many lives, the Seminoles were prevailed upon to migrate to the Indian Territory W. of the Mississippi. Five or six hundred of them, however, remain in the Everglades, and send a representative to the legislature. After the removal of the Indians in 1842 the Territory grew rapidly in population, and in 1845 was admitted into the Union as a State. Its fine climate and its facilities for agriculture, though but slightly developed, attracted immigrants, but the presence of slavery in a community of but small wealth was a hindrance to its prosperity. In 1860 it had a population of but 140,424, of whom about one-half were slaves, and seemed to lack enterprise. In the events which preceded the late civil war the State took an active part, and on Jan. 10, 1861, passed the ordinance of secession. The State did not send a very large quota of troops to the Confederate armies, as its own exposed situation compelled their retention to defend their own territories. The battle of Olustee, fought in Feb., 1864, and resulting in a defeat of the Union troops, was one of the severest of the minor battles of the war. The Federal loss in killed and wounded was about 1200. Florida was one of the first States to return to the Union, having called a convention which met Oct. 25, 1865, and repealed the secession ordinance, recognized the Emancipation Act, repudiated the Confederate debt, and formed a new constitution. After the passage of the Fourteenth and Fifteenth amendments of the Constitution of the U. S., and their ratification by the State, another convention was called, the State constitution further modified, and the State readmitted to the Union in June, 1868. Since her readmission the State has been gradually but steadily improving in its financial and political character. The tide of immigration has again set toward it; its credit, at one time in some peril, has been restored; its educational system is becoming much more efficient; and though the last census revealed an alarming amount of illiteracy, yet the authorities are making every effort to make their schools better and to diffuse more widely a liberal public-school education.

Governors of Florida.

TERRITORIAL GOVERNORS.		STATE GOVERNORS.	
Andrew Jackson	1821–22	William D. Moseley	1845–49
William P. Duval	1822–34	Thomas Brown	1849–53
John H. Eaton	1834–36	James E. Broome	1853–57
Richard K. Call	1836–39	Madison S. Perry	1857–61
Robert R. Reid	1839–41	John Milton	1861–65
Richard K. Call	1841–44	Wm. Marvin, *Provis'l*	1865–66
John Branch	1844–45	David S. Walker	1866–68
		Harrison Reed	1868–Dec. 31, '72
		O. B. Hart	Jan., 1873–Mar., '74
		M. L. Stearns	1874

Popular and Electoral Vote for President.—As Florida

was not admitted to the Union till 1845, her first Presidential vote was cast in 1848. She did not vote in 1864 and 1868, but at all the other elections since 1848 her vote has been recorded:

Election Years.	Electoral Vote.		Popular vote.					
	Elect. Votes	For whom cast.	Candidate.	Popular Vote.	Candidate.	Popular Vote.	Candidate.	Popular Vote.
1848	3	Zachary Taylor............	Lewis Cass	1,847	Zachary Taylor....	3,116		
1852	3	Franklin Pierce...........	Franklin Pierce...........	4,318	Winfield Scott.......	2,875		
1856	3	James Buchanan	James Buchanan	6,358	Millard Fillmore..	4,833		
1860	3	John C. Breckenridge....	J. C. Breckenridge	8,543	John Bell............	5,437	Stephen A. Douglas....	367
1864								
1868								
1872	4	Ulysses S. Grant.	Horace Greeley............	15,427	U. S. Grant...........	17,763		

L. P. Brockett.

Florida, tp. of Parke co., Ind. Pop. 2110.

Florida, post-tp. of Berkshire co., Mass. Here is the Hoosac Mountain, pierced by the celebrated Hoosac Tunnel (which see). There are manufactures of lumber. Wool, live-stock, and maple-sugar are the other products of considerable importance. Pop. 1322.

Florida, post-v. of Jefferson tp., Monroe co., Mo. Pop. 120.

Florida, tp. of Montgomery co., N. Y., on the S. of the Mohawk and on the Erie Canal. It is chiefly agricultural, and contains several villages. Pop. 3002.

Florida, post-v. of Warwick tp., Orange co., N. Y., on the Pine Island branch of the Erie R. R. It is the seat of S. S. Seward Institute, founded by the father of the late Hon. W. H. Seward. It has three churches. Pop. 459.

Florida Keys, a group of small islands lying off the extremity of Florida, partly in Dade and partly in Monroe co. The keys are based upon the Florida Reef, a coral reef of great extent and of much danger to mariners. The extreme western group of keys is the Dry Tortugas (which see). Besides these, the W. coast of Florida is lined with keys or islets, from Cedar Keys southward; but the Florida Keys proper are on the reef. The soil of some is productive of tropical fruits, sweet potatoes, etc.; others are hopelessly barren. Many of them have jungles of mangroves, with some pine, buttonwood, sweet bay, palmetto, and other trees. In general their flora is quite distinct from that of the mainland, and is West Indian rather than continental in character. Some, like Key Biscayne, are ridges of siliceous sand, but most are masses of broken coral, shells, etc., with calcareous and foraminiferous sand. Some, like Double-headed-shot Key, are composed of rocky, rounded, treeless knolls; others, like Sugar-loaf Key, are dead levels, with woods and numerous lagoons. Some are dunes of sand, held in place by a creeping vine, *Batatas littoralis*. Many are covered in part with grasses. Sugar-loaf Key covers some 50 square miles, inclusive of its lagoons. Salt Key and others have valuable lakes of intensely salt water. Indian Key, Key Largo (40 miles long), and Plantation Key are the most important as regards soil. Key West, or Thompson's Island, contains the city of Key West. The islands are healthful except during epidemics of yellow fever. They are the resort of innumerable birds, and abound in rare mollusks and fishes. The sponge-fishery is an important industry.

Florid'ia, t. of Sicily, 7 m. W. of Syracuse. Pop. 7030.

Flor'id Style (*Contrapunto fiorito*, or *Stylus floridus*), in music, a species of composition more free, ornate, and discursive than would be admissible in the earlier and more severe modes of "strict" counterpoint. The old masters were accustomed to arrange their elementary exercises in harmony in five "classes," styles, or forms, in each of which the student was to practise with a rigid adherence to the rules set forth and illustrated in those "classes." The first class consisted of the simplest application of harmony to a plain theme or choral, note against note. By progressive steps the pupil reached the fifth class, denominated the *florid*, in which room was given for the play of the imagination, and for the free use of certain harmonies and progressions which were interdicted under the preceding classes. In modern schools of music the florid style has, for the most part, supplanted those more strict and severe forms of composition which the masters of a former age regarded as the foundation of all excellence. Relaxation of old rules and the introduction of many new and beautiful combinations have now brought the florid style into such general use as almost to banish both the use and the study of strict counterpoint, except in music for the church. William Staunton.

Flor'in [It. *fiorino*, either from *Florence*, where it was first coined, or from the figure of a lily which it bore], a Florentine coin first struck in gold in 1254. Gold and silver coins called florins, and of various values, have since been coined in many countries. England struck a gold florin in 1343. At present the English two-shilling silver piece, first coined in 1849, bears the official name of florin. It has nearly the value of the Austrian new silver florin, a unit of account, worth 48.6 cents of our money.

Florin'ians, a sect of Gnostics of the second century, named from the founder, Florinus. (See Gnostics.)

Flor'isant, post-v. of St. Ferdinand tp., St. Louis co., Mo., on the Missouri River, 15 miles N. W. from St. Louis. It was settled by the French. It has manufactures of importance. The Jesuits and nuns of Loreto have important establishments here.

Flori'nus, a Roman presbyter and heresiarch of the second century, who was deposed by Eleutherius. His followers were called Florinians. His heresy was a form of Gnosticism (which see), essentially the same with that taught by Valentinus.

Flo'rus, a Roman historian, of the circumstances of whose life very little is known, and whose full name is a matter of dispute. In the earlier editions of his history he appears as L. Annæus Florus, and is supposed to have been a member of the family to which Seneca belonged. Duker, following Vossius (*Hist. Lat.*), infers from his style, family name, and the age in which he lived, his identity with the poet Annæus Florus, who interchanged sportive verses with the emperor Hadrian. Though in the preface to his work he speaks of a revival of Roman vigor under Trajan, and would seem therefore to have lived in his reign or in that of Hadrian, Titze, who has devoted much study to the subject, rejecting the passage as an interpolation, maintains that he is the Lucius Julius Florus to whom two of Horace's epistles are addressed, and places him therefore in the time of Augustus. The researches of Otto Jahn and Halm, based upon a thorough examination of the best existing codex, give the name as Julius Florus. From this author we have a concise and highly rhetorically written history of the Roman people from King Romulus to Augustus Cæsar. In the earlier editions the work was entitled *Epitome Rerum Romanarum*, and was divided arbitrarily into four books. But Jahn and Halm, following the Bamberg codex, give the title *Epitoma de Tito Livio Bellorum omnium Annorum DCC. libri duo*. The first book contains the account of the external wars of Rome, while the second deals chiefly with the domestic contentions and the seditions of the people, and the wars in which Augustus was engaged, ending with the closing of the temple of Janus as the token of universal peace. The work of Florus, taken, as the name indicates, in the main from Livy, is a concise but interesting record of the progress of the Roman people, written in a rhetorical and rather ambitious style, without much regard to accuracy of facts or of dates, and is to be regarded rather as a panegyric than a history. The best of the earlier editions are those of Duker, Leyden, 1722, re-edited by Hübner and Jacobitz, Leipsic, 1832, 2 vols.; and of Titze, Prague, 1819; more recent and critical those of Otto Jahn, Leipsic, 1852, and of Halm, Leipsic, 1854. (See *Das Geschichtswerk des Florus*, von J. Reber, Freising, 1865; C. Heyn, *De Floro Historico*, Bonn, 1865.) H. Drisler.

Florus (Drepanius), a Gallo-Roman divine of the ninth century, a deacon at Lyons, is remembered as the opponent of Gotteschalk and Scotus Erigena; against the latter he wrote *Liber de Predestinatione* (852 a. d.); author also of extant Latin hymns, tracts *De Actione Missarum* and *De Electionibus Episcoporum*, a commentary on the Epistles of St. Paul (compiled from St. Augustine), and other works. D. about 860 a. d.

Floss Silk is silk which has been broken in the reeling. It is steeped in water, pressed, dried, oiled, carded, and spun on a flax-wheel into soft, coarse yarn, which is made into shawls, stockings, dress-goods, and other fabrics, either alone or mixed with cotton or wool.

Flo'tow, von (Friedrich Ferdinand Adolph), a German composer, b. at Teutendorf, in Mecklenburg-Schwerin, Apr. 27, 1812. A passion for music diverted him from the diplomatic career his parents had marked out; went to Paris and took lessons in composition from Reicha. His first operas, produced when he was scarcely eighteen, were rejected by the theatrical managers. But he persevered, and in 1838 obtained great success by his *Le Naufrage de la Meduse*, which was performed fifty-four times in a single season at the theatre of the Renaissance. From that time his operas followed in easy succession: *Le Forestier*, 1840; *L'esclave de Camoens*, 1843; *Alessandro Stradella*, 1844; *L'ame en peine*, 1846; *Albin*, 1856; *Martha*, 1858; *Zilda*, 1866. The last three, written in German, are favorites on the German stage with the lovers of light opera. *Martha* is popular everywhere, and is better known in America than any other of all Flotow's works. Flotow, after living several years in Paris and a short time in his native place, took up his abode in Schwerin, where he is superintendent of the court theatre. In 1864 was made corresponding member of the French Institute. O. B. Frothingham.

Flot'sam [Sax. *floten*, to "float"], a legal term employed in reference to the law concerning wrecks. It denotes goods which float upon the surface of the water when a ship is sunk or they are thrown overboard as a measure of safety. By the common law, if no owner appears to claim them after their recovery, they belong to the Crown. (See Jetsam and Ligan.)

Floun'der, a name given to various marine fishes of the family Pleuronectidæ. They are flat, and swim with one side, not one edge, uppermost; both eyes are on the upper side, and the lower side is much whiter than the other. Several species occur in the American waters, where they are caught for market, and are regarded as tolerable food.

Flounder.

Flour [a word kindred to *flower; i. e.* the "flower" or choicest part of the wheat]. When dry wheat is crushed, as in a mortar or between revolving millstones, the product is a powder mixed with scales, known as whole meal. The process of sifting or bolting separates the whole meal into two portions, known as flour and bran. The latter consists of the outer woody portion of the grain, with adhering portions of the interior; and flour is the name given to the remainder. The latter is white—the former is reddish or grayish. This simple nomenclature was suited to the earliest forms of milling. It applies as well to rye, except in the matter of color, as to wheat, and more or less to other grains, and to some extent to seeds.

With refinements in the art of making bread, cake, and pastry came a demand for finer flours. New modes of milling were introduced, and the product was separated into more numerous grades. It was customary, a few years ago, comparatively speaking, in this country, to divide the product into three grades—flour, connell, and bran. The flour, including so much as could be separated of the requisite whiteness, amounting to some 70 per cent., was removed by bolting from the remainder; and this remainder, by passing over a coarser sieve, was divided into larger scales and fragments called bran, and lesser scales and fragments called connell. The latter is also known as shorts and middlings. These three have been further increased by improved appliances both in this country and England, and especially in Hungary. The grades of flour produced by the best mills number ten.

The principles which have guided the inventor of milling devices will be best understood after a study of the *structure of the wheat grain*. The grain of wheat has the form of an irregular oblong spheroid, having a longitudinal groove on one side, and terminating at one end in minute vegetable hairs or bristles, and at the other in a slightly corrugated surface covering the germ. If this grain be moistened and rubbed with a dry rough cloth, there will be detached from the surface two outer coats composed of woody fibre. Within there is a thin coat, also composed of woody fibre, which, from the peculiar network of fibres and tubes, suggesting the appearance of cigars placed side by side, has been called the cigar-coat. This is succeeded by another coat of exceeding tenuity, like the others chiefly composed of woody fibre. Within these is the nutritious portion of the grain. There is first a framework of cells entirely enveloping the white portion of the flour. The cells are filled with a class of nitrogenous bodies of albuminous character and certain mineral salts, almost wholly phosphates, of which the chief is the phosphate of potassa, with much smaller proportions of phosphates of magnesia, lime, soda, and iron, the whole, with the cell framework, being known as the gluten coat. At the germ end of the berry, opposite the brush end, there are certain organic forms, constituting the embryo of the grain. The whole of the remaining interior is occupied by a framework of coarse, open cellular tissue, filled with starch grains, which are coarse, and others, exceedingly minute, containing albuminoid or nitrogenous constituents. If a sharp knife be passed through a plump berry of wheat perpendicular to its axis halfway from end to end, and the section so exposed be treated with solution of iodine, the entire surface bordered by the gluten coat, but not including it, will be changed from whiteness to dark purple, demonstrating the presence and extent of the starch. If another section be exposed to the action of a solution of blue vitriol in ammonia (ammonio-sulphate of copper), the starch of the interior will be but little affected, but the gluten coat which surrounds it will have become green, from the formation of phosphate of copper. A solution of ammonio-nitrate of silver (nitrate of silver dissolved in ammonia) will color the gluten coat yellow, from the formation of phosphate of silver. If the crushed berry be treated with weak acetic acid, and the result of the digestion be filtered and ammonia added to the clear liquor, there will be separated from the solution on standing minute crystals of phosphate of magnesia and ammonia. If a drop of nitrate of silver dissolved in water be poured upon the flour, no change will take place, but if nitrate of silver dissolved in ammonia be poured upon the flour, it will yield, as already observed, the yellow compound of phosphate of silver. Strong nitric acid will color the flour orange, from its action on the albuminoid substances. If a quantity of flour intimately mixed to a stiff emulsion with water is set aside at a temperature of about 70°, after a while it will begin to evolve bubbles of gas, and after a longer time it will become acid and offensive to the taste, and the liquid will contain phosphoric acid, readily recognizable by chemical tests.

The phosphatic and nitrogenous constituents and the starch all have nutritive value, and are indispensable as elements of food. Of these, the starch is far the most abundant, constituting about 70 per cent. of the whole grain. The nitrogenous constituents or the albuminoid bodies constitute from 12 to 18 per cent., and the phosphatic salts about 2 per cent., the rest being mainly woody fibre. Of the nutritious portions, weight for weight, the phosphatic constituents are undoubtedly entitled to the first rank. The portion of the nitrogenous constituents lodged with the phosphates in the cells of the gluten coat have been shown by Mègè Mouriès to be peculiarly susceptible to fermentation when exposed to a moist atmosphere. They are encased in capsules impervious to the air in the berry. If these capsules be ruptured or crushed, exposure to the air is inevitable.

On this structural peculiarity of the grain rests the foundation of a philosophical system of milling. The larger the percentage of the interior of the berry in flour, the less must be its nutritive value; and correspondingly, the larger the percentage of the gluten coat in flour—the chief deposit of the phosphates—the greater its nutritive value; and in bran, the smaller the percentage of adhering gluten, the more nearly worthless as an article of food the bran would be. If it were practicable to reduce the percentage of pure starch and increase the percentage of phosphatic and nitrogenous constituents, the nutritive value of the flour would be augmented.

The presence of minute particles of woody fibre in the flour gives to it a yellow shade. That system of milling which should most nearly remove all the woody fibre, and none of the gluten or phosphates, from the flour would accomplish one of the chief ends to be gained.

To appreciate the difficulties that present themselves to the inventor of milling machinery, let us consider the berry as we find it in commerce. It is very rare that any considerable quantity of wheat is to be found in the market absolutely free from foreign ingredients, such as chaff, fung-

ments of straw, oats, chess, mustard, cockle, grass-seed, sand, etc.; it is rarer still to find wheat grains uniformly filled out and without shrivelled or blasted kernels. Wheat is sometimes plump, the starch of the interior being mealy, so that if the berry were cut in halves it would be easy with a pin to detach all the white interior, leaving two cups lined with the gluten coat and invested with the woody bran-case. The wheat is sometimes slightly shrunken, hard and brittle from the surface to the centre, and cuts like the rind of old cheese. It is sometimes shrivelled, as if its growth had been arrested at the commencement of the period when the berry is in what is technically called "the milk," or as when it has been struck with rust—a microscopic vegetable growth accompanying the loss of milk from the berry. It is plain that shrivelled berries in the process of milling would for the most part be resolved into fine bran, and so be with difficulty separated from the flour, and thus the flour be discolored and rendered less nutritious. It is plain, too, that the plump berry with the mealy interior would be easily mashed in the process of grinding, while the hard, brittle berry would more easily be cracked.

Purification of Commercial Wheat.—Two principles underlie most of the devices for separating the light grains from the heavy, and the foreign seeds, grains, and other impurities from the wheat. The one is the process of sifting—the other, that of exposing a thin cascade of falling grain to a current of air. To these a third has been added, that of centrifugal force, taking advantage of unequal specific gravity and unequal extent of surface. In the sifting process advantage is taken of the unequal sizes and of the different shapes of the bodies to be separated from each other. It is easy to see how light grains and chaff and bits of straw and dust would be farther diverted from a perpendicular in falling through a stratum of air driven by a revolving fan. This principle was illustrated in the earliest times, when the mixed wheat and chaff were tossed together into the air, to be separated by the wind before reaching the ground, and is the principle underlying the ordinary fanning-mill. The separation of mustard and cockle and grass seed from the wheat may be easily effected by passing the mixed grains over inclined plates perforated with holes large enough for the smaller seeds to pass through, but not large enough for the wheat. The oat grain is separated by taking advantage of its elongated form. The mixed oat and wheat grains are discharged in a thin sheet upon an inclined thin iron plate perforated with round holes at intervals nicely determined by experiment, abundantly large for the ready passage of both the wheat and oat grains if presented end foremost perpendicularly to the surface of the plate. But as the plate is inclined, each berry must be tipped forward in order to enter a hole. An individual hole is of such diameter that when the wheat grain, sliding forward, carries its centre of gravity beyond the support of the upper edge of the hole, there will be no room for the prow—the forward end of the grain—to sweep downward through the hole without striking the lower margin, and thus the wheat grains are separated. The oat grain, however, in sliding down the inclined plane, before its centre of gravity has passed beyond the support of the upper margin of the hole, will, by reason of its prolonged keel, extend over the lower margin of the hole, and thus fail to fall through. As the oat advances the centre of gravity will pass beyond the lower edge of the hole, and gain the support of the continuous surface before the tail of the berry will have lost the support of the upper edge. Fragments of straw and chaff pass on with the oats.

The dust, smut, and rust which may cling to the berry are separated by discharging the impure grain into the space between what may be regarded as a vertical cylinder, the surface of which is covered with brushes, and a closely-fitting iron case perforated with numerous slits or holes, which serve the double purpose of making the surface rough and providing an escape for the separated dust. Round seeds are separated by taking advantage of the superior velocity they acquire in rolling down an inclined plane, as compared with the long grains, which slide. The former leap an opening into which the latter drop.

By these and kindred processes it is now practicable to obtain good wheat from a sample of spring wheat of which not more than one-half is fit for making flour, by the complete separation of every foreign matter from the sound, serviceable wheat grains. Such an achievement a few years ago would have been regarded as practically beyond the reach of mechanical contrivance.

The wheat thus prepared is a structure the chemical, physiological, and mechanical composition of which we have already glanced at. If the grain of wheat be subjected to pressure, as in a vice, so that its diameter shall be lessened by a certain definite amount, the interior may be partially pulverized without rupturing the surface. If the pressure reducing its diameter by the same amount be of the nature of impact or of a blow, the interior will be cracked, but not pulverized, with the probable rupture of the surface. If the pressure of the vice be continued until the grain is flattened, the product will be large scales and powder. If the blows be repeated with change of position of the berry, the product will be dust, fragments including the inner layers of the bran, the gluten coat, and starch extending to the centre of the berry, and the outer scales of the woody covering more or less separated from the gluten coat. The product derived from pressure may by sifting be separated into its constituents of scales (or bran) and powder (or flour). The bran will contain a large proportion of the gluten coat; the flour will consist of starch, with associated albuminoids, and gluten-cells detached from the bran. In the case of reduction by blows the dust will be chiefly composed of starch (which, it will be understood, though by far the largest constituent, may contain a larger percentage of the nitrogenous constituents than the gluten coat), the scales will be mainly of woody fibre, and the lumps or groats will be composed of starch, with the associated albuminoids on the interior, more or less of the bran coat on the exterior, and the gluten coat between. The dust may be easily removed by bolting; the outer scales of bran, mainly of woody fibre, may be easily separated by a current of air directed upon a thin cascade of the mixture—the bran-scales, with a given weight of material, presenting a greater extent of surface to the blast than the compact granules from which they are to be discharged.

It is plain that, weight for weight, the groats contain much more nutritive matter relatively than either of the two portions which have been separated from them. If, now, these groats be subjected to attrition among themselves, their corners will be rounded off, the scales on the outside of the gluten coat will be more or less detached, and the starch on the interior will be more or less worn off. The tenacity of the gluten coat will tend to preserve its integrity, while the relative friability of the starch in the interior and the fibrous texture of the outer covering of the gluten coat will facilitate their separation under the influence of attrition. If, now, the process of attrition be intermittent and alternating with the process of bolting and the use of the fan-blower, the groats will ultimately assume the form of little concave disks, largely freed from the bran without, and for the most part freed from the starch within. As these alternating processes have been worked, there will have been produced successively a series of brans growing richer in gluten, and a series of starches growing richer in gluten, and a final result of groats consisting mainly of gluten, with scarcely any starch or bran.

The two plans of reduction thus illustrated may be regarded as exhibiting the principles underlying the extremes of high and low milling; in practice, however, no such extreme is attained. The best forms of low milling include more or less of the principle of impact, and the best forms of high milling take advantage more or less of the principle of pressure without impact.

Milling.—The trituration of wheat is now almost universally accomplished between what are called millstones. These are two short cylinders of hard stone placed one over the other, having the two horizontal surfaces between them peculiarly grooved to fulfil the office which they are expected to perform. To understand this office we must take into account a property of the gluten to which no allusion has as yet been made.

Gluten.—If a handful of flour be moistened with water and fashioned into dough, and then continuously kneaded in a slender stream of falling water, the starch will gradually be separated from the dough, and there will remain at length pure gluten, a singularly tenacious and homogeneous substance. On drying, this body will become quite hard and somewhat brittle. On subjecting it to moderate heat after it has been thoroughly dried at common temperatures, it will be found to lose weight. It will have parted with water of hydration. On withdrawing the heat the gluten will re-absorb this water of hydration from the air at common temperatures, and recover its original weight. In the same manner the gluten of the flour subjected to heat will part with its water of hydration; and this escape of water will be accompanied more or less with the rupture of the cells in which the gluten is encased. The openings through which the moisture has escaped will permit the air to enter, and with it more or less the germs of microscopic vegetation, which, taking root in the gluten, produce the well-known effect described in the term *musty*, the flour acquiring an unpleasant odor and an inferior taste, the gluten at the same time losing an appreciable portion of its tenacity, and the bread made from it acquiring a less palatable flavor and being less light.

It is obviously desirable, therefore, that in the process of grinding the wheat the wheaten meal should be sub-

jected to as little friction with the millstones as may be, or within certain limits, successively to interrupt the process and allow the materials to cool. The surfaces of the millstones present a series of grooves, or lands and furrows. These are oblique in some instances, and curvilinear in others. Great ingenuity has been displayed in the conformation and arrangement of the grooves with a view to attaining the best results. If it were the sole object to have the wheat pass through the stones without abrasion, it is manifest that the best form of the groove would be that which a grain of wheat would pursue discharged from the hopper and traversing the surface of the millstone under the influence of the centrifugal force. This path has been ascertained by allowing grains of wheat coated with plumbago to fall upon a smooth millstone, the surface of which has been chalked, so as to receive the marking of the plumbago as the stone was revolved with its determined velocity. The calculated direction of this curve has been found to coincide very precisely with the path as ascertained by experiment. The curves of the upper (the running) stone being reversed, as compared with the curves of the lower stone, the action of the edges of the opposing curves is to some extent like that of shears, and when the grains have been broken they fall into the grooves of the lower stone, and are gradually pushed to the periphery with but little further friction. Among the best results that have been attained in this direction are those of the Istvan steam-mills at Debreczin in Hungary, under the direction of the engineer in charge, Prof. Pekar, in which with a stone fifty-four inches in diameter, the width in grinding surface from the periphery inward is only nine inches. This gave nearly 80 per cent. of flour, with 20 per cent. of bran and 3 per cent. of waste.

The primary function of the grooves is that of trituration. As the grooves present one vertical surface, from the bottom of which the depth lessens by an ascending inclined plane, it will be seen that the grooves in the upper and nether stones provide that in the process of milling the action shall be in some degree like that of shears, in some degree that of impact, and in some degree that of mashing; and the relative measure of these will be determined by the distance of the stones from each other when in service. The stones may be placed so far asunder that the wheat will pass through without being crushed at all. In this case the interval must exceed the greatest length of the kernel of wheat. With the distance a little less than this the brush at the end of the kernel opposite the embryo will be cut off. As the distance is further lessened the grains will be cracked, until they may be brought so near that the gluten cells will be crushed, and the moisture evolved from them, in consequence of the heat produced by friction, will soften the gluten and cause the stones to adhere and the milling to be arrested. Between these extremes the art of the miller so adjusts the distance and velocity that, taken in connection with the other mechanical appliances of his mill, he is enabled to turn out the best product, in condition and quality, which the grain submitted is capable of yielding.

Walz Muhl of Hungary: Grinding between Grooved Steel Rollers.—As one of the results of the study of the nature of the grain, a process of milling has been perfected in which the millstones are replaced by pairs of small horizontal steel rollers, the surfaces of part of which are traversed by small, sharp grooves parallel to the axis of the rollers. These pairs of rollers are arranged in sets of three, one above the other, with considerable intervals between, so that the heat produced by the slight crushing will be counteracted as the product passes through the air on its way from one pair of rollers to the next. These pairs of rollers are adjusted so that the crushing effect of any one pair is slight, and as many as six or seven sets, making from eighteen to twenty-one pairs of rollers, according to Kick's account of the Pesth Walz Muhl, so called, are necessary to produce the various grades of flour. These in the Austro-Hungarian classification number ten in all, besides the groats and bran. At intervals the products of the several sets of pairs of rollers are subjected to processes involving bolts and currents of air to separate the flour-dust as detached and the bran produced.

The operations for grinding and bolting other flour-producing grains than wheat (such as rye, spelt, buckwheat, etc.) are essentially similar to the milling of wheat, but the details vary with the different grains. None of these products are of sufficient commercial importance to warrant an elaborate notice in the present work. In composition these flours differ considerably from that of wheat and from each other.

Grading Flours.—The relative quantities of the different grades of flour vary with the kind and excellence of the wheat employed. The following list, taken from the record of a mill near Trieste, the products of which were on exhibition at the Vienna International Exposition, will illustrate the refinement to which the art of milling has been brought:

Groats, A and B	2	per cent.	41 per cent. of extra flour.
Flour, No. 0	5	" "	
" " 1	12	" "	
" " 2	6	" "	
" " 3	6	" "	
" " 4	5	" "	
" " 5	5	" "	
" " 6	14	" "	38 per cent. medium and common flour.
" " 7	9	" "	
" " 8	5	" "	
" " 9	10	" "	79 per cent.
Bran	18	" "	
Loss	3	" "	

Of these quantities, in a comparison with a view to determine the best work of a system of milling, a mixture of the first total 45 per cent. is taken.

Low Milling.—In this country the prevailing process is that of low milling, as better meeting the general demand, and as yielding at the same time adequate profit to the miller. The first step in the first-class mills, after the removal of the foreign seeds and shrunken berries and dirt, is to pass the wheat through a smut-machine, which, besides removing any smut or dust, largely removes the outer coat of the berry, together with the brush of vegetable hairs at one end, and more or less of the germ at the opposite end. It is then ground, and the product passed through the bolting cylinders or sieves, which separate the flour from the connell or middlings and coarser bran. The middlings, which consist of coarse gritty flour, or what are called fine grits and fine bran, which together pass through the same meshes of the bolt, are then discharged upon a slightly inclined sieve, which is subjected to a gentle jarring action. The meshes of the sieve are sufficiently large to let the whole product pass through, but the bran is kept above by a current of air sweeping upward through the sieve, sufficiently strong to keep the bran from falling, but not strong enough to keep the gritty flour from passing through the meshes. These fine grits, or "groats," are in some mills separately ground, and sold by themselves as an extra quality of flour. In most they are conducted back to be mixed with fresh wheat as it enters the run of stones, and incorporated with the general product, and separated with the fine flour in the next bolting.

Judging Flour.—The excellence of flour may be judged in some degree by its shade of color—the presence of minute particles of bran tending to give it a yellowish hue; by its freedom from musty odor or taste—proving that it has not been overheated and is comparatively new; and by the elasticity and tenacity of the dough which it yields when mixed with a small quantity of water and kneaded. To this may be added the odor which the dough in thin layer yields when submitted for a brief time to a sharp baking temperature of about 400° F.

Composition of Flour.—It has been convenient to treat of the composition of wheat as including the outer envelope, bran; the inner envelope, the gluten coat; and the mass of the interior, the starch and associated albuminoids. Proximate physical analysis and detailed chemical analysis have shown a much greater variety than would be indicated by these three. Of the outer coats there are five that may be readily separated from each other—the gluten coat, consisting of the framework of cells and the capsules and their contents of minute grains that fill the cells, the loose cellular tissue spanning the whole interior of the berry and supporting the starch-cells and their contents: opposite the brush end, distinguished as a tuft of vegetable hairs, there is the complete structure of the embryo. The outer coats contain, besides the woody fibre and cellular tissue of their structure, various inorganic substances, including silica. The gluten coat contains, besides the framework of cellular tissue, various nitrogenous substances, the chief of which is gluten—albumen, glutin, mucin, and cerealine, which differ from each other mainly in their solubility in water and in their susceptibility to fermentation and disintegration. Besides these there are contained bibasic phosphates, of potassa the most abundant, then magnesia next, lime, soda, iron, in combination with which the nitrogenous bodies above mentioned seem more or less to play the part of bases; and in addition to these oil and sugar.

The interior, besides the open cellular tissue and starch-granules, contains albuminoid bodies, kindred with those of the gluten coat, and in some grains in larger proportion; and a small percentage of phosphates. The ratio of phosphates in the interior to the salts in the bran and gluten coats is about as 1 : 10. The embryo contains, besides its organic texture, the nitrogenous and phosphatic constituents found in the gluten coat.

The following analyses by Dempwolff show the percentages of the proximate constituents of the wheat, the nitrogen and phosphates in the different grades of wheat flour:

In 100 parts are	Water	Ash phosphates	Nitrogen.	Albuminoids.	Starch.	Cellulose.
Groats and extra imperial	10.6	0.41	1.80	11.7	70.0	7.29
Roll flour	10.5	0.60	2.08	13.3	67.2	8.40
Bread flour	10.7	0.96	2.40	15.4	63.4	9.80
Dark flour	8.5	1.55	2.30	14.9	61.0	14.05
Bran	10.7	5.46	2.20	14.3	43.6	25.95

The following analyses of the flour of the Pesth Walz Muhl (cylinder mill), made by the writer, show the relations of the phosphoric acid to the nitrogen in the different grades into which the flour is resolved in that renowned mill. (It should be remarked that the so-called "groats" are masses of the interior of the berry.)

	Water.	Ash.	Phosphoric acid.	Nitrogen.	Albuminoids, calculated.
Groats	10.57	.42	.20	{2.24 2.27	14.65
No. 0	10.37	.43	.14	1.68	10.76
No. 1	10.23	.41	.21	{1.68 1.68	10.76
No. 2	10.47	1.03	.22	1.72	11.02
No. 3	10.07	1.02	.17	1.72	11.02
No. 4	10.24	1.19	.25	1.74	11.15
No. 5	9.66	.69	.35	1.80	11.54
No. 6	11.12	1.04	.24	1.84	11.79
No. 7	10.99	0.81	.21	1.80	11.54
No. 8	9.86	1.01	.36	1.90	12.18
No. 9, coarse bran.	9.71	7.32	2.14	1.98	12.69
No. 10, fine bran	11.01	4.21	.70	2.20	14.16

The constituents of the gluten coat when moistened with water spontaneously undergo chemical changes. The starch and sugar by themselves, similarly treated, experience no change. But when the starch and gluten are mingled together and mixed with an adequate quantity of water, the changes which the nitrogenous bodies experience are transferred to the starch, and that is also converted into new substances. At a moderately low temperature the starch is converted into lactic acid. At a temperature of from 70° to 80° F. the starch is converted first into a kind of dextrine, then into grape-sugar, and then this grape-sugar into alcohol and carbonic acid; at a more elevated temperature butyric acid, succinic acid, hydrogen, with carbonic acid and other volatile products, are produced. In the art of bread-making advantage has been taken of this susceptibility to fermentation, producing volatile products, to give to the moistened flour or dough, and ultimately to the loaf, the quality of porosity or cellular structure. This quality of the loaf, as is well known, facilitates digestion. The later refinements in the production of fermented bread have been directed to securing from sound flour that kind of fermentation only which yields mainly alcohol and carbonic acid, and is called vinous fermentation. Incidentally with these products there is yielded a certain amount of gum, and sometimes of sugar, beyond that converted into alcohol and carbonic acid, and also an agreeable volatile essential oil or ether, which imparts to the fresh loaf a pleasant aroma.

There are two principal modes of effecting fermentation—one by the introduction of the purified yeast-plant (now an article of manufacture and commerce on a large scale in Austria, and in a condition more or less pure in various other parts of Europe, and recently in this country, and known as press-yeast); and the other by the incorporation with fresh flour and water of a portion of the fermenting dough of a previous batch, which is of course filled with yeast-germs. This yeast-plant, when mingled with the flour and water, grows at the expense of the flour, and if skilfully manipulated yields only the products of vinous fermentation, but where neglected and allowed to become old and to undergo spontaneous decay, or where impure from the presence of germs of putrefactive fermentation, the bread produced takes on the offensive qualities of the yeast, and instead of being grateful to the palate and uniformly porous, may be offensive to the taste and smell, and heavy or sodden, or partially filled with bubbles of irregular and greatly unequal size. The presence of acid in the yeast tends to liquefy the gluten, and deprive it of the quality of tenacity upon which the production of pores of uniform size depends, and which when destroyed permits the bubbles of gas in the dough to break through their walls and run together, producing on the one hand great cavities, and on the other heavy streaks in the bread.

Unfermented Bread.—In view of these difficulties, incidental to the process of vinous fermentation, effort was made long since to convert flour into porous bread without the aid of fermentation. As the porosity was due solely to the spontaneous evolution of the gas from every point in the interior of the dough, it was evident that so far as cellular structure was concerned it need not be produced from fermentation. It would only be necessary to mix, by the process of sifting, a finely powdered alkaline carbonate with the flour, and then make the flour into dough by incorporating with it acidulated water. The acid of the acidulated water, combining with the alkali, would set the carbonic acid free, which, taking on the gaseous form in every part of the loaf, would make it porous. This principle was illustrated early in the use of sour milk as the acidulated solution. The lactic acid of the milk, combining with the soda or the potash of the alkaline carbonate, drove the carbonic acid out. In place of the sour milk, hydrochloric acid was employed, producing the porous structure by the evolution of carbonic acid, and when carbonate of soda was used yielding common salt in the bread.

Self-raising Flour.—It was obvious from the experience with lactic acid and hydrochloric acid that if an acid which has a solid form, and is not hygroscopic at common temperatures, but readily soluble in water, were pulverized and mixed with bicarbonate of soda in proper proportions to yield a neutral compound of the acid and alkali, there would be practicable yeast-powder—that is to say, a preparation in the form of powder which would fulfil, upon the addition of water, the office of yeast. The substance chosen for this purpose was tartaric acid, or its compound with potassa, the bitartrate of potassa or cream-tartar. This, mingled with bicarbonate of soda in proper chemical proportions, is intimately incorporated with the flour by the process of sifting, and the mixture constitutes what has been called a *self-raising flour.* The form in which this yeast-powder has been produced is in glass bottles or tin cases in quantities suited to domestic use, the preparation of the self-raising flour being made by the cook on the occasion for each batch of bread or cake.

The preparation of self-raising flour on a commercial scale was instituted in England in the use of tartaric acid. This was first intimately incorporated in given proportion with flour, and then an equivalent of bicarbonate of soda was incorporated with another portion of flour, and then these two portions of flour were intimately mixed together. This so prepared self-raising flour, to which has been added the proper proportion of salt, on a mixture with a proper quantity of water or milk, yields, by the action of the tartaric acid on the bicarbonate of soda, carbonic acid gas, rendering the moistened flour porous; in which condition it is put into the oven and baked.

In place of the tartaric acid, which yields no nutritive value to the flour, there has been introduced the use of acid phosphate of lime in the form of powder, with a view to restoring the phosphates lost with the bran in the ordinary process of bolting. The acid phosphate prepared from bones, besides acid phosphate of lime, contains acid phosphate of magnesia and iron, and when mingled with the bicarbonate of soda in flour yields a product containing neutral phosphates in condition to be converted into acid phosphate by the gastric juice, and taken up in the processes of digestion and assimilation. (See BREAD.)

Bread is also made from a mixture of rye flour and wheat flour, and from whole wheat meal, as well as from oat meal and corn meal. These are to some extent mingled with each other, and with rice and potato flour. E. N. HORSFORD.

Flour Manufacture, New Process of. A large proportion of the most valuable part of the wheat is, in the old flouring process, carried off as "middlings," a product chiefly used for feeding stock and for distilling. For many years experiments have been made in Europe and the U. S. with a view to preventing this waste. A plan introduced from Paris in 1872 by a Mr. Lacroix, a manufacturer of Faribault, Minn., and subsequently much improved by Mr. George C. Smith and others, has been very successfully and extensively employed in the North-west. The grinding is done at a relatively low speed of the stones, and the flour is consequently coarser or "higher" than ordinary. Bolting-cloths of large capacity are employed, a strong blast of air passes up continuously through the bolt for the prevention of clogging, and the upper side of the bolt is acted upon by a system of brushes, which facilitates the process. There are, in fact, several processes, but in all the principle is essentially the same; excepting that in some of the best no brushes are employed. Already (1874) the following results have been accomplished: (1) the amount of flour yielded by a bushel of wheat is increased more than 8 per cent.; (2) the quality of the flour is vastly better than that previously made; (3) spring wheat, the sort most abundantly produced, is becoming the highest in value, since the new processes are thus far failures when applied to winter wheat. At present (Nov., 1874) "new-process" flour is quoted in New York at the highest figures. The result of the new inventions may in time become very

important to consumers, manufacturers, and producers alike.

Flourens (GUSTAVE), French *littérateur* and politician, b. at Paris Aug. 4, 1838, was deputy professor at the College of France in 1863; fought in Crete against Turks 1865–68; took part in the electoral movement at Paris 1868; was arrested Apr., 1869, and the same year was wounded in a duel with Paul Granier de Cassagnac; took part in the Communal insurrection in Mar., 1871, and was killed near Paris on Apr. 3, 1871. *Discours du Suffrage Universal* (1865), *Question d'Orient* (1867), *Science de l'Homme* (1869), *Paris Delivrée* (1871), were his productions. He was a son of Prof. M. J. P. Flourens.

Flourens (MARIE JEAN PIERRE), French physiologist and author, b. at Maureilhan Apr. 15, 1794, became M. D. 1813, and a resident of Paris 1814; admitted to the Academy of Sciences in 1828; professor of comparative anatomy in 1832; perpetual secretary of the Academy of Sciences in 1833; and member of the French Academy in 1840. His *Researches on Irritability and Sensibility* appeared in 1822; *Researches on the Properties and Functions of the Nervous System in Vertebrate Animals* in 1824; *Analysis of the Labors of Cuvier* in 1841; *Buffon, Histoire de ses Idées et de ses Travaux*, in 1844; *Theory of the Formation of the Bones* in 1847; *Course of Comparative Physiology*, 3 vols., 1854; *Human Longevity, and the Quantity of Life on the Globe*, in 1854. D. near Paris Dec. 6, 1867, having been made peer of France in 1846, and grand officer of the Legion of Honor Aug. 11, 1859.

Flournoy' (THOMAS S.), b. in Virginia, was M. C. from that State 1847–49. Was killed in battle in Virginia in June, 1864, fighting for the Southern Confederacy.

Flow'er [Lat. *flos, floris;* Fr. *fleur*]. The organs of fructification of a phænogamous plant, with the envelopes or peculiar leaves which enclose or surround them, constitute the flower. Yet some flowers are destitute of all envelopes or leaves, and the flowers most prized for ornament, such as full "double" roses or camellias, consist wholly of leaves. The latter are botanically monstrosities, and incapable of performing their office of propagation. Even normal flowers are so various that, for rightly defining or understanding them, it is needful to take a complete flower as a pattern.

A complete flower consists of its essential organs of two kinds, male and female; the latter in the centre, surrounded by the former, and these surrounded by two floral envelopes, the leaves of the blossom, as they are sometimes called. The outer envelope is the *calyx* or flower-cup (and this is the meaning of the word, the same as "chalice"), for the leaves which compose it are often consolidated more or less into a cup. These calyx-leaves when separate are named *sepals*. The calyx is more commonly green and leaf-like, but by no means always so. The inner floral envelope, whether in form of a cup or of separate leaves, is the *corolla*, and its separate leaves or pieces are called *petals*. The corolla is usually the attractive part of a flower, the texture delicate, and the color white, blue, red, yellow, or some other color than that of the herbage. The functions of the floral envelopes are, in part, protection of the essential organs within, while the calyx, when green and sufficiently ample, may contribute to their nourishment, acting in the same manner as foliage. As to the gayly-colored parts, such as the corolla, it is now well made out that they subserve an important use in attracting insects, etc. to the blossom, thereby aiding fertilization. The fragrance subserves the same end, and the nectar produced by most colored flowers, and by many that are not brightly colored, is the real attraction to insects and their wages for the service which they perform.

The organs next within the corolla are the *stamens*, the male or fertilizing organs. The essential part of a stamen is the *anther*, a case usually of two cells or compartments, containing *pollen*, a powdery substance consisting of minute grains. The anther is commonly borne on a stalk-like support, the *filament*. In the centre are the female or seed-bearing organs, one or more—the *pistils*. A pistil consists of two essential parts—viz. the *ovary* (in Latin, *ovarium*), which contains *ovules*, destined to become seeds; this is surmounted by a *stigma*, which is a knob, line, or other surface receptive of the pollen, which falls upon or is in some way conveyed to it, and which serves to fertilize the ovules, so that an embryo is formed and they become seeds. (See PHYSIOLOGY, VEGETABLE.) In most flowers the stigma is elevated more or less above the ovary upon a column often resembling the filament of a stamen; this is called the *style;* it is not essential and is often wanting.

A name sometimes employed to denote the envelopes of a flower taken together is the *perianth*. This term is seldom used, however, except where there is only a single envelope, or where both calyx and corolla are combined into one cup, as in the lily-of-the-valley and hyacinth, or appear so much alike as seemingly to form one circle, as in true lilies. A technical name for the stamens of a flower, taken together, is *andrœcium;* for the pistils, taken together, *gynæcium;* but these terms are not often used. The axis of the flower, the apex of the flower-stalk out of which all the organs grow, is the *receptacle* or *torus*. The idea of the flower, morphologically, is that the receptacle is axis or stem, and that the sepals, petals, stamens, and pistils respectively answer to leaves, more or less transformed and adapted to special functions. (See BOTANY.)

A *complete* flower, as above described, is one which possesses all these organs. A *symmetrical flower* has the same number of parts of each set or circle—2, 3, 4, 5, or whatever the ground-plan of the particular blossom may be. A *regular* flower has all the parts of each set alike; in an irregular flower some are unlike the others in size or form. A *perfect* or *hermaphrodite* flower has both stamens and pistils. In *unisexual* flowers these organs occupy different blossoms, either borne on the same plant (*monœcious*) or on different plants (*diœcious*); the flowers which bear stamens only are *staminate* or *male*, sometimes also called *sterile;* those with pistils only, *pistillate, female*, or *fertile*. Flowers which want all floral envelopes are called *naked*, or *achlamydeous;* those which want the corolla are *apetalous;* those in which the corolla consists of separate petals, *polypetalous;* those in which the petals are combined into a cup or tube, *monopetalous*, or, better, *gamopetalous*, or, still better but less commonly, *sympetalous*.

There are also in some plants *neutral* flowers—*i. e.* where some of the blossoms are destitute both of stamens and pistils. These are either wholly abortive or rudimentary, destitute of function, or else such as consist of a showy perianth only, usually a corolla, which is much more conspicuous than that of the perfect flowers. Of this sort are the outer flowers of the cluster in *Hydrangea* and the *rays* or ray-flowers of sunflower. Their use doubtless is to attract insects, etc. to the feeding-ground in the cluster they encircle. What were formerly called *compound* flowers, of which the sunflower is a good and familiar illustration, are dense clusters or heads; and, when their marginal flowers are thus enlarged and attractive, and especially when they are *ligulate* or strap-shaped (as in sunflowers, where they are neutral, or in asters, where they are pistillate and fertile), these heads do bear much resemblance to single blossoms, the ray-flowers imitating petals. In some flower-clusters the show or attraction, ordinarily the function of petals, is assumed by leaves of the *involucre* surrounding the head, as in flowering dogwood (*Cornus florida*), or by leaves still more distant from the flowers themselves, as in *Poinsettia*.

In *anthesis* (*i. e.* in the expansion of the blossom) some flowers are fugacious or ephemeral, opening but once and for a brief period; some continue for days, and even a week or more, either remaining expanded or more commonly opening and closing by night or by day or at particular hours, according to the species. Some evening primroses open in twilight, and fade the next morning; others open in the morning and fade at night; still others open in daylight and for several successive days. Poppies drop the calyx when the petals expand, and the petals at or before sunset. Cistuses and rock-roses open in the morning and cast their petals at nightfall. The night-blooming *Cereus* expands its huge and magnificent flower at evening, to close with the light of the next morning, and to collapse into an unsightly and deliquescent mass. On the other hand, some of the most showy orchids of conservatories retain their beauty and freshness for weeks.

W. W. BAILEY. REVISED BY A. GRAY.

Flower (WILLIAM HENRY), F. R. S., English surgeon, b. at Stratford-on-Avon Nov. 30, 1831; was educated at University College, London, and at Middlesex Hospital; entered the army as assistant surgeon in Apr., 1854; served in the Crimean war; was assistant surgeon and demonstrator of anatomy at the Middlesex Hospital, and in 1861 conservator of the museum of the Royal College of Surgeons; since 1869 he has been Hunterian professor of comparative anatomy and physiology. Published *An Introduction to the Osteology of the Mammalia* (1870), and memoirs on anatomical and zoological subjects.

Flow'erfield, post-v. and tp. of St. Joseph co., Mich., on the Michigan Southern R. R., Kalamazoo division. Pop. of v. 210; of tp. 1558.

Flower-Pot, a vessel usually of burnt and unglazed clay, with a perforated bottom and a saucer, designed for holding earth for the growth of plants in houses or greenhouses, or for other special uses in gardening. There are also various ornamental forms, such as rustic and pendent flower-pots. For window-gardening costly encaustic-tile boxes are fashionable, and are often highly ornamental.

Flow'ers, the name formerly given to sublimates, such as flowers of sulphur, benjamin or benzoin, antimony, arsenic, zinc, etc.; only used now in connection with sulphur.

Flowers, Artificial. This art or branch of manufacture is of very old date. Flowers and leaves of painted linen have been found in tombs at Thebes, and the Egyptians also invented flowers of horn shavings stained in various colors. The Chinese have made artificial flowers from very remote times of the pith of a kind of bamboo. Crassus was the first in Rome who had them made of real gold and silver. During the Middle Ages they were much used, not only in the Roman Catholic Church and with a symbolical signification, but also at secular festivals and merely as ornaments. They were generally made of paper, satin, silk, metal, and wax, and the most celebrated were made in Italy. But in 1728, Seguin, a botanist and chemist, began the manufacture in Paris, employing parchment for the flowers and bristles of the wild-boar for the stems, and his imitations were so successful as to arouse the jealousy of the painters. From this time the manufacture steadily increased and developed in France, which still stands at the head of this kind of industry. The French wholesale houses engaged in this business have each some special branch. Thus, one makes only roses; another, wild flowers; a third, leaves. The workpeople earn from two to six francs a day, according to their skill. Of the money received by the Parisian manufacturers, three-fifths are paid to the workpeople, one-fifth covers incidental expenses, and one-fifth defrays the whole cost of materials. According to the latest decennial report of French manufactures, it appears that in 1866 the exports to all countries amounted to 8,065,587 francs, of which the U. S. received 1,034,886, and Great Britain 6,152,454. (*Tableau décennal du Commerce de la France avec ses Colonies, etc., 1857 à 1866.*) From the reports of the Exhibitions, etc., it would appear that notwithstanding the check given to French industry by wars, etc., this amount has more than doubled during the last eight years. It is comparatively only of late that English flower-making has rivalled the French manufacture. It was introduced into England during the French Revolution of 1790 by refugees, who employed the art as a means of subsistence.

The principal tools used by artificial florists are: *stamps*, a kind of knives of various sizes and shapes, by means of which leaves and petals are cut out very rapidly. The material to be shaped is laid, folded several times, upon a leaden table, and the stamp is driven through it with a hammer. This part of the work is done by men. Stamps (or, as they are often called, *irons*) were invented in Switzerland at the beginning of the last century. Leaves and petals had previously been cut out with scissors. *Goffering-irons* of different kinds, the commonest being a ball of polished iron fastened to a handle, are used to hollow the petals. *Moulds* called *veiners* are, as the name indicates, employed to vein the leaves. *Burnishers* of glass or agate give the petals the polished appearance of most real flowers. Many other tools exist, but of late years their use has greatly diminished. The florist's fingers, guided by skill and taste, are found better than any mechanical appliance. The best flowers are carefully painted by hand. (See *Dictionnaire Universel du XIXe Siècle*, Larousse, art. "Fleurs Artificielles;" and *Art of Making Paper Flowers*, by Mrs. Bartlett (New York).) JANET TUCKEY.

Flowers, Colors of. Although the coloring principles contained in many of the most important vegetable dyestuffs have been isolated and their composition and chemical relations clearly established, as in the case of madder-root, Brazil-wood, logwood, quercitron bark, indigo, weld, archil, etc., and some of them, as the alizarine of madder, have been produced artificially, the colors of flowers have, with few exceptions, thus far resisted all attempts at isolation. This is perhaps partly owing to their fleeting character and the changes which they so readily undergo. The colors of flowers often change spontaneously during the life of the flower. The flowers of *Myosotis versicolor*, the common garden weed forget-me-not, open with a yellow tint, but soon change to blue. The *Cheiranthus mutabilis* opens yellow, then changes to orange, red, and finally to purple. Some flowers even change color during the day. Garden phlox is blue in the early morning, and pink in the middle of the day. *Hibiscus variabilis*, which is white in the morning, is pink at noon and bright red towards night. The colors of flowers are very sensitive to chemical reagents. The petals of the purple or violet dahlia are reddened by acids, the purple being restored by alkalies, but changed to green by an excess of alkali; a red rose is bleached by sulphurous acid, but the color is restored by dilute sulphuric acid.

Many flowers contain more than one coloring-matter. The petals of the safflower yield a yellow color to water and a red principle to alkalies. The orange-colored *Tropæolum majus* yield a purple coloring-matter to boiling water, becoming yellow; boiling alcohol then extracts a purple substance. When the purple is absent the flowers are yellow; when present, they exhibit various shades of brown. The flowers of the brown *Calceolaria* yield two similar colors under like treatment.

In but few cases have the coloring-matters of flowers been isolated and their nature determined with any certainty. The coloring-matter of the saffron crocus (*Crocus sativus*) has been isolated, though not in a pure state. It is known as *saffranin*, and is supposed by Rochleder to be identical with *crocin*, $C_{29}H_{42}O_{15}$, the coloring principle of Chinese yellow berries. (See SAFFRON.) The red coloring principle of the safflower (*Carthamus tinctorius*) is a very important dye. (See SAFFLOWER.) It is called *carthamin*, $C_{14}H_{16}O_7$. The blue and red pigments of flowers are generally soluble in water, while the yellow matters are often resinous, and dissolve only in alcohol and ether. They are generally very fugitive, and consequently of little value in dyeing.

Schübler and De Candolle claimed the existence of two distinct series of colors in flowers—the xanthic, which produce yellow and red tints, and the cyanic, which produce blues; both formed from chlorophyl (plant-green), the former by oxidation, the latter by deoxidation. Their views have not been confirmed. The term *cyanin* is applied now to the blue coloring-matter of flowers. It is contained in violets, iris, etc., and in many red and black flowers. It is extracted by alcohol; the solution is evaporated, and from the residue the cyanin is dissolved out by water. It is then precipitated by acetate of lead; the lead is separated from the precipitate by sulphuretted hydrogen; the solution is evaporated by dryness; the coloring-matter extracted by absolute alcohol, and precipitated by ether in blue flocks. Cyanin is a blue amorphous body, soluble in water and in alcohol. It is decolorized by reducing agents, as sulphurous acid, but regains its color when exposed to the air. It is colored red by acids, green by alkalies. To this is ascribed the fact that some flowers of the borage and mallow families are red in the bud, turn blue when they open, and become green as they fade. These reactions render cyanin useful for the preparation of test-papers. A tincture of the petals of *Iris germanica* or *Iris pumila* is well adapted for this purpose. Hope applied the name *erythrogen* to a flower-pigment which is reddened by acids, but Féhal considers it identical with cyanin. Some red flowers, as varieties of the aloe, contain a red principle sparingly soluble in water, but readily soluble in alcohol, which is not changed by acids or alkalies.

Xanthin, *xanthein*, and *xanthogen* are names given by different chemists to yellow principles obtained from flowers, but their exact composition and chemical relations have not been satisfactorily settled. C. F. CHANDLER.

Floy (JAMES), D. D., b. in New York Aug. 20, 1806; studied for a time in Columbia College, and afterwards in London; became a preacher in the Methodist Episcopal Church in 1833: preached in New York, Brooklyn, N. Y., New Haven, Conn., etc.: edited *The National Magazine* and *Good News;* edited the works of Stephen Olin, and served on the "committee on versions" of the American Bible Society. *Old Testament Characters*, *Guide to the Orchard and Fruit-Garden*, etc. were from his pen. He was prominent as an anti-slavery leader. D. in New York Oct. 14, 1863. ABEL STEVENS.

Floyd, county of Georgia, bordering on Alabama. Area, 540 square miles. The surface is in part mountainous, and much of the soil is productive. Wheat, dairy products, and cotton are staples. Iron and lead ores and other valuable minerals abound. The county is traversed by the Selma Rome and Dalton R. R. Cap. Rome. Pop. 17,230.

Floyd, county of Indiana, bordering on the Ohio River. Area, 148 square miles. The surface is broken by knobs and bluffs. Iron ore, building-stone, and timber are abundant. Cattle and grain are the agricultural staples. The manufactures are diversified and very important. It is traversed by the Louisville New Albany and St. Louis and the Louisville New Albany and Chicago R. Rs. Cap. New Albany. Pop. 23,300.

Floyd, county in the N. of Iowa. Area, 480 square miles. This county is undulating prairie, well watered, and produces good crops of grain. It is intersected by the Iowa Central, Milwaukee and St. Paul, and the Cedar Falls and Minnesota R. Rs. Cap. Charles City. P. 10,768.

Floyd, county in the E. of Kentucky. Area, 500 square miles. The surface is mountainous, but affords good pasturage. Immense quantities of excellent bituminous coal occur here, but it is not much wrought. Corn and cattle are the staple products. Cap. Prestonsburg. Pop. 7877.

Floyd, county in the S. S. W. of Virginia, lying N. W.

of the Blue Ridge. Area, 280 square miles. It is mountainous, but produces grain and tobacco, and has abundant pasturage and fine water power. Copper and iron ores and other valuable minerals abound. Cap. Jacksonville or Floyd Court-house. Pop. 9824.

Floyd, tp. of Warren co., Ill. Pop. 1146.

Floyd, tp. of Putnam co., Ind. Pop. 1269.

Floyd, tp. and post-v. of Floyd co., Ia., on the Mona branch of the Iowa division of the Illinois Central R. R. Pop. 1328.

Floyd, post-v. of Carroll co., La. Pop. 157.

Floyd, post-v. (FLOYD CORNERS) and tp. of Oneida co., N. Y. It has 3 churches and 4 cheese-factories. Pop. of v. 95; of tp. 1209.

Floyd Court-house, post v., county seat of Floyd co., Va., is 180 miles W. S. W. from Richmond. Called also JACKSONVILLE (which see).

Floyd, tp. of Scott co., Va. Pop. 1171.

Floyd (JOHN), b. in Beaufort, S. C., Oct. 3, 1769; moved to Georgia in 1791; was brigadier-general of the Georgia militia Aug., 1813, to Mar., 1814; commanded at the battle with the Creek Indians at Autossee, Ala., Nov. 29, 1813, and at the battle at Camp Defiance, Ala., Jan. 27, 1814. Was often in the State legislature; M. C. in 1827–29; and also major-general of the State militia. D. in Camden co., Ga., June 24, 1839.

Floyd (JOHN), b. in Jefferson co., Va., was many years in the Virginia legislature, was M. C. from that State from 1817 to 1829, and governor of Virginia 1830–34. D. at Sweet Springs, Va., Aug. 16, 1837.

Floyd (JOHN BUCHANAN), b. in Montgomery (now Pulaski) co., Va., 1805; graduated at South Carolina College 1826; studied and practised law; removed to Helena, Ark., 1836, returning to Virginia in 1839; member of Congress from Washington co., Va., 1847–49; governor of Virginia 1850–53; took an active part in favor of the nomination and election of James Buchanan as President, by whom he was appointed secretary of war Mar., 1857. During his term of office he used his power in dispersing the U. S. army to distant and not easily accessible parts of the country, in transferring arms and ammunition to Southern arsenals, and generally in preparing for the conflict which it now appears he must have been aware was impending between the North and the South. On the secession of South Carolina he became a zealous sympathizer with the secession movement, opposed the reinforcement of the forts and troops in Charleston harbor, and upon President Buchanan refusing to withdraw the U. S. forces from that harbor, resigned his office. Was indicted by the grand jury of the District of Columbia as being privy to the withdrawal of a large amount of bonds from the Department of the Interior, but having left Washington, was never brought to trial. Was appointed brigadier-general in the Confederate army, and commanded in 1861 in Western Virginia. His operations here were unsuccessful, and severely commented upon by the Virginia press. Was subsequently transferred to Kentucky, and at Fort Donelson commanded a brigade, being senior officer, but abdicated his command and withdrew, the night previous to the surrender, with Gen. Pillow and some 5000 men. He afterward held several unimportant commands, and d. at Abingdon, Va., Aug. 26, 1863.

Floyd (Gen. WILLIAM), b. in Suffolk co., L. I., Dec. 17, 1734; was in the Continental Congress 1774–83, and signed the Declaration of Independence; was again in Congress 1789–91; was a presidential elector 1800, 1804, 1820, and was a prominent State legislator. He served actively in the Revolution, in which he lost much property. In 1803 he removed to Western, Oneida co., N. Y., where he d. Aug. 4, 1821.

Floyd's, tp. of Horry co., S. C. Pop. 630.

Floyd's, tp. of Newberry co., S. C. Pop. 2133.

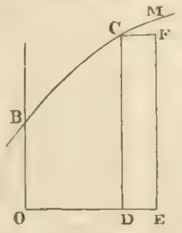
Fludd (ROBERT), M. D. (*Robertus de Fluctibus*), "the Searcher," an English Rosicrucian and alchemist, b. at Bearstead, Kent, in 1574; entered St. John's College, Oxford, in 1591; studied five years on the Continent; took his medical degree at Oxford 1605, and d. at London Sept. 8, 1637. He was a famous physician, and the author of numerous obscure Latin works, theosophical, philosophical, and mathematical, but his enigmatical style prevents the intelligent study of his works. His doctrine was a refined dualism; his writings have only an historic value. Kepler, Gassendi, and P. Mersenne were his adversaries. Some critics have found atheism, fraud, and all manner of follies in Fludd, while others regard him as a great though misguided genius, and a man of exalted piety.

Flue. See CHIMNEY.

Flu'ents and **Flux'ions** [Lat. *fluo*, *fluxum*, to "flow"]. These terms are so connected that they can best be defined together. The *fluent*, or flowing quantity, as the term signifies, is the same as the *function* in modern calculus; and the *fluxion* is its *differential*.

The idea of fluents and fluxions, as first developed by Newton, was based on the idea of motion. According to this view, we may conceive a plane curve or line to be generated by a point moving uniformly in the direction of some fixed line, and having at the same time a transverse motion, which varies according to some law; which law determines the nature of the curve. The part of the curve that has been generated up to any instant of time is called the *fluent*, and the infinitesimal element of the curve that is generated in the next infinitely small, but constant, period of time is called the *fluxion*. Excepting the case of the straight line, both fluent and fluxion are variable.

Let C be the position of the generating point at any time t, OE the line in whose direction motion is uniform, and OB a perpendicular to OE. Let CF be the distance through which C moves in the direction OE, and FM the distance through which it moves parallel to OB in the next infinitely small, but constant, period of time dt. Then will M be the position of the point at the end of the time $t + dt$, and CM will be the portion of the curve generated during the time dt. The indefinite portion of the curve BC is the *fluent*, and the infinitesimal element CM is its *fluxion*.



If, in addition to the two motions already explained, we conceive the generating point to have a third motion in the direction of a line perpendicular to both OE and OB, it will generate a line in space, which may be a straight line, a plane curve, or a curve of double curvature. As before, the part generated up to the end of the time t is the *fluent*, and the part generated during the infinitesimal time dt is its *fluxion*.

It is easy to conceive that such laws of motion may be assigned as to cause the generating point to describe any curve whatever. It is also plain that if we know the laws of its motion, the nature of the curve may be determined. It is on these principles that the science of fluents and fluxions rests. Returning to the figure already referred to, the line OD is the abscissa of the point C, and DC is its ordinate. Whilst C is moving to M, each of these elements varies by an infinitely small amount, and these variations are the fluxions of the elements. DE is the fluxion of the abscissa, and under the supposition made it is *constant*; FM is the fluxion of the ordinate.

If we suppose the ordinate DC to move with the generating point, it will generate a plane area, limited by the curve, the axis OD, and any two ordinates. The part of this area that is generated up to the end of the time t is a fluent, and the part generated during the time dt is its fluxion. In the case considered the area CBOD is the fluent, and the area MCDE is its fluxion. If we suppose the plane area to turn around OE as an axis of revolution, the curve BC will generate a surface, and the area CBOD will generate a volume of revolution; at the same time the line CM will generate the fluxion of the surface, and the area MCDE will generate the fluxion of the volume.

If we suppose a plane curve to move uniformly in some fixed direction, varying in magnitude according to a determinate law, it will generate a surface which we may regard as a fluent, and the portion generated in an infinitesimal portion of time will be its fluxion. In like manner, if we suppose a plane area to move uniformly in a fixed direction, the bounding line varying in magnitude according to any determinate law, it will generate a volume which we may regard as a fluxion, and the portion of this volume generated in the time dt will be its fluxion.

In accordance with these views, any magnitude may be regarded as flowing from a point: for a moving point may be made to generate any line, a moving line of varying magnitude may be made to generate any surface, and a moving plane area of varying magnitude may be made to generate any volume.

The system of fluents and fluxions was admirably adapted to convey a clear idea of the nature of the infinitesimal calculus, but has been superseded by the method of integrals and differentials principally on account of its cumbrous methods of notation.

The methods of notation are explained below:

Variables are denoted by final letters of the alphabet, as x, y, z, etc., and their fluxions are indicated by the same letters with a dot over each. Thus, the fluxions of x, y, z, etc. are represented by the symbols $\dot{x}$, $\dot{y}$, $\dot{z}$, etc. Since fluxions are usually variable, they may in turn be regarded as

fluents, whose fluxions may be found; these are denoted by the same letters with two or more dots, according to their order. Thus, $\ddot{y}$ denotes the fluxion of $\dot{y}$; $\dddot{y}$ denotes the fluxion of $\ddot{y}$; $\ddddot{y}$ denotes the fluxion of $\dddot{y}$; and so on. The number of dots denotes the order of the fluxion.

If the fluent is a radical, as $\sqrt{x-y}$, or a fraction, as $\frac{x}{y}$, it is enclosed in a parenthesis, and a dot is placed over it in the manner of an exponent. Thus, the fluent of $\sqrt{x-y}$ is written $(\sqrt{x-y})^{\cdot}$; the fluxion of $\frac{x}{y}$ is written $\left(\frac{x}{y}\right)^{\cdot}$; and so on.

Sometimes the fluxion is denoted by the letter F, and the fluent by the letter f. Thus, $F(\sqrt{x-y})$ is equivalent to $(\sqrt{x-y})^{\cdot}$, and $F\left(\frac{x^2}{y}\right)$ to $\left(\frac{x^2}{y}\right)^{\cdot}$. Also, $f\,(\dot{x}\sqrt{a+bx^2})$ is equivalent to *the fluent whose fluxion is* $\dot{x}\sqrt{a+bx^2}$, and $f\left(\frac{b\dot{x}}{a+x^2}\right)$ to *the fluent whose fluxion is* $\frac{b\dot{x}}{a+x^2}$.

W. G. PECK.

Flue, von der (NIKOLAUS), SAINT, b. at the estate of Fluehli, Unterwalden, Switzerland, Mar. 21, 1417, of a good family; was carefully educated; became a distinguished soldier, and for nineteen years was state councillor and judge. In 1467 he left his children, and went to live among the Alps, a hermit, bareheaded and barefooted; and we are told that for twenty years he ate only the eucharistic bread. In 1477 he began to preach in his little chapel, and in 1481 he visited the Diet at Stanz and prevented the breaking up of the confederation. D. Mar. 21, 1487. In 1669 he was canonized. He was commonly known as BROTHER KLAUS.

Flü'gel (GUSTAV LEBRECHT), German Orientalist, b. at Bautzen Feb. 18, 1802, educated at Leipsic, became the pupil in 1827 of Von Hammer at Vienna. The *Arabic Anthology of Thâalibi* (fugitive poetry), published in 1829, led to his appointment on a scientific mission by the Austrian government. In it, for three years, he travelled in Hungary, Styria, parts of Germany, and in France. Became professor in the College of Meissen in 1832; resigned 1850; published his *History of the Arabs* in 1833, and an edition of the Koran, and subsequently a *Concordance of the Koran.* In 1835–54 appeared, at the expense of the London Oriental Society, his Latin translation of *The Encyclopædic and Biographic Dictionary of Hadschi-Chalfa*, with commentary; wrote also *Mani und Seine Lehre*, 1862; published Arabic, Turkish, and Persian MSS., and other works. D. at Dresden July 5, 1870.

Flügel (JOHANN GOTTFRIED), German lexicographer, b. at Barby on the Elbe, 15 m. from Magdeburg, Nov. 22, 1788; spent ten years in the U. S. (1810–19); was professor of the English language in the University of Leipsic 1824–38, when he was appointed U. S. consul at Leipsic, where he d. June 24, 1855. He published, besides other works, a *Merchants' Dictionary, in German, English, and French* (3 vols., 1840; 2d ed. 1854), but is best known by his *Complete English German and German English Dictionary* (2 vols., 1830), in the last edition of which (1852) he was assisted by his son, Dr. Felix Flügel. R. D. HITCHCOCK.

Flu'id [Lat. *fluidus*, from *fluere*, to "flow"], a body whose particles move over each other without sensible resistance, yielding to the slightest pressure. Such bodies under the influence of natural forces assume forms of static equilibrium. Such forms will be changed by the action of any new force, but will be immediately restored when the disturbing force is withdrawn. Fluids are of two classes, liquid and aëriform. The property which distinctively characterizes aëriform fluids or gases is that they are perfectly elastic; whence it follows that, temperature remaining constant, their volume is always inversely as the pressure to which they are subjected. This law is subject to a practical qualification, in regard to which see GAS. With diminished pressure, therefore, they tend to expand indefinitely; but as expansion is accompanied by depression of temperature, the process may be naturally arrested by the condensation of the body to the liquid state. This is what happens with the aëriform bodies called *vapors*, which differ from permanent gases only in being condensable at temperatures naturally occurring. Liquids are but slightly reduced in bulk by pressure—to common observation not at all. A liquid introduced into a vessel having a capacity greater than its bulk occupies but a part of the vessel; whereas the smallest portion of any permanent gas fills the containing vessel entirely, however large it may be. Liquids are sometimes called non-elastic fluids, and sometimes *dense* fluids. The terms are convenient, but neither of them is severely correct. When elastic fluids are spoken of, aëriform bodies are always intended. Some writers have been disposed to restrict the term *liquid* to such dense fluids as have the property of *wetting* the solid bodies immersed in them. Water, alcohol, and oil are examples of this kind; mercury is an example of the other. But such distinctions will not hold universally. Water will not wet a charred cork; mercury will readily wet gold or silver or lead or zinc, though it will not wet platinum, nor iron, nor glass, nor stone, nor wood, nor organic or mineral substances generally. F. A. P. BARNARD.

Fluid'ity, the condition of matter in which its molecules glide upon each other without sensible resistance from cohesion. Though the term *fluid* is applied to bodies both liquid and gaseous, the word *fluidity* in its ordinary sense is understood of liquids only. Brande distinguishes the state of fluidity as that state in which bodies are capable of forming *drops*, since this property belongs neither to gases nor to finely comminuted solids. The formation of drops is evidence that the molecules, notwithstanding their freedom of motion, adhere to each other with a certain tenacity. They adhere in like manner to solids capable of being wetted by them; as when, in lifting the finger from a vessel containing water, a drop remains suspended at its extremity.

The three physical states of matter, the solid, the fluid, and the gaseous, are commonly explained on the hypothesis that the molecules are subject to the action of two opposing forces, the one attractive and the other repulsive. When these two forces are in equilibrium, fluidity is the result. When the attractive force predominates, the body becomes solid. When the repulsive force is in excess, the molecules tend to recede from each indefinitely, and the gaseous state supervenes. The physical state of a body is determined by the conditions in which it is placed—mainly as it respects temperature and pressure. By properly managing these, any solid not liable to be chemically altered in the process may be made to pass successively into the fluid and the gaseous state. F. A. P. BARNARD.

Fluke-worm, a name applied to various entozoic worms, constituting the order TREMATODA (which see). They are as a rule flat and oval, smooth, soft, and not jointed, and are mostly hermaphrodite, having sexual organs which constitute a large part of the organism. Some are produced by simple generation, but many striking examples of alternate generation and parthenogenesis occur in the order; for instance, in *Distoma* and other genera. The disease called "rot" in sheep is caused by the presence of flukes in the biliary passages. The endemic hæmaturia of the Cape of Good Hope and the dysentery of the Nile basin are examples of diseases in man caused by these parasites. As a rule, the flukes have, when perfect, an alimentary canal without vent.

Flume, The, in the Franconia Mountains, and in the town of Lincoln, Grafton co., N. H., is a cleft between two walls of rock through which flows a small stream. This stream, just below, falls over 600 feet down The Cascade. It is one of the finest resorts of the White Mountain region.

Fluohy'dric (or **Hydrofluor'ic**) **Acid,** HF, was first prepared (containing silica) by Scheele in 1771. Gay-Lussac and Thénard first obtained it pure in 1808, but they regarded it as an oxygen acid. Ampère in 1810 suggested that it was a hydracid analogous to hydrochloric acid—a view which was confirmed by Davy. *The aqueous acid* is produced by the action of sulphuric acid on metallic fluorides, fluor spar or cryolite being generally employed, the operation being conducted in leaden or platinum vessels, as the acid rapidly corrodes glass and porcelain.

$$CaF_2 + H_2SO_4 = CaSO_4 + 2HF.$$

The acid distils over, on the application of heat, as a gas holding a certain proportion of water; it is condensed in a small quantity of cold water placed in the receiver, and must be preserved in bottles of lead, platinum, or gutta percha. The concentrated aqueous acid is a colorless liquid, sp. gr. 1.06; on dilution its density increases to 1.15. The strong solution gives off fumes which are very caustic and irritating, and the liquid itself is extremely corrosive. On the skin it produces painful ulcers, difficult to heal. It dissolves metals readily, with the liberation of hydrogen—even copper, silver, and the elements silicon, boron, zirconium, titanium, and tantalum; but not gold. Ignited silicon and titanium require for their solution a mixture of hydrofluoric and nitric acids. Silica and the silicates (glass, porcelain, etc.) are energetically attacked by this acid. Silica dissolves to a clear solution with elevation of temperature, forming hydrofluosilicic acid, $2HF,SiF_4$. With silicates it forms silicofluorides — $CaSiO_3 + 6HF = CaF_2.SiF_4$. Placed upon glass, heat is evolved, fumes of SiF_4 are given off, and a roughened spot is produced. This action upon glass distinguishes it from all other acids.

The anhydrous acid is prepared by heating a mixture of fluoride of lead and charcoal in a current of dry hydrogen in a platinum tube, or by heating the dry acid fluoride of potassium, HF,KF, in dry hydrogen. It is a colorless gas, which is condensed by freezing mixtures to a mobile liquid, sp. gr. 0.9879, boiling at 67° F. (19.4° C.), fuming in the air and rapidly absorbing water. It is one of the most dangerous substances known to chemistry. Gore (*Jour. Chem. Soc.* [2], vii. 368) examined it very carefully, with a view to determining its true character and settling the question as to the character of fluorine. He found that its gas did not attack glass in the absence of aqueous vapor, and that it did not contain oxygen. He concludes that in chemical properties it lies between hydrochloric acid and water, most nearly allied to the former. He also calls attention to the fact that the atomic weight of F (19) lies between those of oxygen and chlorine (16 and 35.5), and that the sum of the atomic weights of oxygen and fluorine nearly equal that of chlorine.

Uses.—The aqueous acid is extensively used for etching glass, designs being produced by first tracing them in a coating of wax or varnish previously applied to the surface. Lines etched by the vapor of the acid are opaque—by the liquid, transparent. For etching with vapor a leaden box is employed containing a mixture of fluor spar and sulphuric acid. The waxed plate is placed over it, waxed side down, and a gentle heat is applied to the bottom of the box. The acid is very useful in the laboratory for decomposing silicates for analyses. C. F. CHANDLER.

Fluores'cence [Lat. *fluor*, a "flowing"] is the name given to an action by which certain substances absorb light-waves of certain lengths when exposed to them, and then re-emit the same energy in waves of greater length. For example, when violet light falls on a solution of chlorophyl (the green coloring-matter of leaves), it is changed into or re-emitted as crimson light, whose waves are about twice as long as those of the violet light to which they owed their origin. This action finds its analogy in the process by which light-waves falling on dark-colored bodies are converted into the longer waves of heat. As to the process by which this result is effected, we know nothing beyond the fact that an absorption and re-emission does take place; which appears from the fact first shown by Stokes, that if the light falling on the fluorescent substance is polarized, the light emitted by fluorescence is entirely without polarization. As to the phenomenon in its various modifications, a vast amount of detail has been accumulated during the few years which have elapsed since Stokes in 1852 first recognized this action.

To understand clearly the relation of fluorescence to other departments of physical optics, a few general statements must be recalled. Thus, we must in the first place remember that, according to our established theory, light is a wave or vibratory motion, and differences of color are simply differences in the lengths (or, what is the same thing, frequency of recurrence) of these waves. Thus, red light is simply light made up of long waves, which therefore succeed each other at longer intervals; and blue light is only light made up of shorter waves, which therefore succeed each other more quickly. White light is moreover a compound of a multitude of waves of every possible length, or, in other words, a mixture of light of all colors.

Easy as it might appear to change the lengths of light-waves, and so alter the color of the light, this is nevertheless one of the most impossible of changes, except in the case of our present subject; and until this action was pointed out by Stokes no one had dreamed of its existence. With this above-named exception, substances, even the most brilliantly tinted, have not the minutest power of changing the lengths of the light-waves which they reflect or transmit, but owe their brilliant hues solely to their power of extinguishing certain rays, while they transmit only others; and thus, when illuminated with white light, which contains all colors, they glow with those tints which they reflect or transmit, having in one way or another suppressed the rest. Thus, a scarlet flower does not look red because it has any power of converting other colors into red, but simply because when white light falls on it all but the red waves are suppressed, and these alone are reflected.

So with transparent colors. Red glass is only red because it refuses to transmit any but the red waves of light. If no red waves are present in the illuminating light, the most vivid red object looks absolutely black, or devoid of all color whatever. This is well illustrated by the effect of illuminating brightly colored objects of various tints with light of a single color—say yellow, which is easily obtained by burning an alcohol lamp with some common salt on the wick. All color then vanishes, and we have only shades of yellow and black.

There exists, then, the almost universal rule that wave-length or color is an unchangeable property in light rays, and that blue can no more be transmuted into yellow than lead into gold. It is to this all but universal rule that the present subject is the sole and therefore startling exception. The first recorded observation in this direction is by Sir David Brewster in 1833, in the *Edinburgh Philosophical Transactions*, vol. xii. p. 542. In 1846, in the 16th volume of the same, he published a further account of some phenomena now known to belong to our present subject, as also in the *Philosophical Magazine* of June, 1848. In 1845, Sir John Herschel described certain appearances in solutions of quinine under the name of "superficial color" or "epipolic diffusion." In none of these papers was the true nature of the action recognized.

In the *Philosophical Transactions* for 1852, part ii. p. 463, appeared a paper by Prof. G. G. Stokes, filling more than 100 pages, and not only recounting a vast number of observations and experiments, but also pointing out the true nature and relation of this remarkable action. He showed that the action of fluorescence consisted in a change in the wave-length or color of light, brought about by some bodies in the course of what otherwise generally resembled an ordinary irregular or scattering reflection. In this same essay is developed the only general law which up to the present time has been discovered in connection with the subject of fluorescence—namely, that the light developed by this action is always of a greater wave-length than that by which it is excited. Thus, violet rays falling on an acid solution of sulphate of quinine will develop by fluorescence from it rays of blue and other still greater wave-lengths, such as green, yellow, red; but there will be in the fluorescent light no trace of violet or other shorter waves. Again, certain red rays will excite fluorescence in a solution of chlorophyl, but this fluorescence will consist only of still longer-wave red light.

Shorter waves than these red ones can be developed by fluorescence in this substance, but only by the action of yet shorter waves in the exciting light.

In 1859, Ed. Becquerel published in the *Annales de Chimie et de Physique*, 3d series, vol. lvii. p. 101, an account of a long series of experiments upon bodies which he designates as "phosphorescent." According to his definition, all fluorescent bodies would come under the description of phosphorescent substances, or, what will be an easier transition to us in the present case, we may say that phosphorescent bodies are those in which the "fluorescent" emission continues for an appreciable time after the exciting light has ceased to act. Thus, if violet light falls upon a certain sulphide of calcium, not only will this emit green waves, but if carried away from the violet light into a dark room, green rays will be emitted for a minute or more. This action, however, seems to have all the other characteristics of Stokes's "fluorescence;" and indeed this characteristic of duration seems to be the only one by which the two actions can be distinguished. As Stokes was the first to investigate the action, it would seem that his name has the prior claim. It should be remembered that the phosphorescence above mentioned has no connection with chemical phosphorescence or the slow combustion of phosphorus.

In his large work entitled *La Lumière*, published in 1867–68, Becquerel devotes over 200 pages to the same subject. In the *Comptes Rendus* of Aug. 3, 1872, he moreover published an abstract of researches on the same class of properties in certain salts of uranium, and in the *Ann. de Chem. et Phys.* for December of the same year appeared the entire memoir. Hagenbach in *Poggendorff's Annalen*, vol. cxlvi. pp. 65, 232, 375, 508, has discussed the fluorescent properties of a vast number of substances. Besides these, many brief notices have appeared on certain points from time to time. Lastly, the present writer has devoted much time to the study of fluorescence, chiefly in the salts of uranium and in certain hydrocarbons found in coal-tar and in petroleum distillates. Some of the results so obtained will be discussed farther on.

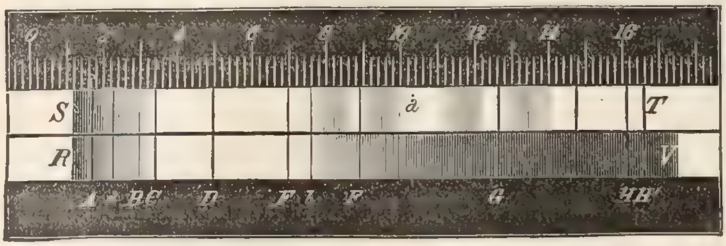
Returning to the characteristics of fluorescent action, as developed by Stokes and others, we observe—

1st. That the power of exciting fluorescence is not confined to any class of rays, though it is general only for the very short ones like the violet. These, indeed, will develop fluorescence in all bodies capable of exhibiting this phenomenon at all. The longer waves, on the other hand, only excite fluorescence in some substances. Thus, for example, as already stated, chlorophyl in solution has fluorescence excited by rays of various tints, including those as low as the red; so also with extract of stramonium-seeds in alcohol; so also guaiacum in alcohol, which is excited by rays as low as almost to the orange; turmeric in alcohol, excited by rays as low as the yellow-green; litmus, by rays as low as the red; and similarly with many other bodies as shown by Hagenbach. On the other hand, solution of sulphate of quinine shows no fluorescent action under the influence of any rays lower than the indigo. So likewise with æsculine,

the principle found in the bark of the horse chestnut, with solution of bichlor-anthracene in alcohol, of bisulpho-bi-chlor-anthracenic acid in water, and many others. In each and all of these, however, fluorescence is excited by the violet rays, those rays being pre-eminently fluorogenic.

2d. In most bodies there are several special wave-lengths

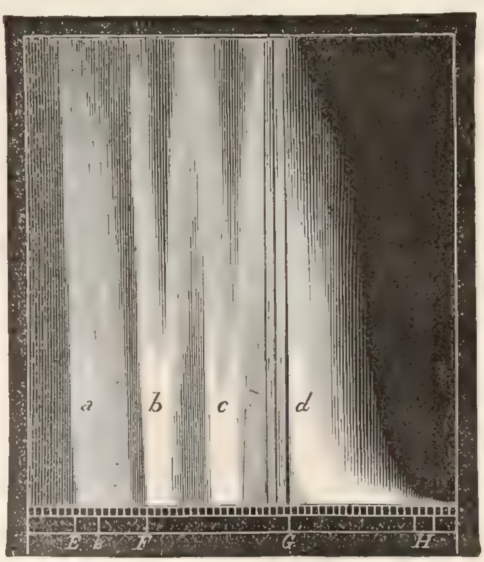
FIG. 1.



which excite fluorescence better than those between. Thus, for example, suppose a continuous spectrum, or one from sunlight, to fall on a screen partly coated with a fluorescent body, as in Fig. 1, where R V represents the solar spectrum falling on the part of a screen covered only with paper, and S T the part painted with a certain fluorescent substance (in this case a hydrocarbon discovered by the present writer in petroleum distillates, and named thallene); then, while the natural spectrum R V would show red at A and B and C, orange at D, green at E, blue at F, indigo at G, and violet fading into darkness at H H, the upper one on the thallene, though corresponding with the other up to F, would show at that part and above only green of various intensity. In other words, all the rays of shorter wave than F would excite green fluorescence in the thallene, but not all equally. The waves of the length corresponding to F would have a more powerful effect than those above until we came to the part between 10 and 10.5 on the scale, where again the waves of these lengths had a powerful effect, lost in turn above until we come nearly to G; and again lost, but recovered with vastly increased power, at 14 of the scale, above which the effect is most powerful and unvaried, as far as any rays at all are obtainable.

Such maxima and minima of excitability in various parts of the spectrum constitute striking features in many fluorescent bodies much studied by Stokes, and yet more fully investigated since by Hagenbach. In the case of liquids, they were likewise examined by Stokes and by Hagenbach, who threw a spectrum on the side of a tank containing the substance. The effect so obtained is often very beautiful. Thus, Fig. 2 shows the appearance given by a solution of

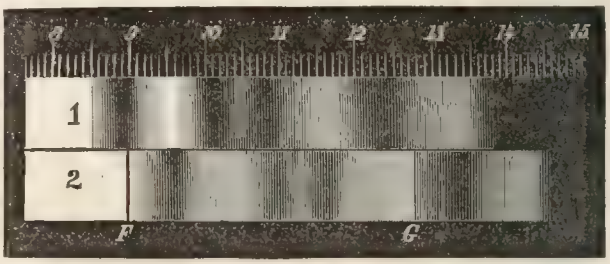
FIG. 2.



thallene in benzole, looking down upon a rectangular tank against one side of which a solar spectrum is thrown. We there see a powerful fluorescence excited by the rays immediately above F, another by those halfway between F and G, and again a strong action above G. As might naturally be expected, where light is thus powerfully active in developing fluorescence it is quickly absorbed, and thus we have the dark blades running in from the opposite side of the tank, which simply indicate that the corresponding rays are absorbed in producing the brilliant streaks *b c* and *d*.

This correlation of absorption and fluorescent excitement is an important fact, much studied by Stokes and also by Hagenbach; and it may in general be stated that in all cases just those rays or waves which most powerfully excite fluorescence are most absorbed; and thus if light which has traversed a fluorescent body is analyzed by a prism or spectroscope, just those rays will be missing which most powerfully excite fluorescence; or, in other words, absorption bands or dark spaces will be found in those parts of the spectrum. Thus, if a thin layer of the substance thallene, whose maxima of fluorescent excitement are shown in Fig. 1, is so placed that sunlight after passing through it is examined with the spectroscope, bands such as are

FIG. 3.



represented in 1 of Fig. 3 will be apparent, and these will be found to correspond exactly with the maxima of fluorescence as given in Fig. 1. 2 of Fig. 3 shows the absorption bands of the solution of the same, whose maxima of fluorescence are given in Fig. 2.

We must not, however, suppose because all fluorescence must have its corresponding absorption, that all absorption has its corresponding fluorescence. There are multitudes of absorbing bodies which have no fluorescence, such as permanganate of potash, salts of didymium, some aniline colors, etc.; and there are also some fluorescent ones, such as the uranic salts, which besides the absorption correlative with fluorescence, have a very complicated selective absorption which has seemingly no direct relation to fluorescence. Thus, the nitrate of uranium shows a broad absorption of all rays above the green, with exception of a narrow part in the lower blue, corresponding to its fluorescence; but besides this it shows eight narrow, regularly spaced dark bands which have no relation to its fluorescence.

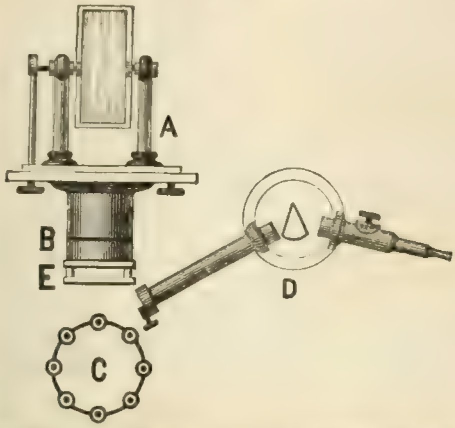
We have thus far considered the relation of the exciting light to the fluorescent body, but there is an equally important department of the subject in the character of the light emitted by the body in its act of fluorescence. In other words, we have seen that certain bodies react with certain waves so as to absorb and re-emit them with new wave-lengths; our attention, however, having thus far been directed only to what wave-lengths would react with the different substances. Now we turn to consider what wave-lengths are produced by this action, or to study the composition of the emitted light of fluorescence.

With many substances this emitted light is composed, like that of luminous hot solids, of an indefinite variety of wave-lengths. In other words, when analyzed by the prism it yields a continuous spectrum or band of blended colors. So is it with the light given by a solution of sulphate of quinine, of æsculine, of stramonium, of morin, etc. With chlorophyl, on the other hand, we have the dispersed light made up almost exclusively of certain red waves, so that, examined with the prism, it shows a red stripe and a very faint green one only. So likewise with the red platino-cyanide of magnesium, whose fluorescent light resolves only into a red band. Yet again, nitrate of uranium yields a green fluorescence, which, however, divides by the prism into seven well-defined stripes, including red, orange, and green tints, but very sharply divided by dark spaces, indicating the absence of waves of certain lengths.

This department of the subject was ably opened up by Stokes, who studied a number of uranium compounds and some other materials in this relation by the use of a prism. Becquerel applied the spectroscope in the same way, as also did Hagenbach, and a yet more extended investigation has been carried out by the present writer by the further

developments of the same methods. The method pursued may be briefly stated as follows: Sunlight is thrown by the mirror of a porte-lumière (A, Fig. 4) through a window

Fig. 4.



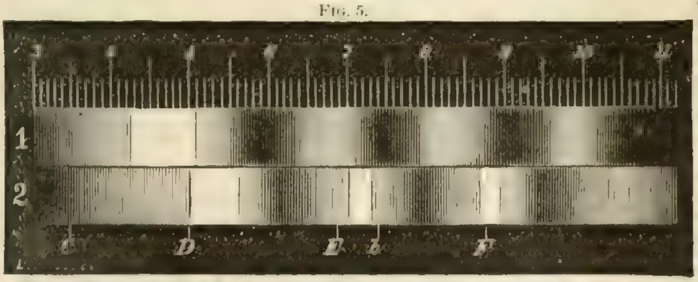
upon a lens at B, in front of which is placed a tank E containing a solution of ammonio-sulphate of copper, by which all but the blue and violet rays are absorbed. At a point where the transmitted rays are most concentrated they fall upon the substance to be examined, which is supported by a revolving table E, which enables the observer to bring various bodies rapidly into identical positions for comparison. The nature of the emitted light is then examined by aid of a spectroscope placed at D.

For example, a portion of thallene being placed as indicated, we see with the spectroscope such a spectrum as is shown at 1 of Fig. 5, consisting of a broad red and yellow band, 3.5 to 5.5; a narrower green one, 6.4 to 7.2; another bluish green, 7.8 to 8.7; and a fainter blue one, 9.5 to 10.3. The spectrum shown at 2 of the same figure is that given by the solution of thallene in benzole.

In a combined research made by the writer and Dr. H. C. Bolton on the uranium salts, a great number of their spectra have been compared, measured, and mapped, of which one or two examples will suffice. Thus, 1 of Fig. 6 shows the spectrum of the fluorescent light emitted by the double oxychloride of uranium and potassium, while 2 of the same figure gives that of the oxychloride of uranium.

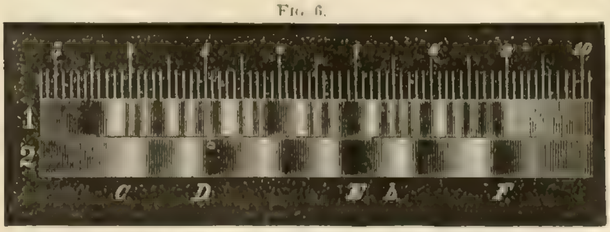
To illustrate one out of many of the applications which have been made of this study of these spectra, one case will

Fig. 5.



suffice. Having heated for a certain time some of the ammonio-uranic sulphate whose normal spectrum is shown at 1 of Fig. 7, the present writer found that it showed the

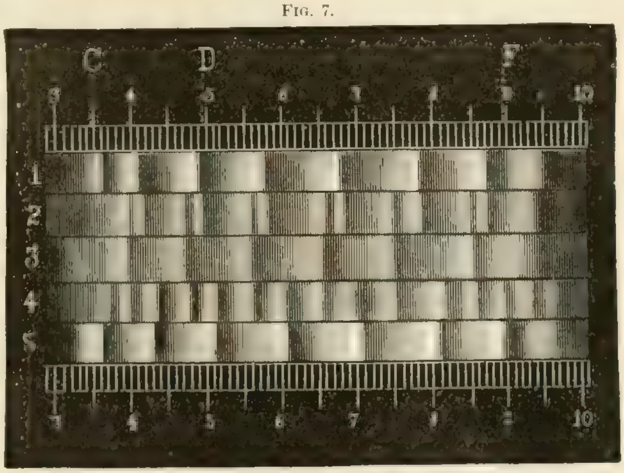
Fig. 6.



spectrum given at 2 of the same figure, in which to the bands of the normal spectrum were added as many more, each located a little farther down than its corresponding band in the first spectrum. Now, it was evident that water was being driven off from the salt in the process of heating, and therefore natural to suppose that these new bands belonged to a spectrum of the anhydrous salt which was being formed in admixture with the other. By continuing the heat until no more vapor escaped, the body was found to yield the spectrum shown in 3 of Fig. 6, which was thus probably the spectrum of the anhydrous salt; and in fact the salt in this state, being submitted to Dr. Bolton for analysis, proved to be the anhydrous ammonio-sulphate of uranium. But this was not all. On further heating to a temperature approaching redness, the spectrum changed to the appearance shown at 4 of Fig. 6, fumes evidently consisting of ammonium sulphate being given off; and on continuing the heat until these fumes were no longer evolved, the spectrum assumed the character shown in 5 of Fig. 6. This material again being submitted to Dr. Bolton, and analyzed by him, proved to be an ammonio-diuranic sulphate, a salt not before known to chemistry.

Fluorescent Phenomena.—Among the more striking phenomena involving fluorescence are the following: By means of a mirror placed outside of a window we reflect a beam of sunlight through a hole in a shutter into an otherwise darkened room. Over this hole we place a sheet of dark violet-colored glass or a tank containing a strong solution of ammonio-sulphate of copper. This will admit none but the violet and actinic rays, and the room will be to the eye almost perfectly dark. If now, however, we

Fig. 7.



place in the line of the violet beam a mass of uranic nitrate, it will blaze out with a magnificent green color, lighting up the whole room. A mass of chromate of potash or ferrocyanide of potassium similarly placed will have no such effect, but will remain dark and dead in the violet rays. Or if into a jar of pure water illuminated as above we throw some fragments of the bark of the horse chestnut, beautiful streams of luminous blue will seem to run down from it as the æsculine it contains dissolves in the water.

A clear and perfectly transparent solution of sulphate of quinine, slightly acidulated with sulphuric or tartaric acid, will under like conditions seem to be opaque, with a *luminous* milky precipitate. Designs drawn on paper with quinine sulphate, invisible in ordinary light, shine out with a phosphorescent luminosity when held in this violet light, and similar drawings made with a varnish thickened with thallene will have a yet more brilliant effect. In place of sunlight, the electric light or that given by burning magnesium may be employed in the same way. By employing muslin of the color of thallene, and attaching to it a design cut from sheets of paper coated with thallene, a screen may be prepared which by gaslight, or the electric light filtered through yellow, green, or red glass, will show no pattern whatever; but when illuminated by the electric light filtered through cobalt blue glass, it will show the thallene design as if on fire on a background as dark in appearance as black velvet.

It is well known that the visible violet rays do not represent the shortest waves existing in sunlight or the electric light, but that if this light is passed through a

prism of quartz, and the resulting spectrum is received on a sensitive photographic film, there will be an impression extending above the limit of the visible violet to a distance many times the length of the whole visible spectrum.

If in place of the sensitive film a screen of some powerfully fluorescent substance is used, these invisible light-waves will be rendered sensible by the fluorescence which they will develop on the screen; and we shall see this greatly elongated spectrum with perfect distinctness. (*Stokes*, *Phil. Mag.*, 1862, p. 599.) The most effective screens for this purpose are made with the platino-cyanide of barium in a certain state which is very difficult to secure, even with the purest product, or with thallene or an analogous body found in coal-tar distillate, called chrysene.

The violet-colored light produced by a powerful electric discharge in rarefied nitrogen is very rich in fluorescence-exciting rays, and advantage has been taken of this in the construction of certain forms of Geissler tubes (see article on ELECTRICITY for drawings of some of these), in which arrangement is made to pass a discharge through an exhausted tube, which is either made of "canary glass" (glass stained with oxide of uranium), which is a highly fluorescent substance, or the tube itself being of ordinary glass, it is surrounded by a glass jacket which can be filled with a fluorescent solution.

The most powerfully fluorescent bodies known are the following:

Solids:

- Thallene, emerald green.
- Chrysogen, light green.
- Chrysene, yellow green.
- Platino-cyanide of barium, uranic salts generally, and especially certain phosphates, double oxychlorides and sulphates, also canary glass, emerald green.
- Platino-cyanide of magnesium, red.
- Platino-cyanide of potassium, blue.
- Solarized thallene (petrolucene), blue.
- Anthracene, purplish blue.

Solutions:

- Acid quinine sulphate in water, blue.
- Alkaline or neutral æsculine in water, blue.
- Bichlor-anthracene in alcohol, purple.
- Bisulpho-bichlor-anthracenic acid in water, purple.
- Extract of stramonium-seeds in alcohol or water, green.
- Solution of morin, obtained from fustic or Cuba-wood in water with alum, green.
- Alcoholic solution of chlorophyl, best obtained from tea-leaves exhausted with water previously, red.

The above list includes only some of the more brilliantly fluorescing bodies, and might be greatly extended, as can be seen by a reference to the various original investigations quoted above. HENRY MORTON.

Flu′oride of Alu′minum and So′dium (*Cryolite*), $6NaF,Al_2F_6$, a beautiful white mineral found in large quantities in Greenland. It is now extensively employed for the preparation of hydrofluoric acid, of alumina, sulphate of alumina, alum, caustic, and carbonate of soda. Its use for these purposes is a monopoly in the U. S. in the hands of the Pennsylvania Salt Manufacturing Co., which has works at Tarentum, Pa., and at Philadelphia. (For the processes employed see SODIC CARBONATE.) A beautiful opaque white glass, called "hot-cast porcelain," is made by fusing together 30 parts of cryolite, 100 parts of quartz sand, and 10 parts of oxide of zinc. By the aid of metallic oxides a great variety of colors can be given to this, and all the spotted and mottled marbles are thus imitated in a much harder and more durable material. (See GLASS.)

C. F. CHANDLER.

Fluoride of Calcium. See FLUOR SPAR, by EDWARD C. H. DAY, M. D.

Flu′oride of Sil′icon, SiF_4, a colorless gas produced by the action of hydrofluoric acid on silica and silicates, as glass, etc. It is best prepared by heating in a glass flask a mixture of fluor spar, quartz sand, and sulphuric acid:

$$(1)\quad CaF_2 + H_2SO_4 = 2HF + CaSO_4.$$
$$(2)\quad SiO_2 + 4HF = SiF_4 + 2H_2O.$$

The gas must be collected in dry receivers over mercury. It is colorless, is very pungent and suffocating, fumes in the air, and has a density of 3.60 (air = 1). In contact with water it is decomposed, forming fluosilicic acid and gelatinous silica—$3SiF_4 + 2H_2O = 2H_2SiF_6 + SiO_2$. The experiment must be very carefully conducted to avoid serious accident. (See FLUOSILICIC ACID.) C. F. CHANDLER.

Flu′oride of So′dium, NaF, obtained by saturating hydrofluoric acid with sodic carbonate. This is probably the cheapest soluble salt of fluorine. According to Jean (*Chem. News*, xvii. 252) it can be prepared very readily by fusing together 100 parts of fluor spar, 140 of calcic carbonate, 200 of sodic sulphate, and an excess of carbon. Water extracts nearly pure fluoride of sodium, leaving an insoluble oxysulphide of calcium. C. F. CHANDLER.

Flu′orine, a non-metallic element belonging to the group which includes chlorine, bromine, and iodine. It occurs abundantly in fluor spar, which is a fluoride of calcium; in cryolite (fluoride of aluminum and sodium), topaz, mica, amphibole, chondrodite, tourmaline, apatite, and numerous other minerals. It is very generally diffused, occurring in all rocks in small quantities. It is also found in almost all waters in minute quantities; in plants, especially in grasses and Equisetaceæ; and in animals in the bones, teeth, brain (*Horsford*), blood, urine, milk, etc. The name fluorine is derived from fluor spar, from *fluo*, to "flow," because this mineral has long been used as a flux.

As early as 1670, Schwankhardt of Nuremberg observed that glass could be etched by fluor spar and sulphuric acid. Scheele in 1771 referred this action to a peculiar acid liberated by the sulphuric acid. Of fluorine in the free state little is known. Fluorides are readily decomposed by chlorine, yielding chlorides. Fluorine is undoubtedly set free at the same time, but as it enters into combination with the material of almost every vessel that can be used to collect it, its isolation becomes a matter of great difficulty. Souyet (*Compt. Rend.*, xxii. 960) decomposed fluoride of silver by chlorine or iodine in a vessel of fluor spar, and obtained a colorless gas which did not bleach vegetable colors, but which decomposed water and attacked most metals. Frémy (*Compt. Rend.*, xxxviii. 393; xl. 966), by decomposing fused fluoride of potassium by the voltaic current, obtained a gas having similar properties. He also obtained a gas which corroded glass by the action of chlorine and of oxygen, on red-hot fluor spar. H. Reinsch (*N. Jahrb. Pharm.*, xi. 1), by heating a mixture of cryolite, plumbic peroxide, and acid potassic sulphate, obtained a colorless gas consisting largely of oxygen, but containing another gas possessing a pungent odor, like that of nitrous acid, which he supposed to be fluorine. Kämmerer (*J. pr. Ch.*, lxxxv. 452), by heating iodine with fluoride of silver, obtained a colorless gas which did not attack glass, could be collected over mercury, and was rapidly absorbed by potassic hydrate. Prat (*Compt. Rend.*, lxiv. 345, 511) claims that fluor spar and other metallic fluorides are oxyfluorides (an old idea), and that by heating fluor spar with potassic chlorate, a mixture of oxygen and fluorine is liberated, from which the fluorine can be absorbed by silver. He also finds that by passing the mixed gases over heated baryta the oxygen is absorbed, leaving the fluorine. He describes the fluorine as a gas heavier than air, nearly colorless, fuming in the air, smelling like chlorine, bleaching indigo, etc. P. Cillis (*Zeitsch. f. Ch.* [2], iv. 660) repeated Prat's experiments, and concludes that his statements are entirely erroneous. From the nature of the compounds of fluorine it is supposed to be a gas, to possess color like chlorine, atomic weight 19, equivalence 1, molecular weight 38, molecular volume 2, density 19 (H = 1), 1.31 (air = 1). One litre weighs 1.7 grammes or 19 criths. Its symbol is F.

The detection of fluorine is effected by decomposing the supposed fluoride with sulphuric acid in a vessel of lead or platinum, and allowing the hydrofluoric acid liberated to act upon glass, which is etched or roughened by it. If silica is present, fluoride of silicon will be evolved. In this case the experiment should be conducted in a test-tube, and the gas passed into water, which decomposes the fluoride of silicon, forming a gelatinous precipitate of silica and hydrofluosilicic acid, which remains in solution. On saturating this with ammonia it is decomposed, with the formation of fluoride of ammonium and a further precipitate of silica. The mixture is filtered, and the clear filtrate evaporated to dryness, and tested with sulphuric acid and glass, as when silica is absent. (*Q. J. Chem. Soc.*, v. 151.) Sullivan gives a delicate method for detecting fluorine in siliceous rocks in the *Lond. and Ed. Phil. Mag.*, xxvii. 229. Nickles (*Compt. Rend.*, xliv. 679) recommends rock-crystal in place of glass, as some other acids corrode the latter. Fluorine may be detected in many minerals by mixing them with phosphorous salt, and heating in an open glass tube with the aid of the blowpipe. Hydrofluoric acid is evolved, which corrodes the tube.

Compounds of fluorine with hydrogen, boron, silicon, sulphur, phosphorus, and nearly all the metals have been described, but none are known with oxygen, chlorine, bromine, or iodine. Solid fluorides have no metallic lustre; most of them fuse readily; when dry they are not decomposed by heat, though many of them are volatile without decomposition. The fluorides of hydrogen, ammonium, tin, and silver are readily, the fluorides of sodium, potassium, and iron sparingly, soluble in water; most of the other fluorides are insoluble in water. Some fluorides, as HF,SiF_4,BoF_3, are gases; TiF_4 is a fuming liquid. Fluorine manifests a strong tendency to form double fluorides;

some of which, containing hydrogen, possess acid properties:

Cryolite	$6NaF,Al_2F_6 = Na_6Al_2F_{12}$.
Fluohydrate of potassium	$HF,KF = HKF_2$.
Borofluoride of potassium	$KF,BF_3 = KBF_4$.
Hydroborofluoric acid	$HF,BF_3 = HBF_4$.
Silicofluoride of potassium	$2KF,SiF_4 = K_2SiF_6$.
Hydrofluosilicic acid	$2HF,SiF_4 = H_2SiF_6$.

This tendency of fluorine to form double salts has suggested the idea that it is diatomic and analogous to oxygen, with an atomic weight of 38. This theory would make hydrofluoric acid, H_2F, like water, H_2O. The two salts of potassium would be K_2F and KHF, corresponding to K_2O and KHO. The theory, however, which is generally accepted, considers fluorine as monatomic, with an atomic weight of 19, and analogous to chlorine. The investigations of Gore (*J. Chem. Soc.* [2], vii. 368) confirm the latter theory. C. F. Chandler.

Fluor'otype, a photograph taken upon paper treated with a compound containing fluoride of sodium or some other equivalent fluoride. This process was brought forward by Mr. Robert Hunt in 1844. (See Photography, by Prof. H. B. Cornwall, E. M.)

Flu'or Spar, Flu'or, or **Flu'orite** [from *fluo*, "I flow," in allusion to its use as a flux in metallurgical operations], a mineral composed of fluoride of calcium (F48.7%, Ca51.3%). It crystallizes in the monometric system (in cubes, octahedra, etc.), and has a perfect octahedral cleavage. Its hardness is 4 (see Hardness), and its specific gravity 3.18. It occurs frequently very perfectly crystallized, and of beautiful and bright colors; pulverized, it becomes below a red heat brilliantly phosphorescent. It is sometimes carved into ornaments, and is used in the arts as a source of hydrofluoric acid for etching, and, as above stated, as a flux. Edward C. H. Day.

Fluosil'icates, salts formed by replacing the hydrogen in fluosilicic acid by metals. (See Fluosilicic Acid.)

Fluosilic'ic (Hydrofluosilic'ic or Silicofluor'ic) Acid, $2HF,SiF_4$. This acid is formed by the action of water on the fluoride of silicon ($3SiF_4 + 2H_2O = 2H_2SiF_6 + SiO_2$). As the gelatinous silica formed would quickly close a moist delivery tube, it is necessary to arrange the apparatus in such a manner as to prevent the contact of the gaseous SiF_4 with water before it is clear of the end of the tube. The flask containing the mixture of fluor spar (or cryolite), quartz sand, and sulphuric acid (see Fluoride of Silicon) is provided with a delivery-tube which dips beneath the surface of mercury, above which the water is placed. The gas passes through the mercury, and on reaching the water is decomposed. The silica set free forms an envelope round the bubble of gas as it rises through the water, often forming a complete tube to the surface of the water. Finally, the liquid becomes thick and gelatinous from the separated silica. By squeezing in linen, and finally filtering through paper, the acid is rendered clear. According to J. Lawrence Smith (*Reports U. S. Com. to Paris Exp.*, 1867), Du Motay and others have simplified the manufacture of this acid to a degree which will extend its use to many important industries. A mixture of fluor spar, alumina, silica, and carbon is made into bricks and melted in a blast furnace. Fluoride of silicon is evolved, and a fusible slag is from time to time drawn from the furnace. The gas is conducted through a series of five wooden chambers, containing inclined shelves of glass which are moistened by a spray of water. Silica is deposited at the bottom of the chambers, and the acid solution passes from chamber to chamber, and may thus be concentrated to between 5° and 10° B. (1.031 to 1.070), equivalent to from 4 to 8½ per cent. of acid. The acid thus prepared costs about four times the price of its equivalent quantity of sulphuric acid. Hydrofluosilicic acid is a sour, fuming liquid, which can be evaporated in platinum vessels without leaving a residue. It does not attack glass except when evaporated in it, when fluoride of silicon is first given off, leaving hydrofluoric acid, which corrodes the glass. Stolba has given (*J. f. pr. Ch.*, xc. 193) a table showing the percentage of acid in solutions of different densities from 0.5 to 34 per cent. The following are a few of the figures: 1.004 = 0.5 per cent.; 1.008 = 1; 1.0161 = 2; 1.0407 = 5; 1.0834 = 10; 1.1281 = 15; 1.1748 = 20; 1.2235 = 25; 1.2742 = 30; 1.3162 = 34. Chloride of barium gives a crystalline precipitate, BaF_2,SiF_4, in solutions of the acid; chloride of potassium, a transparent gelatinous precipitate, $2KF,SiF_4$. When ammonia is added to the acid, even with the greatest care, a portion of the acid is decomposed, with the precipitation of silica, while the rest is changed to the ammonium salt, $2NH_4F,SiF_4$; $2HF,SiF_4 + 6NH_4HO = 6NH_4F + SiO_2 + 6H_2O$. A similar decomposition occurs whenever the acid is neutralized by a base. In the laboratory the acid may be used as a test for barium and potassium. In the arts it is suggested as an agent for removing potassa from sugar and syrups in sugar-refining, especially when beet-sugar is employed, which contains much potassa, which interferes with the operations of refining. It may also be used for making chloric acid from chlorate of potassa. It is proposed to make it the agent for preparing useful salts from the chloride of potassium, found at Stassfurt. The acid, being added to a solution of this salt, precipitates silicofluoride of potassium, setting free hydrochloric acid — $2KCl + 2HF,SiF_4 = 2KF,SiF_4 + 2HCl$. This salt can be used as a substitute for borax, and in place of carbonate of potassa in making flint glass. It is sold in France at 10 cents a pound. It can be converted into caustic potassa by first heating in retorts, when fluoride of silicon is driven off, to be again converted into hydrofluosilicic acid, and fluoride of potassium remains behind. This salt is readily decomposed by lime or carbonate of lime, forming caustic or carbonate of potassium and fluoride of calcium, to be used again. Thus, the acid becomes a mere agent, to be used again and again to extract potassa from the native chloride. (See articles on this acid and its applications in Wagner's *Jahresberichte*, 1865, p. 277; 1867, p. 221; 1869, pp. 330, 417; 1870, p. 206.) C. F. Chandler.

Flush'ing [Dutch, *Vliessingen*], seaport of the Netherlands, in the province of Zealand, strongly fortified. It is situated on the island of Walcheren, at the mouth of the Western Scheldt, and in connection with the ports of Rammekens and Breskens, it commands the entrance of the Scheldt. It has an excellent harbor and extensive dockyards. Pop. 11,800.

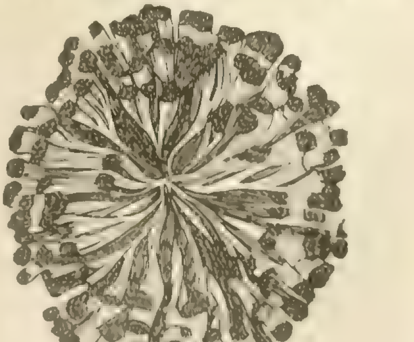
Flushing, tp. and post-v. of Genesee co., Mich. Pop. of v. 687; of tp. 1919.

Flushing, a post-v. and tp. of Queens co., N. Y., at the head of Flushing Bay, 7 miles from New York City, to which it has half-hourly trains by the Flushing and the Flushing and North Side R. Rs., also steamboat communication. It has 1 State and 1 savings bank, several institutions of learning, an infant asylum, 8 churches, 3 newspapers, and the modern improvements, including gas and water. Gardening, the nursery business, and fruit-raising are leading pursuits. It is a handsome and rapidly-growing town. Pop. of v. 6223; of tp. 14,650. W. R. Burling, Pub. "Times."

Flushing, tp. and post-v. of Belmont co., O. Pop. of v. 206; of tp. 1484.

Flus'ser (Charles W.), U. S. N., b. Sept. 27, 1833, in Annapolis, Md.; graduated at the Naval Academy in 1850; became a lieutenant in 1855, a lieutenant commander in 1862. In 1862 commanded the Commodore Perry at the capture of Roanoke Island, in the action with the enemy's gunboats and batteries at Elizabeth City—where he "took the flagship Sea Bird in gallant style, running her down and sinking her"—and in a severe engagement near Franklin, Va. In 1863 participated in various skirmishes in co-operation with the army, and on Apr. 19, 1864, fell mortally wounded on the deck of the Miami, a wooden vessel, in an encounter with the iron-clad ram Albemarle, near Plymouth, N. C. His eulogy is written by Rear-admiral Lee in these words: "Lieutenant commander Flusser was killed on the deck of the Miami in a night-action with a ram. This brave officer was a native of Maryland and a citizen of Kentucky. His patriotic and distinguished services had won for him the respect and esteem of the navy and the country. He was generous, good, and gallant, and his untimely death is a real and great loss to the public service." Foxhall A. Parker.

Flus'tra, a name given to the "sea mats," a genus of



Flustra avicularia, natural size.

infundibulate marine Bryozoans. They are flat and leaf-

shaped, and are generally confounded by the uninstructed with pale brown sea-weeds. But each leaf-like body consists of a mass of horny cells; and if the living frond be placed in a vessel of sea-water, many little tentacles may be observed playing briskly about. The genus belongs to the order Gymnolæmata, sub-order Chilostomata, group Radicellata, family Flustridæ.

Flute [said to be from the Lat. *fluta*, a "lamprey," which has seven holes upon its side, to which the holes of a flute were likened], a musical instrument made of ebony, box, ivory, or silver, and consisting of a tube closed at one end, and having one large hole on the side, into which air is blown directly from the lips or through a mouth-piece. It is generally made with three joints or in four pieces, has six finger-holes, and a variable number of keys which open or close other holes. Flutes are made with various compass of sound, those of the highest register receiving the name of piccolo. The flutes of ancient Egypt, Chaldæa, Greece, and Rome were blown into at one end. The emperor Nero was a famous flute-player, and won 1800 prizes by his skill, or more probably by the subserviency of his subjects. Ptolemy (XI.) *Auletes*, a depraved king of Egypt, was so named for his skill in flute-playing.

The nose-flutes of the South Sea Islanders are flageolets, or straight pipes, into one end of which the performer blows through the nostril.

Fluvan'na, county of Virginia, bounded on the S. by the James River. Area, 170 square miles. A portion of the surface is broken and sterile, but the remainder is fertile, producing grain and tobacco. Cap. Palmyra. Pop. 9875.

Flux [Lat. *fluo*, to "flow"], a substance or mixture used to promote the fusion of bodies. Limestone is the usual flux for ores of iron in the blast furnace; it unites with the alumina and silica of the ore, forming a fusible slag. To flux silica and silicates, alkaline or basic fluxes are selected, as carbonate of soda or potassa, litharge, lime, or carbonate of lime; fluor spar is very effective. For lime, alumina, oxide of iron, etc. acid fluxes are selected, as borax, silica, glass, etc. Nitre and litharge are both oxidizing agents and fluxes, while cyanide of potassium is a reducing agent as well as a flux; it frees metals, such as lead, from sulphur and from oxygen. *White flux* is a mixture of carbonate, nitrite, and nitrate of potassa, prepared by projecting a mixture of equal parts of nitre and argol or crude cream of tartar into a hot crucible in successive small portions. It is an oxidizing flux. *Black flux* is prepared of the same materials and in the same manner as white flux, but the quantity of argol employed is double that of the nitre. As this proportion of nitre is not sufficient to completely oxidize the carbon of the argol, the mixture contains only carbonate of potassa and carbon. It consequently reduces metallic oxides by the union of the carbon with the oxygen. *Morveau's reducing flux* is composed of 16 parts of window glass, 2 of calcined borax, and 1 of charcoal. *Flux for colored flames* before the blowpipe.—To enable the lithium, sodium, potassium, strontium, copper, etc. contained in minerals to color the blowpipe flame, Poole recommends a flux composed of 1 part of fluor spar and 2 parts of sulphate of lime (selenite). *Deflagrating fluxes*, for decomposing silicates, are very convenient in qualitative analysis, as they enable the student to do without the platinum crucible. For the detection of alkalies a flux composed of nitrate of baryta and charcoal is prepared. This is mixed with the finely pulverized mineral, placed on a plate of sheet iron, and fired with a match. On treating the residue with water a solution will be obtained which can be tested as usual for potassa and soda. For the detection of other bases a flux composed of carbonate of soda, nitrate of soda, and charcoal is employed; the residue, after deflagration, being treated with hydrochloric acid, evaporated to dryness to render the silica insoluble, moistened with hydrochloric acid dissolved in water, filtered, and tested for bases as usual. This flux may also be used for the decomposition of insoluble sulphates of barium and strontium. On treating the residue after deflagration with cold water, and filtering, the sulphuric acid will be found in the filtrate, and the bases on the filter as carbonates.

C. F. CHANDLER.

Fluxions. See FLUENTS AND FLUXIONS, by PROF. W. G. PECK, LL.D.

Fly, a name applied to many insects, mostly belonging to the order Diptera, and more especially to the families Muscidæ (house-flies, flesh-flies, blow-flies, etc.) and Œstridæ (bot-flies). The common house-fly (*Musca domestica*) is universally prevalent. Flies, though often a serious annoyance, are extremely useful as scavengers and preventers of disease. Many species, especially in hot countries, inflict severe and sometimes dangerous bites upon men and beasts.

Fly-Catchers, a name applied at first to birds of the genus *Muscicapa*, now applied to a large number of American birds, none of which are of the above genus. They are assigned to the Tyrannidæ and other families of the section Clamatores or shrieking birds, and the order Passeres. They are distributed in many genera. These birds all have the habit of lying in wait until insects come near them, when they dart upon them with wonderful quickness. The *Tyrannus Carolinensis*, or king-bird, is one of the best known. The Savannah fly-catcher, *Milvulus Savanna*, is found in the Southern States.

Fly Creek, post-v. of Otsego tp., Otsego co., N. Y., has 3 churches, a machine-shop, foundry, and manufactures of agricultural tools.

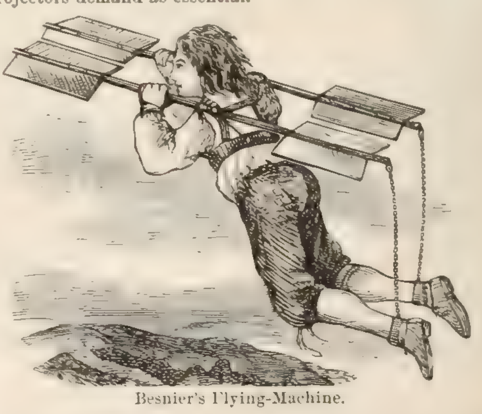
Flygare (EMILIE). See CARLÉN, E. F.

Fly'ing, the motion of a living animal through the air when propelled by its own wings. Among vertebrates, most birds and all the bats possess, and the pterodactyl and some other fossil reptiles once possessed, the power of flight. It is probable that flying fishes also have a limited power of true flight, the pectoral fins serving as wings. Many insects also have the power of flying, but their wings, though functionally analogous, are not structurally homologous to those of vertebrates. In the latter the wing is the representative of the arm and hand or anterior limb of other vertebrates. The so-called flight of the flying squirrels, flying dragons, etc. is by no means a true flight. The parachutes (not wings) of these animals enable them to glide safely through the air, simply prolonging the leap of the creature, or at most joining to a parachute-action that of a sail or a kite.

The *mechanics* of flying is not yet well understood. In some birds the shape of the quills is such that at the stroke of the wing the greatest possible surface is opposed to the air; while in the *recovery*, or expansion of the wing, the edge of the quill-feather is opposed to the air. Bats are thought to partially fold the wing during the recovery, and the same may be true of some insects, and even birds. The more rapid closure of the wing also secures a greater resistance from the air during the stroke than can be offered during the expansion of the wing.

There are many varieties of flight among birds; of these among the most remarkable is the sailing motion, in which the wings are but slightly moved. There is considerable doubt as to the means by which such birds as the condor and albatross can maintain their long and almost motionless poise in the air.

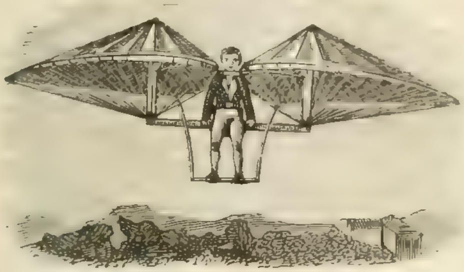
Flying, Artificial. This term is properly applied to aërostation by dynamical agencies, either with or without balloons to provide ascensive power. The first requisite of a flying-machine is that it shall overcome the force of gravity; the second, that in moving more or less horizontally it shall overcome the resistance of the atmosphere, and be capable of guidance as to the direction of its flight. The balloon provides the first, but its great size precludes the second. Very many plans have included balloons furnished with screw-propellers, wings, and other mechanical appliances, and probably an equal number have been made to depend upon the latter alone. All, with a few trifling exceptions, have been utter failures in practice, but the exceptions have sufficed to indicate the prerequisites of success, which in some distant age may be provided; for the state of the arts and applied sciences at the present time is not sufficiently advanced to provide the accessories that projectors demand as essential.



Besnier's Flying-Machine.

The first authentic account of a flying-machine that operated at all is that of one Besnier, a locksmith of Sablé, France. As nearly as can be ascertained from the imperfect record left by him, his apparatus comprised four rect-

angular wings arranged in pairs at opposite ends of two rods passing over the shoulders, the rear extremities of the rods being connected by cords to the ankles of the wearer, to enable the legs to assist the arms in giving a vibratory movement to the rods, and consequently to the wings. Besnier was not enabled to rise direct from the ground, but by starting from an elevation he flew across rivers of considerable width, and a pair of wings which he sold to another was used with a similar success. This was in the latter part of the seventeenth century. About a century and a quarter later one Jacob Degen, a prisoner at Vienna, constructed an apparatus having two umbrella like wings of large area worked by manual power. With this machine he rose to a height of fifty feet, as measured by a cord attached to prevent escape and held by the jailer. This was done in two minutes' time, but the effort quite exhausted the strength of the adventurous mechanic. These experiments of Besnier and of Degen are perhaps the most



Jacob Degen's Flying-Machine.

notable on record of those in which muscular power alone has been employed. Both comprised wings attached to the body, in substantial imitation of those of a bird; and the futility of all such devices is shown by the fact that while the pectoral muscles of a bird exceed in weight all the other muscles, in man they form but one seventieth part of the whole, and no assistance from the legs can compensate the enormous disproportion. Hence, artificial flying, if ever practised, must depend primarily upon motive-power in lieu of physical energy.

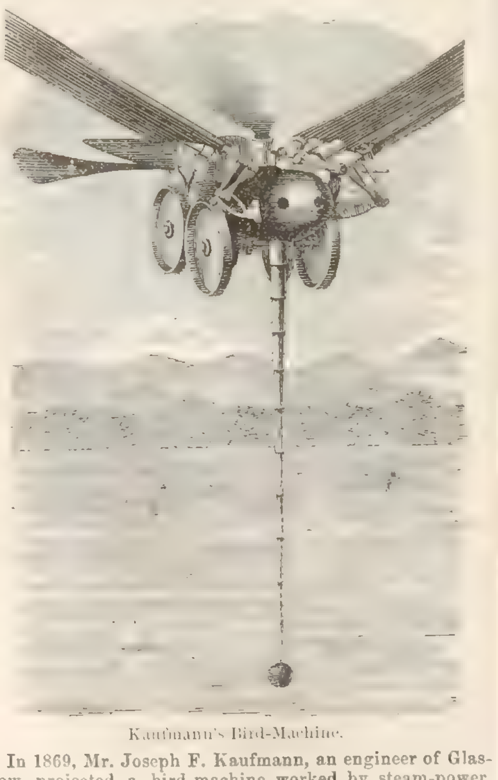
Before proceeding to the consideration of the flying-machines devised or tested in this country, we may fitly consider those of England, where projects looking to the navigation of the air antedated somewhat the earlier American experiments, though no more successful than the latter. In 1815, Messrs. Pauly and Egg secured the first British patent for an aërial machine. In this a balloon of fish or bird-like form was to have "wings or fins" and a "tail," which were to be of silk stretched upon whalebone strips fastened to operating staves. The inventors also proposed to use the fins and tail without the balloon. Eleven years later, James Viney and George Pocock obtained a patent for the use of kites for "raising weights or persons in the air." In 1840, Moses Poole suggested propellers for moving "vessels floating in the air." Two years later, William Henson brought forward a most elaborate scheme for artificial flying, which attracted much attention at the time, the bill to incorporate a company to work the machine having been introduced in the House of Commons by Mr. Roebuck. The apparatus was to carry "letters, goods, and passengers." It comprised a horizontal plane composed of wire and hollow wooden bars, arranged on the principle of a trussed girder and covered with silk. This plane was furnished with propellers driven by a steam-engine. A tail capable of being brought to any desired angle to the horizontal was arranged, to quote the inventor, "so that when the power acts to propel the machine, by inclining the tail upward the resistance offered by the air will cause the machine to rise, and when the tail is reversed the machine is propelled downward, and passes through a plane more or less inclined to the horizon as the inclination of the tail is greater or less." The machine was to be guided laterally by a vertical rudder. The engine, passengers, freight, and fuel were to be located in a car placed midway in the plane. The apparatus entire would weigh about 3000 pounds, the horizontal plane or silk-covered frame was to have an area of 4500 square feet, and the tail to have 1500 square feet. A high-pressure copper boiler of peculiar construction was to furnish steam to the engine, the latter being, moreover, provided with a condenser, in which condensation was to be effected by air-currents instead of water. It was not expected that the ponderous machine would lift itself from the ground, but it was to be started from an elevated point by running down hill on wheels upon a suitable track until the plane, being caught and buoyed up by the atmosphere underneath, should be floated off into space, whereupon the propellers would be put in operation to keep it in motion when once fairly launched. Five years later, two propellers, arranged to

"Two-Propeller" Flying-Machine.

work in opposite directions at the front and stern of an aërial carriage—a system since revived in various shapes —were proposed by Von Hecke. In 1853, J. H. Johnson patented, as a communication from abroad, an elongated balloon used in connection with "parachute or umbrella-shaped propellers," which opened when pushed against the atmosphere, and closed when retracted, being simply a modification of the well-known duck's-foot propeller tried on vessels in the infancy of steam navigation: this apparatus was to have triangular sails fore and aft to prevent it from rolling, and ballast was to keep it at any desired angle to the horizontal. In 1861, J. S. Phillips applied for, but did not obtain, provisional protection on "the propulsion of a plane against the atmosphere" by means of feathering paddles fixed on the peripheries of revolving wheels, the paddles being made of flexible material, and collapsing during one-half of their revolution, and opening against the atmosphere during the other half.

These examples illustrate the drift of invention in England, as relates to artificial flying, previous to the year 1866, when renewed interest was given to the subject by the organization of the Aëronautical Society of Great Britain, under the presidency of the duke of Argyll. Of course, a much larger number than here described were patented anterior to 1866, and of these twenty-two were designed to work wholly by mechanical means, and twenty by such means in conjunction with balloons. Of these, again, sixteen had propellers, eighteen were provided with rudders, ten specified steam as the motive-power, twenty-four were to have wings, and in eight tails were essential to their equipment. Of course, several of these devices were shown in one and the same apparatus. The plans evolved before the Aëronautical Society were for the most part revivals of previous systems, but the discussions led to the formulation of numerous data that, perhaps, may be of use as the basis of calculations for future machines. According to elaborate estimates of the ratio that should exist between the surface of an aërial machine, made by Mr. Thomas May, a machine with one horse-power of propelling power should have 1.455 square feet of sustaining surface, with an average weight of one and one tenth ounces to the square foot. By increasing the power to that of four horses, with the same weight of machine (100 pounds), 91 square feet, with an average of 17½ ounces to the foot, would be required. This has reference, of course, to the area of a plane; and the deductions are followed up by the same writer by others concerning speed at different angles to the horizon, as follows: "Supposing, first, that the angle is 45° to start with, and the speed 10 miles an hour, the thrust (of the propeller) would be equal to the load, 100 pounds; but as it gathers way the thrust decreases, and when going 17 miles an hour the angle would be reduced to 30° and the thrust to 58 pounds; going on again to 27 miles an hour, the angle would be reduced to 20° and the thrust to 36.7 pounds; and still further increasing the speed to 59 miles an hour, the angle would be 10° and the thrust only 17 pounds." The greater angle and greater thrust with the lower speed would be the necessary incidents of rising at the start. Another member, Mr. Harrison, proposed to propel the inclined plane by an apparatus resembling a velocipede, and suspended from the plane, the front wheel to actuate two propellers rotating in opposite directions, in order that their operation should not twist the machine around, and located one on each side of the rider. But, as we have seen, no mere muscular power can be sufficient for the work, and hence the vital necessity of a motor that shall combine great power with little weight. The efforts of the society to secure such an engine led to the construction of at least one steam engine of remarkable lightness in proportion to its power, but its durability may be questioned. It received the prize of £100 at the exhibition of the society in 1868, and was probably the lightest ever

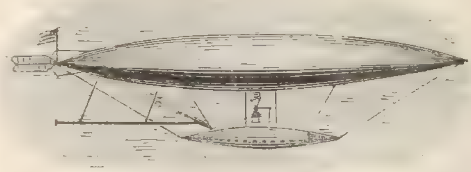
made. The following sketch is from the London *Mechanics' Magazine*: "The cylinder was 2 inches in diameter, stroke 3 inches, and it worked with a boiler pressure of 100 pounds per square inch, the engine making 300 revolutions per minute. In the jurors' report the data for estimating the power are taken as follows: Area of piston, 3 inches; pressure in cylinder, 80 pounds per square inch; length of stroke, 3 inches; velocity of piston, 150 feet per minute; $3 \times 80 \times 150 = 36{,}000$ foot-pounds. The weight of the engine and boiler was only 13 pounds. The engine, boiler, car, and propellers together were afterward weighed, but without water and fuel, and were found to be 16 pounds." The ratio of weight to power in this engine is remarkable, but probably strength was sacrificed to lightness; and even under the most favorable conditions the weight would doubtless have to be somewhat greater. But the advance is manifestly great when it is remembered that the engines proposed for Henson's flying-machine were calculated to weigh 150 pounds per horse-power. The load of fuel and water would be a serious drawback, but it is just within the bounds of possibility that liquid hydrocarbons for the one and air-condensers for the other would obviate the excessive load. Another member, Mr. A. Alexander, C. E., made the following estimate, based on the flight of a pigeon weighing two pounds: "180 completed strokes per minute, the centre of pressure of wings moving 9 inches, or per complete stroke 1 foot 6 inches; then 1.5 feet $\times$ 180 strokes $= 270$ feet, and $270 \times$ weight of bird, or 2 pounds $= 540$ foot-pounds. This in a minute is 0.0163 horse-power, and hence, if the proportion is to be maintained, one horse-power must not weigh over 122 pounds." Allowing 15 per cent. for loss in transmission, the permissible weight would be reduced to 103.7 pounds per horse-power, including, of course, fuel, water, aërostat, and load. Mr. Alexander advocated screw-propellers as equivalents of vibratory wings, and his calculations appear to have had special reference thereto. In commenting upon Mr. Alexander's paper, Mr. Wenham gave the results of his own observations of the pelican, a bird whose wing-strokes can be readily counted. The number of strokes being 70 per minute, and having at the middle of the wing a sweep of 2 feet, the weight of bird 21 pounds, $70 \times 2 \times 21 = 2940$ foot-pounds, or $\frac{1}{11}$ of 1 horse-power—about one-half that of a man. According to this estimate, 1 horse-power should sustain 231 pounds in a flight equal to that of the pelican.



Kaufmann's Bird-Machine.

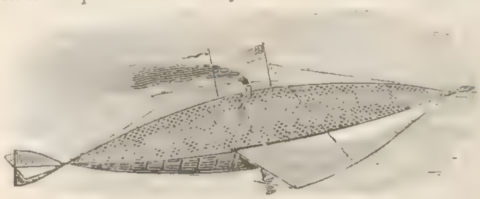
In 1869, Mr. Joseph F. Kaufmann, an engineer of Glasgow, projected a bird-machine worked by steam-power, with wings giving 120 strokes per minute, and a pendent weight designed to keep the machine in equilibrio when elevated in the air. Lateral guidance was to be had by means of a flat rudder answering to the tail of a bird.

The first projector of flying-machines of any note in the U. S. was Rufus Porter, who at the date of the present



Rufus Porter's Aëroport.

writing (Nov., 1874) is still living at New Britain, Conn., at upward of fourscore years of age. He claims to have conceived the main features of his "aëroport" in the year 1820, but it was not until 1833 that a working model was constructed. This was at Bristol, Conn. Fourteen years afterward he made another, which was exhibited in New York City. These were actuated by springs connected with propellers. About the same time, or a little later, he proceeded to Washington, D. C., and constructed a working model operated by steam. Porter's apparatus, it must be explained, comprised a cigar-shaped balloon, with a car or saloon suspended underneath, the car carrying the motive-power for propelling the whole. The Washington model had a balloon twenty-two feet in length and four feet in diameter. It was made of fine oiled silk stretched upon an internal skeleton or frame consisting of twelve rods three-eighths of an inch in thickness, and joined at their ends to form the pointed extremities of the balloon. The saloon, three feet below the balloon, was suspended therefrom by cords, and was seven feet long, ten inches in diameter, furnished with a row of miniature windows in each side, and, except that it was square in its cross-section, conformed on a smaller scale to the shape of the balloon. The machine was provided with a pair of screw-propellers, and with "a four-leaved rudder;" in other words, one having its cross-section thus, +. This model rapidly made the circuit of the hall in which it was tested in Washington. Soon after this it was publicly tried in the Merchants' Exchange in New York City, and, as one of the journals of the day declared, "made the circuit of the rotunda eleven times like a thing instinct with life." At a still later date the inventor built what would have been a full working machine had it ever been quite completed. It was 160 feet long, the balloon being 16 feet in diameter at the centre and made of varnished linen; the car or saloon was 60 feet in length and 8 in diameter, and contained, within a chamber 6 feet by 5 in horizontal area, the steam-engine designed to furnish motive-power to a pair of six-bladed propellers, connecting with the engine by endless-chain belts. The rudder was four-leaved, as in the smaller models, and capable of vertical or horizontal adjustment by four steering lines extended to and within the saloon. The buoyant power of this apparatus, over and above its own weight, would have been 700 pounds had it, as was intended, been filled with hydrogen gas. But it failed, because it was found impossible to prevent the leakage of the hydrogen to an extent that wholly destroyed the lifting power of the balloon. The production of a varnish practically impervious to the thinner gases, notably of hydrogen itself, is one of the most important problems yet to be solved before the balloon, either alone or in conjunction with operating mechanism, will develop its fullest utility.



Marriot's Avitor.

In 1869, Porter's cigar balloon, with certain additions, was revived at Shell Mound Lake, Cal., by Mr. Frederick Marriot, who termed it the "Avitor." The balloon had a length of 37 feet and a diameter of 8, and, like that of Porter, tapered to points at the ends. It was surrounded by a longitudinal frame of wooden strips firmly wired together, the frame being attached in position by bands and straps. This frame was provided at its forward half with two laterally projecting wings, and at the rear was furnished with the four-leaved rudder, and at the sides by two propellers operated by a small steam-engine. This apparatus worked well in a still atmosphere, but proved a failure in brisk winds.

Another American flying-machine was that devised by

S. P. Andrews, and tried with uncertain results in the vicinity of New York about the same time that the Avitor was the subject of experiment in California. In this the balloon comprised three cylindroids with pointed ends (each cylindroid 100 feet long and 20 in diameter) secured in position side by side. The balloon, as thus constructed, contained upwards of 80,000 cubic feet of gas, and had a buoyant power of about 5700 pounds. The balloon was furnished with a rudder, and had suspended 30 feet below it a saloon 16 feet long, in which was a ballast car capable of being moved from end to end of the saloon. By bringing the ballast-car to one end of the saloon the apparatus was made to incline from 10° to 20°; and the balloon, rising with a surface of 6000 square feet, moving against the superincumbent atmosphere, was expected to move forward in the direction of its elevated end simultaneously with its ascent, ballast being thrown out to secure the latter. About the year 1866 a flying-machine, comprising a metal cigar-shaped body, furnished with propellers, was constructed under the auspices of the U. S. government, but is reported to have been finally abandoned.

Of proposed machines that have attracted less attention, because evidently less plausible in their theory of operation, a few may be mentioned as illustrating the different principles of construction on which inventors have proposed to work. Among these was the steam-rocket flying-machine, in which a fish-shaped balloon, furnished with the four-leaved rudder, was to carry beneath it a car for passengers and a steam-boiler, from which, through suitably arranged pipes, steam was to be carried to the rear of the balloon, and there ejected against the atmosphere. Another is a modification of the two-propeller plan, without a balloon, which has met with much favor among English projectors, the two propelling wheels revolving in opposite directions to counteract any tendency of the machine to turn around. In the modification just indicated the propellers are arranged horizontally on opposite ends of a horizontal bar, and worked by crank and suitable gears, rods, etc. by manual power of passengers in a car suspended from the bar.

The available data on artificial flying are scant, and the facts here given have been derived from isolated and widely-scattered sources. The British patent-office has published in pamphlet form brief extracts of English patents, prior to 1866, relating to aëronautics. The London mechanical journals reported with considerable fullness the proceedings of the Aëronautical Society during its existence, and the U. S. patent-office reports, if diligently searched, will be found to show some curious devices, of which, for want of space, no mention has here been made. (For a thorough mathematical investigation the reader is referred to that of M. Gustave Lambert, *De la locomotion mécanique dans l'air et dans l'eau*, Paris, 1864; also for summary thereof to AËRONAUTICS, by Gen. J. G. Barnard, U. S. Army.) JAMES A. WHITNEY.

Fly'ing Dragon, or **Fly'ing Lizard,** a name applied to a species of lizards belonging to the genus *Draco* and closely allied genera of the family Agamidæ, in which the ribs are elongated and exserted, supporting lateral expansions of membrane which serve the animals as parachutes. The type of the group is *Draco volans* of the Indian Archipelago. The term flying dragon, in addition to its mythological application, has sometimes been applied to the extinct *Pterodactyla*. E. C. H. DAY.

Fly'ing Fish, a term applied to various fishes that are enabled by means of very enlarged and elongated pectoral fins to support themselves for a brief time in the air. Of these the most remarkable are species of the family Exocœtidæ, and others of the genus *Dactylopterus* of the Triglidæ or family of gurnards.

Fly'ing Fox, a name sometimes given to the *Galeopithecus*, but more frequently applied to the fox-bats, or bats of the genus *Pteropus*. E. C. H. DAY.

Flying Gurnard. See DACTYLOPTERUS.

Fly'ing Le'mur, an aberrant form, variously classified with the Insectivora, the Cheiroptera, or placed near the Lemuridæ, amongst the Quadrumana. *Galeopithecus*, having a parachute-like membrane extending between the fore and hind limbs, and thence to the tail, is popularly known by this name. E. C. H. DAY.

Flying-Machine (addendum to AËRONAUTICS). The experimental construction of M. Dupuy de Lome (see above article, vol. i.) is styled by him "*L'aérostat dirigeable muni d'un propulseur*," and is described with an account of an experimental ascension given by the inventor himself, in the *Revue Maritime et Coloniale*, vol. xxxiv., 1872; also, more briefly, in *Engineering*, Mar., 1872, and *Prof. Papers R. E.*, vol. xxi. The aerostat consists of a fusiform balloon (a figure generated by an arc of a circle turning about a horizontal axis) and a suspended car, to which by a central shaft, with screw-blades, the motive power is applied. The balloon is made of silk, kept always distended by means of a smaller internal balloon, into which atmospheric air can be pumped in case the outer one by escape of gas becomes flabby. The car, of light material, long and narrow (somewhat boat-shaped), is suspended by an arrangement of netting peculiar and regarded as an important discovery. The length and greatest diameter of the balloon are 118½ and 48⅔ feet respectively; length and greatest width of car, 41¼ and 10⅔ feet; diameter of driving screw, 29½ feet. The screw is driven by four or by eight men, working at a crank (*treuil*); the steering rudder is a triangular sail attached to a boom, 19½ feet long, beneath the balloon, and worked by steering ropes led down to the car. With eight men an estimated speed of 12½ kilomètres (8 miles) per hour could be obtained. Total weight, 1.75 tons; of crew, provisions, etc., 1.45; or 3.85 tons in all, which is about the "ascensional force" of the balloon. A successful "trial-trip" was made at Vincennes, Feb., 1872, and a speed of about 10¼ kilomètres (6 miles) attained. This balloon would carry an eight-horse power steam-engine (provided the risk of fire in connection with a hydrogen gas balloon be overcome), which would give a speed of 22 kilomètres (14½ miles). (See Fig. in AËRONAUTICS.)

A Spanish engineer, M. E. Heriz, has recently published a memoir, in which, concurring with M. Lambert (see vol. i.) as to the principles governing *form*, he differs as to the principle of self-sustentation, maintaining that the aërial ship, made heavier than the air, must depend upon mechanical power not only for horizontal propulsion, but for sustentation. In this he differs less from De Bruignac, whose inclined planes are analogous to the rudder for vertical steering or "parachute" of Heriz. He sums up: To navigate the air, the balloon must give way to the aërial ship; iron to aluminium for a Behrens rotary engine; steam to vapor of ether, with petroleum for combustible. His propeller consists of two driving helices on the same axis, but turning contrariwise. (See *Revue Maritime et Coloniale*, Apr., 1875.) J. G. BARNARD.

Fly'ing Pha'langer, a name given to several marsupials of Australia and the neighboring islands which are surprisingly like the flying squirrels in appearance and habits. They are, in fact, the marsupial representatives of those squirrels. The species are rather numerous. The largest, the *Petaurus flaviventer*, is twenty inches long, and its tail measures eighteen inches. The smallest, *Acrobates pygmæus*, is two inches long, and its tail is of the same length. One of the most beautiful of these creatures is the *Petaurus ariel*.

Fly'ing Squid, a name given to the Cephalopods of the genus *Ommastrephes*, of which there are some fourteen species known, varying in length from one inch to four feet. They have a remarkable power of leaping from the water, whence the name. They are preyed upon by sperm-whales, birds, and fishes, and are largely employed as bait by fishermen. The pen or bone is ribbed. One species is greatly prized as food at the Sandwich Islands.

Fly'ing Squir'rel (*Pteromys*, Cuv.), a remarkable genus of the Sciuridæ, characterized by a hairy expansion of the skin between the fore and hind limbs, by which the animal is enabled to glide from tree to tree in very prolonged leaps. The common species of the U. S. is *Pteromys volucella*.

Flynn, tp. of Sanilac co., Mich. Pop. 131.

Fly-wheel, the heavy wheel attached to engines and various kinds of machinery, and designed to act as a reservoir of living force or momentum. It serves to carry the motion of cranks beyond dead-points, and tends to equalize motion when the work is variable in character.

Fo, the Chinese BUDDHA (which see), often confounded with **Fo-Hi** (Fuh-hi), with whom, however, he has nothing in common. The name is derived from *Buddha*, of which word it is a very corrupt form.

Fobes (PEREZ), LL.D., b. at Bridgewater, Mass., Sept. 21, 1742, graduated at Harvard University in 1762, and was ordained at Raynham, Mass., Nov. 19, 1766; in [illegible] became professor of natural philosophy in the College of Rhode Island. Published *Sermon* [illegible], 1791; *Election Sermon*, 17[illegible]; and *A Topographical Description of Raynham*, in 1793. D. [illegible], 1812.

Fo'cus [Lat., "hearth," "fire-place"], a point at which rays of light meet after deviation by a lens or mirror.

FOCUS OF A CONIC SECTION. A point on the principal axis through which a double ordinate to that axis is equal to the parameter. The ellipse and hyperbola have each two foci, and the parabola has one. In all the conic sections the foci possess the remarkable property that they are the only points in the plane of the curve from which the distance to any point of the curve can be expressed rationally in terms of the abscissa of that point. The name *focus* was given to

these points from the property that rays of light proceeding from one focus and reflected from the curve pass through the other focus. In the *ellipse* rays of light from one focus reflected from the curve pass directly through the other focus; in the *hyperbola* rays of light from one focus reflected from the curve take such directions that on being produced backward they will pass through the other focus; in the *parabola* we may suppose a second focus on the principal axis at an infinite distance, in which case rays from either focus reflected by the curve will go to the other focus. In the last case rays from the second focus are parallel to the principal axis, and after reflection they go to the first focus; rays from the first focus are parallel to the principal axis after reflection. If either of these curves is revolved about its principal axis, it will generate a surface of revolution whose foci are identical with those of the generating curve. Rays of light from either focus of such a surface will be reflected from the surface in accordance with the laws already explained.

Focus of a Lens or Mirror. The point from which rays of light proceed before being deviated by a lens or mirror is called a *radiant* point; if the rays converge before deviation, they must be produced beyond the lens to meet, and this point of meeting is called a *virtual radiant*. The point at which the rays meet after deviation is called a *focus;* if the deviated rays diverge after deviation, they must be produced backward to meet, and this point of meeting is called a *virtual focus*. The radiant point and focus are reciprocal; that is, if the focus be taken as a radiant, the radiant will become the focus. Any two points so related with respect to a lens or mirror are called *conjugate foci*. The *principal focus* of a lens or mirror is the focus that corresponds to rays parallel to the axis. In this case the radiant point is on the axis at an infinite distance. Rays proceeding from the principal focus are so deviated as to be parallel to this axis. In this case the focus is on the axis at an infinite distance. In all cases the conjugate foci are on a line through the optical centre of the lens or mirror.

W. G. Peck.

Fœ'tus [Lat. *fœtus* or *fetus*, originally a verbal noun from the obsolete *feo*, to "generate"], the name given to the young of viviparous and oviparous animals from the time of their complete formation until birth. To the stages of development preceding the formation of all the parts the term *embryo* is applied. In general use the young of the *human* species is meant when the word *fœtus* is used, and in that sense it will be employed in this article.

The brief history of the embryo and fœtus is as follows: A germ-cell (ovum) and a sperm-cell (spermatozoon), coming in contact with each other, unite, most probably by the passage of the latter through the envelope and into the substance of the former. A peculiar vital power resides in the germ-cells and sperm-cells after union, which is without parallel elsewhere. The germ-cell discharged from the ovary, if uninfluenced by the presence of a sperm-cell, pursues a retrograde course, and finally disappears. The sperm-cell discharged from the testicle, after a time, the exact limits of which are not known, likewise perishes. Each of these cells by itself, therefore, only retains its vitality for a short time after it ceases to be an integral part of the ovary or testicle which produced it. But as soon as union has taken place there is a generation of a new vital force, which enables them not only to live, but to expand into the development of all the organs and tissues of the body; and this without any other assistance than that derived from the absorption of nourishment from the blood of the mother.

As the result of such union of the cells, there first appears a breaking up of the substance of the ovum, so as to form two layers of cells, from the external of which, by progressive development, are formed the body, head, and limbs, while from the internal the stomach, liver, intestines, etc. and generative apparatus are developed. After the formation of these two layers there appears a longitudinal groove on the surface of the external layer, called the "primitive trace." This widens and becomes club-shaped anteriorly and pointed posteriorly; and at the same time, by rapid increase of the thickness of the walls on either side of it, these meet together and unite, thus converting the primitive trace into a tubular canal, which is enclosed on all sides. In this canal nerve-tissue is developed, and it becomes the spinal cord, while its enlarged anterior extremity becomes the brain. Prolongations of the thickened portion which behind shuts in the primitive trace push on anteriorly from either side, and are called the "abdominal plates." They finally meet in the front of the body and unite in the median line. At the bottom of the primitive trace, and parallel with it, is a cartilaginous cord, which later on becomes bony and constitutes the backbone, while from its sides processes pass down in the abdominal plates to form the ribs.

Very soon two anterior offshoots from the body appear, and two posterior. It is by a prolongation of these that the arms and legs are formed; and, curiously enough, their development takes place in a direction contrary to what we would expect. First of all, the fingers and toes appear; then the wrists and ankles; then the fore arms and legs; then the elbow and knee joints; then the arms and thighs; and finally the shoulder and hip-joints. In the head the various organs of the brain are being formed, and as offshoots from the cerebral vesicles we have the eyes, which at first are wide apart and situated on the sides of the head, but which afterwards come to be nearer together and in the front of the face, owing to the more rapid growth of the posterior and lateral parts of the head; by which means the relative position of the parts in front is changed. The ears also are formed from offshoots of other cerebral vesicles. The eyelids are formed by prolongations of the integument, which grow so rapidly that by the end of the second month they are in contact with each other, and their edges grow together and remain adherent until the seventh month.

The skin at first is very thin and transparent, but it gradually becomes thicker, and is so plentifully supplied with blood-vessels that even at birth it is very ruddy in color. The hairs are a part of the integument, and appear at about four and a half months. The nails commence to grow about the third month, but their complete formation is delayed until the fifth.

Simultaneously with the processes just described other changes are going on in the *internal layer* of cells. At first a spherical membrane, it gradually becomes elongated, and forms a nearly straight cylindrical tube. Its further changes consist in its increase in length and diameter, and its becoming very much convoluted. This is the intestine, and its anterior extremity widens, with a constricted orifice, to form the stomach. As yet there is no communication between it and the outside of the body, neither is there any division of the trunk into abdomen and chest. The next thing is the formation of a mouth by the liquefaction of a part of the front of the face. By a continuance of the same process a canal is excavated from the back of the mouth, or *pharynx*, as it is called, down into the stomach; and in this way the gullet is formed. Upon each side of this, by a protrusion which starts from the pharynx, the lungs are formed, which grow downward into the abdomen. Then a partition stretches across this which divides it into two portions. The partition is the *diaphragm*, and the cavity above it is the chest, containing the lungs and the heart—an organ which makes its appearance some time before the fifteenth day as an outgrowth from the fibrous coat of the intestine.

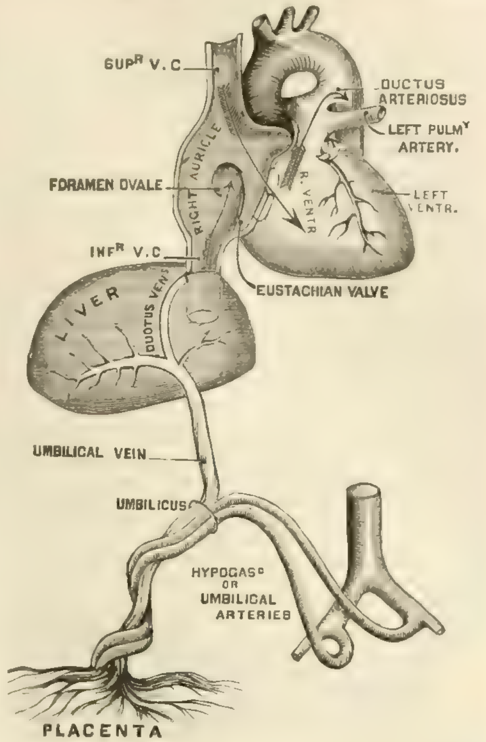
Besides the intestines, the abdomen contains the liver, pancreas, spleen, kidneys, and internal organs of generation. The liver takes its origin from the upper part of the intestine during the third week. This organ is from the first of very large size comparatively, for between the third and fifth weeks it weighs half as much as the whole of the body. From this time on its proportionate weight diminishes until birth. By the third month the gall-bladder is formed, and during the next six weeks various changes take place looking toward the complete histological development of the organ, which by the end of this time is fully accomplished. In the neighborhood of the liver, a little after its formation, the spleen and pancreas are developed. The kidneys themselves do not appear until the seventh week, but as early as the end of the fourth week bodies of very similar structure, and having the same function, are to be seen in each side of the abdomen, which rapidly grow until they extend over its whole length. These are the "Wolffian bodies," and as their function is temporary their existence is short. Gradually becoming smaller, they disappear in the early part of the third month, the kidneys having by this time grown sufficiently large to perform the duties for which the Wolffian bodies were created. Directly in front of the latter, which are themselves in front of the kidneys, at the end of the seventh week those internal organs of generation begin to be formed which are known as the "pars genitalis" of the "uro-genital sinus." At this early period they are precisely alike for both sexes, but as development proceeds they acquire the characters belonging to each sex. The "pars urinaria" of the "uro-genital sinus," separated by a partition from the "pars genitalis," contains the termination of the ducts leading from the kidneys, and, gradually growing in an upward direction, becomes the urinary bladder.

It remains to describe the manner in which the embryo and fœtus obtain the nourishment necessary for their growth. It will be remembered that the internal layer of cells becomes elongated to form the intestine. Within this layer is contained the yolk of the egg, which consists of albuminous and fatty material. But the whole of this layer does not go to the formation of the intestine. A part of it

becomes shut out of the body by the rapid growth of the abdominal plates. That portion which is shut out, and contains much of the nutritious yolk, is called the "umbilical vesicle," and its cavity is continuous with the cavity of the intestine by a small opening for a short time. The first nourishment of the embryo is derived by the liquefaction and direct absorption of the yolk. Very soon, however, two blood-vessels shoot out from the heart, and, bending backward, unite into one trunk, from which branches are given off to supply different parts of the embryo, and also to form a network of vessels over the surface of the umbilical vesicle and the membrane immediately surrounding the embryo. This network is called the "area vasculosa," and it is in it that the absorption of the liquefied food-yolk takes place. The blood of the area vasculosa, surcharged with nutritious materials, is returned to the body of the embryo by two veins called "omphalo-mesenteric," while the blood sent to it from the body goes by two arteries, also called omphalo-mesenteric. Before long the two omphalo-mesenteric arteries and veins are replaced by one trunk each. Gradually, the food-supply of the umbilical vesicle becoming exhausted, it shrivels up, and the omphalo-mesenteric artery and vein become proportionately insignificant. By this time the growth of the embryo has assumed such proportions that a new food-supply must be procured, and also a means of discharge for its own used-up materials. The organ which now appears to perform this double office is the "placenta," or afterbirth, as it is commonly called. Both the fœtus and the mother contribute to the production of this organ. The embryo furnishes itself almost immediately with a membranous covering called the "chorion." At first smooth, it very soon becomes velvety by the growth from its surface of minute projections, which give off numerous small branches like the roots of a tree. At about the end of the second month the chorion commences to get smooth by the gradual disappearance of the velvety growths over two-thirds of its surface. Those of the remaining third continue to increase and grow, and minute blood-vessels from the intestine of the embryo penetrate them to their farthest extension. Turning now to the uterus of the mother, we find that as soon as impregnation has taken place its mucous membrane becomes thickened and its blood-supply increased. In its natural condition this mucous membrane has a great number of little depressions or follicles in it, each one of which is surrounded by a moderately close network of blood vessels. As soon as the impregnated egg finds its way into the womb it is grasped by its mucous membrane, which rapidly thickens and grows up around it, so that after a while the embryo is entirely shut up in a wall of uterine mucous membrane. The projections on the surface of the chorion immediately insinuate themselves into the follicles of the mucous membrane, which increase in size to correspond with their continued growth. The mucous membrane which is in contact with that portion of the chorion which is becoming smooth grows thinner and thinner by expansion from the enlarging embryo, while at that spot where the villosities are increasing it becomes thicker and more vascular. The villosities, which at first merely penetrated the uterine follicles, now become adherent, and the walls of the villosities and follicles fuse together. The blood-vessels surrounding the follicles increase to such an extent that each follicle seems to be bathed in a lake of blood. The wall just described now disappears, the walls of the uterine and fœtal blood-vessels come in contact with each other, and, finally fusing together, the placenta is formed. It is therefore a mass of blood vessels, derived partly from the mother and partly from the fœtus. It commences to grow about the latter part of the second month, and its structure is completed by the end of the third.

The blood-vessels passing from the fœtus to the placenta and back again are four—two umbilical arteries and veins. After a time one of the veins disappears, leaving two arteries and one vein, which, being twisted together, form the "umbilical cord." The blood of the fœtus therefore, contaminated by circulation through its body, is sent through the umbilical arteries to the placenta. Here it is brought into almost actual contact with the blood of the mother. From it it takes oxygen and nutritious ingredients, and to it it gives up carbonic acid and excrementitious matters, and returns to the fœtus by the umbilical vein.

During the time of the placental circulation the course of the blood in the fœtus is as follows (see diagram): The pure blood returning from the placenta by the umbilical vein goes at once to the liver, a part of it supplying that organ, while another part passes directly through it by the "ductus venosus" to enter the "inferior vena cava." The blood of the inferior vena cava passes up into the "right auricle," whence, being directed by the "Eustachian valve," it goes into the "left auricle" through the "foramen ovale." From thence, passing into the "left ventricle," it is discharged into the "aorta," and supplies



mainly the head and upper limbs. The blood returning to the "right auricle" by the "superior vena cava" passes at once into the "right ventricle," and from this to the "pulmonary artery." A small part of this blood is sent to the lungs (for at this time they are in a rudimentary condition), but by far the greater part passes through the "ductus arteriosus" into the aorta, from whence it is distributed throughout the body.

This mode of circulation remains until birth, when the ductus venosus and ductus arteriosus become obliterated, the foramen ovale becomes closed, and the Eustachian valve disappears. By means of these changes all the blood of the venous system is carried to the right auricle to be discharged into the right ventricle, from which it goes to the lungs by the pulmonary artery. After becoming aërated in the lungs it returns by the "pulmonary veins" to the left auricle, through which it passes into the left ventricle, and from thence into the aorta, through which, by its branches, it is distributed to the whole of the general system. This is the plan of the adult circulation, and it continues through life without change.

The development of the fœtus goes on without producing any conscious impressions in the mother, other than certain sympathetic conditions in other organs, until "quickening," which commonly occurs about the eighteenth week. Hence many suppose that a child is without life until that time. But we have seen that the fœtus is endowed with life, growth, and vitality of its own from the very moment that conception occurs. Hence, viewing the subject with reference to abortion, if it is wrong to destroy a fœtus of five months because it has quickened, it is just as wrong to destroy one of six weeks or two months. It is a destruction of *life* in either case, the only difference between the two being in the extent and direction of its manifestations. The development of a fœtus ordinarily goes on for forty weeks, and by the act of parturition it is expelled from the womb to enter a new phase of existence. But it does not seem to be absolutely necessary that the period of gestation should be as long as this. Abundant experience has shown that children born after having completed their seventh month in the womb with care have a reasonable chance of living; and a child has lived which, it seems to be conceded, was born in the middle of the twenty third week after intercourse. Sometimes the period of gestation extends beyond forty weeks, but the best authorities will not concede a greater protraction than from four to six weeks. (See EMBRYOLOGY, by PROF. J. C. DALTON, M. D., M. N. A. S.) G. H. WYNKOOP.

Fog. A fog has properly been defined as a cloud at the

surface of the earth. It is produced by the condensation of the vapor of the atmosphere into liquid particles of extreme minuteness. De Saussure thought these particles were vesicles, and not solid globules, and that their suspension in the atmosphere was due to the rarefaction of the air within them, caused by the radiant heat absorbed from the sun. But later meteorologists do not subscribe to this hypothesis—first, because it is impossible to conceive of any operation of nature by which such hollow globules could be formed; and, secondly, the formation of the rainbow is in strict accordance with the laws of the refraction of light from solid globules. Furthermore, Plateau of Ghent has shown by a very ingenious experiment that the particles of fog do not contain air. For this purpose he filled a glass tube, closed at one end, with cold water; then gradually inverted it with such precaution that the water was sustained in the tube by the pressure of the atmosphere. Under the mouth of this tube was placed a rising column of steam or visible vapor, which being condensed by the surface of cold water with which it came in contact, the contractile power of the bubbles would in this case eject any air which might be contained in them into the column of water, where its presence would in due time be made manifest, especially by the aid of a magnifying-glass. No air was found in this experiment. The suspension of the cloud is due to the extreme fineness of the globules, and also perhaps slightly in the daytime to the higher temperature of the air which surrounds them. The rising of a fog from the surface of the earth is evidently due to the latter cause, when the source of vapor is cut off. A fog is produced when a gentle current of warm air surcharged with moisture passes over a colder surface, as is the case especially on the lower Mississippi River during the prevalence of a warm southerly wind in the early spring. At this season of the year the water of the lower river, having come from a northern latitude, is much colder than the air above it, and hence a precipitation of the vapor takes place.

A fog, however, is not produced in absolutely still air even when resting on a colder surface. In order to this effect it is necessary that two strata of air be mingled with each other, one of which, being the colder, precipitates on itself, as it were, the particles of invisible vapor of the other. This fact is illustrated by the phenomenon of dew, in which atmospheric vapor is condensed into water without producing fog. In this instance the process may be conceived as follows: An indefinitely thin stratum of air resting directly upon a surface cooled by radiation deposits its moisture, leaving it unsaturated; the vapor of the stratum immediately above it is then diffused into the first stratum; the second is then unsaturated, and diffusion takes place into this from the third stratum, and so on, without the production of a fog. If, however, the radiation takes place into a clear sky from a sloping surface of ground, the colder and consequently heavier air resting on such surface will roll down into the valley, and there, mingling with the warmer saturated air, produce a fog. A fog is also produced when a current of cold air passes over warmer water or a warm damp soil. Water evaporates at all temperatures, and in the case just mentioned the vapor as it rises is condensed into visible fog. But the density of fogs produced in this way is not usually as great as that which is generated by the other process.

The eastern coast of the U. S. is especially subject to fogs, the cause of which will be readily seen, from what we have before mentioned, when we consider the relative position of the currents on the western side of the Atlantic Ocean. First, a cold polar current coming out of Baffin's Bay is thrown by the revolution of the earth laterally against the coast of North America from Labrador to Cape Hatteras, where it passes under the Gulf Stream. Contiguous to, but outside of, this current, and moving in an opposite direction, is the great Gulf Stream, an immense body of warm water, which throughout its whole course across the Atlantic heats and saturates with vapor the air immediately over it. Now, it must be evident that whenever the wind is in such a direction as to blow this warm and saturated air across the cold surface of the polar current, mingling the heated and moist air with the colder stratum, a fog must be the result. Hence, the fogs on the Banks of Newfoundland, and also along the coast of Maine, whenever the wind is in a southerly direction, especially in the warm summer months. As we proceed southerly along the coast the direction of fog-bearing wind is more and more easterly. Fogs are also produced on the western coast of North America when the wind from the exterior ocean passes across the coast current which comes from the N. The production of fog is in this case more complex, since the coast current is in fact the eastern portion of the great Gulf Stream of the Pacific. The northern part of this current is warmer than the surrounding ocean, while in its southern portion its temperature is less than that of the water through which it is passing. But in either case a fog will be produced when a wind of opposite temperature blows from the exterior ocean across this current. On the same principle fogs are produced in other parts of the world; and their existence may be inferred from the relative position of the cold and warm currents of the ocean. Fogs are sometimes associated with smoke in the atmosphere; minute particles of carbon radiating heat tend to become colder than the surrounding air, and thus condense the particles of vapors around them. London and other cities of England are frequently covered with fogs of this kind. JOSEPH HENRY.

Fog'áras, a fortified town of Transylvania on the Aluta, gives name to a Catholic archbishop's see of the Roumanian rite. Pop. 4714.

Fogg (GEORGE GILMAN), editor and Congressman, b. at Meredith, N. H., May 26, 1813; graduated at Dartmouth College, 1839; practised law at Gilmanton, N. H., in 1842; and was in the State legislature in 1846. From 1846 to 1861 edited the *Independent Democrat* at Concord, N. H.; in 1846 was secretary of state of New Hampshire; from 1861 to 1865 was U. S. minister to Switzerland; and in 1866–67 U. S. Senator in place of D. Clark, resigned.

Fog'gia, or **Capitana'ta,** province of Apulia, in Southern Italy, washed on the N. and E. by the Adriatic, into which extends the peninsula called Gargano. The province, as a rule, is mountainous, well watered, and very fertile of grain, oil, wool, etc. Cap. Foggia. Pop. 322,758.

Foggia, town of Southern Italy, the capital of the province of Capitanata. It is a beautiful city, situated in the rich plain of Apulia, whose commercial centre it is. Pop. 38,138.

Fo'go, a port of entry of Newfoundland, and capital of Fogo Island district, 122 miles N. W. of St. John's. Lat. of Fogo Cape, 49° 41′ N., lon. 54° W. It has important fisheries and considerable trade. Pop. 740.

Fo'go, or **Fue'go,** one of the CAPE VERDE ISLANDS (which see), consists of one single volcanic cone rising 9157 feet above the sea, and surrounded at the base with a steep wall of immense lava-blocks. The soil is extremely fertile, and produces grain, wine, fruits, and tobacco of the very first quality. But, besides suffering occasionally from the eruptions of the volcano, of which that in 1847 was very destructive, the island lacks water, and the droughts are sometimes so prolonged as to cause famine, during which thousands of the inhabitants are starved to death. Before 1834 the population numbered about 17,000, but in the three dry years it sank to 5600, and it has risen very slowly since.

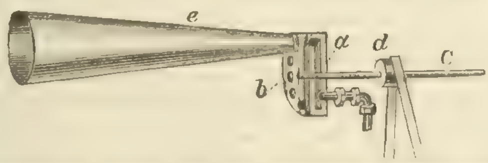
Fog-Signals. In various parts of the world, and especially on the coast of the U. S., fog-signals are indispensable aids to navigation. Along the eastern coast of the U. S. fogs prevail almost continuously at certain periods of the year; and as the shore is exceedingly precipitous, the sounding-line cannot be used with any certainty, and therefore fog-signals must be resorted to. Attempts have been made in France and England to penetrate fogs by means of lights of intense character, such as those of aluminium and electricity; but that these could not be successful must be evident from the consideration of our every-day experience, that a mile of cloud—or, in other words, of fog—shuts out the image of the sun. Recourse must therefore be had to sound, which, when of a powerful character, is not materially affected in its propagation by fog.

For the production of sound for this purpose bells, gongs, whistles, trumpets, and sirenes have been used by the lighthouse board of the U. S. Although a powerful sound may be produced by a cannon, the shortness of its continuance, and the blending of the echo with the original impulse, render it less favorable to the precise determination of its direction than the prolonged sound produced by the trumpet or the whistle. Bells, even of a large size, give too feeble a sound to be distinguished across the breakers at a sufficient distance or in opposition to the wind; they are only used when a signal is required to give warning of danger at a short distance at intermediate positions. They are rung by a weight wound up at intervals, the descent of which is regulated by the vibration of a pendulum with clock escapement. In some cases an automatic apparatus actuated by the waves of the sea has been used for ringing a bell, but this device has not found favor with the U. S. lighthouse board, since every automatic instrument is liable to get out of order, and so fail to point out the direction of danger at a time when it is expected to do so. Uninterrupted action is a fundamental principle of lighthouse signals.

Gongs, although they appear to produce a powerful sound when near the ear, in reality give an impulse of too feeble a character to be heard under all circumstances at a distance.

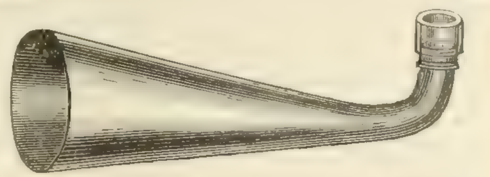
The mechanisms which have been found to produce sound of the greatest penetrating power are those which depend upon the principle of resonance, such as the organ-pipe, the trumpet, and the whistle, in which the air itself becomes the sounding body, as well as the medium of conduction of the sound. Of this character is the ordinary locomotive whistle, in which the vibration is produced by a thin sheet of air striking against the edge of a resounding cavity called the bell. The stiffness—if we may use the expression—of the sheet of air depends upon the tension of the steam in the boiler; and in order that the vibration of this sheet may be in unison with the reverberation of the air in the resounding cavity, the sheet must be increased and diminished in length; which is effected by a screw, the turning of which increases or diminishes the distance between the narrow opening through which the sheet is emitted and the lower edge of the bell-shaped cavity. As the loud sound is produced in this instrument by the vibrations of the air in the resounding cavities, the form or material of the enclosure of the latter has little effect upon the result. Instead of a metallic cylinder, we may use a square wooden box, the orifice through which the sheet is ejected being made to correspond in form. The locomotive whistle is the simplest of the more powerful of the fog-signals employed by the lighthouse board of the U. S. It is actuated by an ordinary locomotive steam-boiler at a pressure of from 50 to 75 pounds per square inch. The sound is distinguished from that of locomotives and steam-vessels by the length of the blast and the interval between two soundings; and these are regulated and produced automatically by a small engine attached to the boiler, which opens and closes the valves, letting on and shutting off the steam at the proper intervals. The whistles employed are from eight to twelve inches in diameter.

The next powerful instrument used is that called the reed or Daboll trumpet, actuated by air condensed in a reservoir by means of an Ericsson caloric (or heated-air) engine. In this instrument the trumpet itself is the resounding cavity, and the reed by its vibration produces the requisite motion of the air. The reed, consisting of a bar of iron, is, in the larger class of trumpets, eighteen inches in length, two inches in width and three-quarters of an inch in thickness at the fixed end, thinning gradually toward the free end. In order to the best effect, sound from these two parts must be in unison, and for this purpose means should be provided for gradually increasing or diminishing the length of the trumpet. With a given stiffness of the reed the pressure of the air in the reservoir cannot exceed a given intensity, since beyond this the reed cannot recoil, and the orifice remains closed. A pressure of from 10 to 15 pounds per square inch is the maximum employed. This instrument is the most economical of power, giving the greatest amount of sound with a given expenditure of fuel. Its range of power, however, with a given size of trumpet is less than that of the 18-inch whistle; still, it is a valuable instrument in all places where fresh water cannot be obtained, since the motive-power consists of heated air, and not of vapor generated from a liquid.

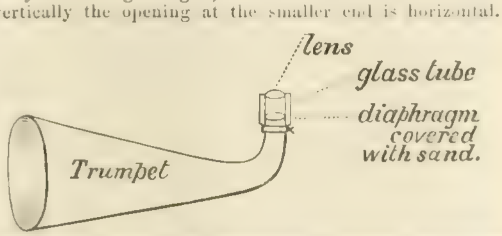


Explanation.—*a*, steam drum, with one hole on front face; *b*, revolving plate, perforated with eight holes and supported on the shaft *c*; *d*, a pulley, to which rapid motion is given by a band and driving-wheel; *e*, resonator or trumpet.

Another instrument, and the most powerful of all yet employed, is the sirene trumpet. The part of this which gives the impulse to the air producing the sound consists of a flat drum, or, in other words, of a hollow cylinder with a short axis, one head of which is perforated with an orifice, which admits the steam from a pipe connected with a locomotive boiler. The other head of the drum is perforated with eight holes, before which, and almost in contact with this head, is a revolving disk also perforated with eight holes. At each revolution of the disk eight holes are alternately opened and shut, allowing egress to as many impulses of steam, which in turn produce a violent agitation of the air, giving rise to a most powerful sound, reinforced by the resonance of a trumpet of suitable length. The disk is made to revolve at the required velocity by a small engine attached to the boiler, the motion being transmitted by a band over pulleys of proper size. The sound from this instrument can be distinctly heard in still air at a distance of from 20 to 30 miles, even during the existence of a dense fog. The sirene has been long known to physicists as the invention of Cagniard de Latour, but its application as a fog-signal and the addition of the trumpet have been patented by Messrs. Brown of New York. The sirene trumpet is usually operated at a pressure of 75 pounds of steam, generated in a locomotive boiler. It is not improbable that a better effect would be produced by using condensed air, since the space immediately around the point of origin of the sound is filled with steam, which must have an effect upon its subsequent transmission to the air. On the other hand, however, the increased complexity of machinery would probably more than neutralize any increase of effect from the change in question. By increasing the number of revolutions of the disk the pitch of the sound may be changed, and by this means the fact has been established that a medium pitch gives a sound of a greater penetrating power than one lower or higher. It is probable that the effect upon the tympanum of the ear will be in proportion to the quantity of air moved, multiplied by the square of the velocity, since at a very high pitch the amplitude of vibration must be exceedingly small, as well as the quantity of air put in motion, and the effect will be less. The shrill sound of the boatswain's whistle is heard more distinctly at a moderate distance, not on account of its more penetrating power, but on account of its dissimilarity to the ordinary coexisting sounds. It is impossible to judge of the penetrating power of a sound by its effect upon the ear when placed near its origin. To ascertain this it is usual for the observer to separate himself gradually from the place of origin of the different sounds of which the penetrating power is to be compared; the relative penetrating power being determined by the distance at which the sounds can be heard. To obviate



the inconvenience of going off, it may be, a distance of many miles, an instrument has been employed by the writer of this article, consisting of a horn, of which the mouth is about nine inches in diameter and the axis about four feet in length. The smaller part of this horn is gradually bent at right angles, so that when the mouth is held vertically the opening at the smaller end is horizontal.



Across this smaller end is stretched a delicate membrane on which fine sand is strewn. When the instrument is held in the hand horizontally, and the mouth is directed towards a sounding instrument, the sand, protected from the wind by a cylinder of glass, is observed to be agitated. The instrument is then carried off from the source of sound until the sand ceases to be moved. The measured distance at which the agitation ceases is taken as the relative penetrating power of the sound under examination as compared with the standard instrument, such as a reed horn or a bell. This instrument has been found by repeated comparison to give the same relative indications as those of the ear. Its degree of sensitiveness will depend upon the relative size of the mouth and of the smaller orifice. In the more perfect form of the instrument it is so constructed as to be capable of a slight increase or diminution in length—an adjustment which is necessary in order that the horn may not be in unison with the sound to be measured, since in that case the resonance would produce an exaggerated effect in the increase of distance at which the agitation of the sand would take place. With an instrument of this kind having a small mouth a series of experiments have been made to determine the number and best form of the openings in the head of the drum and the revolving plate of the sirene, without going to a distance of more than a few rods from the instrument.

In experimenting with sounds of such powerful magnitude as those produced by the instruments we have described, certain peculiarities are observed which escape detection in ordinary acoustic investigations with sounds of inferior power. The first to which we call attention is

that of the great divergence of powerful sounds. It is well known that there is a striking analogy between the reflection of sound and that of light—that sound, like light, may be concentrated and directed in parallel lines by concave reflection; but this appears to be true only to a limited extent, and perhaps for more feeble sounds, since we have found that although the sonorous ray from a parabolic reflector, in the focus of which a powerful steam-whistle is sounded, is more powerful in the direction of the axis of the reflector than in any other at a comparatively short distance—for example, a mile or so—yet when the distance is increased to four or five miles the effect of the reflector is almost entirely lost, and the sound in the line of the axis may be heard apparently with the same intensity behind as before the reflector. This lateral divergence of the sound explains some abnormal phenomena which have been observed; for example, when a building or an elevation of ground exists between the observer and the reverberating body, the sound of the latter may be distinctly heard at a distance, but is lost on gradually approaching it in a direct line, the observer falling, as it were, into the sound shadow. This frequently happens in cases where the instrument is placed on one side of an island. At a distance it is heard almost equally well in every direction, while nearer it can only be heard on one side of the island.

Another set of phenomena which are conspicuously presented in the observation of loud sounds are those which result from the effect of the wind. It is a fact of daily observation that sounds are heard farther with the wind than against it, and that even a gentle breeze produces a remarkable effect in the way of increasing or diminishing the intensity of a given sound. The explanation of this phenomenon is by no means simple; which will be evident when we reflect that the velocity of sound is at the rate of 700 miles an hour, while that of a wind which will nearly obliterate the perception of the sound at a given distance may be only 3 or 4 miles per hour. The only explanation of the effect of a wind on sound is that first indicated by Prof. Stokes of Cambridge. To understand this, let us recall the fact that a beam of sound consists of a series of waves the length of the crests of which is at right angles to the direction of the sound. Now, although the wind may have very little effect upon the absolute velocity of these waves, it may materially affect their relative position, and consequently the direction of the sound. To render this plain, let us suppose the beam of sound to be represented by a series of parallel rods which in still air are perpendicular to the horizon. Let us next suppose a wind blowing against the sound—that is to say, towards its origin; the stratum of this wind next the earth will be the most retarded, on account of friction and other resistance; the one next above less retarded; and so on towards the upper stratum, which will have the greatest velocity. The effect of a moving river of air of this character will be to cause the perpendicular rods representing the waves of sound to lean, as it were, backward, and the sound itself to take a direction upward, passing far above the ear of an auditor placed on the surface of the earth at a distance to the windward of the origin of the sound. An opposite effect will be produced by a wind in the direction of the sound; the upper part of the rods or waves will be inclined downward, and the sound, which in still air would pass above the ear of the observer, would in this case be thrown down upon it. In accordance with this hypothesis, it must be evident that a variety of phenomena in regard to sound must result from the slight changes in the intensity and direction of the wind. Thus, a sound which may be heard at a distance of 10 miles with a slight wind against it is lost on approaching its origin, or even becomes inaudible at several intermediate points by an imperceptible increase in the velocity of the wind at the surface—a greater change perhaps taking place above. That this phenomenon cannot be explained by the interposition of strata of air acoustically rendered flocculent and opaque by an admixture of invisible vapor, is evident from the fact that in a case of this kind the whistle from an approaching vessel has been continuously heard while the sound from the instrument on shore has been, as stated above, interrupted in its passage.

That a sudden change in the condition of the air by its saturation with moisture will have some effect in the propagation of feeble sounds, is evident from both experiment and analogy; but this cause is entirely insufficient to produce the effects we have described, since they are exhibited without any apparent change in the hygrometrical condition of the atmosphere. Besides this, the fact that they depend upon the direction of the sound with reference to the wind is conclusive evidence that they are the result of the latter. From a series of observations by two observers, A and B, each sounding a powerful instrument, it frequently happens that when A can distinctly hear the sound from B, the sound from A cannot be heard by B. To explain this phenomenon on the principle of an acoustic opacity produced by flocculency would require a medium which would transmit sound in one direction, and not in the opposite.

JOSEPH HENRY.

Fo-Hi (*Fuh-hi*), a half-mythical character in Chinese history, b. in Shen-Si, became emperor, or rather king, and reigned B. C. 2952. He introduced social order, music, writing, and marriage, and established a kind of mystic religion, which superseded to a great extent the ancient star-worship. He was the reputed author of the *Yih-King*, the most venerable of the Chinese classics still extant, but written mostly in a character now unreadable, although its teachings are known from commentaries. Since Fo-Hi and his family were miraculously saved from a flood, some have considered him the Chinese Noah, but the flood was not improbably an overflowing of the Hoang-Ho.

Föhr, an island of Denmark, off the W. coast of Sleswick, in the North Sea; area, 25 square miles. Pop. 5000. It is a good bathing-place, and exports a great quantity of oysters to Hamburg.

Foil [Lat. *folium*, "leaf"], thin sheets of metal (gold-foil, tin-foil, etc.) thicker than the leaf-metal of commerce. Gold-foil is obtained by beating. It is in fact unfinished gold-leaf, and is chiefly used by dentists for stopping decayed teeth. Tin-foil is obtained by rolling the metal or by shaving a thin layer from a block of tin in an ingenious machine, which not only cuts off the foil, but rolls and stretches it at the same time. It is of late much adulterated by lead. Pure tin-foil is of great use in chemistry and the arts. Foils of copper and other metals are used for the backing of gems by the lapidary. The skilful use of nicely-colored foils sets off and greatly heightens the effect of most precious stones.

Foix, town of France, in the department of Ariège, at the foot of the Pyrenees. It was the birthplace of Gaston de Foix and the residence of the counts of Foix. It has some trade in iron. Pop. 5507.

Fo-Kien, a province of China, situated between lat. 24° and 28° N. and lon. 116° and 121° E., and bounded E. by the China Sea, W. by the Nan-Ling range. Its area is 39,183 square miles, with a population of 14,779,158 inhabitants. The Min is its chief river; Foo-Chow-Foo its capital city. It is mountainous, and produces the best black tea.

Foktcha'ny, or **Fokcha'ni,** a town divided by the Milkow in two parts, one of which belongs to Moldavia, the other to Wallachia. In population it is the third in rank of the cities of Roumania. Pop. 37,504.

Folc-Land, a term of the Anglo-Saxon laws and institutions, used to designate lands owned by the community at large, and not by individual proprietors—that is, lands the title of which was held by the state, although the possession and usufruct might be temporarily enjoyed by private persons; literally, *folk* or *people land.* The researches of Sir Henry Maine and other recent writers have rendered it probable, if not indeed certain, that the original form of property was that of ownership by a community, and that the notion of individual ownership was subsequent in time and derivative in its nature. That this primitive mode of proprietorship existed among the ancient Germans, and was the basis of their tribal polity, is ascertained beyond the possibility of doubt. When their institutions first came within the observation of the Romans, land was owned by the community. The territory of a tribe, being divided into cantons and then into townships (marks), was allotted at regular intervals by the tribal authorities to the individual freemen; such distribution, according to Cæsar, being made annually. Mr. Kemble is of the opinion that this common or public land did not embrace all the territory belonging to a tribe, but that the notion of private, absolute proprietorship had already become familiar to the Teutonic peoples. It is certain that at the epoch of the final overthrow of the Western empire this notion was established as a part of their tribal institutions. Upon the barbarian invasions of Gaul, Spain, Italy, etc. the provincial owners were at once deprived wholly or partially of their lands. Of the territory thus seized by the conquerors, a portion was divided in unequal amounts among the warriors and heads of families, who took an absolute property or inheritance in their allotments, and who thus became, according to the nomenclature of the modern law, *allodial* proprietors. The remainder of the territory belonged to the community, and, as a more regular and firm political organization grew up, it was held under the control and at the disposal of the supreme authority—king or assembly of the people. Of this public land, a part was appropriated to the uses of the government and to the support of the Crown; a part was from time to time granted to allodial proprietors; while another part was bestowed

upon individuals, not in absolute ownership, but as benefices to be held in consideration of fealty and services rendered, so that the beneficiaries or tenants enjoyed the usufruct only (*dominium utile*), the ultimate ownership (*dominium directum*) remaining in the state. In respect to the modes of ownership, there thus existed simultaneously among the Teutonic successors to the Western empire three varieties or species of land: (1) the public land, owned by the state and under its immediate control; (2) allodial land; (3) land held by tenure from the state or from some superior lord, to which the name *feudal* was subsequently applied. In the lapse of time, and especially during the periods of internal discord, the allodial mode of proprietorship very generally disappeared, the allodial proprietors finding it for their advantage to voluntarily change their lands into feudal benefices, and by this means to obtain for themselves as vassals, and for their estates, the protection of powerful superior lords.

The foregoing description applies in all its substantial features to the history of land tenures among the Anglo-Saxons in England. Separated at first into a number of petty states, each under the headship of a military chief whose authority in civil affairs was merely nominal, and preserving their ancient forms and modes of local administration in full vigor, they converted the land which they had seized from the Britons partly into allodial estates of inheritance granted to individual freemen, while they retained the greater part as the property of the public, and held it at the disposal of the state. As the former portion was granted to the recipients thereof by means of written charters or deeds, it collectively received the appellation "*boc-land;*" the latter, belonging to the people at large, was appropriately termed "*folc-land.*" "Folc land" was, then, land the *title* to which was in the community as a whole, but not necessarily that which was actually *possessed* and used in common. While some of it might be suffered to remain in common—and in fact a tract of common land seems always to have been left in every Saxon township, as afterwards in every Norman manor—it might also be granted by the state to separate and individual occupants. Such grants, however, could not be for a longer period than the life of the grantee; to confer an inheritance would be to change its nature from folc-land to boc-land. Those who thus obtained temporary possession and usufruct of tracts of folc-land held them subject to heavy burdens. Among these burdens resting upon the occupant were his liabilities to render military service, to contribute to the repair of roads, bridges, and fortifications, to pay various dues to the king, to furnish transportation for public messengers, to furnish provision, horses, and carriages for the king on his travels, and even to provide for the royal hawks, hounds, and horses. Tracts or parcels of folc-land might thus be held by freemen of every degree, noble or not noble, and even by the king himself. An ancient document, preserved from the time of King Alfred, shows that a nobleman owning great estates of boc-land was also possessed of a life interest in certain folc-lands, and these latter he prays the king to continue to his son after his own death.

In addition to these donations or grants, in which the recipient acquired no absolute or inheritable estate, and which did not change its nature, folc-land was the source —or, so to speak, fund—out of which gifts were made in perpetuity to the military or civil servants of the state as rewards or compensation for their services. The tract thus transferred, however, was at once severed from the mass of folc-lands, and passed into the class of boc-lands. If the grant was to a military servant—a thegn—the term "thegn-land" was applied to the portion so conveyed; if to a civil officer, the corresponding designation was "reeve-land" (gerefa-land). Indeed, Mr. Kemble supposes that all the territory in a Saxon kingdom was at first considered as folc-land, and that whatever estates of inheritance were held by private persons were derived from this original source; so that every particular case of boc-land had been at some time carved out of the soil once belonging to the people. All boc-land was held by the proprietors under the particular limitations contained in the first charter or grant and under the common burdens imposed by the law. Although there was doubtless some variation in the extent and character of the limitations prescribed to the first grantee, there was a general sameness among them all. The estates were inheritable and alienable, and, although subject to certain common services due to the Crown, it is clear that these services were far less onerous than those which were required from tenants during the flourishing periods of the feudal system under the Norman kings. The gifts of the people's land to private persons which have been thus described are intended to embrace also those made to the Church, which obtained in this manner vast quantities of the public domain.

Another use to which the folc-land was put was the maintenance of the Crown and the defraying of the public expenses. Income was derived from some portions of it which were granted to life-tenants upon the payment of rents, which were generally, however, products of the soil, and not money. Other portions were retained for the actual use of the Crown, in all respects resembling the demesne-lands of a manor occupied, cultivated, and enjoyed by the lord thereof for his personal convenience and benefit. As the royal prerogative increased in strength, these lands came to be regarded as the private property of the king.

Folc-land, being the property of the people as a whole, could not be alienated or changed into boc-land without some act of the government. In the earliest periods of the Saxon commonwealths the "gemote" or general assembly of the nation alone possessed this power. In later times the charters or deeds ran in the name of the king, but still required the assent of his "witan" or council of advisers. As the royal powers increased, and the king came to be regarded as the representative of the state and as embodying in himself the supreme authority, the theory was suggested, and in time was adopted, that the folc-land belonged to him in his official capacity—that it was to be used for his maintenance, and employed by him at his pleasure in rewarding his servants. When this notion was universally accepted the term "folc-land" disappeared from ordinary speech and from the language of all official writings, and that of "*terra regis*" or "crown-lands" was substituted.

From the foregoing sketch it is apparent that the description of folc-land given by many legal text-writers, which makes it synonymous with "common land," or land possessed "in common" or by the common people, is altogether a mistaken one. Sir William Blackstone has fallen into a still graver error in his statement that it was land possessed by the serfs or villeins alone, and therefore belonging, together with themselves, their families, and their effects, to the lord of the soil. (For an exhaustive discussion of the subject, with a citation of ancient documents and proofs, the reader is referred to the following authorities: *The Saxons in England*, by JOHN MITCHELL KEMBLE, M. A., F. C. P. S., vol. i. chs. ii and xi.; *Inquiry into the Rise and Growth of the Royal Prerogative in England*, by JOHN ALLEN, pp. 129–155; *The Rise and Progress of the English Commonwealth—Anglo-Saxon Period*, by FRANCIS PALGRAVE, F. R. S., F. S. A., pp. 65–104; *A History of England under the Anglo-Saxon Kings*, translated from the German of Dr. J. M. LAPPENBERG, by BENJAMIN THORPE, F. S. A., vol. ii. pp. 323–326.) JOHN NORTON POMEROY.

Földvár, or **Foldvar Duna,** town of Hungary, on the right bank of the Danube, in the county of Tolna. It occupies a strong and picturesque position. It has important sturgeon fisheries and a heavy trade in wine, grain, and salt. It is a point of considerable strategic importance. Pop. 12,382.

Fo'ley (JOHN HENRY), R. A., sculptor, b. in Dublin May 24, 1818. His first impulse toward sculpture came from his step-grandfather, who was a sculptor in that city. When Foley was thirteen years old he entered as a student in the Dublin Royal Society, and obtained a number of prizes. Came in 1834 to London, and entered the Royal Academy as a student. He first exhibited in 1839; his *Death of Abel* and *Innocence* of that year announced the entrance of a strong man into the profession of sculpture. Produced in 1840 *Ino and Bacchus*, which was purchased by the earl of Ellesmere, and made him a European reputation. Entered in 1844 into the competition for the decoration of the palace at Westminster with statues, exhibiting his *Ino and Bacchus* and a figure made for the occasion, *A Youth at a Stream*, and as one of the successful candidates received the commission to make a statue of John Hampden, now in the Houses of Parliament. Later, Foley made for the same building a statue of Selden, and another of Sir Charles Barry. In 1856, Foley produced his bronze equestrian portrait-statue of Lord Hardinge for Calcutta. This is counted his finest work, and it was so much admired that efforts were made to have it duplicated for England, but though the names of the most distinguished men in literature, art, and society were appended to the appeal to the public, money sufficient was not forthcoming, and the project had to be abandoned. Later, he made an equestrian statue of Outram, also in bronze, which added greatly to his reputation. Foley was of a sensitive disposition and rather recluse in his habits, and somewhere about 1864 he took offence at the way in which his statues were treated by the "hangers" at the Royal Academy exhibition, and never afterward would contribute any work of his to the exhibition, nor take any advantage whatever of his membership. He made the statue of the prince-consort for the national memorial in Hyde Park at the personal request of the queen, and he also made the group of *Asia* for the

same unfortunate monument. Among his other works must be mentioned statues of Oliver Goldsmith and Edmund Burke for Dublin, and a statue of Father Mathew for Cork. The Oliver Goldsmith has been particularly praised. Foley was a sculptor of whom any nation might be proud. He was born an artist, and he lived in his art, through which he expressed a nature glowing with Irish fire, with manly pride, and with a fellow feeling for noble, heroic character that has given his statues of his great countrymen a place apart in the sculptures of modern times. Foley's latest work was a statue in bronze of the Confederate general Stonewall Jackson, a commission from the State of South Carolina.—A brother of the sculptor, EDWARD FOLEY, acquired considerable distinction for his skill in manipulating marble, and the statues of John Foley owe much to his brother's workmanship. Unfortunately, Edward Foley's habits were his ruin, and he died, not without strong suspicion of suicide, by drowning in the Regent's Canal a few weeks before his more distinguished brother. John Henry Foley d. in London Aug. 27, 1874. He was buried in St. Paul's Cathedral Sept. 5. CLARENCE COOK.

Folger (CHARLES J.), LL.D., b. in Mass. Apr. 16, 1818; graduated at Hobart College, Geneva, N. Y., in 1836; admitted to the bar in 1839; judge of Ontario court of common pleas in 1844, and also master and examiner in chancery; county judge 1851–55; N. Y. State senator 1861–69; assist. U. S. treasurer at New York 1869; elected associate judge of N. Y. court of appeals 1871; chief judge 1880.

Fol'ger (PETER), American writer, b. in England 1617, went from Norwich in 1635, and with his father settled at Martha's Vineyard, Mass.; in 1663 removed to Nantucket. His daughter Abia was Benjamin Franklin's mother. From 1673 he was clerk of the courts, and wrote several pieces, among them, in poetry, *A Looking Glass for the Times, or the Former Spirit of New England revived in this Generation* (1675), reprinted 1763. D. at Nantucket 1690.

Folia'tion and **Fo'liated** [Lat. *folia*, "leaves"], terms applied to sedimentary rocks composed of very thin layers, or metamorphic rocks which show slaty cleavage.

Foli'gno, town of Central Italy, in the province of Umbria. Its manufactures of woollens and parchment are celebrated. It is an unattractive place, a bishop's see, and is connected by rail with Florence, Rome, and Ancona. It is the Roman *Fulginium*. Pop. 7891.

Fol'ker, tp. of Clarke co., Mo. Pop. 824.

Folkland and **Boc-Land.** See FOLC-LAND, by PROF. J. N. POMEROY, LL.D.

Folk-Lore, a word recently introduced into the English from the German to indicate the knowledge which has been gained from a scientific study of popular traditions and tales. The Brothers Grimm in their *Kinder und Hausmärchen* may be said to have inaugurated the study, and since the publication of that work many others have been diligently collecting in all parts of the world the stories which have been orally transmitted from generation to generation. These stories have been taken from the lips of unlettered men and women among different nations all over the earth. The Germans, Danes, Russians, Highlanders, Irish, North American Indians, Zulus, South Sea Islanders, Hindoos, have all contributed to the general fund. The tales thus gathered have been carefully compared with each other, analyzed, and traced back to their oldest forms. Many new and important facts have been discovered in these old wives' fables concerning the literary character of our ancestors, their household utensils, habits of life, sports, worship, moral qualities, superstitions, and ideas of another world. The study has also been of great service to the ethnologist, the historian, and the philologist in showing popular affinities, giving additional information about early migrations, and unfolding more clearly the meaning of words. Says one of the ablest investigators of this folklore: "One of the many indications of that synthetic and reconstructive rather than analytic and destructive tendency which marks the second half of the nineteenth century is the fact that historical scholars are beginning to look on popular legends and romances, not certainly with the uncritical credulity of the days before Niebuhr, but with the belief of finding in them such records of historical evidence as will pay the trouble of investigating them."

The Germans have done more than any others in developing this new science. Their most important works upon it are *Kinder und Hausmärchen*, by the Brothers Grimm; *Deutsche Mythologie*, by Jacob Grimm; *Die Herabkunft des Feuers und des Göttertranks*, by Adalb. Kuhn; *Norddeutsche Sagen, Märchen, und Gebräuche*, by Kuhn and Schwartz. Several important works have also been published in English upon the subject. Among these the best for reference are Campbell's *Tales of the West Highlands;* Dasent's *Popular Tales from the Norse;* Kelly's *Curiosities of Indo-European Tradition and Folk-lore; Popular Romances of the Middle Ages*, by Cox and Jones; *Myths and Myth-Makers*, by John Fiske; *Fiction of the Irish Celts*, by Kennedy; *Curious Myths of the Middle Ages*, by Baring Gould; *Popular Epics of the Middle Ages*, by Ludlow. L. C. SEELYE.

Folk'stone, town of England, on the S. E. coast of Kent. Steam-packets sail hence to Boulogne. It is 83 miles by rail S. E. of London, and is a favorite bathing-place. Pop. 12,694.

Fol'len (CHARLES THEODORE CHRISTIAN), PH. D., LL.D., a writer, reformer, and liberal preacher, b. at Romrod, in Hesse-Darmstadt, Sept. 4, 1796; was educated at Giessen, where there were many schools of learning, preparatory to the university. Sharing the German enthusiasm of 1814, the youth joined the army that resisted Napoleon. The campaign ended, he returned to Giessen to pursue his studies, and soon became known as a leader among the ardent patriots as well as the diligent students of the university. Earnest, bold, ready with tongue and pen, he drew on himself the suspicion of the authorities, but the degree of doctor of civil and ecclesiastical law was given him in 1818, and he remained at the university as a lecturer on jurisprudence. His patriotic feelings bringing him into sympathy with the people, and making him their advocate against the oppressive edict that would compel them to pay the debts of the war, made him especially obnoxious, and though he gained his point, he ruined his professional prosperity. A similar fortune awaited him at Jena, whither he removed from Giessen. Thrice he was arrested on charges of implication with revolutionists, and, though acquitted, was forbidden to continue his lectures. At Giessen the authorities were on the watch for him, and he fled to Paris. Paris was soon left for Switzerland. At Chur (Coire), the capital town of the Grisons, he was appointed professor of Latin and history in the cantonal school, but being a liberal in theology as well as in politics, his lectures gave offence to the Calvinistic ministers; so that, finding his position uncomfortable, he resigned it and left, carrying with him testimonials of character and learning. Next he lectured on law and metaphysics at Bâle, but his reputation went with him; the allied powers demanded his surrender, orders came for his arrest, and again he fled under cover of a chaise-boot, this time through Paris to Havre, whence he embarked for the U. S. Here, thanks to influential friends—La Fayette among them—he found welcome. A few months after he landed, in the autumn of 1825, he was made tutor of German at Harvard College. Three years later, having in the mean while studied divinity with Dr. Channing, and been admitted to the Unitarian ministry, he was appointed professor of ecclesiastical history and ethics in the Cambridge Divinity School; in 1830 the professorship of German language and literature was conferred on him. In the five years he held it he did much to make that department attractive by the charm of his manner and the life of his intelligence. His German Grammar and Reader outlived, as text-books, his time. The Christian ministry, however, had greater attractions for him than the professorship, and for a short time (1836–37) he was pastor of the First Unitarian church in New York, following Rev. Wm. Ware. His freedom of speech about slavery cut short his ministry there, and in 1839 he accepted a call to East Lexington, Mass., where he had hardly established himself when he was lost in the steamer Lexington, which was burned on Long Island Sound Jan. 13, 1840.

Dr. Follen was a frequent lecturer, a copious contributor to magazines, a philosophical writer of ability. He was interested in all questions of social reform, but especially in the question of slavery. The frankness with which he uttered the convictions of an abolitionist on this then unpopular subject materially compromised his professional and literary success. His writings, with memoir, were published in 5 vols. at Boston in 1841. O. B. FROTHINGHAM.

Follen (ELIZA LEE), wife of Dr. Follen, daughter of Samuel Cabot, b. in Boston Aug. 15, 1787. She, like her husband, whom she married in 1828, was an earnest abolitionist from first to last, and a diligent writer. Her writings are mainly of a religious character, and are intended for the moral instruction of the young. Her little books for children are deservedly popular for their purity and practical wisdom. Her *Selections from Fénelon, Well-spent Hours, Married Life*, exerted wholesome influence in their time. The memoir of her husband was from her pen. *The Child's Friend* was under her editorship from 1843 to 1850. D. Jan. 26, 1860. O. B. FROTHINGHAM.

Fol'let (DAVID LYMAN), an American lawyer, b. July 17, 1836, at Sherburne, Chenango co., N. Y., educated at Cazenovia Seminary, N. Y., was admitted to the bar in 1858 at Binghamton, N. Y., and settled at Norwich, the

capital of his native county. In 1867 was appointed assessor of internal revenue for the nineteenth district, and held the position until the abolishment of the office. In 1871 became the attorney for the New York Oswego and Midland R. R., and has frequently distinguished himself by his legal attainments. He is prominent in the counsel of his political (Republican) friends, and in 1874 was elected by a large vote justice of the supreme court of N. Y. State. JAMES H. WORMAN.

Fol'ly Is'land, in Charleston co., S. C., extends S. W. from Lighthouse Inlet to Stono River, having Folly Island River on the N. W. and the ocean on the S. E. It is in part heavily timbered. It was the scene of important operations during the civil war.

Fol'som (GEORGE), LL.D., b. in Kennebunk, Me., May 23, 1802; graduated at Harvard University, Mass., in 1822, and studied law. In 1830 published a *History of Saco and Biddeford, Me.*; in 1837 removed to New York and became a member and librarian of the New York Historical Society; in 1841 edited a volume of its *Collections;* afterwards translated the *Despatches of Hernando Cortes;* in 1843 published the *Political Condition of Mexico;* in 1858, *Documents Relating to the Early History of Maine.* He was a member of the New York State senate in 1844–48, and *chargé d'affaires* to the Netherlands 1850–54. Mr. Folsom delivered several lectures before the New York Historical Society, and was president of the American Ethnological Society. D. at Rome, Italy, Mar. 27, 1869.

Folsom (LEVI), M. D., b. in Limerick, Me., in 1802; studied at Exeter, N. H.; practised medicine with success in Limerick, Me., Lowell (1833–36), Boston (1836–37), and New Bedford, Mass. (1837–53), and afterwards in Cincinnati, O., and in New York City (1858–67). D. in New York Oct. 27, 1867.

Folsom (NATHANIEL), b. at Exeter, N. H., 1726; commanded a company at Fort Edward 1755, and a regiment of militia before the Revolution; as brigadier-general of the New Hampshire forces served in the siege of Boston until July, 1775; was a member of the Continental Congress 1774–75 and 1777–80; councillor in 1778; and president of the convention which framed the constitution of New Hampshire in 1783. D. at Exeter May 26, 1790.

Folsom (NATHANIEL SMITH), b. at Portsmouth, N. H., Mar. 12, 1806; graduated at Dartmouth College 1828, and at Andover (Mass.) Theological Seminary in 1831; ordained at Bradford, Mass., 1831; was missionary in Liberty co., Ga., in 1831–32; was professor in Lane Seminary and in Western Reserve College from 1833 to 1836; was pastor of the Congregational church at Francestown, N. H., from Oct. 12, 1836, to Aug. 21, 1838; then of a church at Providence, R. I., 1838–40; of a Unitarian church at Haverhill, Mass., 1840–47; edited the *Christian Register* 1847–49 at Charlestown, Mass.; and was professor of literature and biblical interpretation at Meadville College, Pa., from Sept., 1849, to 1861. He published an address on temperance (1839), and an *Interpretation of the Prophecies of Daniel* (1842).

Fol'som Cit'y, a post-v. of Sacramento co., Cal., on the S. bank of the American River and on the Sacramento Valley R. R., 20 miles E. by N. of Sacramento, is a pleasant town in a picturesque wine and raisin growing region. Placer-mining, granite-quarrying, and the collecting of paving-stones from the river-bed are carried on in the vicinity. Folsom City has a weekly newspaper and some fine buildings.

Foltz (PHILIPP), b. May 11, 1805, at Bingen on the Rhine, studied art at Mentz and Düsseldorf, and was professor of painting at Munich and director of the royal galleries. He helped design the frescoes of the Glyptothek and the Arcades at Munich, and produced remarkable portraits and fine historical and rural scenes. D. Aug. 5, 1877.

Folz, or **Folcz** (HANS), b. at Worms in 1478, became a Protestant of Nuremberg, and was by profession a barber. He was one of the most noteworthy of the German mastersingers, and besides mastersong wrote dramatic Shrovetide pieces and rhyming tales. His lyrics are often spirited, graceful, and of high moral tone and much literary merit; but his other writings are often marked by needless coarseness and a roughly vigorous style of humor.

Fomenta'tion [Lat. *fomentatio*, from *foveo*, to "soothe," to "cherish;" also to "bathe"], in therapeutics, the application of hot epithems, wet or dry (wet fomentation, dry fomentation), to diseased parts. Fomentations act chiefly by the heat and moisture they convey to the surface treated, but they are sometimes medicated. Fomentation is usually a safe, and often an effective, means of treating many diseases.

Fom'ites [Lat., the plu. of *fomes*, "fuel"], a term much employed in sanitary science to denote objects, such as clothing, furniture, bedding, wall-paper, etc., by which the infection of certain diseases is retained, and by which disease may be propagated.

Fonblanque (ALBANY WILLIAM), a London journalist, b. in 1797, was the son of John de Grenier Fonblanque (1759–1837), a famous equity lawyer, and a brother of John Samuel Martin Fonblanque (1787–1865), an able writer on law-reform. Mr. Fonblanque was (1820–46) editor of *The Examiner*, and was distinguished for literary abilities and for his useful labors as a publicist. He was (1846–72) chief of the statistical department of the board of trade and comptroller of the corn returns. D. at London Oct. 13, 1872.

Fon'da, post-v. of Pocahontas co., Ia., on the Iowa division of the Illinois Central R. R., 225 miles W. of Dubuque and 100 miles E. of Sioux City. It has several stores, shops, and hotels, and one newspaper. Principal business, farming and dairying. Pop. about 300.

M. D. SKINNER, ED. "TIMES."

Fonda, post-v., cap. of Montgomery co., N. Y., on the Mohawk River and the New York Central R. Rs., and the terminus of the Fonda Johnstown and Gloversville R. R. It has a national bank, 1 newspaper, 2 flouring mills, 3 churches, 3 hotels, and the usual number of stores, shops, etc. Principal business, farming and dairying. Pop. 1092.

C. B. FREEMAN, ED. "MOHAWK VALLEY DEMOCRAT."

Fonda's Bush, a v. of Broadalbin tp., Fulton co., N. Y., is the seat of thriving manufactures. (Post-office, BROADALBIN.) Pop. 987.

Fond du Lac, county of Wisconsin, at the S. end of Winnebago Lake, whence the name (Fr., the "end of the lake"). Area, 754 square miles. The county is divided by a steep limestone ridge. The W. part is prairie, the E. timbered land. The soil is very fertile. Cattle, grain, wool, hay, and dairy products are the staples. The manufactures include carriages, flour, lumber, saddlery, metallic wares, etc. It is traversed by the Sheboygan and Fond du Lac and the Lake Superior line of the Chicago and North-western R. Rs. Cap. Fond du Lac. Pop. 46,273.

Fond du Lac, tp. and post-v. of Tazewell co., Ill., opposite Peoria, Ill., and near the S. extremity of Peoria Lake. Pop. 889.

Fond du Lac, tp. and post-v. of St. Louis co., Minn., on the Northern Pacific R. R., 15 miles S. W. of Duluth, at the head of navigation of the St. Louis River, near the head of Lake Superior. It is an old settlement, once a very important station of the American Fur Company. It has good water-power. Pop. of tp. 800.

Fond du Lac, city, cap. of Fond du Lac co., Wis., on Lake Winnebago, at the mouth of Fond du Lac River, 148 miles from Chicago, 63 from Milwaukee, 65 from Green Bay, and 43 from Sheboygan, thus enjoying the advantages of four competing lake-ports. It is the junction of three railway lines—the Chicago and North-western, to Chicago on the S. and Green Bay and Lake Superior on the N.; the North-western Union, to Milwaukee on the S.; and the Sheboygan and Fond du Lac, to Sheboygan on the E. and the Fox River on the W. Steamer lines connect with ports on Lake Winnebago. Fond du Lac county embraces some of the finest agricultural property in the West, and in the State stands fourth in wealth and population. The city is delightfully situated on a plain surrounded by hills and in the midst of generous groves. It contains many elegant residences, costly business-blocks, and heavy manufacturing establishments. Water is supplied from about 1000 artesian wells, the mineral properties of which have rendered the place famous. The hotels are numerous, provided with modern appliances, and enjoy an enviable reputation. Fond du Lac has 20 churches, 3 public halls, an opera-house, 2 public libraries, and several public gardens for out-door amusements. There is a steam fire department and a fire-alarm telegraph. There are within the city limits 12 steam saw mills, 1 extensive car works, 1 blast furnace, 1 threshing-machine works, 4 flouring-mills, 5 sash, door, and blind factories, 3 foundries and engine-works, several shingle-mills, 10 wagon and carriage works, 2 paper-mills, 2 agricultural works, 2 stave-factories, 1 drug-factory, 1 very large tannery, 6 planing-mills, 1 plaster-mill, 6 cigar-factories, 1 large soap-factory, 3 candy-factories, 1 steam bakery, 1 oil factory, 1 plough factory, 5 banks, and 1 steam printing-office; and many other branches of manufacturing industry are represented. There are 4 newspapers and 2 independent job printing offices. Pop. 12,764; of tp. 1266.

TIM. F. STRONG, JR., ED. "FOND DU LAC JOURNAL."

Fon'di, town of Italy, in the province of Terra di Lavoro, is miserably built, dirty, and unhealthily situated, but the surrounding districts are very fertile, and were

famous in ancient times for the wine they produced (*vinum Caecubum*). It is enclosed by cyclopean walls, and has a fine cathedral. Pop. 6478.

Foner'den (John), M. D., b. in Baltimore in 1804; graduated in 1823, and soon after became a distinguished physician and philanthropist. He was pre-eminently the friend of the friendless, and on more occasions than one went into the cell of a raving maniac, soothed him by a few kind words, unlocked the door, and walked with him through the hospital grounds. PAUL F. EVE.

Fonse'ca, Bay of, or **Gulf of Conchagua,** extends into Central America from the Pacific Ocean, and has the state of San Salvador on the N. W., Nicaragua on the S. E., and Honduras at its head. Length, 40 miles.

Fonseca, da (PEDRO), D. D., "the Portuguese Aristotle," was b. at Costizada in 1528; became a Jesuit in 1548; held professorships at Coimbra and Evora; resided at Rome 1572–79; was the instructor of Molina; wrote commentaries on Aristotle (4 vols., 1572–1602), *Institutiones Dialecticæ* (1564), and a treatise on foreknowledge and free-will (1588). D. at Lisbon Nov. 4, 1599.

Font [Lat. *fons*, a "fountain"], a vessel used in churches to contain the baptismal water. The font is smaller than the baptistery, the latter being in general designed for the administration of the ordinance by immersion, while the font was used in the other and later modes of baptism. It is usually of stone, sometimes of silver or other metal, ordinarily stands near the entrance of the church, and often is enclosed by a rail. The font is frequently fashioned with much taste and skill. The name *font* is often incorrectly applied to the stoup, stock, or *bénitier*, a vessel containing holy water, and placed near the entrance of Roman Catholic churches.

Fontainebleau, town of France, in the department of Seine-et-Marne, 35 miles S. E. of Paris. Its palace, built in the twelfth century and enlarged and embellished in each succeeding century, is one of the most magnificent buildings in France. The forest which surrounds it, and which is wholly laid out as a landscape-garden, comprises 64 square miles. Pop. 11,939.

Fonta'na (DOMENICO), an Italian architect and engineer, b. 1543, is chiefly remembered for his great feat, the transportation of the Egyptian obelisk to the square of St. Peter's, Rome, in 1586, for which he received great honors. The obelisk had been brought to Rome in Caligula's time. He also finished the cupola of St. Peter's basilica, finished the palace of Monte Cavallo, and planned the Vatican Library. D. 1607.

Fontana (PROSPERO), b. at Bologna in 1512, was a painter of much ability, but a too rapid and careless worker. His portraits won him much fame, but were not equal to those of his daughter Lavinia (1552–1614), a clever and painstaking artist. He instructed the Caracci. D. 1597.

Fontanel' [Fr. *fontanelle;* Lat. *fons palpitans*], the soft palpitating spot upon the head of a young infant; so called because its throbbing was likened to the welling up of a fountain. The fontanels are usually from four to six in number, but only one or two are easily detected in most cases. The great fontanel is at the crossing of the coronal and sagittal sutures. It is generally closed by the development of the neighboring bones within two years after birth. The smaller posterior or bregmatic fontanel is at the junction of the sagittal with the lambdoidal suture, and closes in a few months after birth. There are also two sphenoidal and two mastoidal or Gasserian fontanels, but they are very small, and generally close soon after birth. The two principal fontanels are of great importance in midwifery, as they enable the skilful practitioner to determine the position of the fœtus in head presentations.

FONTANEL is also a small issue or artificial ulcer made by the surgeon for its derivative effect. A common dried pea, a lump of beeswax, or other hard mass is kept in a small cut under the skin, causing a flow of pus. The fontanel, though a valuable therapeutic means, is at present not much employed.

Fontanel'la (FRANCESCO), b. at Venice June 28, 1768; became a priest, and was for a time professor of grammar in Venice, and afterwards professor of Latin eloquence at Udine, but his principal employment was proof-reading; author of Greek and Hebrew grammars and lexicons, and of several learned philological treatises. D. at Venice Mar. 22, 1827.

Fontanelle, post-v. of Adair co., Ia., is about 70 miles W. of Des Moines, midway between the Chicago Rock Island and Pacific and the Burlington and Missouri River R. Rs. It has 2 hotels, 2 weekly newspapers, and several dry goods and grocery stores. It is a trading town for a considerable district. Its public schools are efficient. Principal business of the vicinity, farming. Pop. about 500.

JAMES M. GOW, ED. "ADAIR COUNTY REPORTER."

Fon'te Avella'na, Order of, a monastic order established 1001 at Fonte Avellana, near Faenza, Italy, by Ludolf, bishop of Iguvium. In 1570 it was united to the Camaldulians. St. Peter Damian was its most famous member.

Fontenay-le-Comte, town of France, in the department of Vendée, on the Vendée. It has great linen manufactures and tanneries. Pop. 7971.

Fontenelle, tp. and post-v. of Washington co., Neb., on the Fremont Elkhorn and Missouri Valley R. R., 10 miles N. E. of Fremont, and on the Elkhorn, here crossed by a bridge. It has a fine soil, and is the seat of Nebraska University. Pop. of tp. 400.

Fontenelle, de (BERNARD DE BOVIER), French author, b. at Rouen Feb. 11, 1657; admitted to the French Academy in 1691, and to the Academy of Sciences in 1697, of which he was perpetual secretary from 1699 to 1741. D. at Paris Jan. 9, 1757. His *Dialogues of the Dead* was published in 1683, *Discourse on the Plurality of Worlds* in 1686, and *Essay on the Geometry of the Infinite* in 1727. Wrote also *History of Oracles*, and in forty years composed eulogies on about seventy members of the French Academy of Sciences.

Fontenoy, a v. of Belgium, in the province of Hainaut. Here was fought, May 11, 1745, the famous battle between the French under Marshal Saxe and the allied English, Dutch, and Austrians under the duke of Cumberland, in which the French won a great victory.

Fontevrault, small town of France, in the department of Maine-et-Loire. In its church are the tombs of Henry II. and Richard I. of England. This church, now a prison, is nearly all that remains of the ancient abbey of Fontevrault, once the mother-house of the monastic order of Fontevrault, founded 1100, and broken up at the first Revolution. The order contained monks and nuns, and was at one time Augustinian, but became an independent congregation.

Fonvielle, de (WILFRID), French aëronaut and popular scientific writer, b. at Paris in 1828, was a teacher of mathematics, then a journalist and aëronaut. During the siege of Paris he escaped from the city in a balloon. *L'Homme Fossile* was published in 1865, *Les Merveilles du Monde Invisible* in 1866, *Eclairs et Tonnerres* in 1867 (translated into English as *Thunder and Lightning*), *L'Astronomie Moderne* in 1868. Accounts of his balloon ascensions were published in 1871 under the title of *Travels in the Air*. He has written several political pamphlets.

Foo-Chow, popularly called **Hok-Chin,** is the capital of the Chinese province of Fo-Kien, the residence of the viceroy of Fo-Kien and Che-Kiang, the seat of several high civil and political authorities, and stands on the river Min, 35 miles from its mouth. The number of its inhabitants is variously given. According to Scherzer and the *Missionary Herald* (Boston, Feb., 1872) it is about 1,000,000, but others call it 800,000, 600,000, and 500,000. The number of 600,000, which has been adopted by Behm and Wagner in *Bevölkerung der Erde* (Gotha, 1874), seems to come nearest to the truth. The town is beautifully situated on both banks of the river, which rise in terraces and are connected by stone bridges; it has an excellent harbor, and is surrounded with an old wall 30 feet high, 12 feet thick, and surmounted with high towers. Its general aspect is most striking; the broad river is entirely covered with floating houses and innumerable junks, and stretches through the valley like a boisterous market-street, while on both sides the town rises like an amphitheatre. The town itself is dirty, however, and makes a poor impression on account of its miserable buildings, though its streets are lined with shops crowded with goods and stirring with traffic. The most remarkable institution of Foo-Chow is its arsenal. It is a perfectly modern establishment, is under the direction of a Frenchman, and has 50 European engineers, teachers, and superintendents, and about 1200 Chinese workmen. It was founded in 1867. China has only three other arsenals arranged on the European plan—namely, those of Shanghai, Nanking, and Tientsin. But its greatest importance is derived from its tea-trade, and from the circumstance of its being open to foreign commerce. Its position offers a cheap and convenient communication with the interior, and since 1853—in which year the firm of Russell & Co. shipped the first cargoes of tea directly from Foo-Chow to Europe and America—its commerce has increased so rapidly that as a tea-market it now ranks next to Shanghai: 550,239 piculs of tea were exported in 1867; 603,770 in 1868; 581,003 in 1869. The business of the foreign houses in Foo-Chow is confined to

the exportation of tea, the importation of opium and lead, and ship-brokerage. Although, with respect to the inland traffic, the harbor is of great consequence as a market for building timber and paper, and although large quantities of cotton and woollen goods are imported, yet the foreign houses have very little to do with these branches of the trade. The Chinese merchants carry them on; all woollen goods are bought by Chinese houses in Hong-Kong and shipped to Foo Chow on European vessels. The value of imported foreign goods has during the last few years amounted to about $6,000,000 annually; that of imported Chinese produce to about $3,000,000, and that of the entire exportation to about $15,000,000. About 300 vessels of 250,000 tons burden annually clear the harbor.

August Niemann.

Food, a substance which supports the functions and powers of the body—one by which the body may live, act, and grow. It is not one which simply satisfies or arrests appetite, for a nauseous smell or a mental shock will do that; nor one simply which gives a sense of satisfaction at the stomach and removes craving for food, like the lump of clay which is swallowed by savages in the absence of food; yet food does both. Neither is it a substance which controls and regulates the functions, for that is the special duty of a medicine; and yet it so far governs that it increases the activity of some or all of them. With want of food there is a natural subsidence of vital action, accompanied by craving for food and appetite or relish for it, whilst after food has been eaten the action of the heart, lungs, and other organs is increased, heat is generated, appetite is arrested, and a sense of satisfaction is felt, whilst a glow of warmth pervades the whole body. After an interval of three or four hours appetite and a sense of want of food return, and the process of renewal must be repeated.

Hence food must be identical with the elements of our bodies, or be capable of transformation into them, supplying the want caused by waste and the material required for growth. It must also be adapted to the needs of the infant as well as those of man at all ages and in various conditions of season, climate, modes of life, and exertion. Its nature must be such that it can be digested within the usual period, lest the body starve whilst food is within it; but this is commonly assisted by the process of cooking, which by softening the food shortens the term subsequently required for digestion. Thus, a piece of the bark of a tree contains the elements of food, but in a form most difficult of digestion. When in periods of great privation it has been eaten, it has been first broken up into the smallest pieces, immersed and then boiled in water to soften the fibre and to cause the starch-cells to burst. Or, again, to give the ordinary food of man, which requires four or five hours to digest, to an infant whose functions are performed so rapidly that it must receive food every two hours, would starve the child, whilst food would accumulate in the stomach and bowels, and destroy the appetite for it. An infant cannot live well even on bread, which is the staff of life to man.

Classification.—As foods have two very evident duties to perform—viz. to maintain the heat of the body and to supply material for growth—they have of late years been divided into *heat-generators* and *flesh-formers*, the former consisting of carbon, hydrogen, and oxygen, and the latter of these elements, with the addition of nitrogen. Hence, the two classes are likewise called, respectively, *hydro-carbons*, or carbo-hydrates, and *nitrogenous*; but, although two, they are so nearly one that in nature they are invariably found and eaten together at each meal. Thus, the three great hydro-carbons are fat, sugar, and starch; but fat is found with lean flesh in animals and with albuminous matter in seeds, both of which are rich in nitrogen; whilst sugar and starch never exist alone, but always with juices and tissues containing nitrogen, from which they may be separated by artificial means. Hence, whilst one kind of food may contain a far greater proportion of nitrogen than another, and may therefore be *par excellence* a nitrogenous food, all foods contain carbon or hydrogen, or both, in large quantities, and are therefore heat-generators.

The classification of foods on their chemical constituents is thus shown to be of comparatively little importance, and as we proceed to further regard their origin from vegetables and animals, the same fact will be yet more evident. A vegetable food is derived from the soil and air, and when eaten becomes flesh; but when we eat the flesh of animals we eat that which was previously derived from vegetables, and we may therefore be said to eat vegetables specially prepared and transformed by animals for our use. When the refuse of flesh is eventually given to the earth, it again produces vegetables, and thus the round of creation and transformation of food is complete. This implies that vegetable and animal foods have the same elements, or are capable of transformation, the one into the other; and so bread, meat, and milk, however different in appearance, have their essential elements in common. It also leads to the inference that as animal food is a nearer approach to the composition of our own bodies, it should be, as it is, more readily and quickly appropriated by us than vegetable food. It is also a more compendious food.

Foods will be considered in this article under the two general heads of solids and fluids, the former being divided into three classes, according to their source—viz. mineral, vegetable, and animal.

I. Solid Foods.

A. *Mineral Food.*—The bones, nearly every soft tissue, and the blood require mineral matters combined with acids, and foods supply them in about the following proportion: Common salt, or chloride of sodium, is found in water and in many animal and vegetable substances, but it is usual to eat from one-quarter to one-half an ounce daily with our food. Potash is supplied by lemons, oranges, grapes, pineapples, strawberries, mulberries, tamarinds, apples, and nearly all fruits, as well as by potatoes, cauliflowers, cabbages, cucumbers, artichokes, asparagus, rhubarb, and nearly all garden vegetables. Sulphur is contained in albumen (as the white of eggs), fibrine, and caseine in proportions of 3½ to 7 parts in 1000. Iron enters into the composition of most vegetable foods, as potatoes, carrots, cucumbers, peas, cabbages, and mustard, and into many animal substances, as milk and flesh. Alumina exists in carrots, and silica, or flint, in potatoes, wheat, rice, and numerous vegetable structures. Phosphorus, when combined with a base, as lime, magnesia, soda, potash, etc., is found in nearly all vegetable and animal foods. Thus, there are in blood 0.14; barley, rice, and oats, 0.22 to 1.32; milk, 0.56; wheat, 0.8 to 2.0; potatoes, 2.5; caseine, 13.2; and in bones, 27 to 72. It is also found in fibrine, albumen, the brain, and numerous other structures of the bodies of animals.

From this statement it follows that whilst the need of the body for mineral matter may be supplied in very different quantities, a mixture of foods is the most fitting; and with such we may be assured that a sufficient quantity is afforded. But of all classes those which contain fresh vegetable juices appear to be the most important, for without them the nutrition of the body cannot be long maintained.

B. *Vegetable Foods.*—The lowest classes of vegetables which supply man with food are the lichens, fungi, mosses, and sea-weeds. Lichens and mosses are ordinary articles of food in the northern regions, as in Lapland and Greenland, and supply food to man and beast for several months in the year. Iceland moss (*Cetraria Islandica*) has long been appreciated in more southern climates for its mucilaginous quality, and is eaten alone, as an infusion in hot water, or made into various compounds, as Iceland moss cocoa. It is deficient in flavor, and requires the addition of sugar and a condiment, but it produces a more valuable infusion than linseed tea. Reindeer moss (*Cladonia rangeferina*) has similar qualities, but is inferior as a nutriment, since, whilst the former yields about 30 per cent. and the latter has only about 1 per cent. of starch, the potato usually contains about 18.0 or 19.0 per cent. of starch: it is inferior in that respect to Iceland moss. Irish or carrageen moss (*Chondrus crispus*, a sea-weed), is not equal in nutritive value to Iceland moss, but is a well-known article of food or physic. Sea-weeds have long been in use as food in Scotland and the more northern islands of Europe, particularly when other vegetable food is scarce. They have also been used in periods of abundance by a few persons, so that laver (*Porphyra laciniata* and *vulgaris*) is eaten with roast meat at the most luxurious tables. There are many edible sea-weeds, but as all have a bitter flavor, which soda only partially removes, they are not likely to be generally used as food. They, however, rank very high in nutritive value, for they are said to contain 10 to 15 per cent. of nitrogenous and 60 to 70 per cent. of carbonaceous matter, and therefore merit the attention of countries having a wide seaboard and a poor population.

Mushrooms (*Fungi*) constitute a large class of vegetables, many of which have most attractive colors, and not a few very repellant odors. There is great difference of opinion as to their edible qualities, some asserting that nearly every kind may be eaten, whilst others allow but one or two kinds, and particularly the common edible mushroom of small size (*Agaricus campestris*). It is quite certain that persons have been poisoned by eating mushrooms, and therefore that all mushrooms cannot be edible. In chemical composition this class of vegetables ranks somewhat high, but they are very light in structure, and from the bulk required at a meal could not become a necessary article of food. They are generally luxuries, or, when made into ketchup, may be called condiments. Truffles, whether white or black (*Rhizopogon albus* and *Tuber cibarium*), grow about one

foot in depth under ground, to the size of a potato, and are now more fashionable than useful food.

Succulent Vegetables.—This very large class of foods is eaten chiefly for their juices and starch, and are prized according to the abundance of those elements and their flavor.

The potato (*Solanum tuberosum*) occupies the first place in temperate climates, on account of the large quantity of starch and potash which it contains, and its agreeable flavor. It is a native of N. and S. America, but has become acclimatized in all except very hot and very cold climates. It contains only about 2.1 per cent. of nitrogenous matters and salts, and is therefore not fitted to be a sole article of food. The greater the specific gravity the larger is the quantity of starch which it contains; so that with a specific gravity of 1.123 there is 24.14 per cent. of starch, whilst with a specific gravity of 1.090 the starch is only two-thirds of that quantity, or 16.38 per cent. The sweet potato (*Batatas edulis*) and the yucca are eaten largely in America. The yam (*Dioscorea alata*, *batatas*, or *sativa*) is a common food in China and many other countries, and contains a quantity of starch scarcely less than that of the common potato, but is not equal to the latter in flavor. There are many edible tubers bearing starch growing in South America, and also a few in North America, as the prairie turnip (*Apios tuberosa*), which contains a larger proportion of edible matter than the common potato. The artichoke (*Cynara scolymus*) is valued for its flavor, as well as for its nutritive qualities, but it is yet more valuable for its large proportion of salts, of which more than one-half are potash, whilst the leaves yield 40 per cent. of salts of lime. The *Helianthus tuberosus*, or Jerusalem artichoke, has edible and quite nutritious tubers, which are, however, rarely used as human food.

The fruit of the bread-fruit tree (*Artocarpus incisa*) and of the plantain (*Musa paradisiaca*) may be regarded either as culinary vegetables or fruits, but from the quantity of nutritive material which they afford they belong rather to the former. The bread-fruit is always cooked by baking in an earthen oven or on heated stones, and then resembles wheaten bread.

The carrot (*Daucus carota*), parsnip (*Pastinaca*), beet (*Beta vulgaris*), turnip (*Brassica*), vegetable marrow, and pumpkin (*Cucurbita*) occupy a position between potatoes and ordinary green vegetables, since they contain a larger quantity of starch and sugar, and are therefore more nutritious, than the latter. They are nearly equal in nitrogenous elements—viz. about 1.3 per cent.—but in reference to sugar they vary as follows: turnips, 2.1 per cent.; parsnips, 5.8; carrots, 6.1; and beets, 10.5. Swedish turnips contain more carbonaceous matter (starch and sugar) than the white variety, but the flavor is harsher, though in the U. S. the more delicate varieties are highly prized as food for man.

All the well-known succulent vegetables, as spinach, turnip-tops, cabbage (*Brassica*), broccoli, cauliflower, sea-kale, tomatoes, nettles, lettuce, dandelion, endive, chicory, may be regarded as nearly alike in nutritive value, whilst they vary extremely in flavor, and are chiefly valuable for their fresh juices. They should be well cooked, for if eaten in large quantity they do not readily digest. No part of a dietary is more valuable than the abundant supply of such substances, but when eaten raw or in salad, it should be in moderation. Cucumbers (*Cucumis*) are regarded apart from this class, since they are always eaten raw, and many believe them to be injurious to health; but if prepared like other raw vegetables, and without vinegar, they rarely disagree. Rhubarb (*Rheum*) has the character of a fruit rather than a vegetable, and has juices so valuable that it is scarcely possible to eat too much of it. Wild lettuce (*Lactuca sativa*) is poisonous, whilst when cultivated it is both harmless and agreeable.

Fruits may now be considered, since they are more like succulent vegetables than any other productions in the composition of their juices and their uses in the animal economy. It is needless to cite them by name, since they are well and widely known, and it would be impossible to refer to more than a very small proportion of them. No products are so universal and none so agreeable. All agree in having a larger proportion of sugar and vegetable acid than occurs in ordinary vegetables, and flavors of infinite variety and delicacy. Some, as the date, are so valuable as to be a chief support of life, but the characteristic of the class is to afford agreeable and refreshing rather than nutritious elements. It is, however, worthy of note that in these qualities the choice fruits of our gardens and hothouses far excel those of the products of Eastern climates, whilst the chemist has produced substances which closely imitate the flavor of all the most appreciated fruits. The following table may be useful, as it contains the percentage quantities of water, sugar, and free acid in our ordinary fruits:

	Water.	Sugar.	Free acid.
Grapes, generally	79.8	13.8	
Klaubegen, ripe	...	10.59	
White Austrian	...	13.78	
Red Asmannshäuser, ripe	...	17.28	
Oppenheim, ripe	...	13.52	
" overripe	...	15.14	
Johannisberg	...	19.24	
Mulberries	84.7	9.19	1.86
Bilberries	77.5	5.78	1.34
Blackberries	86.4	4.44	1.18
Cherries, black	79.7	10.70	0.56
" sweet, light red	75.3	13.11	0.35
Apples, English golden pippin	81.8	10.36	0.48
" English russets	82.0	6.83	0.85
Pears, sweet red	85.0	7.94	trace.
Strawberries, wild	87.0	4.55	1.33
" cultivated	87.4	7.57	1.13
Raspberries, wild	83.8	3.59	1.98
" cultivated, red	86.5	4.70	1.35
Plums, green gages, yellow	80.8	2.96	0.96
" " large and sweet	79.7	3.40	0.87
Apricots, large	82.1	1.50	0.76
" small	83.5	2.73	1.60
Peaches, Dutch	84.9	1.58	0.61
Gooseberries, large red	85.5	8.06	1.35
" small	84.8	8.23	1.58
Currants, white	83.4	7.12	2.53
" red	85.2	6.44	1.84

Seeds.—The seeds of plants have so much in common that they may be treated under one head, notwithstanding their infinite variety of flavor and diversity of production. The most highly nitrogenized seeds are peas, beans, lentils, and numerous other products of pod-bearing plants, called pulses, or dahls and grain in India, and frijoles in Mexico. While potatoes contain about 2 per cent. of nitrogenous matter, peas have 23 and lentils 25 per cent., and are the most highly nitrogenized natural foods known to mankind. They are also rich in starch, for peas contain 55 per cent. of that substance. Whole nations are largely indebted to these foods for their highest nourishment, and it seems as if the nitrogenous vegetable food were more suitable to the body in hot climates than meat. The 4 ounces of dahls which each inhabitant of a large part of India eats daily is to the rice accompanying it that which buttermilk is to the potato in Ireland; and it is scarcely possible to overestimate its value. The flavor is, however, somewhat harsh as compared with that of fine wheaten flour, and with the luxurious habits of the age the latter, although affording less nutriment, is preferred. The most agreeable member of this class in Europe is the haricot bean, which is in almost daily use in France, and is served alone or with meat and sauce. All such foods require to be well cooked by boiling, and the skins should be rejected. They are deficient in fat, and being highly nitrogenized demand an abundant addition of that food. When eaten too abundantly and constantly they are liable to produce skin-disease and indigestion. The least nutritious seed in extensive use is rice, for it contains but 6.3 per cent. of nitrogenous matters, and the next is millet, with 9 per cent.; yet these substances supply the chief food of more than one-half of the inhabitants of the world. At the same time they supply a proportionally greater amount of starch—viz. rice, 79.1, and millet, 74 per cent., as against 55.4 per cent. in peas. Experience has shown that whatever may be the use of nitrogen, it is eaten less abundantly in hot than in cold climates, whilst starch, and probably sugar, are the reverse. They are regarded as insufficient to maintain strength in our climate. But it is needless to discuss this statement, since we have substances which are better and cheaper than either rice or millet, and therefore do not find them necessary foods. As a part of a dietary they are agreeable and valuable, but new rice should not be eaten. Ground rice is commonly added to fine wheaten flour to make it whiter. It cannot alone be made into a loaf, but small cakes and biscuits are prepared with it. Parched rice made into *sulpawn* is in common use in the East.

The seeds which supply our staple vegetable foods occupy a position between these and peas, and have a close similarity in their nutritive qualities—viz. wheat, maize, and oats, which possess 11 to 12 per cent. of nitrogenous and 75 to 80 per cent. of carbonaceous matter. They differ in flavor, so that both maize and oats are said to be rough, whilst wheat has a softer and perhaps sweeter flavor; and although wheat has the preference, wherever it is grown each kind of corn has its advocates. Regarded simply as nutritive foods, one may be substituted for the other, but in practice they are not interchangeable. Thus, wheat when ground can be made into loaves, biscuits, and pie-crusts, whilst maize and oat meal are made only into small or thin cakes. Moreover, wheaten bread may be eaten alone with a relish, whilst corn cake and oat cake are repulsive unless accompanied by fat, milk, or sweets. This appears to be due to the greater ease with which the starch-cells in wheaten flour are acted upon by heat and

water, so as to become a soft and homogeneous mass, whilst both maize and oat meal remain rough and gritty unless cooked for a much longer period and with the grains loosely separated.

Bread which is made from wheat may have all or any part of the husk or bran of the grain in it. If there be much, it is called brown bread, and as the flinty covering of the bran is indigestible, it is very apt to cause purging, and is the rich rather than the poor man's food. White flour has lost the nitrogen of the bran, but it is more digestible, and therefore more useful, and probably the most nutritious kind is that known as seconds or households. Fourteen pounds of fine white flour should make 19½ to 20 pounds of bread. Passover cakes are made from the finest and purest flour. Oat meal is never met with entirely devoid of the hard and indigestible skin, to which also it owes its high percentage of nitrogen; but when the whole grain has been decorticated it is known as groats. Maize is the only grain under consideration which is eaten whole in its unripe condition and when full of milky juices, but whole ripe wheat is steeped in water to make frumenty, and both the oat grain and the skin of the oat meal are used to make foods in Wales and Scotland under the name of *sowens* and *sucan* or *slyman*. Very valuable preparations for infants' food and puddings are now made from them, as corn flour and semolina.

The nutritive qualities of all these grains vary with climate and season, so that moderately hot and dry climates and seasons produce the best wheat, and the highlands better oats than the lowlands. The *tortilla* is a cake prepared in Mexico and South America with ground maize, whilst johnny cake and corn bread are commonly made in North America from the same grain.

Rye and barley, although inferior grains, are largely eaten by the poorer inhabitants of Northern and Central Europe. Their proportion of nitrogenous matter is only from 7 to 8 per cent., and therefore but little exceeding that of rice and millet, whilst the carbonaceous is 78 to 80 per cent. An improved food is made by a mixture of rye and wheat called *maslin*, which is in use in Northumberland and North Yorkshire, and it is not unusual to add a little rye meal to wheat meal in making bran bread, with a view not to increasing the nutritive value of the latter, but to keep the bread moist. The Norwegian *flödegröd*, or cream porridge, is made by boiling barley meal in cream, during which process it is stirred with a *grödstick* twisted between the palms of the hands.

The following table shows the percentage composition of the chief representatives of this class of seeds and foods:

	Water.	Nitrogenous	Carbonaceous, including Sugar.	Starch.	Fat.	Salts
Maize	14	11.0	0.4	64.7	8.1	1.7
Millet	13	9.0	74		2.6	2.3
Rice	13	6.3	0.4	79.1	0.7	0.5
Oat meal	15	12.6	5.4	58.4	5.6	3.0
Wheaten flour, seconds	15	10.8	4.2	66.3	2.0	1.7
Wheaten bread	37	8.1	3.6	47.4	1.6	2.3
Barley meal	15	6.3	4.9	69.4	2.4	2.0
Rye meal	15	8.0	3.7	69.5	2.0	1.8

Nuts.—There are numerous seeds which are regarded as fruits from their agreeable flavor and unfitness to be eaten as standard articles of food, such as the cocoa nut (*Cocos nucifera*), Brazilian nut (*Bertholletia excelsa*), earth-nut (*Arachis hypogæa*), walnut (*Juglans*), chestnut (*Castanea*), and almonds (*Amygdalus communis* and *amara*), constituting a very large class, and found in almost every part of the world except the extreme N. and S. They are rich in albuminous, saccharine, and fatty elements, and supply a much larger quantity of nutriment than our ordinary cereals. The cocoa-nut is doubtless the most valuable nut in hot countries, both as yielding fluid and solid food, besides oil and fat for commercial purposes; whilst the edible chestnut is the most useful in temperate climates, and supplies a larger proportion of starch and smaller proportion of fat than the cocoa-nut. The nutritive value of these products has not yet been sufficiently appreciated.

Starchy Foods.—Foods which are composed almost exclusively of starch are artificial, for they must be prepared by man from natural foods. Such are sago, tapioca, arrow root, cassava meal, and manioc. None are absolutely destitute of nitrogen, but the quantity is so small that it may be practically discarded in our calculations. Sago is obtained from several palms by beating and washing the pith, whilst all the others are extracted from the roots of plants. Arrow root is prepared from the *Maranta arundinacea*, or even the potato, and the others from the *Jatropha* and other euphorbiaceous plants, which contain poisonous juices until expelled by heat. The process is the same in all viz. to beat the root and wash and dry the fecula. The size and color of the grains depend upon the mode of preparation. All are practically equal in nutritive value, but Bermuda arrow-root is preferred in the market. These foods may be readily distinguished from each other by the microscope, which shows the figure and size of the starch-cells. As all are really starches, their respective values depend upon flavor and abundance in the market, and not upon their relative usefulness in the system. All alike require to be sufficiently cooked, so as to burst the cells and to thicken the fluid in which they are macerated, and for the use of young infants must be given with milk and other nitrogenous food. Hence, they are of even less value than the potato as separate foods, but as adjuncts are most agreeable, and therefore useful.

Sugar is found in almost every kind of vegetable foods, but particularly in fruits, where it is called fruit or grape sugar; in the sugar-cane (*Saccharum officinarum*) and Chinese sugar grass (*Sorghum saccharatum*), where it is known as cane-sugar; and in milk, as milk-sugar. The composition of sugars varies only in the elements of water, and that of cane is $C_{12}H_{11}O_{11}$; but all are not equal in sweetening properties. The quantities per cent. found in certain foods are as follows: raw sugar, 95; treacle, 77; buttermilk, 6.4; carrots, 6.1; parsnips, 5.8; oat meal, 5.4; skim milk, 5.4; new milk, 5.2; barley meal, 4.9; wheat flour, 4.2; rye meal, 3.7; wheaten bread, 3.6; potatoes, 3.2; turnips, 3.1; peas, 2.0; Indian meal and rice, 0.4.

The largest source for the sugar-market is doubtless the sugar-cane, and the next beet-root (*Beta vulgaris*), but a considerable quantity is obtained in North America from the sugar-maple (*Acer saccharinum*). In India much is extracted from the juices of various palm trees, and particularly of the wild date and the *Arenga saccharifera*. The juice is expressed from the whole substance of the cane and beet-root by great pressure, whilst the tree of the sugar-maple is tapped for the exudation of the juice, and the male flower of the palm is cut off for the same purpose. In all cases there are impurities with the sugar, which are extracted by the addition of quicklime and by the removal of a scum which arises with furious boiling. The liquor is then evaporated and crystallized in vacuum pans, leaving an uncrystallizable sugar in the form of treacle. The crystals are further purified, either by the aid of moist clay or by the centrifugal process. Refined or loaf sugar is purified by treating the dissolved crystals with bullocks' blood, and again concentrating and crystallizing in the vacuum pan, and the uncrystallizable syrup is removed from the crystals. That kind of raw sugar is the best which has the largest crystals and the least proportion of moisture; and of loaf sugar that which is the whitest and hardest. Golden syrup is produced in refining sugar.

Honey is not the product of the bee, as many believe, but is simply collected by that useful insect from flowers, and has a flavor varying with its source. Some of the finest is obtained from Mount Hymettus in Greece, whilst that procured from certain plants, as the azaleas, is said to be poisonous.

Manna as ordinarily obtained is derived from the juices of the manna ash, growing in Southern Europe. It is also found as a deposit upon the trees and ground under certain conditions of weather and climate, when it is in grains as small as a coriander-seed, and if not carefully picked will be mixed with other substances. Its peculiar substance is called *mannite*.

C. *Animal Foods.*—All kinds of flesh have their essential properties in common, and for ordinary dietetic purposes are interchangeable; but as lean corresponds with lean and fat with fat, the true distinction is the proportion of one to the other: thus, there is the largest proportion of fat in the pig, and a greater in sheep than oxen as ordinarily fed and when ready for the butcher. The same quantity of food produces a larger quantity of fat in one than in the other: thus, with 100 pounds of nitrogenous food the pig produces 13.5 pounds of fat, the sheep 4.2 pounds, and oxen 4.1 pounds, while the same quantity of carbonaceous material produces 18.5 pounds, 9.4 pounds, and 7.2 pounds in the three classes.

The flesh of all animals consists of bundles of extremely fine tubes which contain the meat juices. The better the breed and feeding, the richer are the juices in flavor and fat, whilst the older the animal, the tougher are the fibres or tubes and the tissue which connects them. Each class of animals has its own special characters, but the quantity of meat depends upon these two conditions. This is true of the nitrogenous part of an animal, but the fat, which is carbonaceous, is nitrogenous only to the extent of the fine tissues in which it is contained. Beef has always been regarded as the kind of flesh which gives the best nutriment to the eater, whilst mutton and poultry are softer in texture and more delicate in flavor. The flesh of wild animals approaches to, if it does not exceed, beef in nutritious qualities, but it is almost always harder, and requires a degree of decomposition to separate its fibres. The rich

flavor of wild game seems to be due chiefly to the activity of the animal, and is nearly lost with domestication. Pork and veal have always been regarded as less digestible than beef, but this depends upon the quality and age of the animals. Some pieces of pork are hard, and masticated with difficulty, whilst other kinds are soft, and easily crushed by the teeth. Very young veal has fibres so soft that the teeth can scarcely grind them, whilst a calf eight or ten months old affords meat as easily masticated and digested as mutton.

The juices of flesh are obtained when making beef-tea and Liebig's extract of meat. In the former the meat is cut into extremely small portions and heated for some time with a little water, whilst in the latter the flesh is boiled down and all the fat, fibrin, and albumen removed. Both contain nearly all the salts which were present in the flesh, but the latter has a larger portion of extractives, containing the peculiar flavor of the meat. Liebig's extract is valuable as a nervine stimulant and meat flavorer, but is not a rich nutrient in the ordinary sense of the word, and should not be depended upon to serve as food without admixture of other nutritious substances.

The flesh of fish contains more phosphorus, and differs little from that of animals in chemical composition, but much in texture and flavor, and the nearest approach is found in salmon and sturgeon. The proportion of fat and oil to flesh is in some kinds greater than that of quadrupeds, for the eel contains 50 per cent., herring 30 per cent., and a salmon in fine condition 10 to 20 per cent. White-fish usually contains less than red-blooded fish, but some of the former, as the cod, lay up a large store of oil in the liver. Fish is rich in phosphorus. On the whole, fish is excellent food, but not equal to flesh, nor sufficient to maintain full health and strength. Leprosy is found chiefly in fish-eating and poverty-stricken populations. The roe of fish is a luxury, and contains both albuminous and fatty matters, and when obtained from the sturgeon and some other fish, and prepared, is called *caviare*. It is eaten raw in Sweden and Russia as an appetizer before dinner. The gelatinous parts of fish, as the head and fins, are also much prized, but unless eaten in great quantity do not suffice for a meal. When fish, as herring, is cheap, it is the cheapest of all animal foods in the market in proportion to the nutriment contained in it, but its price is subject to great variation. Oysters are delicacies rather than necessary food, whilst lobsters and similar shell-fish are too indigestible to be eaten by some persons with impunity.

Eggs consist chiefly of albumen, but the yolk contains oil, and there are also sulphur and other elements which have a certain nutritive value. They are not fitted to supplant flesh, but rank next to fish. All have the same nutritive value in proportion to their size, but some are repelling in flavor, as those of fish-eating birds, whilst others are delicious, as those of well-bred and well-fed barndoor fowls. Those of the plover are amongst the most delicate in flavor. It is not desirable that they should be boiled hard, unless to be grated down, but they may be boiled, as in puddings, when well divided into the semi-liquid state. The highly nutritious quality of an egg may be appreciated from the following percentage analysis, and but few know that it contains so large a proportion of fat as is shown in the following statement: thus, dry matter, 30; dry fat, 11.0; carbon, 17.52, or carbon and nitrogen reckoned as carbon, 20.56; mineral matter, 1.4; nitrogen, 2.0; besides water.

Gelatine is a very valuable food, notwithstanding the erroneous inferences which have long been made from the report of the French gelatine commission, and in composition is practically identical with albumen. Isinglass from the gut of the sturgeon is the best form of it, but in China certain birds' nests, with which soup is made, have the preference. It is, however, usually obtained from the bones, skins, and hoofs of animals, of which it constitutes about one-half.

Caseine is obtained principally from milk, but exists largely in peas and almonds, and has the same nutritive character as albumen and gelatine. As ordinarily found in cheese, it is mixed with a proportion of fat (butter), and by drying, as well as by decomposition, acquires a flavor very different from that of fresh curd. Whilst the latter may be eaten with impunity, the former is digested with difficulty and requires careful mastication. Skim-milk cheese contains a larger proportion of nitrogenous and a less proportion of carbonaceous matter, as shown in the following percentage analysis:

	Water.	Nitrogen	Fat	Salts
New-milk cheese, very good	36	28.4	51.1	4.5
Skim-milk cheese	44	44.8	6.3	4.9

The proportion of fat varies much in the best kinds of cheese, as from 18.7 in Neufchâtel to 32.3 in Roquefort, whilst in an ordinary Cheshire cheese it is 26 per cent. The chemical composition of all these elementary substances, and also of flesh if perfectly freed from fat, is almost identical, and may be illustrated by that of albumen, which is C., 53.4; H., 7.0; O., 22.1; and N., 15.7. Hence, the nitrogenous element is somewhat more than one-sixth, and the carbonaceous more than one-half of the dried substance.

Offal.—The offal of animals are the head, feet, liver, lungs, and heart, whilst the blood and bowels may be added to the list for dietetic purposes. The heart consists of muscular fibre or flesh, having, however, a firmer texture, is not so easily masticated, and is much inferior to other flesh as food. The lungs and liver consist largely of albuminous, and the head and feet of gelatinous matter, and whilst not equal to flesh are very good foods, and might be eaten by the poor more largely than at present with advantage. Tripe is prepared chiefly from the stomach of the ox, and contains much fat as well as albuminous and gelatinous substances. Its flavor is delicate, and it is quickly digested. Blood is less valuable as a food than any of the foregoing, but as it contains all the elements under discussion, besides iron and other valuable mineral matters, it should be eaten. When heated to 212° F. it loses any diseased taint that it might have acquired. The nutritive elements in liver and tripe may be ascertained from the following percentage analysis, and compared with a similar one on vegetable foods already given:

	Water.	Nitrogenous	Fat	Salts.
Ox liver	74	18.9	4.1	3.0
Tripe	68	13.2	16.4	2.4

The next is a more elaborate analysis of fresh blood (per cent.): water, 77.9; fibrine, 0.22; fatty matter, 0.16; seroline, 0.002; phosphorized fat, 0.049; cholesterine, 0.009; saponified fat, 0.1; albumen, 6.94; blood-corpuscles, 14.11; extractive matters and salts, 0.68; chloride of sodium, 0.31; other soluble salts, 0.25; earthy phosphates, 0.033; iron, 0.057.

The time required for the digestion of these animal substances was well investigated by Dr. Beaumont, with the following results: pigs' feet and tripe, 1 hour; whipped eggs, salmon-trout, and venison steak, 1½ hours; ox liver and dried codfish, 2 hours; roasted eggs, 2¼ hours; turkey, gelatine, goose, sucking pig, and lamb, 2½ hours; fricasseed chicken and boiled beef, 2¾ hours; roasted beef and boiled mutton, 3 hours; roasted mutton, 3¼ hours; stewed oysters, cheese, hard-boiled or fried eggs, 3½ hours; fried beef, boiled and roasted fowls, roasted ducks, 4 hours; and pork, 5¼ hours.

Fats.—The richest hydro-carbonaceous food is fat, for its elements are C_{77},H_{12},O_{11}, whilst those of starch and sugar are respectively C_6,H_{10},O_5 and C_{12},H_{11},O_{11}. It is customary to reckon fat as equal to two and a half times its weight of starch. All fats have nearly the same composition when freed from water and the tissues in which they are contained, so that one may be substituted for another; but they differ in flavor and the temperature at which they liquefy. So also oils remaining liquid at ordinary temperatures may be eaten instead of solid fats. The fats of meat, butter, lard, and dripping are the fats in most general use, and in their natural state the last contains the greatest proportion of the hydro-carbons, since it has the least proportion of water. The fat of meat is selected simply for its flavor, but butter varies with its manufacture, since it may contain ½ an ounce to 3 ounces of water and ¼ ounce to 2 ounces of salt in the pound. Its flavor is due largely to the food of the animal—as, for example, turnips—and the nature of the animal, for it has a much stronger flavor when produced from the goat or the buffalo than from the cow. A clarified butter called *ghee* is used in India, but is by no means so agreeable as our butter. It is prepared from milk (not cream) by first adding *dhye*, or sour milk, and afterwards hot water, and by churning. In a few days it becomes rancid, and is again clarified, and then kept for use in closed pots. Fat of every kind becomes rancid, unless subjected to some preserving process. Thus, fine sugar is used in condensed milk, salt is added to butter and lard or rubbed into pork or other meat fat, and a patent has recently been granted to Mr. Craig under which mutton or beef fat or suet is rendered hard and white, and may be kept almost without further chemical change for years. The quantity which is consumed by an adult daily is probably 2 to 4 ounces in temperate regions, but in cold climates as many pounds are eaten if obtainable.

There are no animal oils which are avowedly used as food in temperate climates, but in the far North whale oil or seal oil is taken either with or without the solid mass which constitutes the blubber. Lard oils and other animal oils are used largely to adulterate vegetable oils, and fish oils are used as medicines. Vegetable oils are, however, in great request in all temperate and hot climates, and are derived from the seeds of many plants, and particularly from

the pulpy pericarp of the olive, and are a much more agreeable and convenient food than butter. The finest salad oil, expressed from the olive berry without heat, and the oil of cucumbers, are deliciously mild in flavor, and good food. No separated vegetable fat is ordinarily used as food in this climate, but both fat and oil are eaten largely in certain seeds, as the Brazilian nut (*Bertholletia excelsa*), the cocoa-nut (*Cocos nucifera*), and almonds (*Amygdalus*). Fats and oils derived from various seeds are much more commonly used in India and other hot countries than in Europe and America.

Condiments. Condiments are rather adjuncts to food or appetizers than food, although vegetable substances used therein are nutritious. This term includes pickles and sauces, which are almost innumerable, besides pepper, mustard, and vinegar, alone or in combination with other substances. The luxurious habits of the day lead to a free use of these substances, but he who would retain a natural taste for food and a good digestion should either eschew them or use them in their milder forms and in great moderation.

II. Fluid Foods.

Milk is the type of nutritious fluids, since it contains all the elements of nitrogenous and carbonaceous foods in a fluid form. It is therefore adapted to every condition of man, but particularly to such as require the immediate use of food, as in infancy and when there is not time for prolonged digestion. It contains caseine and albumen as its chief nitrogenous elements, and sugar and fat as its carbonaceous, besides salts of the most valuable kinds. The proportion of each varies in different animals and with age, food, and climate, whilst certain special flavors, as hircic acid in goat's milk, mark each kind. With so much variety it is impossible to give more than a general analysis, but even that has at least a comparative value, as in the following table:

	Sp. gr. + 1000.	Water.	Solids.	Nitrogenous compounds.	Sugar.	Fat.	Salts.
Goat ...	33.53	84.49	15.61	3.51	3.69	5.68	0.61
Sheep ...	40.98	83.23	16.77	6.97	3.94	5.13	0.71
Mare......	33.74	90.43	9.57	3.33	3.27	2.43	0.52
Ass...	34.57	89.	10.99	3.56	5.05	1.85	0.54
Woman	32.67	88.9	10.92	3.92	4.36	2.66	0.13
Cow ...	33.38	86.4	13.59	5.52	3.8	3.61	0.66

The salts in milk are small in quantity, but of the utmost value in nutrition, and consist of the following in 100 parts: potash, 23.46; soda, 6.96; lime, 17.34; magnesia, 2.20; chloride of potassium, 14.18; chloride of sodium, 4.74; phosphoric acid, 28.40.

Human milk is the standard of comparison for the food of infants, and varies in quality with health, food, production, and anxiety, but a mixture of two-thirds of ordinary cow's milk with one-third of water and one-half an ounce of milk-sugar or cane-sugar in a pint is a tolerable approximation. Ass's milk is sometimes substituted, and equal parts of it and cow's milk fairly represent human milk. For adults the milk of the cow, goat, and sheep is preferable. Skimmed milk has lost nearly all its fat or butter, and if kept in hot weather becomes sour. The addition of half an ounce of suet in a pint makes it equal to new milk. Buttermilk differs little from skimmed milk, except that it has become more sour by the transformation of sugar into acid, and it is in constant use as a food in Ireland, Wales, and many other countries. Whey is much less valuable, since it has lost both the fat and the cheese, but it offers an agreeable acid in warm weather, and the useful salts of milk. It is, however, never absolutely destitute of fat and caseine, and has some nutritive value from its milk sugar. Preserved milk may be made from either new or skimmed milk, or with a part only of the cream removed. It may be simply condensed, so that four parts become one, in which state it will remain good from one to four weeks, or it may be preserved so as to remain undecomposed for many months by the addition of refined sugar and an alkali, and by evaporation. A one-pound tin contains three to four ounces of sugar, and as sugar is destitute of nitrogen, the proportion of nitrogen in the milk is thus reduced. The proportion of nitrogen to carbon in natural milk is about 1 to 12, which is little more than in bread, whilst in sugar preserved milk it is about 1 to 20; and it is more fattening and less flesh-forming than natural milk.

Tea, Coffee, Cocoa, Chocolate.—These substances, from which so large a proportion of our beverages are made, have elements in common by which a sort of unity is given to the whole, viz. the chemically identical compounds called *theine* in tea and *caffeine* in coffee; while the *theobromine* of cacao and chocolate, though by no means of the same composition, is believed to have analogous effects upon the animal economy. The quantity is too small to be regarded simply as a nutrient, but it is believed to exert a peculiar action on the nervous system. (See Tea.)

Tea should always be prepared with water which has just begun to boil, and before the air is expelled, and the water should be from a running stream, and soft, or be softened by the addition of a pinch of carbonate of soda. It has a very powerful action on the respiratory system, by which that function is greatly increased, and also over the nervous system, by both of which wakefulness is very commonly produced. It should be taken with food after a good meal, rather than alone or when fasting. It is especially fitted for warm weather, when there is a desire to cool the body, for it produces perspiration. Europeans and Americans drink a much stronger infusion than the Chinese, but do not do so with impunity, for it is apt to produce nervous and mental excitement and indigestion, and is not unfrequently followed by a reaction in which the spirits and vital powers are depressed.

In preparing coffee for the table it should be freshly ground, and may be mixed with one quarter of its volume of chicory, and infused in boiling water ten minutes or longer, after which it should be boiled for a minute before being served. Hot new milk should be added to it in equal parts. It is a powerful respiratory excitant, but differs from tea in that it tends to dry the skin and to increase the force of the heart's action, and thus it more nearly resembles animal food than tea.

Chicory has an analogous action to coffee (but in greatly inferior degree), so that the addition of it to coffee is not without value. It is prepared from the root of the well-known vegetable after it has been roasted with fat, dried to a brown color, and ground into powder. (See Coffee.)

Chocolate and cocoa are produced from the seed of the *Cacao theobroma*, the pods of the ground nut (*Arachis hypogæa*, the cacao-shrub of Zanzibar, and other plants. The nuts are coarsely broken and called cacao-nuts, after which they are carefully ground under a considerable pressure, and with wheels having a very smooth surface, so as to be reduced to an impalpable powder. Sugar is usually added in preparing chocolate, but not so generally to produce cocoa. The peculiar principle which they possess is called *theobromine*, of the formula $C_7H_8N_4O_2$, but the flavor depends upon volatile oil and fat, which constitute 34 to 37 per cent. of the whole.

Alcohols.—The limits of this article do not allow us to do more than give a general sketch of these important substances, but the subject is discussed at length in our works on *Foods* and *Practical Dietary*. Ordinary or ethylic alcohol is the product of the fermentation of saccharine substances, whether they be malt, grain, potato, beetroot, sugar, or molasses, and comes over, mixed with other compounds, in distillation. The portions which distill early in the process are the finest and purest, and are used for the manufacture of the finest essences and spirits, whilst the later are mixed with an increasing quantity of fusel oil, until at length they are fit only for the manufacture of varnish. Alcohol is an artificial and not a natural product, and in the process referred to is mixed with a proportion of water, but it is possible by a further process to remove the water, when the remaining fluid is called absolute alcohol, of the formula C_4, H_6, O_2, and specific gravity 0.793. It is never sold in this form for use as food, but is mixed with water, and when about equal quantities of water and absolute alcohol are added together, *proof spirit* is produced, with a specific gravity of 0.920. When spirits of various kinds are manufactured they are prepared of various strengths, but usually brandy is imported at 1° or 2°; whisky at proof, or 10° over proof; rum at 20° to 30° over proof; and gin at 17° under proof; which means that if a number of gallons of water equal to the degrees over proof were added, the result would be proof spirit. The retailer often lowers the quantity of the spirit by adding water, so that he may sell the same spirit at 10° to 30° under proof.

It is denied by many that alcohol is a food, since they say it is not decomposed and transformed, but leaves the body in the same or an analogous condition to that in which it entered; whilst others dispute the inference, because the alcohol administered in any one experiment has in no case been all recovered in the excretions. In our experiments on respiration the action of alcohol when it was tolerably pure was to slightly increase the vital actions, but when mixed with much fusel oil it diminished them, and acted as a narcotic poison. Its action was not, however, regular and progressive, like that of food, but irregular and jerky, so that it rather disturbed than increased vital actions. It, however, exerts a physical action, which in part goes temporarily to diminish the necessity for food, in that it dries the skin and thus saves heat; whilst if it be strong it locally stimulates the mouth, throat,

and stomach. It also tends to harden food, and so far to interfere with the digestion of it; and it has been proved to lower the temperature of the body, which is not the characteristic of a food. But alcohol is only one of the elements in this class of fluids, and does not therefore give a uniform character to them all. The essential oils in brandy and other spirits, which are developed in the manufacture or produced by time, give approved flavors, and rum contains a large quantity of sugar, by which it increases the respiratory actions in a degree far beyond other spirits. Alcohol remains in the tissues for a period of one or two days, and as the aim should be to rid the body of it, those forms are the best which increase some diminishing action, as that of the lungs or kidneys. The addition of juniper berries to hollands and gin effects the latter object, but if habitually indulged in may go beyond the necessities of the case and bring on kidney disease. Rum is the least hurtful of spirits—a quality which is owing probably to the eliminating action of sugar. Wines, when the product of the grape only, obtain the alcohol which they possess from the fermentation of the sugar in the juice of the grape, and if the fermentation be complete, no sugar remains. Sugar bears a proportion to the other elements of the juice, and as the quantity of alcohol produced is a measure of the sugar, it is also a measure of all the elements; and therefore, as is the alcohol in natural wine, so is the value of the grape-juice. Thus, the wines of comparatively cold climates, as the Rhine and north of France, do not yield more than 9 to 16 per cent. of alcohol, whilst those of hotter climates and volcanic soils, as Greece, yield 26 or 27 per cent. The latter therefore are fuller in body than the former, and so far should be more valuable as food.

The salts in wine are very valuable as food, as, for example, the tartrates and malates of potash, which give a tartness (but not from a free acid) to natural wines, and are deposited with age, or more rapidly when gypsum (sulphate of lime) is added, which sets free the vegetable acids. When the wine is red the coloring-matter and tannin are deposited with them and form a crust; but in old white wines the tartar may be seen as a whitish powder, moving as the bottle is turned up. The chief advantage of such wines (apart from alcohol), when comparatively new, lies in these salts, but when older in the essential oils and ethers.

There is a flavor and bouquet connected with each kind of wine which gives pleasure to the consumer, and introduces it into the class of luxuries. Such as are in general favor command prices far beyond their value as food, and indeed beyond any value besides that of rarity. Their choice qualities are due partly to growth, for one plot of ground may produce flavors far superior to that of an adjoining vineyard; partly to selection of the ripest grapes and care in the manufacture; partly to the process of maturation, which cannot be determined beforehand; and partly to the age of the wine, and hence skill and capital are largely required to produce a luxurious if not a dietetic wine. The production of this class of wine is most rapidly extending, and now embraces the central parts of Europe, large districts in America, as in Ohio and California, Italy, Greece, Hungary, Australia, and the Cape of Good Hope; but hilly or mountainous ranges, with a warm soil and sunny skies, without extremes of heat and cold, are the most suitable, and the limits may be indefinitely extended.

Fortified wines (and therefore adulterated) are those to which alcohol is added which was not produced from the grapes under manipulation, and which are commonly of inferior quality. Such are port, sherry, and madeira, which are rather weak ardent spirits or liquors than wines. The strength of these wines is from 38 to 42 per cent. of alcohol, and the objects of the manufacturers are to gratify a taste for strong liquors and to preserve the wine. They are prepared for particular markets, and not for home consumption, so that such port and sherry as are sent to England are not drank in the countries of their production. The alcoholic strength of champagnes varies very much, but seldom exceeds 20 per cent.

A chief effect of the addition of alcohol is to arrest the fermentation, and a quantity of grape-sugar remains in the wine which may doubtless ferment in the body, and by producing acetic acid may cause acidity of the stomach. True champagne and other effervescing wines are prepared from ordinary grapes, but the juice is chosen with great care as to its flavor, bouquet, and sugar, and such a combination is made as will produce the quality of champagne which the manufacturer desires. It is fermented in large vats or in smaller casks, after which it is drawn off, fined, and placed in underground cellars. Here it is frequently racked and fined until the following April, when it is bottled, and for three weeks again ferments freely. It is then kept under watch for two, three, or four years, during which time it is at first turbid, but afterwards deposits a substance which by proper inclination of the bottle is left upon the cork; and the latter being skilfully removed, allows the deposit to escape. In this state the wine is matured, and called *vin brut;* and if the quality of the grape was fine and the subsequent treatment successful, the wine is very dry and has the flavor of the grape. Messrs. H. & G. Hirsch of Mayence prepare Rhine and Moselle wines in this state for the market with great success, but it is much more common to add a sweet compound of the finest sugar-candy, champagne, and old cognac or other liquors, by which the required sweetness and alcoholic strength is produced. The quantity of this liqueur is usually from 2 to 6 per cent., but it varies with the natural richness of the juice of the grape converted into champagne. The recent vintages of 1865 and 1868 form the finest *vin brut.* The effervescence is creamy rather than frothy, and rises in bubbles for hours rather than discharges the gas at once, and the bouquet and aroma are perfect. The Muscadine, Lemel, and Frontignac grapes have special odors which remain in the champagne, and some of the ripest bunches are allowed to hang in the cask. Red grapes naturally give a slight tinge to the wine, but pink champagne is artificially colored with cochineal. It is said that a bitter principle is added to certain kinds to modify the sweetness. There are certain wines, as Frontignac, Cyprus, and Tokay, produced from grapes which are allowed to dry upon the vine, and thus become raisins. The flavor readily proves this fact, and as the resulting wine is never perfectly fermented, it is rich and luscious, and contains much sugar. From the foregoing observations it will be seen how readily fictitious wines may be made, either with inferior wines or without grapes, as is commonly effected at Hamburg, Cette, and in the south of France. EDWARD SMITH.

Foolahs. See FELLATAHS.

Fool, Licensed, or **Court Jester,** called also **Clown,** a personage found in the courts of kings and nobles of mediæval Europe, whose employment it was to amuse the household by witty and mirth-provoking acts and sayings. The custom originated in the East, and was not unknown in ancient Greece and in the Roman empire. More than one fool was often kept, and at some courts there were large numbers of buffoons. Court fools were sometimes persons of weak intellect or dwarfs, but were often men of exceedingly sharp wit, and even of learning and talents. Such was John Heywood, the poet and dramatist, who was jester to Henry VIII. The published volume of the jests of John Scogan, fool to Edward IV., show that the coarsest and stupidest jests were tolerated by that monarch. The same thing is shown by the extant writings of John Skelton, who, though a priest, united the office of court-jester to that of poet-laureate. Several volumes of jokes ascribed to Archy Armstrong, court-fool of Charles I., are extant. The reputed jests of this personage and of Patrick Bonnie, a Scottish buffoon, are largely current among the British peasantry. Fools enjoyed large license in the exercise of their profession, but were made the victims of all sorts of practical jokes designed to promote the mirth of the idle people with whom they were associated. Says Ascham (*Tox.*, book i.), speaking of those who oppose archery-practice, "they be not moche vnlyke in this poynt to Wyll Somer the king his foole, which smiteth him that standeth alwayes before his face, be he neuer so worshipfull a man, and neuer greatly lokes for him whiche lurkes behinde an other man his backe that hurt him in dede"—a passage which illustrates at once the license accorded to fools and the stupid abuse to which they were subjected. This Somer lived at the court of Henry VIII. Many jesters seem to have been self-constituted ones. Thus, More (*Utopia*, lib. i., Robynson's translation), speaking of a jester at Cardinal Morton's court, says, "There chaunced to stand by a certain iesting parasite or scoffer which wold seme to resemble and counterfeit ye foole. But he did in suche wise counterfeit that he was almost the verye same in dede that he labored to represent; . . . he himselfe was oftener laughed at than his iestes were," etc. A fool's cap and bells, a bauble (consisting of a stick with a bladder at the end), a coat of motley or of calfskin, and an ass's ears were the usual badges of this office, but the jesters of the better class were not always thus decorated. The names of a large number of French and German jesters and fools have been preserved, some of them apparently men of refinement and real wit, and others of all the grades of stupidity, even to idiocy. C. W. GREENE.

Fools, Festival of [Lat. *Festum Stultorum* or *Festum Fatuorum*], a mediæval Christian merry-making, of fantastic and childish character, which fell especially upon Holy Innocents' Day (Dec. 28), but had more or less to do with the whole period between Christmas and Epiphany (Jan. 6). Exercises were held in the principal church edifice of the

place; a mock pope, archbishop, or bishop was chosen; and all the most sacred rites of Christianity were travestied. The wild license which reigned resembled that of the old Roman *Saturnalia*. The leading performers were of the lower clerical orders, especially the sub-deacons; hence another name for the festival, *Festum Hypodiaconorum*, with some reference to Saint Stephen, who is commemorated on the 26th of December. The aim professed was to interest young and ignorant people in the story of the Advent, but profaneness soon got the better of piety in the matter. This festival, which is first mentioned by the Parisian Ritualist, John Beleth, in the latter half of the twelfth century, originated apparently in France, and was more popular there than anywhere else, though observed also in Spain, in Germany, and in England. In spite of repeated condemnations by prelates and councils, it survived the Protestant Reformation, one instance of its observance being reported as late even as 1644. R. D. HITCHCOCK.

Fools' Par'sley (the *Æthusa cynapium*), a poisonous umbelliferous plant, so called because it somewhat resembles in appearance the smooth-leaved varieties of parsley, so that people who have by mistake gathered it for parsley have been seriously poisoned by it. It is a native of Europe, naturalized in the U. S. It may be distinguished by its acrid taste and fetid smell; its general umbels have no involucre; its minor umbels a partial involucre of three leaves; in both respects quite unlike parsley. It is an acro-narcotic, causing numbness, faintness, and dimness of vision. Give as an antidote a thorough emetic, followed by wine or other gentle stimulant.

Foo'see, or **Fu'si-ya'ma,** the highest mountain of Japan, on the island of Niphon, stands completely isolated and rises 14,170 feet above the sea. According to Japanese historians, this mountain suddenly emerged in one single night in the year 285 B. C., and a corresponding depression formed the lake of Mitsoo at the same time. Although it has had no great eruptions since 1760, it is still an active volcano, and the natives regard it with a kind of religious awe. Its crags are filled with idols, which annually are visited by crowds of pilgrims.

Foo-Shan, or **Fou-Schan,** town of China, in the province of Quang-Tong, 20 miles N. E. of Canton, is said to have 200,000 inhabitants.

Foot, in anatomy. See FOOT, STRUCTURE OF THE, by PROF. EDWARD HITCHCOCK, A. M., M. D.

Foot, the name of the unit of linear measure in common use in the U. S. and in England. All the nations of Europe and their colonies or dependencies employ, or have employed, a unit of length having in each language a name of the same significancy as *foot* in English. This identity of name indicates similarity of origin, which was therefore unquestionably the length of the human foot. No two peoples, however, have agreed in the value assigned to their foot-measures. No two provinces, and hardly any two considerable towns even, have had the same foot. Nor have any of these measures corresponded very nearly with the presumed prototype; nearly every one of them being greater, and many of them much greater, than the average length of the foot of an adult man. In the volume of *Investigations in the Military and Anthropological Statistics of American Soldiers*, by Dr. B. A. Gould, published in 1869 among the memoirs of the U. S. Sanitary Commission, are given measurements of nearly 16,000 individual men, volunteers for the army, of various races and nationalities, 11,000 being white and the rest colored. The mean length of the foot was found for no nationality to exceed $10\frac{24}{100}$ inches, and for none to fall short of $9\frac{89}{100}$; the mean value for the total being $10\frac{058}{1000}$, or about one-twentieth of an inch above ten inches. It is probable that the foot-measures in use in the later centuries have been in general entirely arbitrary. The account commonly given of the adjustment of the British standard yard in the year 1101 from the arm of the king, Henry I., is probably a true one; and the British foot is simply one third of the British yard. But it was doubtless otherwise in the earlier ages. The ancient Greeks first used this measure, and their Olympic foot was said to have been determined by the length of the foot of Hercules. This, according to the best authorities, was about equivalent to $12\frac{14}{100}$ English inches. But there were among them other foot-measures materially differing from this. Thus, the Macedonian foot was 11[illegible] inches; the Pythian, 9[illegible] inches; and the Sicilian, 8[illegible] inches. In more recent times the diversity has been almost endless. In Italy the foot was, not long ago, $11\frac{62}{100}$ inches in Rome, 1[illegible] in Milan, and 2[illegible] inches in Lucca. In France it was 9[illegible] inches in Avignon, $9\frac{73}{100}$ inches in Aix en Provence, 10[illegible] inches in Rouen, 11[illegible] inches in Bordeaux, while the *pied du roi* of Paris was $12\frac{79}{100}$ inches. In Switzerland it was $10\frac{52}{100}$ inches in Neufchâtel, 11[illegible] inches in Rostock, 11[illegible] inches in Bâle, and $19\frac{21}{100}$ inches in Geneva. In the Spanish peninsula it was 10[illegible] inches in Aragon and $10\frac{98}{100}$ in Castile. In Germany it was $9\frac{25}{100}$ in Wesel, $10\frac{89}{100}$ inches in Bavaria, $10\frac{228}{1000}$ inches in Heidelberg, $11\frac{15}{100}$ inches in Göttingen, and 1[illegible] inches in Carlsruhe. And in the Netherlands it was $10\frac{86}{100}$ inches in Brussels and $11\frac{45}{100}$ in Liège. Alexander's *Dictionary of Weights and Measures* (Baltimore, 1850) gives more than 100 foot-measures, all differing from each other. Doursther's *Dictionnaire Universel des Poids et Mésures, Anciens et Modernes* (Brussels, 1840) makes the number more nearly 1000. The confusion resulting from this great diversity was intolerable. The inconvenience caused by it in business transactions prepared the public mind of Europe early in this century to receive with favor the new system of metrology called the metric, introduced first into France at the close of the last. The foot has therefore ceased to be the legal unit of length in all the countries of Europe except Great Britain, Russia, Turkey, and the Scandinavian peninsula, and the mètre has taken its place. The Russian unit of length, the *sagene*, was fixed by Peter the Great after his sojourn in England in 1698, at exactly seven British feet. The foot of the U. S. is identical with that of Great Britain, from which it is copied. In both countries the legal standard is properly the yard of thirty-six inches. The copy of the British standard, by which the U. S. standards were till recently adjusted, is a brass bar prepared by the celebrated Troughton of London to the order of Prof. F. R. Hassler, the first chief of the U. S. Coast Survey, and superintendent of the bureau of weights and measures at Washington. It is eighty-two inches in length, and the thirty-six inches between the twenty-seventh and the sixty-third divisions were taken as the prototype yard of the U. S. A few years since, however, a copy of the British prototype, officially certified, has been substituted for the Troughton bar, and the standards furnished the several States are now carefully adjusted by this. F. A. P. BARNARD.

Foot. In organ music, directions are often given for the use of 4-foot, 8-foot, or 16-foot stops. The meaning is this: the lowest note on the key-board (C. C.) is assumed as the standard for such designations. Now, to produce the sound C. C., an open pipe 8 feet long is required; its octave *above* will be given by a pipe 4 feet long; the double octave, 2 feet, and so on; and for the intermediate notes the pipes are properly graduated in length. A set of pipes of this description is therefore called "an *8-foot stop*" (as the *open diapason, dulciana, trumpet*, and several others). Such stops give the ordinary, standard, or concert *pitch*. If another range of pipes be added, sounding an *octave lower*, they will be of double length, and it will be called "a 16-foot stop" (as the *double-diapason*, or *bourdon*). On the other hand, the *principal* is an octave *higher* than the open diapason; consequently, its pipes are only half as long, and it is called "a 4-foot stop." The *fifteenth*, in like manner, being tuned an octave above the principal, is "a 2-foot stop," its lowest pipe being of that length. In a large organ there are many stops belonging to each of these classes, the largest pipe of a 32 foot stop sounding C. C. C. C. WILLIAM STAUNTON.

Foot (SOLOMON), lawyer and U. S. Senator, b. at Cornwall, Vt., Nov. 19, 1802; graduated at Middlebury College, Vt., in 1826; was principal of Castleton Seminary in 1826 and 1828; tutor in Vermont University in 1827; professor of natural philosophy in the Academy of Medicine at Castleton, Vt., 1828–31; was admitted to the bar in 1831, and settled at Rutland, Vt. In 1833, 1836–38, and in 1847 was in the Vermont legislature, and Speaker of its House for his last three terms. Was M. C. 1843–47, and U. S. Senator from 1850 to his death, at Washington, D. C., Mar. 28, 1866. Mr. Foot was for some years president *pro tempore* of the U. S. Senate; was a Whig in politics, and a man of great probity and wisdom in public and in private life.

Foo'ta (or **Fu'ta**) **To'ro,** a territory of Western Africa, in Senegambia, between lat. 15° and 16° 25' N., consists mostly of low, flat, extremely hot, but very fertile and not unhealthy plains, covered in many places with immense forests. It is inhabited by about 800,000 Mohammedan negroes, who cultivate rice and cotton, have built large cities, established a kind of theocratic government, and started several branches of manufacturing industry. To Medinalla, the chief town, hundreds of Mohammedan youths, Moors and negroes, gather to study the Koran, and in Canel are rich iron mines and large smelting houses, in which a very good cast iron is produced.

Foo'ta Jal'lon is the name of a wild and mountainous region of Senegambia, the highest of that portion of Western Africa in which the rivers Senegal, Gambia, and Grande have their sources. The elevation of the country may not average much above 2000 feet, but some peaks are so high that they are said to be covered with snow during the rainy season. The mountains are rugged and

abrupt, and clad as they are with dense forests, they present most striking and beautiful scenery. Timbo, the capital, is situated in lat. 10° 25′ N. and lon. 10° 40′ W.

Foot-Ball, a game played in the open air with a large hollow ball made of gum-elastic or of the bladder of an ox covered with leather, the latter kind being preferred. This ball is kicked to and fro by a greater or less number of players arranged in two parties, each of which tries to send the ball to the goal of the opposite party, and to keep it from their own goal. The game is a favorite one at many schools, and the rules for playing it are quite various.

Foote, county of the S. W. of Kansas. Area, 720 square miles. It is traversed by the Arkansas River.

Foote (ANDREW HULL), b. May 4, 1808, at New Haven, Conn., entered the navy as a midshipman Dec. 4, 1822; became a lieutenant in 1830, a commander in 1852, a captain in 1861, a rear-admiral in 1863. Among the distinguished men of the navy at the breaking out of the civil war, perhaps none stood higher in the estimation of his brother-officers than Andrew H. Foote, and certainly no appointment gave greater satisfaction to the service than his, in the fall of 1861, to the command of the Western flotilla, then in course of construction for the purpose of opening the navigation of the Mississippi River. "The service," says Secretary Welles in his report of 1862, "was anomalous in its character, and there was with many great incredulity as to the utility and practicability of gunboats in carrying on hostilities on the rivers, where it was believed batteries on the banks could prevent their passage. There were also embarrassments for want of funds and of material for naval purposes, there being no navy-yard or naval dépôt on the Western waters. All these difficulties were met and surmounted by the energetic and efficient officer to whom the duty was entrusted, whose perseverance and courage in overcoming the obstacles that impeded and retarded his operations in creating a river navy were scarcely surpassed by the heroic qualities displayed in subsequent well-fought actions on the decks of the gunboats he had under so many discouragements prepared." On Feb. 6, 1862, Foote took Fort Henry after a most obstinate fight; on the 14th of the same month engaged Fort Donelson, for an hour and a half, with four iron-clads and two wooden gunboats, and so demoralized its garrison as to ensure an easy victory over it by the army on the following morning; and on the 7th of April, after many a hard-fought action with its numerous batteries, received the surrender of Island No. 10, considered by the Confederates, next to Vicksburg, their most important stronghold on the Mississippi. Unfortunately, however, the flag officer had received a severe wound at Fort Donelson, which from neglect had become so serious as to endanger his life, and now, in the full tide of success, he was forced to resign his command to another and return to his home. On June 16, 1862, he received the thanks of Congress and was made a rear-admiral, and on the 22d of that month was appointed chief of the bureau of equipment and recruiting. On June 4, 1863, he was ordered to relieve Rear-admiral Dupont off Charleston, and on his way to his command was taken ill at New York, where he d. June 26, 1863. The loss sustained by the navy in the death of this gallant admiral was almost irreparable, for he had long been looked up to as the best type of a naval officer. An humble and devout Christian, endowed with the noblest attributes of humanity, and possessed of unflinching moral and physical courage, he taught those who served under him, both by precept and example, not only to fight but to pray, turned many a profligate from the error of his ways, smoothed many a dying seaman's pillow, and finally laid down his life with calmness and resignation in the full faith of a blessed immortality. (See his *Life*, by J. M. HOPPIN, 1874.) FOXHALL A. PARKER.

Foote (HENRY STUART), b. in Fauquier co., Va., Sept. 20, 1800; graduated at Washington College, Va., in 1819; was licensed to practice law in 1822; removed to Tuscumbia, Ala., in 1824; edited a Democratic paper, and in 1826 established himself at Jackson, Miss. Was presidential elector in 1844, and in 1847 was elected U. S. Senator, which position he held until 1852. Was elected governor of Mississippi over Jefferson Davis in that year. In 1854 removed to California; in 1858 settled at Vicksburg, Miss., and at the Southern convention at Knoxville, Tenn., in May, 1859, spoke against disunion; was a member, however, of the Confederate Congress. In 1866 he published a *History of the Secession Struggle*. D. May 19, 1880.

Foote (JOSEPH IVES), D. D., b. at Watertown, Conn., Nov. 17, 1796; graduated at Union College in 1821, and at Andover (Mass.) Theological Seminary in 1824. From Oct., 1826, to 1832, was Congregational pastor at West Brookfield, Mass., then in Salina, N. Y., in 1833–35, in Cortland, N. Y., 1835–37, and in 1839 entered upon a Presbyterian pastorate in Knoxville, Tenn. In 1840 was appointed president of Washington College, Tenn. A volume of his sermons, with memoir, was published at New York in 1841. D. Apr. 21, 1840.

Foote (SAMUEL), actor, wit, and dramatist, "the English Aristophanes," b. at Truro in 1720; studied at Worcester College, Oxford (whence he was expelled for indiscretions), and at the Middle Temple, but indulged in gaming and other excesses until his considerable fortune was expended; and in 1744 he made his appearance as Othello at the Haymarket, but his success was small until he began to play in pieces written by himself; and his best characters were ludicrous imitations of living public men. From 1747 to 1767 he conducted the Little Haymarket Theatre without license, no one daring to enforce the law against him for fear of his terrible mimicry. He wrote at least twenty-seven plays of small literary merit, of which twenty or more have been printed. His humor was of the broadest and noisest kind, and his jests were often practical ones, not without a large element of brutality. An accident which led to the loss of a leg was followed by paralysis, and the last years of his life were passed in great physical and mental distress. D. at Dover Oct. 21, 1777.

Foote (SAMUEL AUGUSTUS), LL.D., U. S. Senator, b. at Cheshire, Conn., Nov. 8, 1780; graduated at Yale College in 1797, and practised law in Cheshire; was representative in Congress from Connecticut in 1819, 1823, and 1833; Speaker of the Connecticut assembly in 1825–26, and Senator in Congress from 1827 to 1833. In 1834 was governor of Connecticut, and in 1844 presidential elector. D. Sept. 16, 1846. Senator Foote offered in the U. S. Senate the resolutions upon which the great debate occurred between Hayne of South Carolina and Webster of Massachusetts.

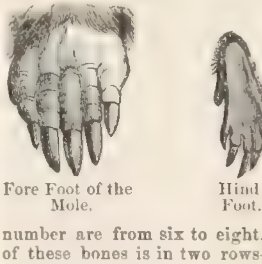
Foote (WILLIAM HENRY), D. D., b. at Colchester, Conn., Dec. 20, 1794; graduated at Yale in 1816; taught at Falmouth and Winchester, Va.; studied in Princeton (N. J.) Theological Seminary; was licensed by the presbytery of Winchester Oct., 1819; preached in Virginia; was agent of the central board of missions; prepared *Sketches, Biographical and Historical, of the Presbyterian Church in Virginia* (2 vols., 1850–55) and in *North Carolina* (1 vol., 1846). Was also agent for Hampden-Sidney College in Virginia, and Confederate chaplain at Petersburg, Va., during its siege. D. at Romney, Va., Nov. 28, 1869. *The Huguenots, or Reformed French Church,* was published after his death.

Foot-Rot, a disease of sheep which is rare in the U. S. Sometimes, when sheep from rocky pastures are taken to the English fen-country to fatten, the hoof grows too rapidly for its new conditions, and when it has become long it may become cracked and broken, or in part separated from the fleshy part of the foot. Sand and grass may lodge on the raw surface, and lead to active inflammation. The cure is in removal of the foreign matter, clipping of the hoof, and the application of stimulants and caustics, with removal to a dry pasture. (See FOUL IN THE FOOT.)

Foot, Structure of the. *Foot of Mammals.*—The foot (*pes*) in mammals, and in some other vertebrates in distinction from the hand (*manus*), is the last member or terminal segment of the pelvic girdle, or lower limb. The fore limbs are more generally used for the support, and the hind limbs for the propulsion of the body. Hence, "the manus is commonly shorter and broader than the pes" (*Prof. Owen*), and but few animals use the foot (hind) for prehension or defence, save in flight. The exception to the rule that the hand is smaller than the foot is seen in the mole, or in the seal and walrus, which are deficient in the hind foot.

The foot is divided into three portions: (1) a group of more or less rounded bones called the tarsus or instep; (2) a row of long bones placed side by side in front of the tarsus—the metatarsus; (3) the phalanges of the digits, or the toes. The complete tarsus consists of seven bones—the astragalus, calcaneum, navicular, internal, middle, and outer cuneiform, and the cuboid. The chief variations in number are from six to eight. The general arrangement of these bones is in two rows—the proximal, or those articulating with the bones of the leg, and the distal row, those joining the metatarsus. The bones of the metatarsus usually correspond in number with the digits, and at their proximal ends the first, second, and third bones are supported respectively by the three cuneiform bones of the tarsus; the cuboid supporting the fourth and fifth. Upon each joint between the metatarsus and the toes are often

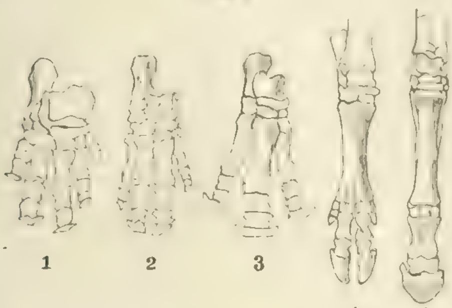
FIG. 1.



Fore Foot of the Mole. Hind Foot.

found a pair of sesamoid bones, for the mechanical advantage of the tendon gliding over them. These are best seen in the mole and tiger. The digits never, except in abnormal instances, exceed five in number on each foot in any existing vertebrate animal above the rank of fishes, and in the class Mammalia, except the Cetacea, the number of phalanges is limited to two in the first digit, and to three in each of the other digits in both fore and hind feet. (*Prof. R. Owen.*) The hallux or great toe, though in man very strong, and one of the largest digits, is in many mammals entirely wanting, rudimentary, or inconsiderable in length. In many climbing animals it is considerably developed and has prehensile characteristics. This is well shown in the gorilla and orang. The other digits vary in number from

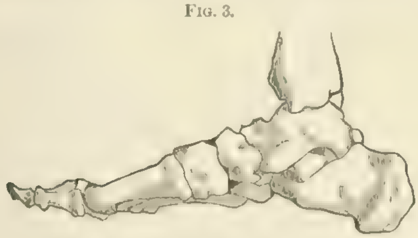
FIG. 2.



SIMPLIFICATION OF THE DIGITS (*after Owen*). 1, foot of the elephant; 2, foot of the hippopotamus; 3, foot of the rhinoceros; 4, foot of the deer; 5, foot of the horse.

one to five, as is illustrated respectively in the horse and the elephant. (Fig. 2.) This modification of the digits is accounted for by their diminution and simplification in a definite order. Thus, in a four-toed animal the great toe is wanting, as in the hippopotamus; in a three-toed animal the outer or smallest digit and the hallux—seen in the rhinoceros; in a two-toed animal, such as the cow or deer, both of those already mentioned and the second digit; and in the one-toed animal, such as the horse, only the third digit remains. That this is the order of disappearance is known by the absence of the corresponding metatarsal bone, each one of which has its definite attachment to one or more of the tarsal bones.

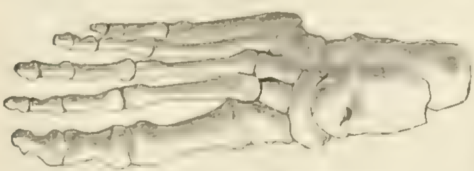
FIG. 3.



A Side View of the Bones of the Human Foot.

The Human Foot. The human foot illustrates the general points of osteology already described, and at the same time is specially modified for its uses peculiar to man, the upright animal. And, as it might properly be stated, the foot is merely a hand modified for a base of structure to support the body. It is always larger than the hand, mainly in length and thickness; is also narrower, and of an ovoidal figure, the long axis reaching from before backward. The longest transverse diameter of the foot is the anterior one, in order to place on a broader base the support to the body, which is carried before the centre of the body in walking. The solid parts of the foot are more firm

FIG. 4.



Skeleton of the Human Foot (*original*).

than the corresponding parts of the hand, and the movable parts of the foot less movable than those of the hand, in order to make the foot as perfect an organ as possible to give support and the surest and most facile locomotion of the body. (Fig. 4.)

The foot is constructed of two arches (Fig. 5), one from

FIG. 5.

1, A view of the natural position of the bones forming the front arch of the foot; 2, a diagram of the same; 3, view of the bones of the side arch of the foot; 4, a diagram of the same. (1, 2, *original*; 3, 4, *after Holden*.)

front to rear, and another from side to side. The antero-posterior arch has for its points of support the heel and forward ends of the metatarsals, and the lateral the cuboid on the outside and the inner cuneiform on the inside. The segments of these arches, however, are not inflexible, but are made to yield among themselves, each a little, by the interposed cartilages. There is also a special arrangement, known as the Y-shaped calcaneo-scaphoid ligament, holding the keystone of the arch, which by its elasticity aids much in securing the beautiful spring of the body in motion. And as this ligament is attached to the heel bone, it is called by the Germans the spring-bone.

One modification of the typical foot of mammals to the special structure of man is the angle of the plane of the foot and the leg. In the horse the angle averages 12[illegible], while in man it is 90°. The design of this variation is to give as secure a leverage as possible to the muscles which must keep the weight of the body securely supported so far above the point of support, about two-thirds of the weight of the body being above the hips. Another peculiarity of the human foot is the great projection and horizontal direction of the heel, or, as some one has said, "ex calce hominem." In all animals it is the largest of the tarsal bones, as it is the lever for moving the foot; but in animals which assume the semi-erect attitude we find either a greater development of this bone or larger development of the muscles of the "calf." Hence, the small "calf" of the negro is attributed by anatomists to the larger heel-bone, the smaller muscles being compensated by a longer lever at which to apply the power. (Fig. 6.)

FIG. 6.

Illustrating the attachment of the muscles of the calf (1) of the human leg to the os calcis (2). (*Original.*)

The articulation of the great toe with the inner cuneiform bone is another special modification of the foot as pointing only to the erect position of the body. In the semi-erect apes, the gorilla especially, this joint is marked by a considerable degree of mobility, and the foot resembles a hand. (See Fig. 7.) But in man's foot the great toe is limited in its motions to simple flexion and extension; it lies parallel to the other toes, and is superior in strength, muscular and bony, to any of the other toes. In fact, each foot is to be viewed as a triangular pedestal of the body, sup-

FIG. 7.

The plantar surfaces of the human and gorilla foot compared: 1, the human foot; 2, the foot of the gorilla (*after Owen*).

ported respectively at the three angles of the great toe, heel, and little toe; so that we find the greatest muscular power furnished to each of these portions of the foot.

The superior length of the great toe is a characteristic of the human foot; for, while the second digit projects farther forward than does either of the other toes when the foot is viewed as a whole, yet the great toe itself alone, if compared with any other of the rows of phalanges, obtains the longest measure.

Although the foot, when compared in structure adapted to delicate operations, with the hand, is very far inferior to it, yet it is astonishing what remarkable work can be accomplished by it when the hands are wanting. Thus, we hear of and see persons continually who carve, write, and paint in a remarkable manner with their toes instead of fingers: so that the phrase "pes altera manus" is often not far from the truth.

Probably no organ in the body has been more abused by the fashion of its dress than has the foot. From time immemorial, and by almost the entire human race, it has been squeezed into an unyielding case of hard leather, never so large as the foot itself when resting on the ground, and with a high appendage called the heel, from whence have come corns, bunions, *et id omne genus* of similar accessories of civilization. EDWARD HITCHCOCK.

For'age, food or fodder, food for animals. The word is also used as a verb, when it means to collect supplies generally for both man and beast, from an enemy by force, from friends by impressment, but giving to friends receipts, to be paid ultimately.

The daily ration of forage in the army of the U. S. is for each horse 14 pounds of hay and 12 pounds of grain, either oats, corn, or barley. For a mule the daily ration is 14 pounds of hay and 9 pounds of grain. The blades of Indian corn are used for forage in absence of hay. The consumption of forage in a large and active army is enormous. Its weight, owing to the number of animals employed in military operations, is about 4½ times as great as that of the subsistence supplies for the same army. There were issued from the dépôt of Washington during the war of 1861–65 4,500,000 bushels of corn, 29,000,000 bushels of oats, and 490,000 tons of hay. Partial reports of the quartermaster-general show issues of forage during the war as follows:

22,816,271 bushels of corn, costing	$29,879,314
78,663,799 bushels of oats	76,362,026
1,518,621 tons of hay, costing	48,595,872
Total	$154,837,212

The weight of these supplies in pounds was—Corn	1,277,711,176
Oats	2,517,241,568
Hay	3,037,242,000

making a total of 6,832,194,744 pounds—numbers, like infinity, difficult to realize, but interesting as showing the magnitude of the operations necessary to provide and distribute these few items of the expenses of war.

M. C. MEIGS.

Fora'men [Lat., an "opening," from *foro*, to "pierce"], (plural **Foram'ina**), in anatomy, denotes in general any natural opening through a substance; more particularly an opening through a bone. It is especially applied to the bony passages through which the nerves and blood-vessels enter and leave the skull and spinal canal.

Foraminif'era [Lat. *foramen*, an "aperture," and *fero*, to "bear"], an order of Protozoa, usually characterized by the possession of a shell pierced by numerous minute orifices, through which filaments (*pseudo-podia*) are protruded. The shell is generally composed of carbonate of lime, but it may consist of particles of sand cemented together, or may be chitinous. The animal may be simple, or may repeat itself indefinitely by budding. The shell is filled with organic matter called *sarcode*, and a layer of sarcode often exists on its outside. The pseudo-podia reach the exterior by perforations in the walls of the shell or by its mouth. The Foraminifera may be divided into two groups, according as their walls are or are not perforated by foramina. In those with calcareous shells, in which the walls are not perforated, the substance of the shell is porcellanous and opaque white. In those in which the shells are calcareous and imperforate, they are vitreous. The arenaceous shells may or may nor be perforated, their texture in either case remaining the same. The Foraminifera are also classified by the forms of the shells. A few of them remain through life as simple cells; *e. g. Orbulina*. More generally, however, the shell becomes many-celled by the budding of the sarcode. In this case the walls between the cells are perforate, and the sarcode in all is so connected as to have a common vitality. The multiplication of the cells in the Foraminifera takes place in several different ways, and hence the resulting aggregate form is very unlike in the different genera and species. Some form elegant discoid spirals (as *Robulina* and *Rotalia*), and this form is called nautiloid: sometimes the added cells compose a constricted or beaded tube, as in *Nodosaria*. In some cases also the shell is much flattened and disk-like (*e. g. Nummulites*); sometimes it is fusiform by lateral elongation, as in *Fusilina*. Most of the Foraminifera are microscopic, but in a few cases the shell attains a diameter of an inch or more.

In a geological point of view, the Foraminifera are of great interest, as they are found in all the formations, from the oldest to the newest, and they frequently make up the chief part of great rock-masses. For example, the chalk is mainly composed of the calcareous shells of Foraminifera, so small that perhaps half a million are contained in a cubic inch. So also the limestones of the Carboniferous age are sometimes largely composed of *Fusilina*, and the Eocene limestones of *Nummulites*. A special interest in late years has been excited in this group by the alleged discovery of a huge Foraminifer (*Eozoon Canadense*) in the Laurentian rocks of Canada, a formation previously considered entirely destitute of fossils. The organic nature of *Eozoon* is, however, doubted by many zoologists, though asserted by even higher authority. Its true character must therefore be considered as not fully demonstrated. By most palæontologists the singular discoid, "engine-turned" fossils called *Receptaculites*, found in such abundance in the Lower Silurian limestones, are thought to be Foraminifera, but Billings considers them sponges related to the Foraminifera. (See PROTOZOA.) J. S. NEWBERRY.

For'bach, town of German Lorraine (Elsass-Lothringen), near the Prussian frontier, 12 miles N. W. of Saargemünd. Near here (Aug. 6, 1870) the French under Frossard were badly beaten by the Germans under Prince Frederick Charles. Coal is mined in the vicinity. P. 5428.

For'bes (CHARLES STUART), English naval officer, b. at Richmond, Surrey, in 1829, entered the navy in 1841; served in the first China war in the Yang-tze-Kiang, and in New Zealand in 1844–45. Promoted to the rank of lieutenant, he served during the Russian war in the Baltic Sea, having previously been with the first expedition sent out to find Sir John Franklin. He took the gunboat Algerine to China in 1857, and for service in the Canton River in Apr., 1858, was made commander. In 1860 was an amateur in the Garibaldian campaign. Published *Iceland, its Volcanoes, Geysers, and Glaciers* (1860), *The Campaign of Garibaldi in the Two Sicilies* (1861), and *A Standing Navy, its Necessities and Organization*. In 1870 he became a captain, and went upon the reserved list.

Forbes (EDWARD), F. R. S., English naturalist, b. in the Isle of Man Feb., 1815, began the study of medicine at Edinburgh in 1830; founded the Botanical Society of Edinburgh in 1836; visited Paris and the Mediterranean in 1837; was naturalist of the expedition to Lycia in 1841; professor of botany at King's College, London, in 1842; F. L. S. in 1843; assistant secretary to the Zoological Society in 1844; F. R. S. in 1845; professor of natural history at the School of Mines in 1852, and in the same year president of the Geological Society; professor of natural history at Edinburgh 1853. D. Nov. 18, 1854. Published *History of British Star-Fishes* in 1841, and, with Hanley, *History of British Mollusca* in 1853, besides other important works, including a great number of valuable papers upon zoological, botanical, and literary subjects. (See *Memoir* by the late DR. GEORGE WILSON and ARCHIBALD GEIKIE, London, 1861.)

Forbes (JAMES DAVID), D. C. L., F. R. S., British physical philosopher, b. at Calinton, near Edinburgh, Apr. 20, 1809; was professor of natural philosophy in the University of Edinburgh in 1833; published *Travels in the Alps* in 1843; made discoveries in the laws of glacial motion, and in the phenomena of radiant light and heat in relation to polarization; and received the Rumford medal and that of the Royal Society of London. In 1860 became principal of the United Colleges in the University of St. Andrew's. *Norway and the Glaciers Visited in 1851* was published in 1853; *A Tour of Mont Blanc and Monte Rosa* in 1855. He published many valuable papers, mostly upon questions in physics. *The Sixth Dissertation*, prefixed to the *Encyclopædia Britannica*, was his production. D. in Clifton, England, Dec. 31, 1868.

Forbes (JOHN), b. at Petincrief, Fifeshire, Scotland, 1710, became lieutenant-colonel in the Scotch Greys in 1745. After service in the German war, Dec. 28, 1757, was made brigader-general in America. Nov. 25, 1758, taking possession of Fort Du Quesne, Pa., he named it Pittsburg in compliment to the English prime minister. D. at Philadelphia, Pa., Mar. 11, 1759.

Forbes (SIR JOHN), F. R. S., English physician and medical writer, b. in Banffshire, Scotland, Oct. 18, 1787;

entered Marischal College in 1805, and was in the English navy as assistant surgeon in 1807; was made M. D. in Edinburgh in 1817; and settled in London in 1840. Became physician extraordinary to the prince consort the same year, and soon after to Queen Victoria; knighted in 1853. D. at Whitechurch, London, Nov. 13, 1861. Translated the works of Auenbrugger and Laennec on auscultation and percussion (1824); was an editor of the *Cyclopædia of Practical Medicine* (1833–35); published *Manual of Select Medical Bibliography* in 1835; and afterwards edited the *British and Foreign Medical Review*. *Physician's Holiday, or a Month in Switzerland in 1848*, was published in 1849; *Memoranda made in Ireland* in 1852; and *Nature and Art in the Cure of Disease* in 1857.

Forbes (JOHN MURRAY), D. D., of Columbia College, New York; S. T. D. by Vatican degree of Pope Pius IX.; b. May 5, 1807; graduated at Columbia College in 1827 and at the General Theological Seminary of the Protestant Episcopal Church in 1830. Before graduation, though receiving his diploma by a special vote of the board of trustees, he became assistant professor of ancient languages in Trinity College, Hartford, but resigned this position on receiving orders from the Rt. Rev. Bishop Hobart in Trinity church in August of the same year. In 1834 became rector of St. Luke's church, New York, and whilst holding this position was appointed by the standing committee of the General Theological Seminary to act temporarily as professor of pastoral theology and pulpit eloquence in that institution. In 1844 and 1847 represented the diocese of New York, as one of her clerical delegates, in the General Convention of the Church. In 1849, in company with Drs. Newman, Manning, and others, he entered the Church of Rome, and became shortly after pastor of St. Ann's Roman Catholic church in New York. In 1852 was appointed by the Rt. Rev. bishop of South Carolina his theologian in the plenary council of the Roman Church, held that year in the city of Baltimore, and in 1854 acted as theologian to the Rt. Rev. bishop of Boston in the provincial council held in New York. In 1859, Dr. Forbes returned to the Protestant Episcopal Church, assigning his reasons for the change in the following brief but comprehensive note, addressed to most Rev. John Hughes, D. D., archbishop, etc.: "It is now nearly ten years since, under your auspices, I laid down my ministry in the Protestant Episcopal Church to submit myself to the Church of Rome. The interval, as you know, has not been idly spent; each day has had its responsibility and duty, and with these have come experience, observation, and the knowledge of many things not so well understood before. The result is, that I feel I have committed a grave error, which, publicly made, should be publicly repaired. When I came to you, it was, as I stated, with a deep and conscientious conviction that it was necessary to be in communion with the See of Rome; but this conviction I have not been able to sustain in face of the fact that by it the natural rights of man and all individual liberty must be sacrificed; nor only so, but the private conscience often violated, and one forced, by silence at least, to acquiesce in what is opposed to moral truth and justice. Under these circumstances, when I call to mind how slender is the foundation in the earliest ages of the Church upon which has been reared the present papal power, I can no longer regard it as legitimately imposing obligations upon me or any one else. I do now therefore, by this act, disavow and withdraw myself from its alleged jurisdiction." In 1862, after the alteration of a canon by the General Convention of the Episcopal Church affecting his case, Dr. Forbes was restored to the exercise of his ministry in that body, and in 1869 was appointed, by an almost unanimous vote of the board of trustees, dean and permanent executive officer of the General Theological Seminary of the Protestant Episcopal Church in the U. S.—an office held by him until the year 1872. Some few printed sermons, essays, and reviews are the only known productions of his pen.

F. A. P. BARNARD.

Forbidden Fruit, a name given in different countries to fruits which, according to tradition, represent the fruit of which Adam and Eve ate at the time of man's fall in Eden. One of these is a sort of thick-skinned orange (*Citrus Aurantium*, var. *Paradisi*), which bears marks which are likened to tooth-marks. The skin is the part eaten; the pulp is very sour, but the skin is soft and pleasant to the taste. Another kind is a small shaddock (*Citrus decumanus*). Still another is the poisonous fruit of *Tabernæmontana dichotoma* of Ceylon, a tree of the order Apocynaceæ. This fruit appears as if bitten; hence the tradition.

For'bush, tp. of Yadkin co., N. C. Pop. 1429.

Forcade-Laroquette, de (JEAN LOUIS VICTOR ADOLPHE), LL.D., b. at Paris in 1820, a half brother of Marshal St.-Arnaud; became an advocate in 1841, and received the doctorate in 1846; became master of requests in 1852; director general of forests 1857; director-general of customs-revenues and indirect contributions, and counsellor of state; minister of finance 1860–61; vice president of the council of state 1863; minister of agriculture, public works, and commerce 1867; was one of the chief promoters of the Havre marine international exposition; minister of the interior 1868; was distinguished for parliamentary eloquence, and was an imperialist of liberal views.

Force, a term applied to denote any action between material bodies by which they change, or tend to change, each other's condition. Every change of condition of a material body implies motion of some kind, either, first, of the mass (molar), or, secondly, of its component particles (molecular). Our earliest idea of force is derived from the resistance of matter to the touch. Matter itself becomes known at the same time: and as we perceive it to have extension, we acquire also simultaneously the idea of space. Matter may be defined as something impenetrable which occupies space. Nothing is known of force except as a cause producing, or tending to produce, motion or change of motion in matter. Force, therefore, is the efficient cause of all physical phenomena, including not only those commonly called mechanical, but also those attendant on heat, light, electricity, and chemical action. Mechanical forces are such as produce their effects upon masses of measurable magnitude directly. They are distinguished as dynamical (producing actual motion) and statical (held in check by opposing forces). Statical forces may be compared with each other by means of the efforts or pressures they exert, which may be measured by a spring balance or by opposing them to known forces through an intervening lever. But as static forces produce motion if opposed by resistances less than themselves, such forces may also be measured by their relative power to generate motion when all resistance is removed. A heavy body resting upon a support exerts a pressure which is due to the force of gravity acting statically. If the support be removed, the body falls. We have the means of ascertaining experimentally the velocity imparted by gravity to a falling body in a unit of time; and this furnishes us with a natural standard for measuring other forces. Observation again tells us that the pressure exerted by a mass in consequence of gravity is proportioned to the mass. It shows us, however, also, that every mass of matter, whether small or great, falls, if unsupported, with the same velocity. By experiments made with Atwood's machine, and in other ways, it is found that if the force which acts upon the same mass is increased or diminished, the velocity generated is also increased or diminished proportionally. It may therefore be said, briefly, that forces are proportional to the masses moved and to the velocities generated at the same time—in other words, that force is as the product of velocity into mass. This product is called moment. Putting, then, f for force, p for pressure, m for mass, and v for velocity, we have $f \propto p$; and $f \propto mv$. Moment as well as pressure may accordingly be taken as the measure of static force; but in this expression v represents what is called a *virtual* and not a real velocity, being that which the mass m would take on if the system were to be set in motion.

When a force acting continuously produces motion or overcomes a resistance through space, it is said to do work. If the resistance is simply the inertia of a constant mass, the work done will consist in accelerating velocity. If the resistance is external (as of friction opposing motion on a horizontal plane), the work done will consist in transferring the mass from one point to another in space. In either case the measure of the work will be the force acting or the resistance opposing, multiplied by the distance passed over. For external resistances, as of friction just mentioned, this is self-evident. For the resistance of inertia it may be shown to be true by considering the case of gravity. The increments of velocity imparted by gravity in successive equal instants of time to a body falling from rest are equal; but the minute spaces passed over in these successive instants, being proportional to the successive actual velocities, form an arithmetical series. (See FALLING BODIES.) The sum of this series gives the total space fallen, which is $\frac{1}{2}vt$. Now, mg being the measure of the static force of gravity, $\frac{1}{2}mgvt$ represents the work of gravity in putting a body into motion with the velocity v. And as $gt = v$, we obtain finally for work (W), $W = \frac{1}{2}mv^2$. Any other constant force, as f, greater or less than gravity, will generate the velocity v in a time proportionally less or greater; but the work done will in all cases be the same, and will be independent of both force and time. For, as $ft = v$, and as v is, by hypothesis, constant, ft is constant also, and $W = \frac{1}{2}vft$ is invariable, whatever be the value of f. In like manner, the work which may be done by the moving mass in overcoming resistance to its motion is equally independent of time, while the space through which it may move in expending the force accumulated in

it will be inversely as the resistance it encounters. Thus, a heavy ball rolling over smooth ice, being but slightly retarded by friction, will roll very far, but a hammer or bullet suddenly arrested will exert an enormous and even destructive pressure.

We thus see that the power of a moving mass to do work is proportioned to the square of the velocity of motion, while the power of a simple pressure to hold in check an opposing pressure is proportioned to the virtual velocity only. For distinction, the product mv^2 is called the *vis viva*, the living force, or the kinetic energy, and mv the moment. By *energy* is meant the capacity of a body to do work. This may depend on its position or condition, and is then called *potential energy*. The body is doing no work, but may be made to do work by some change in one or both the respects mentioned. A clock-weight wound up, the mechanism being at rest, is an example of energy of position. Gunpowder is an example of energy of condition. *Actual energy* is that exercised by a moving mass, and is equivalent to living force. A pendulum at the end of its swing possesses only potential energy, and in the middle of the swing only actual energy.

Thus far we have confined ourselves to the relations of force and energy in mechanics. We now proceed to consider them in their wider significations. The forces of nature which are characteristically different from each other may be stated as follows: 1, gravitation; 2, molecular force; 3, chemical affinity; 4, heat and light; 5, electricity; 6, vital force. Gravitation, which is the attraction between bodies at a distance, is proportional directly to the product of the two masses, and inversely to the square of the distance between them. Molecular force is the attraction between the particles of bodies, and is manifested in solids and liquids by their cohesion and elasticity, and in liquids additionally in capillarity and osmose. Chemical affinity resembles the force last named in acting at insensible distances, but differs in being manifested only between unlike substances. Heat is supposed to be a mode of vibratory motion actuating the molecules of every material substance. Elevation of temperature is explained as an increase in the energy of the vibrations and an enlargement of their amplitude, whereby the volume of the combined mass is expanded, and ultimately the cohesion and even the affinities of its molecules are overcome. These vibrations are supposed to be propagated from body to body by undulations in an exceedingly rare medium filling all space, called ether. When these undulations fall within certain definitely assigned limits as to length, they have power to affect the retina of the eye, and thus give rise to the phenomena of light. Electricity is a very energetic force, the physical theory of which is still unsettled. It produces, according to circumstances, attractions and repulsions between masses and between molecules. Magnetism is but a form of electrical action. Vital force is more obscure as to its manner of action than any other; and it is even denied by many physicists and physiologists that any such distinctive force exists, all the phenomena ascribed to it being attributed to electricity, chemical affinity, and heat. There is no doubt, however, that there exists in the nervous centres of living animals a certain power which can cause contraction of the muscles of the body by exciting the proper nerves. The velocity with which this message is transmitted is by no means great, not exceeding twenty or thirty mètres per second. When a whale is struck by a harpoon, such is the size of the animal that quite an interval elapses before the brain can be informed of the fact and can put the muscles of the tail in operation; so that before this effect is produced the whalers have time to retreat.

Having thus classified forces, we may still further distinguish the kinds of energy dependent on them as follows: Kinetic energy exists in the four forms, A, of bodies in motion; B, of radiant heat and light; C, of electricity in motion; and D, of absorbed heat. Potential energy may be, E, position of the body in regard to gravity or other force acting at a distance; F, molecular separation; G, chemical separation; and H, electrical separation. In the first four of these forms work is obtained directly from the motion of the body or its molecules; in the second four, it is derived from an alteration of its condition.

Whenever energy in one form disappears, it reappears in another, and this property is known as the transmutation of energy or the correlation of forces. (See CORRELATION OF FORCES.) For example, the energy of a moving body suddenly arrested in its motion is converted into heat; the energy of an electric current may be transformed, in an electro-dynamic engine, into kinetic energy or into potential energy of chemical affinity in electrolysis. In general, such transformations are not from one form of energy into a single other form only. The moving body arrested expends some part of its energy in molecular separation (fracture of the opposing body), some part in giving motion to the fragments, and the rest in heat. The energy of the electric current is distributed between mechanical motion, heat, and chemical separation. But if in every such case we could collect and reunite all these fractions of distributed energy, we should find their sum just equal to that which has disappeared; and this leads us to one of the grandest generalizations of modern times, the doctrine of the persistence of force, or the conservation of energy, expressed in the proposition that energy, like matter, is indestructible, so that, however its form may change, its total quantity is for ever constant.

With the demonstration of this doctrine a fatal blow has been given to an illusion which from the earliest times has exercised a singular fascination over many ingenious minds —the belief in the possibility of a perpetual motion. By this was meant, not the eternal persistence of motion in a body which encounters no resistance whatever—for in this sense the doctrine of the conservation of force is also a doctrine of perpetual motion—but the delivery at one part of a mechanical contrivance of a greater amount of kinetic energy than that which is applied at another to set the contrivance in operation. The history of this delusion is given elsewhere. (See PERPETUAL MOTION.)

Measure of Force.—In order to compare quantities of any kind it is necessary that we have some definitely fixed units of measure. By the aid of such units the relative magnitudes of quantities of the same kind are expressible in abstract numbers. And when quantities of different kinds are in the relation of dependent variables, the laws which connect them may be expressed by comparing the abstract numbers which denote their relations of magnitude among themselves. For this purpose it is necessary to take as a starting-point some state of the related quantities of which the conditions are definitely known. Take, for instance, the law of pressure and volume in gases, commonly called the law of Mariotte. If the elasticity of air compressed in a cylinder by a force of 20 pounds to the square inch maintains the piston at the height of 4 feet, 40 pounds to the square inch will reduce this height to 2 feet. We have here a variety of units, and the numbers are unnecessarily large. It would be simpler to say that if under a pressure of 1 (unit of force) the air compressed occupies 2 units of volume, then a pressure of 2 units of force will reduce it to 1 unit of volume. It is therefore desirable that, in order to compare with facility the relations of quantities of different kinds, the units shall be so chosen as to have the simplest possible relations between each other.

The centimètre, gramme, and second have been recommended by the British Association for the Advancement of Science as fundamental units on which to establish other unit measures of quantity and energy for physical purposes, called, therefore, derived units. These fundamentals are sometimes referred to as the "B. A. units" or the "C. G. S. units" (centimètre, gramme, second).

Since, when bodies move uniformly, $s = vt$, the unit of velocity will be naturally that found by making s and t equal to the fundamental units C and S; that is, it will be that velocity which will carry a body 1 centimètre in 1 second. In the same way, if a be put for acceleration, $v = at$; and putting v and t each unity, a is the force required to generate a velocity of 1 centimètre in 1 second. The unit of mass is deduced from the two forms above given for expressing statically the force of gravity—viz. $mg = w$. This gives us $m = w \div g = w \div 981$ centimètres, this last expressing nearly the accelerative force of gravity. If $w = 1$ gramme, m is a little over a milligramme. As all the derivative denominations of this system are decimal multiples of the unit, the introduction of an incommensurable divisor, as in this case, is an incongruity to be regretted, but it is unavoidable. Since g, however, varies in different latitudes (though only slightly), it is advisable to employ, as has been proposed by Sir William Thomson, the value of g at Paris, which is 980.87 centimètres. Hence, putting $m = 1$ and $w = 1$, the unit of mass is 1 gramme divided by 980.87. The unit of force $f = ma$ is found by making $m = 1$ and $a = 1$, when $f =$ the force required to produce in the mass of 1 gramme the unit of acceleration, which, as above, is 1 centimètre in 1 second. But the mass of 1 gramme is, as we have seen, the weight of 1 gramme divided by 980.87. Hence the unit of force, compared with gravity, is $\frac{1}{981}$st part as great, or, expressed as weight, is slightly over a milligramme. This unit of force is called a *dyne*. The unit of work, $W = fs$, is found by making f and $s =$ unity, and is therefore 1 dyne acting through the space of 1 centimètre. This is called an *erg*. The higher denominations in this system are formed by decimal multiplication; and inasmuch as, in consequence of their minuteness, the quantities which we deal with every day exceed them a thousand or a million times, a short mode of writing and naming these multiples has been

adopted; thus: a gramme being 981 dynes, and a kilogramme 981,000 dynes, a mass of 1,000,000 dynes would not greatly exceed a kilogramme. And 1,000,000 dynes is written 1×10^6 dynes, or *one dyne-six*. So, the circumference of the earth being 4,000,000,000 centimetres, is written 4×10^9 centimetres, and is read *four centimetre-nines*. If division is to be expressed, the ordinal numbers are used. Thus, 1 milligramme $= \frac{1}{1000}$th gramme, is written 1×10^{-3} gramme, and read *one gramme-minus-three*. This system of units has not been generally accepted as yet in the scientific world. Still less has it been introduced into the arts of industry. (For the units now generally employed in this and in other countries for computing the force of engines, water-powers, or animals, or calculating the work performed by any of these motive powers, see DYNAMIC UNITS.)

Passing from mechanical to physical units, the most important of all, whether in its scientific or its industrial relations, is the unit of heat, which is the amount of heat necessary to raise the temperature of 1 kilogramme of water 1° C. The number of units of work necessary to generate this amount of heat is called the *mechanical equivalent of heat*. Much careful labor has been expended in the attempt to determine this important constant (for an account of which see HEAT). The value commonly received is 423 kilogrammètres, or 423 kilogrammes raised 1 mètre high. The corresponding value for British units and the Fahrenheit thermometer is 772 foot-pounds, or 772 pounds raised 1 foot high. The derived unit of heat on the B. A. system would be the amount necessary to raise the temperature of one gramme of water through 1° C. The mechanical equivalent of this would be 42,300 grammes raised one centimètre, or 42,300 gramme-centimètres, or centigrammètres; which, in ergs, would amount to 41,491,000, or 41 erg-sixes + 491 erg-threes. (For electrical units see ELECTRICITY.)

Sources of Energy.—The immediate sources of energy in our planet are numerous, embracing, as sources of kinetic energy, the radiation of the sun, the motion of air and water, and the muscular force of animals; and, as sources of potential energy, water accumulated above the general level in lakes and rivers or lifted by the tides, unequal distribution of temperature on the earth, wood, coal, native sulphur, and other combustible minerals, and food as the source of kinetic muscular force. All these, however, except the tides and some unimportant cases under the head of combustibles, are originally derived from the great source first named—viz. the solar radiation. The internal heat of the earth, sometimes exhibited in volcanic action, is a source of energy practically unavailable; but its gradual decline, causing contraction of the interior mass, permits the energy of gravitation occasionally from being potential to become active, and to manifest itself in earthquakes. Tidal action requires some explanation. To an observer on the moon the tidal wave, if visible, would appear as a mass of water nearly at rest, under which the earth is revolving like a car-wheel under the brake. The energy therefore is derived from the motion of the earth, and since this energy is continually converted by friction into other forms, there is a constant drain upon its source; or, in other words, it is continually making the earth turn more and more slowly. This effect is of course exceedingly slight, but it is supposed to account for the astronomical phenomenon known as the secular acceleration of the moon's mean motion, the moon appearing to move faster since the earth moves more slowly. The ultimate result will be that the time of revolution of the earth around its axis will at length equal the time of revolution of the moon around the earth, or the latter will always turn its same face towards the moon. Now, if the moon ever contained a liquid like our ocean, a similar effect would be produced on it, only in a much more marked manner, owing to the larger size of the earth. The necessary result would be that which has actually occurred—that the times of revolution of the moon around its axis and around the earth would be equal.

Although in a system of bodies in communication with surrounding objects the total amount of energy is always constant, yet all of it is not available to do work. For instance, if two bodies, one warmer than the other, are thus isolated, the heat passes from the first to the second, and is thus able to do work; as soon, however, as they both attain the same temperature, the available energy is exhausted, and although their actual temperature may be very high, they have no power of doing work until brought in contact with some cooled body. This available energy is known as the *entropy* of the system. In any actual case a considerable portion of the energy of a body is lost by being converted into a form from which we cannot reconvert it into work. Thus, a heated body when used as a source of energy begins at once to lose its heat by radiation, by heating the surrounding air, and by conduction through its support, the energy being here converted into heat but little above that of surrounding bodies, and therefore not readily convertible into work. A similar loss takes place with an electrified body, since there is no perfect non-conductor of electricity. In the case of motion we cannot avoid the resistance of the air or of friction; and often some surrounding bodies being set in vibration, a portion of the energy is converted into sound. The effect of all this is slightly to warm the various bodies moved, and thus again the energy is brought into a form from which it cannot easily be brought back. This is what is known as the dissipation of energy.

The grandest application of these laws is in astronomy to the determination of the source of energy in the solar system. We have already seen that the effect of a liquid on a satellite is to act as a brake to alter the time of rotation, until it is finally rendered the same as the time of revolution in the orbit, so that the same face shall always be turned towards the primary. The planets would also be affected in the same way, both by their satellites and by the sun itself; and although the problem becomes one of great complication, probably the final result would be the conversion of nearly all the kinetic energy of rotation into heat, which would eventually radiate into space. The far greater energy derived from the sun is also rapidly passing off into space. The total amount received by the earth, great as it is, is almost infinitesimal compared with the amount radiated into space, and thus lost. This energy is estimated at the surface of the sun to be equivalent to 7000 horse-power for each square foot of surface. This amount of energy is so great that if the sun were a mass of burning coal, it would be wholly consumed in 5000 years, and in 5000 years more would have cooled down 9000° C. Since geology proves that for hundreds of thousands of years the temperature of the earth has been about the same as at present, evidently chemical combination is not sufficient to account for this vast fund of energy. The nebular hypothesis assumes that the matter of the solar system was originally distributed through space, and the planets and sun formed by its condensation. Here there would be an enormous source of energy, since the potential energy due to the distance of the particles would by the force of gravitation become kinetic in their approach to each other. On making the calculation, however, the energy thus set free proves to be as much too great as the other was too small; and this theory also must be rejected. The view now held with regard to the source of the sun's heat is that it is due simply to its contraction. The mass of the sun is so great that on the most unfavorable supposition the heat set free by the diminution of potential energy due to its contraction would supply the present loss for 7000 years before the whole mass would have altered its temperature by 1° C. Still, enormous as this supply is, it must eventually be exhausted, and then, by the dissipation of energy, be finally converted into radiant heat and diffused through space. The final result, therefore, would be that all bodies would assume the same temperature; there would be no further source of energy; physical phenomena would cease, and the physical universe would be dead. Such, at least, is the present view of this stupendous question. E. C. PICKERING.

Force (MANNING), b. at Parsippany, N. J., in 1789, joined the Methodist Episcopal Church in his seventeenth year, and in 1811 entered the Philadelphia conference, and filled most of the prominent appointments within its bounds. For twenty-two years was presiding elder in different districts, and was elected to the General Conference in 1824, 1828, 1836, 1840, and 1848. He was superannuated in 1850. D. Feb. 22, 1862, near Andover, N. J. He was of fine personal appearance, generous in heart and noble in sentiment, and beloved by preachers and people. J. H. WORMAN.

Force (PETER), an American historian and journalist, b. at Passaic Falls, N. J., Nov. 26, 1790, came to New York at an early age, where he learned and followed the trade of printer till 1815, when he moved to Washington, where in 1820 he commenced the publication of *The National Calendar*, a volume of national statistics, which he published annually until 1836. He also published (1823–30) a political newspaper, *The National Journal*, which was, during President J. Q. Adams's administration, the official organ. By desire of the government he undertook in 1833 the preparation of a documentary history of the American colonies, a labor to which he devoted thirty years, during which time nine folio volumes were published, entitled *American Archives*. While thus engaged he accumulated a valuable library relating to early American history, consisting of books, documents, manuscripts, maps, etc., which were purchased by the U. S. in 1867, and added to the Congressional Library. From 1836 to 1840, Mr. Force was mayor of Washington, and subsequently was president of the Na-

tional Institute for the Promotion of Science. He also published several volumes of historical tracts relating to the American colonies. D. at Washington, D. C., Jan. 23, 1868.

Forcelli'ni (EGIDIO), a distinguished Latin lexicographer, was b. at Féner, near Feltre, in the Venetian territory, Aug. 26, 1688. From the poverty of his parents he was deprived of early advantages, but having entered the seminary of Padua, he by his marked abilities and devotion attracted the notice of Facciolati, then director, who soon engaged his aid in carrying out his own designs for improving the Latin dictionaries then in use. In 1705, under the direction of his teacher, Forcellini began the revision of the book called *Calepinus* (see FACCIOLATI), and finished it at the end of 1718. Facciolati meantime had conceived the plan of a complete dictionary of the Latin language, which should comprise all the words of existing authors, as well as those found in inscriptions and on medals. The execution of this great work devolved entirely upon Forcellini, and to him this credit belongs, though he enjoyed throughout the whole period the counsel and supervision of his old teacher. A brief memorandum of Forcellini states that he began the work at the end of 1718, and bestowed three and a half years on the letter A. In 1724 he was called away to be professor of rhetoric and director of the seminary at Ceneda, and was obliged to suspend work on the dictionary till his recall to Padua in 1731. From this time he labored steadily for eleven years without interruption, for the next eleven, with more or less hindrance, till the completion in 1753; two years were given to revision, and eight years to the transcription, which was finished Nov. 13, 1761. Forcellini d. at Padua Apr. 4, 1768, one year before Facciolati, and three years before the publication of the work that had occupied nearly forty years of his life. The title-page sets forth fairly the relation of the two editors: *Totius Latinitatis Lexicon Consilio et cura Jacobi Facciolati opera et studio Ægidii Forcellini alumni Sem. Patav. lucubratum.* The work, after lying ten years, was published in 4 vols. folio, under the care of Cognolati, who wrote the preface. A new edition appeared in 1805, and a third, revised with additions by Furlanetto, Padua, 1823–31, 4 vols. 4to. An edition with the Italian explanations translated into English was issued by G. Bailey, London, 1828, 2 vols. 4to. Furlanetto's edition was reproduced in Germany with much improvement by Voigtländer and Hertel, Schneeberg, 1829–45, 4 vols. fol. Two new editions are now (1875) issuing from the press. (See J. B. FERRARI, *Life of Forcellini*, Padua, 1792.) H. DRISLER.

For'ceps [Lat.], in surgery, an instrument for seizing, and often for removing, bodies which cannot conveniently be seized by the hand. Forceps are of many forms. Special kinds are used for special purposes, as for drawing teeth, for cleansing sores, for seizing a bleeding artery, for extracting bullets, for assisting in the birth of the fœtus, and for many other uses.

Forch'hammer (JOHAN GEORG), b. at Husum, Sleswick, July 26, 1794; became a distinguished Danish geologist, mineralogist, and chemist; was the associate of Oersted, and long held the chair of geology at Copenhagen; author of works on the geology of Denmark (1835), of Scandinavia (1843), and a manual of chemistry (1834–35). D. at Copenhagen Dec. 13, 1865.

Forchhammer (PETER WILHELM), distinguished as a traveller and archæologist, was b. at Husum (in Sleswick) in 1803. He studied at the Lyceum in Lübeck, and then at the University of Kiel, where he took his doctor's degree in 1828, and resided for a time as private teacher. In 1830, after spending some months in Paris and London, he set out for Greece, and spent three years in explorations and study. On his return to Germany he published the results of his investigations, and then revisited Greece in 1839, on which occasion he accompanied King Otho through the northern provinces. He also visited Asia Minor to make a survey of the plain of Troy. Having been appointed professor extraordinary at Kiel in 1836, he returned, after visiting Egypt and Rome, to enter upon his duties in 1842, and founded, in conjunction with Jahn, the archæological museum. He contributed valuable articles on Grecian and Roman archæology and topography to many of the leading periodicals. His principal works are *Hellenika*, vol. i. (the only one), Berlin, 1837; *Topography of Athens*, Kiel, 1841; *Description of the Plain of Troy*, Frankfort, 1850; *Halkyonia*, Berlin, 1857; *The Cyclopean Walls*, Kiel, 1847. H. DRISLER.

For'cible En'try and Detain'er. A forcible entry consists, in law, in an unlawful entry upon lands or tenements, accompanied by the exercise of force or by the use of such threats and menaces as overawe those rightfully in possession and prevent their resistance. Forcible detainer consists in wrongfully keeping possession of lands or tenements by force and threats whether the original entry were forcible or peaceable. Entry and detainer are usually included in the same act. This offence is generally prohibited by statute, declaring that "no entry shall be made upon lands except in cases where entry is given by law, and that in such cases it shall be made only in a peaceable manner, not with strong hand nor with multitude of people." The remedies are by public indictment for breach of the peace, by private action against the wrong-doer when he has no claim to the property, and by special proceedings under a statute if any, as is generally the case, be provided. When entry is made by one who seeks to justify his act by a plea of ownership, as by a landlord against a tenant holding over after his term, the tenant, as is generally maintained, cannot bring a private action for the offence, but the landlord is nevertheless punishable for the violation of the peace. When special statutory remedies are provided, they usually consist of measures adapted to put the party dispossessed again into possession of the premises, while necessary costs and expenses are exacted of the person making the wrongful entry. GEORGE CHASE. REVISED BY T. W. DWIGHT.

For'cing, among gardeners, is properly the production of any fruit or flower out of its proper season by the judicious use of hot or cold frames, stimulating ammoniacal fertilizers, and other like appliances. The term may also be extended to the growing, by similar means, of exotic, and especially tropical, fruits or plants in an uncongenial climate.

Ford, county of N. E. Central Illinois. Area, 450 square miles. It is very level and fertile. Grain and hay are important crops. It is intersected by the Illinois Central, the Gilman Clinton and Springfield, and the Toledo Wabash and Western R. Rs. Cap. Paxton. Pop. 9103.

Ford, county in the S. W. of Kansas. Area, 900 square miles. It is intersected by the Arkansas River and the Atchison Topeka and Santa Fé R. R. It has fertile bottom-lands and fine upland pastures. Cap. Dodge City. Pop. 427.

Ford (GABRIEL H.), b. at Morristown, N. J., 1764; graduated at the College of New Jersey at Princeton in 1784; was admitted to the bar in May, 1789; was presiding judge of the court of common pleas for the eastern district of the State; and (1820–40) justice of the supreme court. D. at Morristown, N. J., Aug. 27, 1849.

Ford (JOHN), English dramatist, b. at Ilsington, Devonshire, in 1586; entered the Middle Temple, London, Nov. 16, 1602, and appears to have followed the legal profession with some success; but as early as his eighteenth year published *Fame's Memorial*, a tribute to the memory of Charles Blount, Lord Mountjoy and earl of Devonshire; then wrote several plays not now extant; and finally produced about sixteen others, most of which were performed between 1628 and 1639. D. probably about 1640. "It is greatly to be deplored," says Allibone, "that his taste was as bad as his genius was splendid, and that his licentiousness disgusts even whilst his imagination charms."

Ford (LEWIS DE SAUSSURE), M. D., LL.D., professor forty-two years in the Medical College of Georgia, b. at Washington's head-quarters in Morristown, N. J., Dec., 1801; took his degree in medicine from the College of Physicians and Surgeons of New York City in 1822, and the honorary degree of LL.D. was conferred on him by the University of Georgia at Athens in 1868. Removed to South Georgia in 1822, and to Augusta, Ga., in 1827, where he assisted in organizing the Medical College of Georgia in 1832—an institution in which he has held ever since the professorship either of chemistry or practice of medicine. Prof. Ford contributed valuable essays on paroxysmal fevers, intermittent, simple, complicated, or malignant, from 1836 to 1845, through the *Southern Medical and Surgical Journal*. PAUL F. EVE.

Ford (SALLIE ROCHESTER), American authoress, b. in 1828 in Kentucky; was Miss ROCHESTER, and married Rev. S. H. Ford, Baptist preacher at Louisville, Ky., in 1855. Contributed to the *Christian Repository*, published by her husband, as also to his *Southern Repository*, at Memphis, Tenn., and has written *Grace Truman* (1857), *May Bunyan* (1860), *Romance of Freemasonry; Romance of Morgan and his Men* (1864).

Ford (SEABURY), American lawyer and politician, b. at Pomfret, Conn., Oct. 15, 1801; graduated at Yale College, New Haven, Conn., in 1825; practised law at Burton, O.; was often member and once Speaker of each branch of the Ohio legislature; governor of Ohio 1848–50, and major-general of militia. D. at Burton May 8, 1855.

Ford (THOMAS) was taken by his parents to Illinois in 1804; practised law, and was judge of the supreme court, and governor of Illinois 1842–46. Wrote *History of Illinois from 1818 to 1847* (1854). D. at Peoria, Ill., Jan., 1851.

Ford'ham, post-v. and station on the Harlem R. R., 10 miles from the Grand Central Dépôt, New York, was in 1874 annexed to New York City. It is the seat of St. John's College, a Jesuit institution; also of an academy for ladies, a theological school, a female deaf mute asylum, and other Roman Catholic institutions. Pop. 2151.

Foreclosure. See MORTGAGE, by PROF. T. W. DWIGHT, LL.D.

For'eign Attach'ment, a process of attachment by which the property of a foreign or absent debtor in the hands of third persons, or debts due him from them, may be levied upon for the discharge of his indebtedness to a suing creditor. This form of procedure has existed in England from a very remote period, but only in a few of the larger cities, as London, Liverpool, etc., and owes its origin to immemorial usage in these particular localities, but does not constitute a part of the general common law. In these cities it still subsists in its ancient form, but a process of a similar nature has been established to operate uniformly throughout the realm, which is known as garnishment. This statutory proceeding, however, is applicable not only with reference to foreign but also to domestic debtors; and since it gives a right to seize upon their effects and credits only after the recovery of judgment, it is less beneficial than the special system of foreign attachment. In a number of the States of the Union a process similar to foreign attachment has been adopted by statute, providing for a levy upon the property of absent, non-resident, and absconding debtors, but its extent of application is not always the same. Garnishment, which is known in some parts of the country as the "trustee process," may commence with the suit, and includes both foreign and domestic attachment, and is the term generally used to designate the case where a debtor's property or credits may be attached in the possession of third persons. The statutes of the respective States must be consulted. (See GARNISHMENT.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

For'eign Judg'ment, the judgment of a foreign tribunal. As no state is under any obligation to enforce laws which are not of its own creation, the effect to be given to foreign judgments must depend entirely upon the comity of nations in their mutual relations with one another. But the general voluntary acceptance among the states of Christendom of the doctrines of international law has also extended to the recognition of the validity of such judgments when rendered by tribunals having jurisdiction of the cause determined, and when the proceedings were characterized by no fatal irregularity or fraud. Due inquiry may be instituted in regard to the authority of the foreign court and the conduct of the suit, in order to ascertain whether any oppression was exerted or injustice done; but if no error appears the decree is sustained. This practice operates as a great preventive of vexatious and protracted litigation, by which defendants might otherwise be persecuted and the courts heavily burdened, while it nevertheless tends to secure the administration of full and exact justice.

In all cases when it is desired to introduce into any court the proof of a foreign judgment in order that it may be inquired into or enforced, it must be proved and authenticated as a matter of fact. This may be done either by an exemplification of a copy of the judgment under the great seal of a state, or by a copy sworn to as correct by a witness who has compared it with the original, or by the certificate of an officer properly authorized by law to give a copy; which certificate must itself be properly authenticated. When the tribunal rendering the judgment is one whose acts are recognized by the law of nations, such as a court of admiralty, etc., an exemplification under the seal of the court will be sufficient.

The several States of the American Union are, as regards the proceedings of the State tribunals, regarded as foreign to one another, and judgments rendered in each are accordingly, on general principles of law, sustainable in the others as foreign judgments. But as these States are subordinate to one general government, the effect to be given in one to the judicial acts of another has not been left to depend simply upon inter-State comity. In the U. S. Constitution is contained a provision that "full faith and credit shall be given in each State to the public acts, records, and judicial proceedings of every other State, and that Congress may prescribe the manner in which such acts, records, and proceedings shall be proved, and the effect thereof." In pursuance of this authority the following enactment has been passed by Congress, establishing a mode of proof which is, however, not exclusive of any which the State itself may see fit to adopt. "The records and judicial proceedings of the courts of any State shall be proved or admitted, in any other court within the U. S., by the attestation of the clerk and the seal of the court annexed, if there be a seal, together with the certificate of the judge, chief justice, or presiding magistrate, as the case may be, that the said attestation is in due form. And the said records and judicial proceedings, authenticated as aforesaid, shall have such faith and credit given to them, in every court within the U. S., as they have by law or usage in the courts of the State from whence such records are or shall be taken." If a judgment, therefore, would be conclusive in the State in which it was rendered, it is conclusive in every other State. It is not, however, put upon the same footing in all respects as a domestic judgment. No execution can issue upon it without a new suit in the courts of the State where it is sought to be enforced. It is moreover established that the above statute does not prevent an investigation into the jurisdiction of the court in which the judgment was rendered, or an inquiry as to the point whether it was obtained by fraud.

Some special remarks should be made as to judgments affecting the *status* of a person or thing, commonly called judgment *in rem*. An illustration of such a judgment as to a thing is a proceeding in a prize court to ascertain the title to a ship; of such a judgment as to a person, a divorce from the marriage contract. The peculiarity of such a judgment is, that of its own force it establishes the fact which it announces. A judgment in a prize court that a ship is American makes it American everywhere, even though the court may have proceeded on an erroneous principle of law. In this respect such a judgment differs widely from one between persons (*in personam*), as that requires an act of the executive power (see EXECUTIVE) to carry it into effect.

As to the effect of a decree of divorce, there is a diversity of opinion. The English courts hold that no foreign court can dissolve an English marriage in such a sense that its decree will be recognized in England. In this country a divorce granted in any State between parties who are domiciled there will be recognized in every other State, if the court had jurisdiction over the parties and there is no fraud. The same rule prevails if the plaintiff be domiciled in a State, and the other party makes due appearance either in person or by attorney to defend the action. For this purpose it is held that a married woman may acquire a different domicile from that of her husband. But if a person residing in one State goes into another and obtains a divorce without the presence of the other party, the decree will not in general be respected in the State of the latter's domicile. The reason is, that the court is not considered to have jurisdiction over the absent defendant. (See DIVORCE, MARRIED WOMEN, etc.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Foreign Laws, the laws of foreign countries. Foreign laws have no absolute binding force beyond the boundaries of the country in which they are enacted or established, and, like FOREIGN JUDGMENTS (which see), owe their efficacy in other states entirely to the obligations assumed by international comity. In the administration of justice the courts of one country are frequently under the necessity of adjudicating upon questions arising under a different system of laws, in reference to which the obligations of the parties concerned were created or by which their interests ought rightfully to be governed; and it therefore becomes requisite that the laws of the foreign state be proved in order that a decision may be given in accordance with them. For example, the administration of the personal assets of an intestate must be governed by the law of his domicile at the time of his death; the interpretation and enforcement of contracts are controlled by the "law of the place of the contract"—*i. e.* of the place where it was to be carried into effect according to the intention of the parties. (See INTERNATIONAL LAW, PRIVATE.) In cases of such a nature courts will not take judicial cognizance of foreign laws, but will require specific proof of their contents. When written laws are to be proved, they are authenticated by the exemplification of a copy under the great seal of a state, or by a copy sworn to as an accurate counterpart of the original, or by a certificate in proper form of an officer legally authorized to give a copy. Unwritten laws, customs, and usages are proved by parol evidence, by introducing the testimony of persons to whom such laws are known (experts).

The States of the Union are foreign to one another as regards the system of laws established in each, but their close connection and intimate relations have caused, quite generally, a relaxation of the strict rules prevailing in reference to the laws of different nations. A majority of the States, therefore, follow the practice of accepting a printed volume purporting on the face of it to contain the statute laws of another State, or perhaps even of foreign countries, as *prima facie* evidence of such laws. In New York the rule has been established by statute that printed copies of statutes or of reports of judicial decisions shall be received

as presumptive evidence. There is an act of Congress providing "that the acts of the legislatures of the several States shall be authenticated by having the seal of their respective States affixed thereto." This method, however, is not considered exclusive of any other modes of proof which the States have seen fit to adopt. Unwritten laws of the several States must be proved, as in other cases, by parol testimony, unless some special statutory provision is made relaxing the usual rule.

The States in their relations with the Federal government are not regarded as foreign, but domestic, and when the public laws of any one of them are to be examined and applied in the Federal tribunals, no proof is necessary. These courts take judicial notice of such laws in the same manner as each State by itself applies its own enactments, without requiring testimony in reference to them as matter of evidence. In like manner the State courts take judicial notice of the laws of Congress.

George Chase. Revised by T. W. Dwight.

Foreknowl′edge is God's absolute knowledge or Omniscience (which see) from eternity—His knowledge conceived of, as in advance of, before, the thing known. All human knowledge is, strictly speaking, simultaneous with the object it contemplates, or, in a looser sense, may be subsequent to it. In the doctrine of Predestination (which see) foreknowledge is regarded in its relation to the salvation of men. It is admitted by all thorough theologians that the foreknowledge of God is *dialectically* distinct from His foreordination or eternal purpose, but as to the question whether or how an absolute (that is, an infallible) foreknowledge (which is conceded by both sides) can be consistent with a conditional foreordination, they answer differently. It is also admitted on both sides that there is no interval of time between the foreknowledge and the foreordination of God; both are alike eternal. The question is, Which is properly put first in the system, in the order of nature and of logic? Out of the different answers to these questions have arisen, in large part, the conflicts between Arminianism (which see) and Calvinism (which see). The Calvinists make the foreknowledge subsequent to, and dependent on, the foreordination; the Arminians in some cases invert the relation, and make the purpose or ordination of God dependent upon what He foreknows. In the one system the two are distinct, but not separable; in the other they are separable as well as distinct. C. P. Krauth.

Foreland, North and **South,** two promontories of England, on the E. coast of Kent, 16 miles apart. They consist of chalk-cliffs 200 feet high, on which lighthouses are raised to warn the ships from the Downs and Goodwin Sands, which extend along the coast between them. Lat. of North Foreland, 51° 22′ N., lon. 1° 27′ E.; lat. of South Foreland, 51° 8′ N., lon. 1° 22′ E.

Foren′za, town of Southern Italy, in the province of Basilicata. Pop. 6129.

Foreordina′tion, ordination or decree in advance, the eternal appointment of all ends, and of all men to those ends, by God. When predestination, as some of the Fathers and of the Calvinistic divines have used the term, covers all the acts of God's will, it is synonymous with foreordination. When predestination is confined, as it is in Scripture usage, to the purpose of God in regard to salvation, foreordination is related to predestination as a whole to a part. (See Foreknowledge.) C. P. Krauth.

Fore′rius, or **Foreiro** (Franciscus), b. 1523 at Lisbon of noble stock; entered the Dominican order 1539; studied at Paris, and acquired a brilliant reputation as a linguist, theologian, preacher, and writer; became instructor of the prince Antonio and preacher to the king of Portugal; was prominent in the Council of Trent 1561–64; was one of the committee which revised the missal and breviary and prepared the Tridentine catechism; became confessor to Cardinal Borromeo; and in 1588 provincial of the Dominicans of Portugal. D. at Almeida Jan. 10, 1587. His chief work is a translation into Latin of Isaiah, with a commentary (1563).

Foreshor′tening, in drawing, painting, and engraving, the apparent projection of an object forward or backward from the plane where it is drawn. It takes its name from the fact that while it conveys a just impression of the real length of a figure, it is in fact *shortened* in order to convey that just impression. This invention is ascribed to Cimon of Cleonæ. It was practised with great correctness and boldness by Raphael, Tintoretto, Michael Angelo, and Correggio.

For′est, county in the N. N. W. of Pennsylvania. Area, 376 square miles. Much of the surface is rough and broken, and is covered by heavy pine and hemlock forests which produce large quantities of lumber. The Allegheny River and the Oil Creek and Allegheny River R. R. traverse the W. part of the county, which produces bituminous coal and some petroleum. Cap. Tionesta. Pop. 4010.

Forest, tp. of Sierra co., Cal. Pop. 748.

Forest, post-tp. of Livingston co., Ill., on the Toledo Peoria and Warsaw R. R., 5 miles E. of Fairbury. Pop. 1084.

Forest, tp. of Winnebago co., Ia. Pop. 179.

Forest, tp. of Genesee co., Mich. Pop. 1564.

Forest, tp. of Rice co., Minn. Pop. 577.

Forest, post-v., cap. of Scott co., Miss., on the Vicksburg and Meridian R. R., about midway between Jackson and Meridian. It has 10 stores, 3 churches, 1 newspaper and printing-office, a Masonic lodge, and a union Sunday school. The educational advantages are good. The courthouse and jail have recently been located here. Pop. about 500. S. Davis, Ed. "Forest Register."

Forest, post-v. of Jackson tp., Hardin co., O., at the crossing of the Cincinnati Sandusky and Cleveland and the Pittsburg Fort Wayne and Chicago R. Rs.

Forest, tp. of Bedford co., Va. Pop. 2809.

Forest, tp. of Fond du Lac co., Wis. Pop. 1417.

Forest, tp. of Richland co., Wis. Pop. 926.

Forest, tp. of Vernon co., Wis. Pop. 662.

For′estburg, post-v. and tp. of Sullivan co., N. Y. Dairy products, lumber, and leather are manufactured. The township is traversed by the Monticello branch of the Erie R. R. Pop. 915.

Forest City, thriving post-v., cap. of St. Francis co., Ark., on the Memphis and Little Rock R. R., 45 miles W. by S. of Memphis, Tenn. It has a weekly newspaper.

Forest City, post-v. of Forest tp., Sierra co., Cal. Pop. 152.

Forest City, tp. of Howard co., Ia. Pop. 832.

Forest City, post-v., cap. of Winnebago co., Ia., 140 miles W. of the Mississippi River. It has one newspaper. Principal business, farming. Pop. 155.

Halvorsen & Chase, Props. "The Winnebago Press."

Forest City, tp. and post-v. of Meeker co., Minn. Pop. of v. 181; of tp. 401.

Forest City, post-v. of Lewis tp., Holt co., Mo., on the Kansas City St. Joseph and Council Bluffs R. R. and on the Missouri River, 99 miles by rail above Kansas City. Pop. 676.

Forest City, post-tp. of Sarpy co., Neb. Pop. 383.

Forest City Plantation, tp. of Washington co., Me. Pop. 81.

Forest Culture. See Arboriculture, by J. J. Thomas.

For′ester, tp. and post-v. of Sanilac co., Mich., on Lake Huron. Pop. of v. 233; of tp. 670.

For′est-fly, a name given to those insects of the family Hippoboscidæ, order Diptera, which have well-developed wings. This family includes many of the ticks. All are parasitic. The larvæ are hatched in the oviduct, and turn to pupæ just after birth. The *Hippobosca equina* is a European horse-fly. Others infest sheep, deer, birds, and bats in this country.

For′est Grove, post-v. of Washington co., Or., 23 miles W. of Portland, and on the Oregon Central R. R. It is the seat of Pacific University (Congregationalist), and has one weekly newspaper.

For′est Hill, post-v. of Placer co., Cal., 6 miles S. of Downieville.

Forest Hill, post-tp. of Monroe co., West Va. Pop. 1920.

Fores′ti (E. Felice), LL.D., Italian patriot and scholar, b. near Ferrara about 1793; practised law at Ferrara; was prætor of Crespino in 1816; was arrested Jan. 7, 1819, as one of the Carbonari, and imprisoned at Spielberg until Aug., 1836, when he was permitted to come to America. Was professor of Italian in Columbia College, New York, and a teacher for more than twenty years. Appointed in 1858 as U. S. consul at Genoa, d. there Sept. 14 of that year, having published in the *Watchman and Crusader*, in 1856, *Twenty Years in the Dungeons of Austria*, a biographical sketch; also published *Chrestomazia Italiana*, 1846, and an edition of Ollendorff's Italian grammar, New York, 1846.

Forest Lake, post-tp. of Susquehanna co., Pa. P. 995.

Forest Laws. A forest, under the ancient English law, was a tract of woody country in which the sovereign enjoyed an exclusive right of hunting game. Forests were not necessarily enclosed, but they were under the special protection of certain courts termed "forest courts," and a particular system of laws was established to prevent any

violation of the king's rights. By force of these laws any injury done to the soil or trees of a forest, or to the game sheltered within its limits, received appropriate punishment. Both these courts and laws have now fallen into complete desuetude.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Forest Marble, a series of laminated shelly limestones, forming, locally in England, a part of the lower Oolitic strata. (See JURASSIC.)

Foreston, Ill. See FORRESTON.

For'estport, post-v. and tp. of Oneida co., N. Y. It has manufactures of leather and lumber. Pop. 1276.

For'est Prai'rie, tp. of Meeker co., Minn. Pop. 315.

For'estville, post-v. of Bristol tp., Hartford co., Conn., on the Hartford Providence and Fishkill R. R., 17 miles N. E. of Waterbury.

Forestville, post-v. of Delaware tp., Sanilac co., Mich., on Lake Huron, at the mouth of Cherry Creek. Pop. 121.

Forestville, post-tp. of Fillmore co., Minn. Pop. 599.

Forestville, post-v. of Chautauqua co., N. Y., on the Erie R. R., 8 miles E. of Dunkirk. It has 3 dry goods stores, 2 hardware, 3 groceries, 1 bank, 1 newspaper, an excellent graded school, 3 churches, 1 agricultural and family paper, 2 hotels, 1 flouring and 2 lumber mills, and several shops. Principal business, farming and dairying. Pop. 722.

A. G. PARKER, ED. "FARMER."

Forestville, post-tp. of Door co., Wis. Pop. 351.

Forey (ELIE FRÉDÉRIC), marshal of France, b. in Paris Jan. 10, 1804, was educated at Dijon and admitted to St.-Cyr in 1822, where he became instructor. Was in the first Algerine expedition, in garrison duty in the Pyrenees, and returned as captain to Africa; was at the head of a battalion of *chasseurs-à-pied* in 1840, and went through four other African campaigns, returning to France a colonel. A general in 1848, he took an active part in the *coup d'état* of Dec., 1851, and was made general of division and commander of the Legion of Honor in 1852. For a time he had command of the siege force before Sebastopol in the war with Russia. In 1857 was nominated to the first division of the army of Paris, and, commanding this division during the Italian war in 1859, gained the battle of Montebello; distinguished himself at Magenta and Solferino, being wounded at the latter. Gen. Forey commanded the French expedition against Mexico resolved upon in 1861, stormed Puebla, and threw open the road to the capital; was made marshal for the achievement, and received command in France of the second *corps d'armée* Dec. 21, 1863. In 1867 commanded the camp of Châlons, received the grand cross of the Legion of Honor in 1859, and came to the senate Aug. 16 of that year. D. at Besançon June 20, 1872.

For'far, For'farshire, or **An'gus,** a maritime county of Scotland, bounded by the German Ocean, the Frith of Tay, Kincardine, Aberdeenshire, and Perthshire. Its surface is very varied, ranges of hills, the Sidlaw and the Oatlaw, alternating with valleys, the Vale of Strathmore, and the plain along the Tay, and its soil is fertile and well watered by the Tay, the North and South Esk, and the Isla. It has 240,010 inhabitants, and is a seat of the manufacture of coarse linen.

Forfar, the capital of Forfarshire, situated in the Vale of Strathmore. It has important manufactures of heavy shoes and coarse linens, and is connected with Aberdeen by the Scottish Midland Junction Railway. It has fine public buildings, and is a thriving town. Pop. 11,031.

For'feiture [Low Lat. *forisfactura*, from *foris*, "without," and *facio*, to "make"], a loss of property to the state or an individual as a penalty for the commission of some offence. Forfeiture is either civil or criminal. In civil forfeiture the property passes into the possession of some individual who has been injured by the violation of his rights through some neglect or transgression of duty on the part of the property-owner. There are several classes of cases in which this penalty might be incurred at common law, and in some of them it is still retained. Thus, in former times if an owner of a limited interest in real property, as a tenant for life or for years, attempted to convey a larger estate than he himself possessed by making a feoffment in fee-simple, not only did the grantee receive nothing, but the grantor's entire interest was forfeited to the reversioner or remainder-man. But at the present day this rule has no application, and an excessive grant is operative as a valid transfer of the grantor's actual interest, and of nothing more. In like manner, a tenant might forfeit his estate by disclaiming the title of him under whom he held, or the commission of waste might entail a like result as the effect of a judgment in an action of waste. The effect of disclaiming the title would be to enable the landlord to treat the tenant as a disseisor (see DISSEISIN), and thus to forfeit his estate. The action of waste has been discarded in a number of the States, and even in those which still retain it an action to recover merely the damages sustained is more usually brought than one for forfeiture. One very important case of civil forfeiture is that which occurs when the breach of the condition in a grant has been committed. The grantor may re-enter upon the premises and recover them as his own property. (See CONDITIONS.) This form of forfeiture depends upon the stipulations of the parties, while other forms are referable to rules of law applying irrespective of any agreement.

Criminal forfeiture, under the English law, was the general penalty inflicted for acts of felony and treason, the offender's lands, chattels, or both, being confiscated by the Crown. (See FELONY.) The same penalty has been retained until the present, but with considerable relaxation of its former severity. Attainder for felony entails the entire loss of goods and chattels, but, except in the case of murder, the forfeiture of the criminal's interest in lands in such cases only extends to the profits accruing during his life, and afterwards restoration of the land is made to relatives. When murder is committed the right of retaining and enjoying the profits of the land continues in the estate a year and a day after the wrong-doer's death, with power to commit waste. The only offence which now results in a complete confiscation of the offender's property, to be for ever vested in the Crown, is that of treason. There are a few minor offences to which this kind of punishment is also attached. For instance, striking a person in the superior courts at Westminster, or drawing a weapon upon a judge there presiding, causes a forfeiture of the profits of the offender's land during his life. Forfeiture, in all cases after conviction and attainder, has a retrospective operation, so as to nullify all transfers or incumbrances that may have been effected since the commission of the offence.

In the U. S., forfeiture, as a general mode of punishment for crimes, has never existed. There is a provision in the Constitution that "no attainder of treason shall work corruption of blood or forfeiture, except during the life of the person attainted." This restriction appears to have been copied in substance from the English statutes of 7 Anne c. 21, and 17 Geo. II., c. 29. The language of the first of these acts is, "that no attainder for treason shall extend to the disinheriting of any heir, nor to the prejudice of the right or title of any person or persons other than the right or title of the offender or offenders during his, her, or their natural lives only; and that it shall be lawful to every person to whom the right or interest of any lands, etc., after the death of any such offender should or might have appertained if no such attainder had been, to enter into the same" (sec. 10). Though this phraseology is much more explicit, it is altogether probable that the framers of the Constitution intended to accomplish the same result by a brief form of expression, and to save to the widow of a traitor her dower, and to the heir his estates. Of course it must be understood that this section of the Constitution applies to the result of judicial proceedings, and does not prevent Congress in the case of civil war from treating rebellious subjects as enemies under the law of nations, and seizing their property in that character. This limited authority to declare forfeiture for treason was never exercised until after the breaking out of the civil war in 1861. A previous law of Congress, passed in 1790, had expressly waived the right to impose such a punishment by providing that "no conviction or judgment for any capital or other offence shall work corruption of blood or any forfeiture of estate." The crisis of the civil war was thought to demand more stringent coercive and punitory measures, and in 1862 an act was passed providing for the confiscation of the property of certain classes of persons, but containing the restriction that no punishment or proceedings should be construed to work a forfeiture of the real estate of the offender longer than his natural life.

There are certain specific classes of offences in regard to which particular statutes have been enacted by Congress exacting the forfeiture of property employed as a means of committing the wrongful act or used in an unlawful transaction; but forfeiture in such cases applies only to the particular property designated, and not generally to chattels or lands, as in the other instances which have been mentioned. Thus, laws have been passed from time to time providing that smuggling or importation of goods under fraudulent invoices shall cause a forfeiture either of the entire invoice or of the property wrongfully imported. Acts of piracy entail a forfeiture of the piratical craft and its appurtenances. The same was formerly true of vessels engaged in the slave-trade.

The constitutions of many of the States of the Union, or the laws which they have enacted, contain substantially

the same provisions, prohibiting the general forfeiture of a criminal's property, as the laws enacted by Congress.

George Chase. Revised by T. W. Dwight.

Forge, a workshop and plant for the working by the hammer, or the hammer and rolling-mill combined, of wrought iron, steel, copper, etc. at a red or white heat. The Bloomary (which see) is often called a forge. The different forms of forge are very numerous, according to the kind of work to be turned out. The aid of steam is often called in, not only to furnish the air-blast, but to move powerful hammers, to hoist and turn masses of iron, and the like. The rolling-mill, a comparatively recent invention, has for some purposes superseded the forge.

For'gery, the wrongful making or alteration of a writing with intent to deceive and defraud by its fictitious appearance of genuineness. Lord Coke quaintly describes the term as "metaphorically taken from the smith, who beateth upon the anvil and forgeth what fashion and shape he will." The essential criminality of the offence lies in its tendency to prejudice the rights and interests of innocent third persons, by giving to an instrument an apparent legal efficacy which it would not otherwise have possessed; and the application of this test as a criterion determines both the kind of writings of which forgery may be committed, and how great a degree of change is necessary to be effected in their form and appearance in order to constitute the crime. Thus, the writing must be of such a nature that, whether fictitiously fabricated as a whole or only in part, its use and circulation would be calculated to occasion pecuniary loss, or some infringement upon or injury to legal privileges, or the creation of a liability to which the person injuriously affected ought not to be subjected. The instrument must be legally capable of effecting a fraud. Hence, if its only tendency would be to injure some person's feelings, violate his confidence, or convey false information, without otherwise affecting his interests, no forgery would be committed. But whenever the writing might be made the foundation of a legal liability, as if one should wrongfully make or alter a note or a bill of exchange, or wherever it might cause a wrongful disposition of property or occasion the loss of a situation of pecuniary benefit,—in these and similar cases the unwarrantable falsification is sufficient to constitute the offence of forgery. Not only, therefore, instruments which are manifestly of a pecuniary nature, by directly entitling their possessor to the receipt of money, may be forged, but a letter of recommendation to a servant or a schoolmaster by which he might obtain a lucrative position, or a representation as to the financial credit and standing of a merchant by reason of which those trusting him might be deceived, would come within the same category. The same is true of instruments which unwarrantably prejudice any legal right by effecting a fraud, as a deposition to be used on the trial of a cause in court or a copy of a writing to be used in evidence. If a writing be invalid on its face, it cannot be the subject of forgery, since its power to prove deceptive would be nullified by its own contents. But the invalidity must be readily apparent, for if only discoverable upon examination—though but slight examination would be required—the criminal nature of the instrument is in no way diminished.

The degree of fabrication or alteration of an instrument need be only sufficient to render a fraudulent deception possible. Consequently, not only need the entire contents not be fictitious, but a very slight change, either by insertion, alteration, erasure, or other material modification of the terms of any writing, which would be effectual in giving it a seeming validity or varying its tenor, would be enough to constitute forgery. This may consist either in the addition of a false signature to a true instrument or a real signature to a false one, in the insertion of paragraphs or clauses, or the change of words, or even of letters, if the legal effect of the instrument be thereby altered. Appending the signature of a fictitious person or of one no longer living to an instrument is as fraudulent an alteration as imitating the name of a person still living and generally known. A printed or engraved document, as a railroad-ticket or pass, may be forged, as well as one that is in writing; but when the thing in which the alteration is effected is one which does not consist, in its essential nature, of some form of language, no change of words used in connection with it will be sufficient to constitute forgery. Therefore, the change of an artist's name in the corner of a painting, in order to deceive the public and fraudulently induce a purchase for more than its value, is not forgery.

As in other criminal offences, an evil intent is a necessary element in the offence of forgery. But this principle does not require that there should have been a definite purpose to injure a particular person, but only that the instrument forged shall be intended to be used as if it were genuine. Consequently, if the wrong-doer in using the fictitious paper faithfully designs to take such subsequent measures as shall avert all possibility of injury, he is nevertheless guilty of the crime. By so employing the instrument that others may be defrauded he is conclusively presumed in law to have been actuated by criminal motives. But if a person, believing himself with good reason duly authorized to act as agent in the use of another's signature, does employ it, and has in fact no justification, he is not chargeable with forgery, because his wrongful act was induced by no fraudulent purpose. Generally, wherever an actual forgery is committed, intent is presumed from the mere circumstance that the act was committed.

It is not necessary that any actual injury should result from the offence. It is sufficient, at common law, that the writing has such a deceptive character that if once put into circulation it will, according to natural and reasonable anticipation, entrap and mislead those to whose hands it comes, to the injury of their lawful interests. Whether the person whose writing is imitated or whose name is assumed be immediately affected by the forgery, or loss is occasioned to third persons, is entirely immaterial. The offence is complete without regard to the persons affected.

Besides forgery prejudicial to the rights of individuals, there exist, both at common law and by statute, varieties of this offence more immediately affecting the public. Of this nature are false and fraudulent alterations of any matter of record or of any authentic matter of a public nature, as a parish register, etc. Various statutes in England have specified numerous other instances in which fabrication or alteration of public documents is made punishable.

In the U. S., Congress and the State legislatures severally have enacted special laws against forgery. This crime against the general government can be punished only under the acts of Congress; but, as a general rule, it is held that the State statutes, unless inconsistent with the common law, do not supersede the principles of the common law, so that an offender may be prosecuted either under the statute or not, as may be thought desirable. Some States, however, have discarded the common-law procedure entirely.

The offence of uttering forged instruments—*i. e.* of attempting to effect a fraudulent deceit by making actual use of them—was not a necessary ingredient in the crime of forgery at common law, but was specifically provided for by statutory regulations. In some of the American States uttering has been made an essential element in this offence, while in others it is still considered a distinct crime. (The statutes of the separate States must be consulted.) The word, as used in extradition treaties between the U. S. and foreign nations, would have a signification confined to that in which the word was employed in the general jurisprudence of the respective nations. It would not include the special statutory definition of forgery in one of the States. (See Extradition for authorities.)

George Chase. Revised by T. W. Dwight.

Forget-me-Not [Ger. *Vergissmeinnicht*], the *Myosotis palustris* of Europe, a plant of the borage family, sparingly naturalized in the U. S., and prized by people of many nations as the emblem of constancy in friendship and love. Many other species of the genus are known, chiefly European; the above is the typical species. The U. S. have a number of forget-me-nots, mostly common to the two hemispheres. They generally have brilliant blue flowers. Mouse-ear and scorpion-grass are popular names for this genus. Many varieties appear in cultivation.

Forge Village, manufacturing post-v. of Westford tp., Middlesex co., Mass., on the Stony Brook R. R., 5 miles E. by N. of Ayer. Stony Brook affords good water-power.

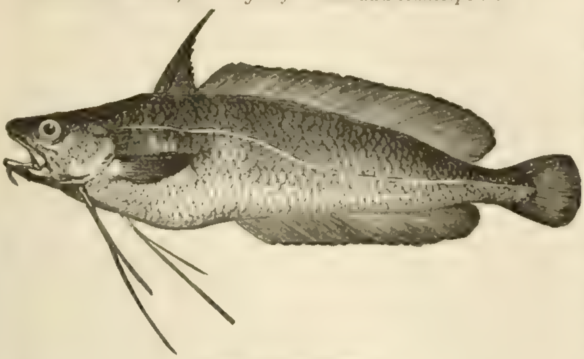
For'ging, the reduction of iron or steel at a high temperature to any desired shape by means of blows of the hammer. Some kinds of work are still forged by hand, but most forging is done by the steam-hammer, though some work is finished by hand. The rolling-mill has also to some extent superseded the forge, doing its work in general much more rapidly, and often just as well as the older process. Very recently a new method of shaping iron has been introduced, in which hydraulic pressure is substituted for the blows of the hammer. (See Hydraulic Forging; see also Iron and Rolling-Mill.)

Fork, a piece of table cutlery employed for holding the food in cutting it with the knife and for conveying food to the mouth. It was probably employed to some extent in the twelfth century, and then gradually came into general use. A bronze two-pronged fork at Kouyunjik, and a silver two-pronged one on the Esquiline Hill, were found in 1874, supposed to have been ancient table-forks. Cheap forks are made of steel or iron, but at most tables silver forks or plated ones are now generally used. There were at first but two prongs, but of late four- and five-pronged forks are more frequent.

Fork, post-tp. of Mecosta co., Mich. Pop. 162.

Fork, tp. of Anderson co., S. C. Pop. 1562.

Forked Beard, the *Phycis furcatus* and *Raniceps tri-*



Great Forked Beard.

furcatus, marine fishes of the cod family found on the European coasts, and so called from their forked barbules. The former is the greater, the latter fish the lesser forked beard. The forked beards of the U. S. waters (*Phycis chuss* and *tenuis*) are called hake, but are much superior in quality to the true hake.

For'kel (Johann Nikolaus), German musical composer and author, b. at Meeder, near Coburg, Feb. 22, 1749; studied at Göttingen 1769–79; was director of music to the university in 1779; member of the academy of Stockholm 1804. D. Mar. 17, 1818, at Göttingen. Published *General History of Music* (2 vols., 1788–1801, unfinished), *Life of Sebastian Bach* (1803), etc.

Fork'land, post-tp. of Greene co., Ala. Pop. 2789.

Fork Lick, tp. of Webster co., W. Va. Pop. 671.

Fork River, tp. and v. of Wayne co., N. C. Pop. of v. 811; of tp. 1611.

Forks, tp. of Northampton co., Pa. Pop. 1450.

Forks, tp. of Sullivan co., Pa. Pop. 854.

Fork's Plantation, tp. of Somerset co., Me. Pop. 159.

Fork'ston, post-tp. of Wyoming co., Pa. Pop. 576.

Fork U'nion, post-tp. of Fluvanna co., Va. Pop. 2794.

Forli', province of Italy, on the Adriatic, and formerly a part of the pope's dominions. Area, 716 square miles. Its coast-region is low and unhealthy, but very productive. Sulphur is mined, and the manufacturing interests are important. Pop. 234,090.

Forli, town of Italy, in the province of the same name, beautifully situated between the rivers Ronco and Montone, at the foot of the Apennines. Among its many interesting monuments are the Palazzo Guersini, designed by Michael Angelo, and the cathedral, with notable pictures by Carlo Cignani and Guido. Pop. 17,723.

Forlorn Hope [Fr. *les enfants perdus*, "lost children"], a name given to a party of picked troops selected for some desperate enterprise in war. The men are usually volunteers, and the honor accruing to them is great in proportion to the peril to which they are exposed.

Form [Lat. *forma*, perhaps a transposition of the Gr. μορφή]. The history of this as a philosophical term begins with the doctrine of Pythagoras respecting numbers. In them is to be found the first dawn of the thought of a principle of form, which was developed by Socrates and Plato into the famous doctrine of ideas (forms, εἴδη, ἰδέαι). To these, in opposition to Heraclitus's theory of universal flux, Plato assigned an independent and eternal existence (Aristotle, *Metaph.* bk. i. cap. vi.), and made them the archetypes of which individual things are the more or less imperfect copies, existing through participation. Aristotle severely criticised the Platonic doctrine, denying the independent existence of archetypal *forms*, and making *form* one of the four αἰτίαι, or grounds of existence. He, however, uses the term in a narrower and in a wider sense. In the former it is the second of the αἰτίαι, constituting, as the inner principle of realization (distinguished from μορφή, or external form), the substance of things. In its wider signification it includes formal, efficient, and final causes, and thus stands opposed to the material principle as actuality to potentiality. In this sense the spiritual is pure form, and the soul the "form of forms." (See Biese, *Philosophie des Aristoteles*, vol. i. p. 439; Trendelenburg, *Aristotelis de Anima lib. iii.*, pp. 301 *seq.*; Bonitz, *Aristotelis Metaphysica*, p. 325 *et passim*; Von Hertling, *Materie und Form*, pp. 48 *seq.*; Ueberweg, *Hist. of Philosophy* (Eng. trans.), vol. i. p. 162; Grote, *Aristotle*, vol. i. p. 354; vol. ii. p. 354, *et al.*; Lewes, *Aristotle*, p. 117.) The term underwent little change of meaning until the time of the Neo-Platonists, who tried to fuse the teachings of Plato and Aristotle. In Plotinus, *form*, instead of being conceived as an αἰτία, is placed in the category of substance, constituting, along with matter (ὕλη), which is not regarded as its substratum merely, substance. (Plotin., *Enneads*, ii., bk. iv.; Kirchner, *Die Philosophie des Plotin.*, pp. 106 *seq.*; Richter, *Plotin's Lehre vom Sein*, pp. 96 *seq.*) From the Neo-Platonists we pass to the Scholastics, who were mostly guided by the authority of the ill-understood philosophy of the ancients, especially of Aristotle. Robert Greathead, for example, who wrote commentaries on Aristotle, distinguished three kinds of forms—form immanent in matter, abstract form, and immaterial form. Albertus Magnus held that form existed potentially in matter; and Thomas Aquinas recognized a *forma substantialis*, or objective universal, and *formæ accidentales*, or subjective abstractions. With him, as with Aristotle, God is pure form—immaterial, as being entirely actual, without potentiality.

Bacon, the most successful of the opponents of Scholasticism, flattered himself that he had broken with antiquity more than he really did. He identified form with law or mode, and even maintained that, as far as thought is concerned, the form of a thing is the very thing itself. (*Nov. Org.* ii. 13.) The philosophy of Bacon and Locke came to a standstill with Berkeley and Hume, and the reaction called forth, on one hand, the Scotch or common-sense philosophy—on the other, the Kantian or critical philosophy. In the latter the word *form* has a purely transcendental meaning—that is, the forms, whether of intuition or of thought, are regarded as native to the mind and prior to experience. The *forms* of intuition are space and time. The *forms* of thought are (*Proleg.* pt. ii. § 20)—

1. Quantity.	2. Quality.	3. Relation.	4. Modality.
Unity,	Reality,	Substance,	Possibility,
Plurality,	Negation,	Cause,	Existence,
Totality.	Limitation.	Reciprocity.	Necessity.

These categories of the understanding stand opposed to the transcendental object or *Ding an sich* (thing in itself), which corresponds to the Aristotelian ὕλη, but is treated less philosophically. Since Kant, this has been the meaning of *form* in German philosophy, except that since Hegel *form* has been conceived as objective as well as subjective, pure knowing being identical with its object. In the Scotch and modern materialistic and cosmic schools the word has no true philosophic meaning. Thomson calls *form* "the means of viewing objects presented to the mind." (*Outline of Laws of Thought*, 2d (English) ed., p. 34.) Thomas Davidson.

Form. In musical composition, this term refers, in part, to rhythmical structure in phrases, sections, periods, etc.; but it also denotes the characteristic outlines, grouping, and configuration of musical ideas, to which it is the office of rhythm merely to give shape and symmetry, even though such ideas are often too wild to be restrained by any system of arbitrary rules. The study of "form" takes precedence of harmony, just as, in drawing, the study of outline takes precedence of light, shade, and coloring, though by culture the mind conceives of form and its ornamentation without this distinction. Wm. Staunton.

For'mal, in philosophy, is a term applied to qualify the idea of cause. The formal cause (Aristotle, *Metaphys.* v. 2) is the form, archetype, idea, or pattern of anything. Thus, the intention or design (idea) of the artist is a formal cause of the statue. The formal cause is the *quidditas* of the Schoolmen.

Formates, salts of formic acid.

Forma'tion, a convenient but not accurately limited term in geology. Properly speaking, it refers to a stratum or series of strata which have a certain unity; as the "Clinton formation," which is equivalent to the "Clinton group," a subdivision of the Silurian system, the "Hamilton formation," an important subdivision of the Devonian. It is also as often applied to an entire system, as the "Silurian formation," the "Carboniferous formation," etc. The theory in the coinage of the word was that it should designate certain strata which were formed by one general, common cause, even though that cause might vary in the nature and in the intensity of its action, and which, though differing in their lithological character and fossils, had still some things in common which served to bind them together. J. S. Newberry.

For'mes (Karl Jean), a famous basso singer, b. at Mühlheim, in the grand duchy of Baden, Aug. 7, 1818.

The possession of a voice of singular depth, compass, and purity, capable of great expression, was the occasion of his forsaking the ecclesiastical calling he had already entered on, and betaking himself to the stage. Driven from Vienna on account of his revolutionary opinions, he repaired to London, where he was considered the rival of the celebrated Lablache. In 1857, Formes came to the U. S., to renew his triumphs on the lyric stage and in oratorio. He liked the American people, institutions, and ideas, reappeared season after season in New York, and, as it was said, purposed at one time making this country his home. In later years his voice gave way, but, being gifted with uncommon dramatic power, he attempted drama in London. In this he failed. Besides being a great artist, one of the greatest of this generation, a singer of equal power in comedy and tragedy, as grand in Elijah as he was droll in Leporello, Karl Formes is a man of unusual intelligence and breadth of humanity—a man of mind. His best-remembered parts are Marcel, Leporello, Bertram, Figaro, Sarastro, Plunkett.

O. B. FROTHINGHAM.

For'miæ, a city of ancient Italy, on the site of the town now called *Formia.* Its origin is unknown. It was on the Appian Way and on the Sinus Caietanus, and has always been famed for its beautiful situation. Cicero and many other Romans had villas here, and at Formiæ the great orator was murdered. A structure called the tomb of Cicero is still shown.

For'mic Ac'id, $HCHO_2$, the simplest member of the fatty series of acids, derives its name from the ant (*formica*), from which it was first prepared. It occurs in the juice of the stinging nettle and in other plants; in the ant, especially the red ant, and is projected by it as a means of defence; in some caterpillars; in human blood, urine, flesh-juice, and perspiration; in some waters. It is formed by a great variety of chemical reactions. Potassic hydrate heated in carbon monoxide is changed to potassic formate —$CO + KHO = KCHO_2$. Potassium spread on the inner surface of a jar of carbon dioxide over water is converted into a mixture of potassic formate and acid carbonate—$CO_2 + K_2 + H_2O = KCHO_2 + KHCO_3$. Wood-spirit (wood-naphtha or methylic alcohol) is oxidized in presence of platinum black into formic acid —$CH_4O + O_2 = HCHO_2 + H_2O$. It is prepared (1) by distilling red ants, previously mashed; (2) by distilling 10 parts of tartaric acid, 14 parts of manganese dioxide, and 35 parts of water; (3) by distilling 1 part of starch with 4 parts of water, 4 parts of manganese dioxide, and 4 parts of sulphuric acid, added in small quantities; (4) by gently heating 10 parts of oxalic acid, with 10 of glycerine and 2 of water, to about 212° F. for twelve or fifteen hours, then adding 5 parts of water and distilling. The addition of water and distillation are repeated till 60 parts of dilute acid have been distilled off. The pure concentrated acid is prepared by saturating the impure dilute acid with plumbic carbonate, crystallizing the plumbic formate, and heating it in a current of sulphuretted hydrogen. The formic acid distils over, and may be freed from sulphuretted hydrogen by a current of carbon dioxide. The concentrated acid is a thin, transparent, colorless liquid, sp. gr. 1.22, boiling at about 212° F. It fumes in the air, and is very corrosive, a single drop placed on the skin causing intolerable pain and producing a painful ulcer. It (or its salts) reduces the oxides and many of the salts of mercury, silver, and gold, forming metallic precipitates.

C. F. CHANDLER.

Formica'tion [Lat. *formica*, an "ant"], a morbid sensation felt in the skin, so called from its resemblance to the feeling produced by the crawling of ants. Formication is a part of the complex sensation called numbness—that which is experienced when after compression of the nerves of the leg the "foot is asleep." In addition to indicating irritation of a nerve by pressure, etc., formication is the result of any kind of irritation of those parts of the nervous centres which are connected with sensitive nerves. Hence, this morbid sensation is often a symptom, and an early symptom, of cerebral or spinal disease. Numbness is often confounded with anæsthesia (loss of sensibility), but this is an error, since numbness almost always coincides with the preservation of sensibility. E. C. SEGUIN.

Formic Ethers, formates of the alcohol radicals, as ethylic formate, $C_2H_5.CHO_2$.

Formo'sa (Port. "beautiful"), [Chinese *Tai-Wan*, "terrace"], an island in the China Sea, 90 miles off the coast of the Chinese province of Fo-Kien, to which it belongs. Its length is 237 miles, its average breadth 70 miles. It is intersected from N. to S. by a range of high volcanic mountains. The eastern part is inhabited by the aborigines, the western by Chinese settlements, which comprise about 500,000 inhabitants. The capital, Tai-Wan, was opened to foreign commerce in 1858. With Fo-Kien, Formosa has a very lively trade, importing tea and different kinds of manufactures, and exporting rice, inferior tea, brimstone, drugs, timber, and provisions. Formosa is called the granary of Fo-Kien, and its rice, besides being very abundant, is of a superior quality. The Chinese settlers are described as enterprising and progressive people; about the aborigines little is known. The wild tribes make use of several languages, and are probably of various origin. The climate is wet and disagreeable. In the interior there have been found remarkable geyser-fields abounding in native sulphur and metallic ores. Good lignitic coal is mined. Formosa in 1874 was invaded by the Japanese, who punished a native tribe for the murder of Japanese sailors, and for some months occupied a part of the island—a proceeding which came near involving Japan in a war with China; but finally China paid the expenses of the invasion, and the Japanese evacuated the island. Most of the native races by no means regard the Chinese as their masters, but consider them base and cowardly intruders.

Formosa, tp. of Halifax co., N. C. Pop. 2957.

Formo'sus, bishop of Porto, became pope in 891; d. in 896. His election caused much controversy during and after his pontificate, since the canons at that time forbade a transfer of bishops from one see to another; and Pope Stephen VI. caused his body to be dug up and cast into the Tiber as an intruder, but John IX. reversed this action as far as possible.

Formulæ, Chemical. See CHEMISTRY, by PROF. GEORGE F. BARKER, M. D.

For'ney (JOHN WEISS), American politician and journalist, b. at Lancaster, Pa., Sept. 30, 1817; apprenticed in the office of the *Lancaster Journal* in 1833, and in 1837 was editor and joint-proprietor of the *Lancaster Intelligencer;* in 1840 he united the two papers. In 1845, in Philadelphia, and thereafter, he edited the *Pennsylvanian,* Democratic journal. In 1851–55 was clerk of the U. S. House of Representatives, editing the *Washington* (D. C.) *Union,* Democratic. Aug. 1, 1857, began the *Press,* Democratic daily newspaper, at Philadelphia, supporting Stephen A. Douglas and opposing the administration of President Buchanan. Was after that clerk of the 36th Congress. At the opening of the civil war of 1861–65 he took strong ground for the vigorous prosecution of the contest by the U. S. government, and has since acted with the Republican party. From 1861 to 1868 was secretary of the U. S. Senate, as well as corresponding editor of the *Press.* Also started during this time the *Washington* (D. C.) *Chronicle,* weekly, which became a daily in Oct., 1862. He travelled in Europe in 1868, and on his return published his letters to the *Press* and *Chronicle* as *Letters from Europe* (1869). Sold his property in the *Chronicle* in 1870, but is yet connected with the *Press.*

For'rest (EDWIN), an American actor, b. in Philadelphia Mar. 9, 1806; d. there Dec. 12, 1872. When a mere boy, not twelve years old, he performed as an amateur, taking female and juvenile parts, Young Norval in Home's play of *Douglas* being particularly remembered. His first appearance on the public stage was at the Walnut Street Theatre, in the rôle of Douglas, on Nov. 27, 1820. A long and enterprising professional tour in the Western cities, during which he undertook characters in Shakspeare, gave him experience and reputation; so that, after filling engagements in Albany and Philadelphia, he presented himself before the New York public at the Park Theatre in the character of Othello. This was in 1826. His success was signal. A natural genius, aided by hard study and set off by a superb form and a noble presence, commanded attention. At the Bowery he was a special favorite. There and at the Park he played long engagements, but, not satisfied with local fame, visited all the principal cities of the U. S. His chief characters were Othello, Macbeth, Hamlet, Richard III., varied by parts like Metamora and Spartacus, which his fine physique and immense energy made effective and kept popular. In 1835, Mr. Forrest made a professional visit to England and the Continent, finding warm friends, conspicuous among whom was the late Mr. Macready, to whom he was indebted for much kindness. In 1837, on the occasion of a second visit, he married Catharine Sinclair, daughter of the popular ballad-singer. After 1845 two years more were spent in England. During this visit his friendly relations with Mr. Macready were broken. His partisans entered zealously into the quarrel, which broke out in the bloody riot of May 10, 1849, when Macready was playing at the Astor Place Theatre in New York. The same year painful difficulties between Mr. and Mrs. Forrest culminated in separation, and in 1852 the wife obtained a verdict of divorce in the New York courts, on the ground of her husband's infidelity. Mr. Forrest resisted, and appealed from court to court till all legal resources were exhausted, alienating from himself all the while the sympathies of the best people. Mr. Forrest announced his retirement from the stage in 1858, but accepted engage-

ments and played at intervals till 1871, when compelled by ill-health to desist. After this he appeared as a public reader of Shakspeare, in which capacity he was heard by a New York audience but a few weeks before his death. He died of a sudden attack of apoplexy.

Edwin Forrest was enriched by his profession. He built a stone castle on the Hudson, now a Catholic convent, and later a spacious and elegant residence in Philadelphia, where he had a splendid library, especially rich in Shakspearian literature, and where he exercised a generous hospitality. He was a man of literary taste, excellent scholarship in his profession, open manners, ardent impulses, impetuous feelings, and frank disposition. A large part of his great fortune was left by him to establish an asylum for aged and indigent actors. His library, with its best treasures, was destroyed by fire Jan. 15, 1873. (Full justice to the best side of Edwin Forrest's character and the more delicate features of his art is done by Rev. Wm. R. Alger in his newly-written biography.) O. B. FROTHINGHAM.

Forrest (FRENCH), American naval officer, b. in Maryland in 1796, became a midshipman 1811; lieutenant Mar. 5, 1817; commander Feb. 9, 1837; captain Mar. 30, 1844; and was dismissed Apr. 19, 1861. He distinguished himself in the war of 1812 on Lake Erie, and in the fight between the Hornet and the Peacock, Feb. 24, 1813. In the Mexican war was adjutant general of the land and naval forces. Followed the State of Virginia when she seceded from the Union, and was acting assistant secretary of the Confederate navy. D. at Georgetown, D.C., Dec. 22, 1866.

Forrest (NATHAN BEDFORD), b. in Bedford co., Tenn., July 13, 1821. In 1834 his father removed to Mississippi, and died in 1837, leaving a large family dependent upon the subject of this sketch. With this responsibility upon him, he devoted himself to farming, being able to give to his own education only a few of the winter months. By energy and good management he had by 1840 secured comparative prosperity for the family, now reduced by death. Entered in 1842 business in Hernando, Miss., where he remained till about 1851; removed to Memphis, Tenn., in 1852, and became a real-estate broker and dealer in slaves; in 1859, having amassed a considerable fortune, he disposed of a large portion of his Memphis business and purchased extensive plantations in Coahoma co., Miss., and became a large cotton-grower, acquiring a large fortune. Though opposed to disunion, he was an ardent States Rights man in politics, and when war became inevitable he espoused the Southern cause with his usual energy. In June, 1861, he joined the Tennessee mounted rifles as a private, but in July, at the request of Gov. Harris of Tennessee, consented to undertake raising a regiment of cavalry, in which he was successful, equipping them largely from his own private means. On the organization of the regiment in October he was chosen lieutenant colonel, and the day following moved his men for Fort Donelson. Their first engagement was with the U. S. gunboat Conestoga at Canton Landing. At Fort Donelson, Forrest bore a conspicuous part, and on the final determination to surrender he remonstrated, and was allowed to attempt an escape with his men before a flag of truce was sent. In this he was successful, reaching Nashville with the main part of his force Feb. 18. On Mar. 10 his regiment reassembled at Huntsville, and a few days later marched to Iuka, Miss.; his force was now increased to ten companies, of which he was chosen colonel. Engaged at the battle of Shiloh (Pittsburg Landing) Apr. 6–7, 1862; wounded in combat Apr. 8. In the following June he was assigned to the command of cavalry at Chattanooga, and participated in the attack on Murfreesboro' July 13; appointed brigadier general July 21, 1862, and placed in command at Murfreesboro' Sept., 1862; in command of brigade Dec. 4, 1862, and engaged in the action of Parker's Cross roads Dec. 31, 1862, and battle of Chickamauga Sept. 19–20, 1863. Transferred to North Mississippi in Nov., 1863, he was appointed a major-general the following month, and assigned to the command of Forrest's cavalry department; in command of forces at the capture of Fort Pillow Apr., 1864; promoted to be lieut. general Feb., 1865; surrendered at Gainesville May 9, 1865; was subsequently pres. of Selma Marion and Memphis R. R. Co. until 1874. D. at Memphis, Tenn., Oct. 29, 1877.

Forrest (URIAH), b. in St. Mary's co., Md., 1756; was lieutenant-colonel in the Maryland line, and was so wounded at Germantown that he never fully recovered. Was auditor of Maryland; member of the old Congress in 1786–87; often in both branches of the legislature of Maryland; major-general of militia; M. C. 1793–95. D. July, 1805, while clerk of the circuit court of Dist. of Columbia.

Forrest City, Ark. See FOREST CITY, ARK.

For'rester (ALFRED HENRY), ("Alfred Crowquill"), English artist and comic writer, b. in London in 1805; educated at Islington; was a notary in the Royal Exchange, but retired about 1839. Began contributing to periodicals at the age of sixteen, and afterwards drew, modelled, and engraved on steel and wood to illustrate his own writings. *Leaves from my Memorandum book* (1826) was followed by *Eccentric Tales* (same year). In 1828 contributed to the *Humorist* in *Colburn's Magazine*, with Theodore Hook, Disraeli, and others; then to *Bentley's Miscellany*, *Punch*, *The London Illustrated News*, etc. Has exhibited large pen-and-ink drawings at the Royal Academy, and gained some repute as a designer and modeller. *Wanderings of a Pen and Pencil*, *The Comic Arithmetic*, *Phantasmagoria of Fun*, etc. are among his works. D. in London May 26, 1872.

For'reston, post-v. and tp. of Ogle co., Ill., on the Illinois Central and Chicago and Iowa R. Rs. It has 1 bank, 2 hotels, 7 churches, dry-goods, grocery, drug, hardware, boot and shoe shops, etc., a planing and a flour mill, 2 carriage-factories, a public high school, and one weekly newspaper. Principal business, farming. Pop. of tp. 2177.
G. L. BENNETT, ED. "JOURNAL."

Forshey (Col. CALEB GOLDSMITH), A. M., b. in Somerset co., Pa., July 18, 1812; educated at Kenyon College, O., and at the U. S. Military Academy at West Point; was professor of mathematics and civil engineering at Jefferson College, Miss., 1836–38; was thenceforth engaged for many years in engineering works in Mississippi, Louisiana, and Texas; was in charge of the U. S. survey of the Mississippi delta 1851–53; chief engineer of the Galveston Houston and Henderson Railway 1853–55; planned the present bridge across Galveston West Bay; founded the Texas Military Institute 1855, conducted it until 1861, when, though opposed to secession, he took service in the Confederate army as lieutenant-colonel of engineers; served on the James River, and afterward as chief engineer on the staff of Gen. Magruder; planned the defences of the Texas frontier and the operations for the recapture of Galveston and the Texas coast. Since the war he has been engaged in railway construction in Texas 1865–71, on the improvements at the mouth of the Mississippi, and in the U. S. engineer service on the Red River and in Galveston Bay 1874–75. Prof. Forshey was one of the founders of the New Orleans Academy of Sciences 1853, and was its first vice-president; has contributed largely to the scientific reviews and periodicals of the South-west, is a man of culture and untiring industry, and is esteemed a high authority upon the subjects embraced in his book, *The Physics of the Mississippi River*.

För'ster (ERNST JOACHIM), a German painter and writer on the history of art, b. in Münchengossenstadt Apr. 8, 1800. His early studies were in theology, philosophy, and philology in the universities of Berlin and Jena, but at the age of twenty-three he devoted himself to painting, under the teaching of Cornelius, one of the founders of the school of which Kaulbach was the most distinguished pupil. Förster's hand is seen in frescoes in the Aula at Rome, in the Glyptothek and Arcade at Munich, and in the chapel of San Georgio at Padua, whose frescoes he restored. But his chief labor has been literary. He has written a *History of German Art* (3 vols., 1851), a *History of Italian Art* (1869), *Studies Relating to the History of Modern Art* (1835), *Letters on Painting* (1838), *Monuments of German Architecture, Sculpture, and Painting* (1855), and guide books to Munich, Italy, and Germany of great merit. He has written besides a life of Jean Paul Richter, and edited several of his works. Förster was the discoverer of several ancient pictures in Italy, notably of the old frescoes of Avanzo in Padua, which he restored. O. B. FROTHINGHAM.

For'ster (CHARLES), b. in Ireland about 1790; educated at Trinity College, Dublin; became rector of Stistead, Essex, in 1838; author of *Mohammedanism Unveiled* (1829), *The Historical Geography of Arabia* (1844), *The One Primeval Language* (1851), *The Israelitish Authorship of the Inscriptions near Sinai* (1856), and other works. His Oriental theories were formerly popular, but have been overthrown by the discovery of the cuneiform inscriptions.

Forster (JOHANN GEORG ADAM), b. near Dantzic Nov. 27, 1754, accompanied his father (Johann Reinhold Forster) around the world in 1772–75; was professor of natural history at Wilna in 1784, and librarian to the elector of Mentz in 1788; envoy to Paris in 1792, and d. there Jan. 11, 1794. Published *History and Description of the Bread Fruit* (1784), *Views of the Lower Rhine, Brabant, Flanders, etc.* (3 vols., 1791), etc. A collection of his letters was published by his widow (2 vols., 1828). He made a translation of the *Sakuntálá* into German, was the tutor of Humboldt, and one of the fathers of modern German literature.

Forster (JOHN), English author, editor, and critic, b. at Newcastle in 1812; was educated for the bar, but devoted himself to literature, contributing to the *London*

Examiner, of which he was editor for ten years; to the *Edinburgh* and *Quarterly Reviews*, the *Foreign Quarterly Review*, of which he was editor, etc. He also edited the *London Daily News* for a year. In 1855 was secretary to the lunacy commission, and in 1861 became a commissioner in lunacy, and retains the office, 1874. His works have been, *Statesmen of the Commonwealth of England* (1831–34), *Life of Oliver Goldsmith* (1848), *Biographical and Historical Essays* (1859), *Arrest of the Five Members by Charles I.*, and *Debate on the Grand Remonstrance* (1860), *Sir John Eliot, a Biography, 1590–1632* (1864), *Walter Savage Landor, a Biography, 1775–1864* (2 vols., 1868), and *Life of Charles Dickens* (vol. i. in 1871; vol. iii. in 1874), *Life of Dean Swift* (vol. i., 1876). D. at London, Eng., Feb. 1, 1876.

Forster (William), English philanthropist, b. at Tottenham, near London, in 1784; became a minister of the Society of Friends in 1803, married Anna, sister of Thomas Fowell Buxton, in 1816. In 1820 visited the U. S.; in 1838 settled as a preacher near Norwich, England; in 1844–45 labored as such in France; in 1846 travelled in Ireland to relieve the distresses there caused by famine. Commissioned in 1849, by the London Yearly Meeting, to present an address on slavery and the slave-trade to rulers in Christendom, he had interviews with European monarchs, and in 1853 with the President of the U. S. and several Southern State governors. D. on the Holston River, Blount co., Tenn., in 1854.

Forster (Rt. Hon. William Edward), English Liberal statesman and orator, b. at Bradpole, Dorset, July 11, 1818; was educated at Friends' School, Tottenham, and is a worsted manufacturer at Bradford. Was first returned to the House of Commons Feb., 1861, for Bradford, and has been in Parliament since then. Was under-secretary for the colonies in Lord John Russell's administration from Nov., 1865, until July, 1866, and vice-president of the committee of council on education in 1868. Mr. Forster is magistrate and deputy lieutenant for the West Riding of Yorkshire. He had much to do with passing through the House of Commons the Education Bill in 1870 and the Ballot Bill in 1871. Mr. Forster is a son of the philanthropist William Forster, and a son-in-law of the late Dr. Arnold of Rugby. In 1874 he visited the U. S.

Forsyth', county in the N. of Georgia. Area, 250 square miles. The Chattahoochee bounds it on the E. The surface is broken, the soil fertile, especially in the valleys. Grain is produced, and gold, silver, copper, and precious stones have been found. Cap. Cumming. P. 7983.

Forsyth, county of N. W. Central North Carolina. Area, 250 square miles. The surface is hilly, but fertile. Products, grain and tobacco. The geological formation is granite. Iron ore is found. Cap. Winston. Pop. 13,050.

Forsyth, post-v., cap. of Monroe co., Ga., on the Central R. R., 25 miles N. W. of Macon. It has a good male school, and is the site of Monroe Female College; has 2 hotels, 3 churches, 2 private banks, a large cotton trade, and a weekly newspaper. Its climate is fine. Pop. of district, 1510. H. H. Cabaniss,

Ed. "Monroe Advertiser."

Forsyth, post-v., cap. of Taney co., Mo., 45 miles S. E. of Springfield, on the left bank of White River. It has 3 dry-goods, 1 drug, and 1 grocery store, a steam saw, flouring and grist mill, 2 blacksmith-shops, 1 weekly newspaper, 1 turning-lathe, 1 cabinet-shop, Freemasons', Odd Fellows', Good Templars', and Grangers' lodges, and 1 hotel. Principle business, farming. Pop. 87.

Brown & Depley, Eds. "Pioneer Farmer."

Forsyth (Benjamin) was appointed lieutenant of infantry for North Carolina Apr. 24, 1808, and was captain of riflemen July 1, 1808; commanded in the victorious assault on Gananoque, U. C., Sept. 21, 1812, and in the capture of a British guard at Elizabethtown, U. C., Feb. 7, 1813, for which, in the same month, he was made brevet lieutenant-colonel; May 27, 1813, he was distinguished in the capture of Fort George, U. C., and was killed at Oldtown, N. Y., June 28, 1814, in a fight with the British and Indians.

Forsyth (John), b. at Fredericksburg, Va., Oct. 22, 1780; graduated at Princeton in 1799. His father, a Revolutionary soldier of English birth, removed to South Carolina, and thence to Augusta, Ga. John became a distinguished lawyer; was attorney-general of Georgia in 1808; was in Congress 1813–18 and 1823–27; U. S. Senator 1818–19 and 1829–37; governor of Georgia 1827–29; U. S. minister to Spain 1819–22; U. S. secretary of state 1835–41. D. at Washington, D. C., Oct. 21, 1841.

Forsyth (John), a son of Hon. John Forsyth (1780–1841), well known for many years as editor of the *Mobile* (Ala.) *Register*, was b. at Augusta, Ga., Oct. 30, 1812; took the first honor at Princeton in the graduating class of 1832; was an officer in the Mexican war, in which he served with distinction, and was U. S. minister to Mexico from 1856 to 1858. He was a Douglas elector in Alabama in 1860, and was one of the three Confederate commissioners to visit President Lincoln in Mar., 1861. During the war between the States he was on the staff of Gen. Bragg, and was the author of that officer's address to the people of Kentucky in 1862. He has held many important public positions in Alabama, and was editor of the *Mobile Register*. D. May 2, 1877. A. H. Stephens.

Forsyth (William), Q. C., English barrister, b. in 1812; educated at Trinity College, Cambridge; graduated in 1834; called to the bar at the Inner Temple in 1839, and became in 1857 queen's counsel, and bencher of the Inner Temple in 1859. Is standing counsel to the secretary of state in council for India, and since 1868 commissary of the University of Cambridge. His work *On the Law of Composition with Creditors* was published in 1841; *Hortensius, or The Duty and Office of an Advocate*, 1849; *On the Law relating to the Custody of Infants*, 1850; *The History of Trial by Jury*, 1852; *Napoleon at St. Helena, and Sir Hudson Lowe*, 1853; *Life of Cicero*, 1864; *Cases and Opinions in Constitutional Law*, 1869; *The Novels and Novelists of the Eighteenth Century, in illustration of the Manners and Morals of the Age*, 1871. He has also contributed to the *Quarterly* and *Edinburgh Reviews*.

Forsy'thia [named in honor of William Forsyth (1737–1804), a Scotch gardener and pomologist], a genus of shrubs of the order Oleaceæ. The *F. viridissima* and *F. suspensa*, small Chinese shrubs, now very common in cultivation, are very hardy, and conspicuous for their yellow flowers in early spring before the leaves.

Fort. See Fortification, by Capt. O. H. Ernst, U. S. Army.

Fort (George Franklin), A. M., M. D., b. at Pemberton, Burlington co., N. J., May, 1809; graduated M. D. at the University of Pennsylvania 1830; became a successful practitioner; was governor of New Jersey 1851–54, and was afterwards a judge of the court of errors and appeals. He held other public positions, and d. at New Egypt, Ocean co., N. J., Apr. 22, 1872.

Fort (Tomlinson), M. D., an eminent physician, statesman, and author, b. in Warren co., Ga., July 11, 1787; d. in Milledgeville May 11, 1859. His father was a soldier in our Revolution. He took his M. D. in 1810 from the University of Pennsylvania, and practised in Milledgeville, where he acquired distinction as a physician and politician. He commanded a company in the Indian campaign in Florida in 1812, and was wounded in the knee. Endowed with genius, industry, and ambition, he soon became a popular man, and was elected to Congress 1827–29. He published a work on the practice of medicine. Few in his day attained greater influence; and none were more sincerely deplored at his death, which occurred after the practice of his profession for nearly half a century. Paul F. Eve.

Fort Ab'ercrombie, post-v. and military post of Richland co., Dak., on the Red River.

Fort Ad'ams, a fortification constructed on Brenton's Point, entrance to Newport harbor, R. I. This work, planned and built 1828–38 by the late Gen. J. G. Totten, subsequently chief engineer U. S. A., is one of the few works of the system of sea-coast defence designed to sustain a regular siege. Its land fronts are elaborately arranged according to the principles of the art as then received.

Fort An'cient, post-v. of Washington tp., Warren co., O., on the Little Miami R. R. Pop. 43.

Fort Ann, post-v. and tp. of Washington co., N. Y., on the Champlain Canal and the Rensselaer and Saratoga R. R. It is mountainous and has several small lakes. The old British Fort Ann was built in 1709, and was captured from the Americans in 1780. Woollen goods and iron are manufactured in this town. Pop. of v. 639; of tp. 3329.

Fort Ar'buckle, post-v. of the Chickasaw Nation, Indian Territory.

Fort At'kinson, post-v. in Washington tp., Winneshiek co., Ia., on the Chicago Milwaukee and St. Louis R. R.

Fort Atkinson, post-village of Jefferson co., Wis., on the Wisconsin division of the Chicago and North-western R. R., on Rock River, near Lake Koshkonong. It contains a large manufactory of furniture, an extensive wagon-factory, 2 foundries, a large steam flouring-mill, and a steam tannery. It has 1 national bank, 2 weekly newspapers, 5 schools, 5 churches, and 12 stores. Pop. 2010.

W. D. Hoard, Ed. "The Jefferson County Union."

Fort Barran'cas, Fla., a small work located on the N. side of Pensacola Bay, on the bluff overlooking the old

Spanish fort San Carlos de Barrancas, which may be said now to form a part of the work above named, designed, in conjunction with other works, for the defence of Pensacola harbor and the U. S. navy-yard therein located. In 1861 this fort was garrisoned by a small body of artillery under command of Maj. Adam Slemmer. Upon the surrender of the navy-yard (Jan., 1861) by Com. Armstrong of the navy, Maj. Slemmer abandoned this work, and succeeded in transferring his command to the more important work, Fort Pickens, on Santa Rosa Island, opposite. Barrancas, falling into the hands of the Confederates, was held until the evacuation by them of Pensacola in the following year.

Fort Bay'ard, post-v. of Grant co., N. M.

Fort Bend, county of Texas, intersected by the Brazos River. Area, 920 square miles. It contains much fertile but heavy clay prairie and a large area of productive bottom-land, which is well timbered. Cattle, corn, sugar, and cotton are produced. It is traversed by the Buffalo Bayou Brazos and Colorado R. R. Cap. Richmond. Pop. 7114.

Fort Ben'ton, post-v., county-seat of Choteau co., Mont., on the left bank of the Missouri River, at the head of steamboat navigation, 2508 miles above St. Louis and 40 miles below the Great Falls.

Fort Bid'well, post-v. of Modoc co., Cal., 160 miles E. of Yreka.

Fort Branch, post-v. of Gibson co., Ind., on the Evansville and Crawfordsville R. R.

Fort Brid'ger, post-v. and military station of Uintah co., Wy., in a wide plain at the base of the Uintah Mountains, is more than 6000 feet above the sea-level. It is 10 miles S. E. of Carter, a station on the Union Pacific R. R. Lat. 41° 18′ 12″ N., lon. 110° 32′ 38″ W.

Fort Calhoun', tp. and post-v. of Washington co., Neb., on the Missouri River and the Omaha and Northwestern R. R., 21 miles above Omaha. Here stood the old Fort Calhoun, now abandoned. P. of v. 236; of tp. 868.

Fort Car'roll, an unfinished casemated work built upon an artificial foundation in the Patapsco River, about 8 miles below Baltimore, for the defence of the channel of approach to that port.

Fort Cas'well, an enclosed brick work on Oak Island, at the mouth of Cape Fear River, N. C.; commenced 1826. On the secession of North Carolina this work fell into the hands of the Confederates, by whom it was held until the fall of Fort Fisher (Feb., 1865), when it was abandoned and blown up. It has not yet been repaired (1874).

Fort Chis'well, tp. of Wythe co., Va. It contains a part of WYTHEVILLE (which see), the county-seat. P. 4034.

Fort Clark, county-seat of Kinney co., Tex. Pop. 395. (P. O. name, BRACKETTSVILLE.)

Fort Clinch, an unfinished fortification on the N. end of Amelia Island, Fla. It defends the entrance into Cumberland Sound. It was seized by the Confederates in 1861, but abandoned to the Federal forces Mar. 2, 1862. It was the first of the captured U. S. forts to be repossessed by the military of the U. S.

Fort Col'lins, post-v., cap. of Larimer co., Col., on the Cache la Poudre River, 60 miles N. W. of Denver. It has an excellent water-power, 1 grist-mill, and other manufactories in course of construction; 1 newspaper, the only one in the county, and a circulating library. The Colorado Agricultural College is located here, and two parks are already laid out. The town is rapidly building up. Principal business, agriculture.

J. S. MCCLELLAND, ED. "LARIMER CO. EXPRESS."

Fort Columbus. See GOVERNOR'S ISLAND, N. Y.

Fort Col'ville, post-v., county-seat of Stevens co., Wash. Ter., on the E. bank of the Columbia River. It is an old trading station of the Hudson's Bay Company. Pop. 57 (garrison).

Fort Con'cho, post-v. of Bexar co., Tex.

Fort Constitu'tion, a new enclosed pentagonal casemated work in Portsmouth harbor, N. H., for the defence, in conjunction with other works, of that port and the U. S. navy yard therein located; commenced in 1863, on the site of an old work of same name.

Fort Cov'ington, tp. and post-v. of Franklin co., N. Y., 15 miles N. W. of Malone, and on the navigable Salmon River, 5 miles from its mouth and 1 mile from the Canada line. The village has 66 business-houses, 3 hotels, 4 churches, a weekly newspaper, and an academy. Dairying and farming are the leading interests. Fort Covington is memorable for the sufferings of the U. S. army at this point in the winter of 1813–14. Pop. 953; of tp. 2436.

W. E. MANSON, PROP. "ST. LAWRENCE VALLEY RECORD."

Fort Craig, post-v. of Socorro co., N. M., 35 miles S. of Socorro and on the Rio Grande.

Fort Cum'mings, post-v. of Grant co., N. M., 50 miles N. N. W. of El Paso.

Fort D. A. Rus'sell, a military station in Laramie co., Wy. Ter., 3 miles from Cheyenne, with which it is connected by a branch of the Union Pacific R. R. There are near by extensive U. S. storehouses. Lat. 41° 8′ N., lon. 104° 45′ W.

Fort Da'vis, post-v. of Presidio co., Tex. Pop. 615.

Fort Del'aware, a casemated fort (built 1835–60) on Pea Patch Island, opposite Delaware City, for the defence of Delaware River and the port of Philadelphia against maritime attack. It is situated in Red Lion hundred, New Castle co., Del. During the civil war it was a place for the confinement of Confederate prisoners.

Fort Dodge, a city, cap. of Webster co., Ia., on the Des Moines River, at the junction of the Dubuque and Sioux City and the Des Moines R. Rs. It has 7 churches, 1 large graded school, 1 Catholic seminary, 2 weekly and 1 monthly newspaper, 2 national, 1 savings, and 1 private bank, a foundry, a furniture-factory, 1 steam and 1 water-power grist-mill, 1 plaster and stucco mill, several hotels, fine quarries of building-stone, large deposits of gypsum, coal, fire-clay, and water-lime, 1 blind factory, and 1 general repair-shop with steam-power. Pop. 3095.

S. R. TRAIN, ED. "FORT DODGE TIMES."

Fort Dodge, tp. and military post of Ford co., Kan. The tp. includes Dodge City, the county-seat, on the Atchison Topeka and Santa Fé R. R., 352 miles W. S. W. of Atchison. Pop. 427.

Fort Dun'can, a military post at Eagle Pass on the Rio Grande, in Maverick co., Tex. Pop. 294.

Fort Duquesne. See PITTSBURG.

For'te [It.], in music, loud, strong. It is generally marked *f*. *Mezzo forte* is a medium degree of loudness, marked *mf*. *Fortissimo* is the superlative, *very* loud, marked *ff*, or sometimes *fff*.

Fort Ed'ward, tp. and post-v. of Washington co., N. Y., on the E. bank of the Hudson River, and on the Rensselaer and Saratoga R. R. at the junction of the Glen's Falls branch, 28 miles N. of Troy, on the Champlain Canal. A dam 900 feet long and 27 feet high crosses the Hudson, and affords great water-power. The village is finely situated, has a seminary and collegiate institute, 2 national and 1 State bank, 2 weekly newspapers, and extensive manufactures of iron, lumber, castings, machinery, stoneware, and other kinds of goods. Fort Edward has some remnants of the old fort of this name. The first fortification here was built in 1709; another and larger one in 1755, called Fort Lyman, but the present name was soon substituted in honor of Edward, duke of York. It was a point of importance during the old French and Indian wars, and was occupied during the Revolution by British and Americans in turn. Pop. of v. 3492; of tp. 5125.

Fort El'lis, a military post in Gallatin co., Mon., on the E. bank of Mill Creek, 3 miles above Bozeman. It is beautifully situated in a pleasant and fertile region, abounding in good lignitic coal.

Fort E'rie, post-v. of Bertie tp., Welland co., Ontario, Canada, on Lake Erie, at the head of the Niagara River, opposite Buffalo, N. Y., with which it is connected by a railroad bridge. It is on the Great Western Railway. Pop. about 1000.

For'tescue (CHICHESTER SAMUEL PARKINSON), English statesman, b. in 1823; graduated B. A. at Christ Church, Oxford University, in 1844; took the chancellor's prize for the English essay in 1846; has been a Liberal member of Parliament for the county of Louth from 1847; was a lord of the treasury 1854–55; under-secretary of state for the colonies 1857–58 and 1859–65. Was made chief secretary for Ireland Nov. 20, 1865, and again in Dec., 1868, having been sworn a privy councillor in 1864. In Dec., 1868, was a member of Mr. Gladstone's cabinet, and Jan., 1871, president of the board of trade.

Fortescue (Rt. Hon. HUGH), EARL, English statesman and author, b. Apr. 4, 1818; educated at Harrow; entered Parliament in 1841; in Dec., 1841, was chosen for Marylebone; resigned and was called to the upper House for his father's barony of Fortescue Dec. 5, 1859, succeeding as third earl Sept. 14, 1861. In 1846–47 was a lord of the treasury, secretary of the poor law board 1847–51, besides being chairman of several successive metropolitan commissions of sewers. Retired from Parliament after 1858 in consequence of ophthalmia, contracted in visiting a hospital with a view to his successful parliamentary motion for sanitary reform, having lost one eye and having suffered in the other. He has written *The Health of Towns*

(1844), *Official Salaries* (1852), *Representative Self-Government for the Metropolis* (1854), *Parliamentary Reform* (1859), *Public Schools for the Middle Classes* (1864).

Fortescue (Sir John), English chief-justice of the king's bench, b. probably about 1395, became serjeant-at-law 1429; one of the king's serjeants in Easter, 1441; chief-justice Jan. 25, 1442, to Easter, 1460; escaped with Henry VI. into Scotland at the end of Mar., 1461; was attainted of high treason 1463; escaped with Queen Margaret to the Continent; was pardoned by Edward IV. Oct., 1473, and was living in Feb., 1476. Wrote *On the Praises of British Laws*, in Latin, between 1461 and 1470.

Fort Fair'field, post-v. and tp. of Aroostook co., Me., on the New Brunswick line. It has 3 churches, and manufactures of lumber, carriages, etc. A fort was built here during the so-called "Aroostook war" (1839). Pop. 1893.

Fort Fet'terman, a military station and post-v. of Albany co., Wy., on the S. bank of the North Platte, at the mouth of La Poele Creek. Lat. 42° 49' 8" N., lon. 105° 27' 3" W.

Fort Fish'er. In the spring of 1865 the only important seaport remaining open to the Confederates was that of Wilmington, N. C., which, from the peculiarities of the harbor, could only be effectually closed by the capture of its strong defensive earthwork, Fort Fisher, situated upon the peninsula between Cape Fear River and the Atlantic Ocean, about 1½ miles N. E. of Federal Point. The work presented two fronts: the first, or land front, running across the peninsula, at this point 700 yards wide, was 480 yards in length; while the second, or sea-front, ran from the right of the first, parallel to the beach, to the Mound Battery, a distance of 1300 yards. The land-front was intended to resist any attack from the N., the sea-front to prevent an enemy's vessels from running through New Inlet or landing troops on Federal Point. For 5 miles N. of Federal Point this peninsula is sandy and low, not rising more than 15 feet above high tide, the interior abounding in fresh-water swamps, often wooded and almost impassable, while much of the dry land to within half a mile of the fort is covered with a low undergrowth, except a strip about 300 yards wide along the sea-shore. To secure possession of this fort a formidable fleet was collected in Hampton Roads, from which point it started Dec. 13, 1864, arriving off Federal Point on the evening of the 15th, but, owing to storms and other causes, it was not until the 23d that everything was in readiness. The troops forming the land-force of the expedition were from Gen. Butler's command, who accompanied them, and indeed took command of them, though Gen. Grant had intended Gen. Weitzel to control their operations. Among the preparations made by Gen. Butler, and from the effects of which great results were anticipated by him, was the filling of a vessel with powder (215 tons), to be exploded as near the fort as it could be brought. At 1¾ A. M. (Dec. 24) the boat having been towed to within 200 yards of the shore, and 1000 yards from the nearest point of the fort, the whole mass of powder was instantaneously ignited, but the effect was unimportant. At 11½ A. M. the fleet opened fire upon the fort, silencing its guns in an hour and a quarter. At 7 A. M. (25th) the bombardment was renewed, under cover of which a portion of the troops were disembarked, and a reconnaissance pushed to within 150 yards of the fort. Gens. Butler and Weitzel both agreeing that an assault with their force was impracticable, the troops were thereupon re-embarked, and returned to the James River. The fleet, however, remaining off Fort Fisher, Gen. Grant determined to renew the attempt. Accordingly, Jan. 2–3, 1865, a force of 8000 men was collected at Bermuda Hundred, to the command of which Gen. A. H. Terry was assigned. Embarking on the 4th and 5th, the transports rendezvoused off Beaufort, N. C., on the 8th, where they were detained until the 12th, arriving off Federal Point that night. At 8 A. M. (13th) the disembarkation was commenced under cover of the fire of the fleet, and completed by 3 P. M., pickets in the mean time having been thrown out, encountering the outposts of the enemy. Gen. Terry's first object after landing was to throw a strong defensive line across the peninsula above the fort, to guard against an attack from the rear. A favorable position was finally discovered about 2 miles from the work, and occupied by 2 A. M. of the 14th; by 8 o'clock a good breastwork was constructed from the river to the sea. The fire from the fleet, which had been maintained during the night of the 13th, was continued throughout that of the 14th. On the afternoon of the 14th, Curtis's brigade was pushed to within 500 yards of the fort, and a careful reconnaissance made, disclosing the fact that the front of the work had been seriously injured by the naval fire; whereupon an assault was determined upon for the next day. By daylight of the 15th the artillery was safely landed and placed in position. The plan of attack was for the army to assault the W. end of the land-face, while a column of sailors and marines should assault the N. E. bastion. At 8 A. M. all the vessels, except a division, opened their fire, which continued till 3.25 P. M., when the signal was given to change the direction of their fire to the upper batteries, and the attack was commenced by the sailors on one side and the soldiers on the other. The former, numbering 2000 sailors and marines, under Capt. K. R. Breese, advanced gallantly up the beach to the attack, but were exposed to so severe a fire that, after heavy loss, they were withdrawn. In the mean time, Curtis's brigade, leading the assault on the land-face, had passed through the palisades and effected a lodgment on the parapet. Gen. Ames, commanding the assaulting division, now ordering Pennypacker's brigade up to support the advance, his line overlapped Curtis's right, and the enemy were driven from the palisading which extended from the land-face to the river; then, pushing to the left, the two brigades drove the enemy from about one-quarter of the land-face. Bell's brigade was now moved up between the work and the river, where, though there was no regular parapet, abundant cover was afforded by excavations, ruins, etc., and by the huge traverses, from behind which latter the enemy stubbornly contested the advance, using them as breastworks; nine of these were successively carried by hand-to-hand fighting of the most desperate character; Terry in the mean time ordering Abbott's brigade into the work. The fighting for these traverses was continued till 9 P. M., when, two more of them being carried, a portion of Abbott's brigade drove the enemy from their last remaining stronghold, and the occupation of the work was completed. The enemy were pursued to Battery Buchanan, which was also captured, with its garrison, among them Gen. Whiting, the Confederate commander. Terry took 2083 prisoners, 169 pieces of heavy artillery, and many small-arms. The Union loss was, in killed, 110, wounded, 536. During the night of the 16th and 17th the enemy abandoned and blew up Fort Caswell and all their extensive works at Smithville and Reeves's Point, thus abandoning control of the mouth of Cape Fear River.

Fort Foote, Potomac River, Md., an enclosed barbette work with exterior batteries, forms the inner line of defence of the channel of approach by water to Alexandria and Washington. This work was constructed during the civil war for the purpose of defending, in connection with Battery Rodgers at Alexandria, the water-approach to the city. It is situated 6 miles below Washington, on a commanding bluff of the Maryland shore, 100 feet above the river.

Fort Fred Steele, a military post and post-v. of Carbon co., Wy., on the Union Pacific R. R. Elevation, 6840 feet. Here the railroad crosses the North Platte by a substantial bridge.

Fort Gaines, post-v., county-seat of Clay co., Ga., on the navigable Chattahoochee River and on a branch of the Central R. R. of Georgia. It has a commanding position, and a good trade in cotton. There are numerous ancient artificial mounds in the vicinity. Pop. 758.

Fort Gaines, an enclosed pentagonal work for defence of the sea-entrance to Mobile Bay, on the E. end of Dauphin Island, Mobile Bay, Ala.; commenced 1818 on the site of old Fort Tombigbee.

Fort Gar'land, a military post, post-v., and one of the principal towns of Costilla co., Col., on the Rio Grande, 90 miles S. W. of Pueblo.

Fort Gar'ry, the cap. of Manitoba and the N. W. provinces of Canada, is situated on the W. bank of the Red River of the North (in Manitoba), just below the mouth of the Assiniboin, 1110 miles W. N. W. of Toronto and 480 miles from Duluth. At the lower or stone Fort Garry the Canadian Pacific R. R. will cross the Red River. Fort Garry is the seat of the Anglican bishop of Rupert's Land. Elevation above sea-level, 640 feet.

Fort George, a fortification in Inverness-shire, Scotland, on a spit of land jutting out unto the Frith of Moray, was built in 1746 to keep the Highlanders in subjection.

Fort George (near Lake George). See FORT WILLIAM HENRY.

Fort Gib'son, post-v. and military post of the Cherokee Nation, Indian Territory, on the Neosho River, near its junction with the Arkansas, near the Missouri Kansas and Texas R. R., 166 miles N. N. E. of Denison, Tex.

Fort Gor'ges, an enclosed irregular hexagon casemated work, with exterior demilune, on Hog Island Ledge, Portland harbor, Me.; commenced in 1857.

Fort Gra'tiot, tp., post-v., and military post of St. Clair co., Mich., at the outlet of Lake Huron, opposite Point Edward, Ontario, Canada. Pop. of tp. 1032.

Fort Grif'fin, post-v. of Shackelford co., Tex. P. 297.

Fort Gris'wold, an open barbette battery on Groton Hill, E. bank of the Thames River, opposite New London, Conn. In 1781 the traitor Arnold conducted an expedition into Connecticut, burning the town of New London and massacring the garrison of this fort. A commemorative monument has been erected near the site.

Forth, a river of Scotland, rises from two different branches, the Avendhu and the Duchray, which unite at Aberfoyle. It then passes, with many windings and sinuosities, through the most picturesque and romantic part of Scotland, by Stirling, and a little above Alloa it empties itself into the arm of the North Sea called the Frith of Forth. It is navigable for vessels of 100 tons to Stirling, and to Alloa for vessels of 300 tons. It communicates with the Clyde through a canal 38 miles long.

Fort Hal'leck, a military post of Elko co., Nev., near the Humboldt River and the Central Pacific R. R.

Fort Halleck, post-v. and military post of Carbon co., Wy.

Fort Ham'ilton, post-v. and fort on the E. shore of the Narrows, the principal entrance to New York harbor, and, in conjunction with Fort Lafayette and the works on the opposite shore (Staten Island), intended to defend that entrance. It is in New Utrecht, Kings co., Long Island, N. Y.

Fort Har'ker, tp., post-v., and military post of Ellsworth co., Kan., on the Kansas Pacific R. R., 180 miles W. of Lawrence. Pop. 293.

Fort Hays, tp. and military post of Ellis co., Kan. Pop. 320. The situation is beautiful and commanding. It is on Big Creek, opposite Hays City, on the Kansas Pacific R. R., 250 miles W. of Lawrence.

Fort Hen'ry, a v. of Granville tp., Mercer co., O. Pop. 153.

Fort Hen'ry and **Fort Don'elson,** two Confederate works, the former on the right bank of the Tennessee River, the latter on the left bank of the Cumberland River, about 40 miles from where these rivers empty into the Ohio, distant from each other about 12 miles, and connected by a direct road. A combined land and naval attack for the reduction of these works having been determined upon, the naval force was entrusted to Com. A. H. Foote, and the land force, numbering about 15,000, assigned to Brig.-Gen. U. S. Grant. On Feb. 2, 1862, the naval fleet left Cairo, followed by the troops in transports, arriving next morning off Fort Henry, where it had been resolved to make the first attempt. This fort was defended by 17 guns and about 3000 men, under the command of Brig.-Gen. Tilghman. After landing the troops and making reconnoissances, the morning of Feb. 6 was settled upon for the combined attack; which was accordingly commenced at noon by the navy, the army having started an hour earlier with the expectation of cutting off the retreat should the fire of the navy compel the enemy to abandon the position; but Com. Foote attacked with such vigor as to compel the surrender of the work in but little more than one hour, while the army, being delayed by the condition of the roads, did not arrive till some time later; the Confederate garrison meanwhile escaping to Fort Donelson, with the exception of about 60 or 70 men, besides Gen. Tilghman and his staff, who surrendered with the work. After waiting a sufficient time to repair the damage sustained by the gunboats, Gen. Grant on the 12th moved with his army toward Fort Donelson, arriving before that work the same afternoon. In the mean time the garrison at Fort Donelson, consisting mainly of those who had escaped from Fort Henry, had been reinforced on the 9th by the command of Gen. Pillow, and on the 12th by that of Gen. Buckner from Bowling Green, and on the following day by the brigade of Gen. J. B. Floyd, who, being the senior officer, assumed command. This work, while it commanded well the river-front, was unprotected against an attack in the rear or land-front, the site being commanded by high ground, which was, however, secured and fortified before the arrival of the Union forces. Gen. Grant at once proceeded to invest the Confederate lines, and early on the morning of the 13th opened a vigorous cannonade, followed in the afternoon by an assault, which was, however, repulsed with considerable loss. On the 14th reinforcements to the number of 10,000 reached Grant, together with the fleet of Com. Foote, and a combined attack was determined upon. Being unable to get the new troops in position, the fleet opened the attack alone in the afternoon, but after an hour and a half, during which time every gunboat was disabled and 54 men killed and wounded, the fleet was compelled to retire. Gen. Grant now proceeded to complete his line of investment and await the reinforcement of his army. The Confederate commanders, however, realizing their danger, had agreed upon a vigorous attack, by which it was hoped to secure an avenue of retreat to Nashville; which, intended as a surprise, was commenced at 5 A. M. on the 15th, but was met by a fire from the Federal force, and a battle ensued with varying success until about 3 P. M., when a final advance was ordered by Gen. Grant along the whole line, which drove the Confederates back to their own lines, while on the left a position was gained within the Confederate works. The loss on each side during this day's conflict was, in killed and wounded, about 2000. Gen. Grant now made his preparations for a general attack the next morning; which, however, was not executed, for during the night the Confederate commanders, finding the Union line of investment completely restored, had determined upon a surrender. Pillow refused to consent to a capitulation, while Floyd acknowledged that "personal reasons" prevented him from acceding to such a decision, thus devolving the surrender upon Buckner. During the night Floyd managed to escape by steamers with some 1500 of his own command, as did Pillow and his staff, also Gen. Forrest with 300 or 400 men, by the river-road. At dawn of the 16th, Buckner addressed a communication to Gen. Grant, asking the appointment of commissioners to settle upon terms of capitulation and an armistice until noon; to which Grant sent his famous reply: "No terms other than unconditional surrender can be accepted. I propose to move immediately upon your works." Buckner, having no alternative, accepted these terms. About 10,000 prisoners, 48 guns, and large quantities of ammunition and supplies fell into Grant's hands.

Fort How'ard, city of Brown co., Wis., on the Chicago and North-western R. R. and on the W. side of Fox River, near its mouth, opposite the city of Green Bay. It has a national bank, 2 newspapers, 3 machine-shops and foundries, a large elevator, 6 churches, 3 railroads, 12 hotels, 2 boiler-shops, many large business-houses, 2 parks, a fine harbor, numerous lumber manufactories, and an extensive trade. More than 40 lumber and shingle mills market their products here to the annual amount of 79,000,000 feet of lumber, besides over 200,000,000 shingles and 6,000,000 staves. Pop. 2462. C. J. PRATT, ED. "HERALD."

Fort Hun'ter, post-v. of Florida tp., Montgomery co., N. Y., on the Mohawk, E. of the mouth of Schoharie Creek. It is on the site of an old Indian fortification. A British fort was built here in 1711. Pop. 200.

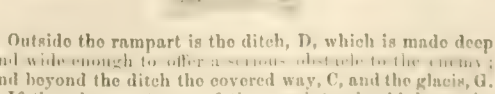
Fortifica'tion. Fortification, or the art of rendering a military position defensible against the attacks of superior numbers, is usually divided into two branches—permanent fortification and field or temporary fortification. Permanent fortifications are constructed to defend a position of permanent importance, and are made of durable materials. Field fortifications are intended to serve a temporary purpose, and the materials employed are those found most ready at hand. The principles of the art are essentially the same in both. Permanent fortifications being the more elaborate, it will be convenient, in a brief exposition of the subject, to consider that branch first. It will be necessary to assume that the reader is acquainted with the elementary terms employed.

I. PERMANENT FORTIFICATION.

General Definitions.—A modern fortress usually consists of an enclosure of earth and masonry, called the enceinte, or body of the place, secured by a citadel within, and strengthened by works on the exterior, called outworks.

The mass of earth employed to cover the bodies of the defenders while in action from the enemy's projectiles is called the parapet. It is raised upon another mass of earth called the rampart, R (Fig. 1).

FIG. 1.



Outside the rampart is the ditch, D, which is made deep and wide enough to offer a serious obstacle to the enemy; and beyond the ditch the covered way, C, and the glacis, G.

If the plan, or trace, of the enceinte should have the form of a simple polygon with only salient angles, the ditch would not be under the fire of the work, and an enemy having reached it would there find shelter. The arrangements by which the exterior slope and bottom of the ditch are brought under fire are called flanking arrangements. In general terms, they consist in arranging the sides of the polygon so as to make both re-entrant and salient angles. In small works, having only salients, galleries are sometimes built behind the counterscarp, having a fire upon the ditch. When the flanking arrangements

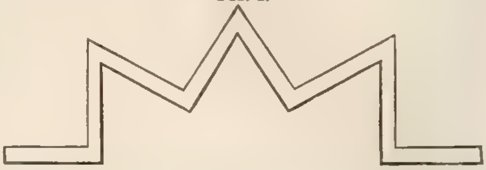
are imperfect, the space left unexposed to the fire of the work is called a dead space.

Systems of Fortification.—The main points to be attained in any fortification are—1st, to offer an obstacle to the advance of the enemy to a hand-to-hand conflict; 2d, to cover the defenders from his projectiles; and 3d, to thoroughly sweep with its fire all the ground within range on the exterior, including its own ditches. It is estimated that over 500 different methods of securing the above ends have been proposed. There are three principal systems, however, which these methods approach more or less closely, and which will alone be noticed. These are the tenailled (Fig. 2), the bastioned (Fig. 3), and the polygonal systems (Fig. 4). The figures represent the systems on a perfectly horizontal site, where there is nothing to cause irregularity. To avoid unnecessarily complicating the figures, only the magistrals, interior crests, rear lines of terrepleins, and foot of rampart slopes are shown. The heavy black lines are the interior crests; the stippled portions are the bottoms of the ditches. In Fig. 2 only the magistral and interior crest of the enceinte are shown.

It will be observed that the lines are straight in all of them. To make them curved would either scatter their fire or concentrate it upon a single point, since the direction of the line of fire is always assumed to be perpendicular to the interior crest, this being the most natural direction for the soldier to fire in, and the one which he will always employ at night. Moreover, if the lines were curved, it would not be possible to flank them, since the path of the projectile is a straight line.

Before describing these systems it should be noticed that the mere enclosing a given space by a rampart of the usual height will not necessarily of itself afford the required cover to the defenders. If the direction given to the lines is such that the enemy can place himself upon the prolongation of them, he can land his projectiles at one end of the terreplein and sweep it to the other; fire striking a line in such a direction is called enfilade fire. Should the enemy be able to take up a position from which he can fire over one portion of the enclosure, and strike in rear the parapet beyond, the latter is said to be exposed to reverse fire. Lines placed so as to be exposed to enfilade or reverse fires are faulty; and though it is not always possible to avoid so placing them, on account of the necessity of giving their fire a suitable direction, it is evident, in comparing the different systems, that the one which will least often require this fault will, so far, be the best.

Fig. 2.



The tenailled trace is shown in Fig. 2. This trace is simple, adapts itself well to irregular ground, and provides a cross-fire upon the approaches. At first glance it seems to be well flanked, but that is not the case. The greatest angle of depression at which artillery is fired is about 1 upon 6. Supposing the height of the gun to be 40 feet above the bottom of the ditch, it cannot strike this bottom at a distance less than 240 feet. Hence, there is a considerable dead space at each of the re-entrant angles. For the same length of parapet this trace encloses less space than either of the other traces. The great number and the sharpness of its salients render its faces peculiarly liable to enfilade and reverse fires.

Fig. 3.

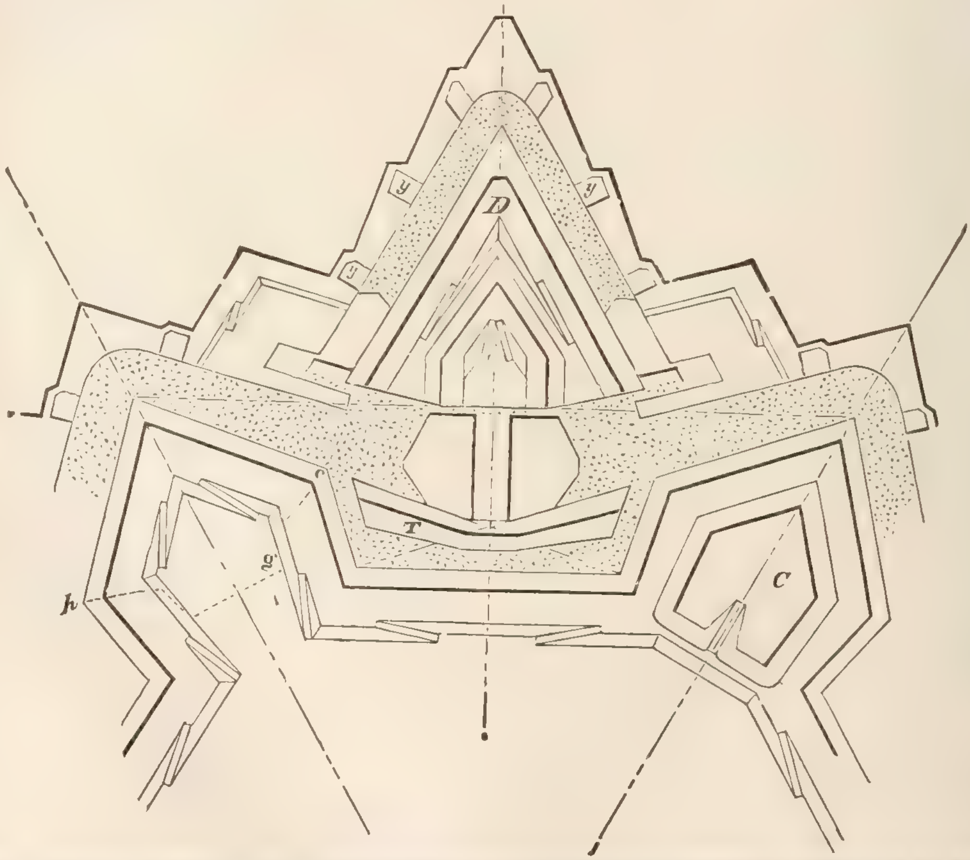
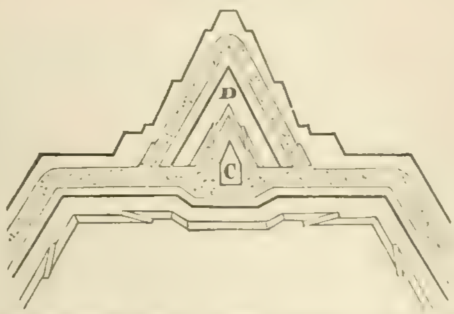


Fig. 3 shows the bastioned trace. It will be observed that the great distance between the flanks and the opposite glacis will expose the masonry scarp of the former to the curved fire of the enemy. To partially remedy this defect, and to cover the masonry of the curtain, the tenaille, T, was introduced. It is a low outwork, so constructed as not to interfere with the fire of the flanks upon the ditch in front of the bastion faces, and is armed with musketry. It creates, however, a considerable dead space.

In the attack of this enceinte the enemy would make his approaches along the capital of the bastion, and the greater portion of the fire which can be brought to bear in this direction is comparatively distant, since it comes from the adjacent bastions. This weak point is strengthened by the construction of the demilune, D. Two adjacent demilunes throw the bastion between them into a strong reentrant, and add enormously to the strength of the front. The demilune serves also to mask the shoulder angles of the bastion and to cover the communications under the curtain.

In the employment of the bastioned system it would be very difficult to so place all of the lines that they will not be exposed to enfilade and reverse fires. The connection between its parts is so rigid that it adapts itself badly to irregular sites, and in very rough sites it is entirely inapplicable. The flanks being situated at a considerable distance from the faces to be flanked, a portion of the range of their guns is lost. The height of the parapet is limited by its length of front.

Fig. 4.



The polygonal trace is shown in Fig. 4. Its flanking arrangements are obtained by constructing a low casemated work, C, called a caponnière, either at the salient or at the middle of the face. To more perfectly secure the caponnière, a demilune, D, is constructed in front of it; this outwork serves also to cover the communications with the exterior, and to give a cross fire upon the approaches.

In this system the faces are but little exposed to enfilade or reverse fires, since the enemy in placing himself upon the prolongation of one of them, will place himself within short range of the adjacent ones; and it is easy to cover these prolongations by adjacent outworks. For the same length of parapet more ground is enclosed than in either of the other systems. The length of a front (or, what amounts to the same thing, of the lines of defence) may be greater than in the bastioned, since the full range of the flanking guns is made available. This system adapts itself better to irregular sites.

Each of these systems has had its partisans. During the present century the contest between those of the bastioned and those of the polygonal has been especially sharp, and has resulted in the adoption, *theoretically*, of the polygonal system by all great nations except the French. Fortifications must, however, adapt themselves to the irregularities of the ground; and this fact is opposed to the universal employment of any fixed system. Enlightened engineers of all nations are therefore in the habit of using either or all of these systems combined, according to circumstances.

Principles of Fortification.—The more important fundamental principles in all systems are—

1st. They must have good flanking arrangements.

2d. The lines of defence must be as long as possible, supposing the dimensions of the fortress to permit it, in order to avoid short fronts and a multitude of flanks. Their length is limited by the range of the weapons used for flanking; and these weapons must be such as will throw a large number of projectiles heavy enough to disable men. Rifled artillery is not suitable; musketry and howitzers are generally used. The former may be replaced by the Gatling gun or the mitrailleuse, the effective range of which, for this purpose, is 800 yards; the howitzer must be retained for the purpose of occasionally throwing shells to destroy any temporary cover the enemy may erect.

3d. The enceinte must have a considerable command over the surrounding country and over the outworks. The height of the interior crest is limited by the necessity of thoroughly sweeping the ground on the exterior, and of covering the masonry from the direct fire of the enemy. It is rarely more than 25 or 30 feet above the natural surface of the ground.

4th. Masonry is not to be exposed to the direct fire of the enemy. This principle has applied until recently only to land defences. In sea-coast fortification it is frequently necessary to concentrate a large number of guns upon a confined space, and they are placed in tiers of casemates, one over the other. These works being subject only to fire from ships, the masonry was exposed with comparative impunity, since this fire is so unsteady as not readily to strike the same spot many times in succession. But a single shot from the powerful artillery of late years will do as much execution as a series of the old ones. Hence, it becomes necessary to greatly increase the thickness of the masonry masses where exposed, and to substitute iron for masonry about the guns. (See *Prof. Papers Corps of Engineers*, No. 21.) In some few cases, as at Spithead and Plymouth breakwater (England), the external walls are wholly of iron. In Europe, and especially England, casemates with iron fronts, or "shields," have within the last decade been extensively constructed. (See SHIELDS.) Works bearing iron revolving turrets, besides casemates or barbette gun emplacements, have been designed, and in one case at least such a work, bearing six turrets for two guns each, and with intermediate shields for two guns in each interval, has actually been constructed.

5th. The nearer the general direction of the fronts fortified shall be to a straight line the better, since thus a large amount of fire can be concentrated upon the approaches.

6th. The arrangement of the works must be such that, as far as possible, the prolongations of the parapets shall not be attainable by the enemy, and the terrepleins be covered against vertical fire. The first is secured by a proper placing of the lines, and the second by casemates and bombproofs.

7th. The outworks must be so arranged that their capture must necessarily be successive, thus introducing the element of time into the defence. If two outworks can be attacked simultaneously, their capture may require more material, but not more time, than if there were only one.

8th. All parts of a fortification should be equally strong. Hence, if one part is the stronger by nature, the others will demand more from art. This sometimes leads to the multiplication of works upon one or more of the fronts.

Accessory Defences.—The advance of an enemy is very seriously retarded by a judicious use of counter-mines. (See MILITARY MINING.) In addition to the works exterior to the enceinte, works are sometimes constructed within it, the object of which is either to defend the breach when made, or to get greater command over the approaches and bring a plunging fire to bear upon them. In the former case they are called interior retrenchments; in the latter, cavaliers. Interior retrenchments are generally arranged so as to isolate the salients, which are the parts usually breached, from the body of the work; they are provided with a ditch with revetted scarp and counterscarp, and are thoroughly flanked. The heavy dotted lines e, g, h, on the left of Fig. 3, show the direction sometimes given to the magistral of an interior retrenchment. Cavaliers may be placed anywhere on the perimeter of the enceinte; in plan they are generally drawn parallel to the magistral of the enceinte, C (Fig. 3).

When the face of a work is exposed to enfilade fire, the destructive effects of the latter may be much diminished by raising masses of earth at intervals along the terreplein. These masses are called traverses, y, y, y (Fig. 3); they extend across the terreplein in a direction nearly perpendicular to the interior crest, a narrow passage-way being left at one end for communication. When a parapet is exposed to reverse fire, a mass of earth is thrown up behind it and its defenders; this mass is called a parados. Both the parados and traverse may be utilized for the purpose of bombproofs and magazines.

It is of great importance to remove all obstacles which could afford cover to the enemy anywhere within range of the guns. Forests and buildings are cleared away, and inequalities of the ground graded off.

Economy of Fortification.—In determining upon the amount of money that can be assigned to the construction of fortifications, the latter should be regarded as so much insurance, and insurance not only against pecuniary loss, but also against national dishonor. Their extent at any given point must therefore depend upon the importance of the point and the risk of its capture. Among a warlike people the risk of capture will be less when the population is dense and reinforcements in material and men can readily be procured. Hence, an isolated point, with but a sparse population in its vicinity, will require the maximum percentage of its value for fortification, supposing always that the facilities for attack are the same, and that the site offers no great natural advantages to the defence. The points of greatest value with a nation having powerful neighbors are the great strategic pivots, the occupation of which by an enemy would endanger the life of the nation; such are, in Europe, the capital and great commercial centres. A very small percentage of their value will give very large sums for their defence, and European nations expend these sums without hesitation.

The size of the works is not always an indication of their strength, nor is their cost always proportionate to the value of the point defended, though their strength must be. Everything varies with the locality.

Permanent Fortifications in the U. S.—The frontiers which are exposed to attack being principally maritime, the fortifications of the U. S. consist almost entirely of batteries of heavy guns adapted to a contest with ships. To secure these batteries from a land attack, they are enclosed in rear

by a land front, traced according to the principles above laid down, and made strong enough to hold an enemy in check until reinforcements can arrive. These land-fronts are seldom designed* to resist a regular siege for a great length of time, it being assumed that our vast resources in men and material, and our system of railroad and water communication, will enable us to bring a superior force to meet an enemy at any point, provided time is allowed us to assemble them; it is to gain this time that the land-fronts are constructed.

The essential feature of these works is the sea-front. Where space is available the guns are spread out in a single tier, and are generally arranged to fire over a parapet, or *en barbette*, as it is called. There is a battery of 15-inch guns, occupying both sides of a headland at the mouth of one of our harbors, said to be a mile long. The guns are usually placed in pairs, each pair being separated from the adjoining one by a high and thick earthen traverse, in which is a magazine or bombproof. In positions greatly exposed to enfilade sometimes there is a traverse for every gun.

Where the space is contracted it has been usual to mount guns in masonry casemates built tier over tier. Some of our works, built prior to 1860, have three tiers of casemates, and a barbette battery on top. This method of building was recognized throughout the world, and was the one generally adopted by us, up to the date of recent developments in the construction of guns and ships, by which the calibre, range, and power of the first were immensely increased, and almost impenetrable iron-clad vessels superseded wooden ones. The method is now discarded, and the question with us of adapting casemates to our sea-coast batteries has not come to a practical solution.

The majority of our present fortifications belong to what is known as the third system, the first comprising those built after the breaking out of the French Revolution in 1789, and the second those built just before the war of 1812. The works of the first and second systems were small and weak. The third alone was systematically planned after a comprehensive study of the coast and northern frontier; a board of engineer and naval officers was convened for the purpose, of which the celebrated French engineer Gen. S. Bernard and the late Gen. J. G. Totten were prominent members. It was commenced in 1816, and notwithstanding the vast extent of the coast it is now in a very fair state of defence. This third system, founded upon broad general principles which are perennial, is now in a measure behind the demands of the times as regards methods of construction. A new one has not been definitely fixed upon, but may be said to await further developments, while in recent constructions we have confined ourselves to earthen batteries for barbette guns. It is true that the enormous guns of the present day are greatly exposed when thus mounted, and need some means of protecting their gunners not demanded by the light guns formerly in use. One of the simplest means is a "counterpoise" or depressing carriage, by which the gun may be brought down behind the parapet for loading. Such carriages have been designed by (to mention two prominent names) Capt. Moncrieff in England, and Major King, corps of engineers, in this country. The carriage of the latter has been successfully subjected to prolonged experimental tests, and it is expected that this or an equivalent will soon be introduced into our new batteries, all of which are designed to receive them.

The scheme of defence, of which fortifications constitute one element, comprises a navy, fortifications, interior communications by land and water, and a regular army and well-organized militia. In the language of Gen. Jos. G. Totten, for many years chief of the engineer corps of the U. S. army, "The navy must be provided with suitable establishments for construction and repair, stations, harbors of rendezvous, and ports of refuge. All these must be covered by fortifications having garrisons of regular troops and militia, and be supplied with men and materials through the lines of interior communication. Not being required to remain in the harbor for their defence, the navy, pre-eminent as an offensive arm, will be prepared to transfer the war to distant oceans and to the shores of the enemy, and to act the great part which its early achievements have foretold, and to which its high destiny will lead.

"Fortifications should—1st, close all important harbors against an enemy, and secure them to our military and commercial marine; 2d, should deprive an enemy of all strong positions where, protected by naval superiority, he might maintain himself during the war, keeping the whole frontier in constant alarm; 3d, must cover the great naval establishments from attack; 4th, must protect the great cities; 5th, must prevent, as far as possible, the great avenues of interior navigation from being blockaded at their entrance to the ocean; 6th, must cover the coastwise and interior navigation, by closing the harbors and the several inlets which intersect the lines of interior communication, thereby further aiding the navy in protecting the navigation of the country; and 7th, must shelter the smaller towns along the coast, and also all their commercial and manufacturing establishments which are of a nature to invite the enterprise or cupidity of an enemy.

"Interior communications will conduct, with certainty, the necessary supplies of all sorts to the stations, harbors of rendezvous and refuge, and the establishments of construction and repair for the use both of the fortifications and of the navy; will greatly facilitate and expedite the concentration of military force, and the transfer of troops from one point to another; will ensure to these troops supplies of every description; and will preserve, unimpaired, the interchange of domestic commerce, even during periods of the most active external warfare.

"The army and militia, together with the *personnel* of the marine, constitute the vital principle of the system.

"It is important to notice the reciprocal relation of these elements of national defence: one element is scarcely more dependent on another than the whole system is to each one. Withdraw the navy, and the defence becomes merely passive; we expose ourselves the more to suffer the evils of war at the time that we deprive ourselves of all means of inflicting them. Withdraw interior communication, and the navy will often be greatly embarrassed for want of supplies, while the fortifications will be unable to offer full resistance for want of timely reinforcements. Withdraw fortifications, and the interior communications are broken up, and the navy is left entirely without collateral aid."

It must be borne in mind that the foregoing was written when our population was small and our present system of intercommunication by railroads and canals not in existence. The *practical application* of the principles laid down has been somewhat modified by these physical developments, but it is not the less interesting and important to understand this masterly exposition of the principles which govern our sea-coast fortification, as distinct from land fortification, which alone forms the subject of most treatises on the art.

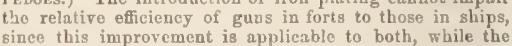
Although it is now the settled policy of the U. S. government to employ permanent fortifications upon the seaboard, this policy has been attacked by men in high station. (A full statement of the arguments for and against it may be found in vol. iv. *Reports of Committees 2d Session 37th Congress*, 1861-62.)

The application of steam to vessels of war brought with it the employment of torpedoes or other obstacles as a necessary complement to sea-coast fortifications. (See TORPEDOES.) The introduction of iron plating cannot impair the relative efficiency of guns in forts to those in ships, since this improvement is applicable to both, while the weight or thickness is in the fort unlimited. (See IRON-CLAD, IRON PLATING, SHIELDS.) At the present day one of the most important applications of permanent fortifications in Europe is to intrenched camps. (See INTRENCHED CAMPS, by GEN. A. BRIALMONT of Belgium.)

II. FIELD FORTIFICATION.

Modification of Foregoing Principles and Rules.—In field fortifications, which are constructed during the exigencies of war, the practical application of some of the foregoing principles is somewhat modified. The parapet, instead of being raised upon a rampart, is placed upon the natural surface of the ground. (Fig. 5.) The ditch is no great

FIG. 5.



obstacle to the advance of an enemy, and is not intended as such. It is excavated to procure earth for the parapet, and is made of the width and depth most convenient for that purpose, the scarp and counterscarp not being revetted. Some obstacle, however, is essential, as before announced, and in field works it consists of a line of obstructions placed about 50 yards in front of the ditch, *a* (Fig. 5). If possible, a second line should be established 50 yards farther to the front. The following are some of the obstacles most commonly employed: *abbatis*, formed of stout limbs of trees about 15 feet long, with the small branches cut off and the large ones pointed, laid as close together as possible, branches towards the enemy; *palisades*, or rows of stout stakes, about 10 feet long and 6 inches in diameter, planted about 3 feet deep in the ground, about 4 inches apart, their tops being pointed and inclined to the front; *trous-de-loup*, or excavations in the form of an inverted

* The few works—*e. g.* Fort Adams, Fort Monroe, etc.—which form the exception were designed and built half a century ago, before the resources and means of inland communication of the country had been developed.

cone, with pointed stakes at the bottom; they must be either so shallow as not to afford cover to skirmishers, or so deep that when a man has fallen into one he shall not be able to use it as a rifle pit; *wire entanglement*, made by driving stout stakes into the ground about 7 feet apart, in three or more rows, arranged checkerwise, and connecting their tops by strong wires crossing diagonally about 1 foot or 18 inches above the ground; *torpedoes*. (See TORPEDOES.)

Inundations are sometimes made by damming back a water-course; if the overflow is fordable, it may be rendered impracticable by digging trous-de-loup, or irregular trenches, and by scattering about harrows, boards with nails in them, or crows'-feet.

The parapet being intended primarily as a cover, and not as an obstacle, no portion of it is revetted except the interior slope, which must be made steep to enable the defenders the more conveniently to fire over it. This is effected by the use of gabions, fascines, or sods, sometimes by logs, posts, barrels, sandbags, or any conveniently improvised means.

Outworks are seldom employed in field fortification, since, even if time permitted their construction, they would obstruct the fire of the enceinte on account of its low relief.

The application of the principle that the works must have good flanking arrangements is modified in the case of field works by the fact of their low relief, which removes to a certain extent the dead spaces in front of them: and further, by the situation of the point where the enemy's advance is checked. In the case of permanent works the enemy meets his most serious obstacle when he reaches the ditch, whereas in the case of field works an enemy having once reached the ditch will, in most cases, not delay to enter the works, and the real obstacles to his advance are found fifty yards from the ditch. Hence, while it is undoubtedly desirable to have good flanking arrangements, a field work may be in an excellent state of defence without them; whereas the want of them in a permanent work would be a vital defect. Indeed, in the case of a small field work it would be injurious to the defence to break up the lines into a series of small ones, scattering the fire in several directions, and rendering it insufficient in all.

Fortifications extending over the front of the position of an army are called intrenchments or lines. Continuous lines are those which extend continuously from one end of the position to the other. Lines with intervals are those in which only the most important points are occupied by detached works, the intervals being left open.

The great development of the front occupied by an army rendered it impracticable, until a recent date, to give to all parts of a continuous line the strength necessary to resist the attacks of very superior numbers; and an enemy forcing his way through at a single point could turn the whole line. Hence, in a strictly defensive position engineers preferred the line with intervals, concentrating all their means upon the detached works, and controlling the intervals by the fire of these works. The recent great improvements in the musket, particularly in loading, by means of which a thin line of troops can deliver a steady stream of fire, have changed the circumstances of the case. It has been definitely shown by many bloody experiments in the recent civil war (1861–65), and in the Franco-German war (1870–71), that a well-intrenched line, properly manned, cannot be carried by an open assault in front. (See *Professional Papers Corps of Engineers*, No. 20, Appendix F.) The experience of these wars has also shown that troops cannot be exposed for even a few moments without some cover, and that the ordinary enclosed field work of earlier days, unprovided with traverses or bombproofs, is of little use against the accurate and distant fire of modern weapons, while it will probably attract a concentrated fire from them. Hence result several important modifications in the application of field fortifications, viz.: 1st, the employment of continuous lines of low command and easy construction for the defence of an army's front; 2d, the constant use of intrenchments on the battle-field, thrown up in a few moments whenever the troops halt; and 3d, the greater care in the planning and construction of enclosed works when such are employed.

The works alluded to under the first heading are called rifle-trenches, popularly known in this country during the civil war as rifle-pits, which term is technically applied to another work. (See SIEGE.) Those under the second heading are used by armies something as the individual formerly employed the buckler and cuirass, and are called shelter-trenches. Rifle-trenches and shelter-trenches receive the generic name hasty intrenchments. Those under the third heading have received the appropriate name semi permanent works.

Hasty Intrenchments.—In modern warfare the first duty of the troops upon halting after a march, when near the enemy, is to intrench themselves. During the varying tides of battle a point gained is at once intrenched. Cover for infantry is most rapidly obtained by excavating a trench about 1½ feet deep, and throwing the earth to the front to form a parapet. This can be widened in a few minutes, so as to afford cover to men lying down. (Fig. 6.)

FIG. 6.

There should be ready means of getting in and out of these trenches, both to the front and rear; the troops should be able to march straight over them when necessary. At intervals of about 100 yards ramps should be formed or breaks be left in the lines, which may here overlap, to enable artillery and cavalry to pass. The trace given to these trenches is evidently the same that would be occupied by a line of battle. No attention is paid to flanking arrangements, properly so called. Should the position be long occupied, the most important points are sometimes secured by enclosed works. Should the ground be occupied for a prolonged period, the trenches are deepened and widened until they become rifle-trenches. A trench 3 feet deep and a parapet 4½ feet high, giving a total cover of 7½ feet, is the greatest vertical dimension generally given them. The natural surface of the ground forms the banquette, the parapet being thrown forward sufficiently far for that purpose. In wooded regions a revetment of the interior slope is frequently formed of logs laid one over the other. Further strength is given to the line by some of the obstacles previously described, placed about 50 yards in front.

It is natural for men lying behind breastworks exposed to fire to crouch low, and thus to raise the muzzles of their muskets while they lower the butts, and fire too high. It is therefore important to provide loopholes along the parapet, to cover the heads of those firing. A log about a foot in diameter is sometimes laid on top of the parapet, notches being cut on the lower side about six feet apart. Loopholes may also be made of boards or of sandbags. A screen of any kind, even if not bullet-proof, is valuable; branches of trees are therefore sometimes employed.

At suitable points the artillery is posted, the terreplein being widened and embrasures cut for the purpose. If a position can be secured where the artillery could enfilade an attacking line, it would of course be occupied, as in posting troops for battle. This is not strictly a flanking arrangement, as the term is employed in fortification.

Woods in front of the works are cleared away and ditches filled up, these clearings being extended by degrees to the full range of artillery, should the position be long enough occupied. Ditches and similar obstacles running perpendicularly to the general direction of the defences may be left, as they will obstruct the circulation of the enemy's troops from one part of his line to the other. In long lines of rifle-trenches branches should be run back, at intervals of 500 or 600 yards, in a direction nearly perpendicular to the main line, to shut off the enemy in case of his forcing his way through, and prevent him from turning the whole line by his advantage at a single point.

The employment of enclosed works upon these hasty intrenchments is exceptional, since the labor and materials required to construct them in accordance with the demands of modern war cannot usually be provided.

Semi Permanent Works.—At the breaking out of the civil war the strategic points of the U. S. were entirely unprovided with land defences. It became necessary to construct strong fortifications, with some durability, for large cities, in a short time. These circumstances gave rise to a new kind of fortification, combining certain of the arrangements of permanent with those of field works, and called by American engineers semi permanent works. It is in this form that enclosed field work will generally be employed in the future; and it is to these that we must always look for the land defences of our cities. The most remarkable example of their application was in the fortification of Washington. (See *Prof. Pap. C. E.*, No. 20.) This city was very much exposed, was of vital importance to the Union cause, and was loosely scattered over a wide area. It was necessary not only to keep out the enemy, but to keep out his artillery projectiles, which had a range of three or four miles. The first defences constructed were of the old field-work type, with thin parapets and steep scarps, and unprovided with bombproofs. They were located at the points most immediately requiring them, and some of them were laid out by the eye, the distances being measured by pacing. Their weakness was recognized. As time and experience were gained, a system of great strength

was developed, the defences at the close of the war consisting of 68 enclosed forts and batteries, having an aggregate perimeter of 22,800 yards (13 miles), and emplacements for 1120 guns, 807 of which and 98 mortars were actually mounted; of 93 unarmed batteries for field-guns, having 401 emplacements; and of 35,711 yards (20 miles) of rifle-trenches, and 3 block-houses. The permanent garrison was about 18,000, though it was expected that this would be greatly reinforced in case of a persistent attack. The length of the line occupied was about 37 miles. "Every prominent point, at intervals of 800 or 1000 yards, was occupied by an enclosed work; every important approach or depression of ground unseen from the forts swept by a battery of field-guns, and the whole connected by rifle-trenches." These enclosed works were the semi-permanent works; they were located upon the principles of lines with intervals, the intervals being afterwards closed, as an additional precaution, by lines of rifle-trenches.

In these detached works bombproofs were provided for the men and material, embrasures for the guns, and well-ventilated magazines, lined in a substantial manner with heavy timber, for the ammunition, space being allowed for 100 rounds per gun. The depth of the ditches was usually 6 feet, their width being regulated by the amount of earth required for the parapets. Glacis were thrown up to bring the ground in front under the musketry-fire from the parapets. Traverses were erected wherever a line was exposed to enfilade or oblique fire. Great care was taken to provide each of the larger works with flanking arrangements. When this could not be otherwise secured, counterscarp galleries were employed. In many cases advanced works, in the shape of rifle-trenches connected with the main works, were constructed. Wells were dug to supply the garrisons with water. Instead of a steep scarp, liable to erosion, the exterior slope of the parapet was continued to the bottom of the ditch.

But the most remarkable improvement upon the old methods was in the structures within the works. In addition to the substantial and roomy magazines already referred to, the larger works were provided with filling-rooms, implement-rooms, service magazines, and guard-rooms, either in the traverses or in separate structures, while nearly all contained capacious bombproofs. The latter were generally arranged to serve the purpose of a parados, or traverse, or interior retrenchment, in addition to their primary object, and were provided with a banquette along the rear, from which musketry-fire could be delivered upon an assaulting party which had succeeded in mounting the front parapet. (An interesting and valuable account of these fortifications is given in detail in GEN. J. G. BARNARD'S *Defences of Washington*, published as *Professional Paper Corps of Engineers U. S. Army*, No. 20, in 1871.)

Block-Houses.—The case frequently arises where it is necessary for a point of considerable importance to be guarded by a small detachment of men, and where circumstances do not permit the construction of a semi-permanent work. Such would be a bridge upon a line of communications passing through the enemy's country which it is necessary to guard against cavalry raids. In this case, instead of the redoubt formerly employed, engineers preferably use the block-house. This is a building of which the sides are composed of heavy timbers placed vertical in juxtaposition, loopholed, and sometimes provided with embrasures for artillery. Earth is heaped up on the exterior to the height of the loopholes or embrasures, and a V-shaped ditch excavated to prevent the enemy using these against the defenders.

Historical Sketch of Fortification.—The origin of fortification is coeval with that of society. The character of the works has conformed to that of the weapons employed in the various ages of mankind. Thus, among the wild tribes of the infant world, armed with clubs and weapons of stone, a wooden barricade or a bank of earth surmounted by a hedge was an efficient defensive work. The introduction of cutting tools of metal rendered these an easy prey to the attack, and a wall of masonry became necessary. As nations grew in power the height and thickness of these walls increased; some are said to have been 100 feet high. The greater their height, the more difficult they were to scale, and the more efficient were the missiles thrown from them; while the greater the thickness, the more space was provided upon them for the engines of war. To procure great thickness two walls were often built parallel to each other, the interval between them being filled with earth. The walls of Babylon are said to have been 70 feet thick, and are supposed to have been built in this way. To cover the men and material on top of this rampart, a thin wall was built up at the front part of it to the height of a man, and furnished with embrasures, through which stones and arrows were discharged at the enemy. To obtain a fire upon the foot of the wall, brackets were built out, and upon them were placed parapet-walls with embrasures. The next improvement was to build towers projecting from the general face of the wall, and providing a fire parallel to it. The distance between these towers was about the range of an arrow. It is doubtful when the ditch was introduced, but it was probably at an early date. During the Middle Ages the art of fortification, like the other arts and sciences, rather retrograded than improved.

The invention of gunpowder caused a radical change in all the methods previously employed. The high walls presented a marked and vulnerable object to projectiles of cannon; they had to be very much lowered. The top of an ordinary wall did not afford room for the guns; space was procured by throwing up a bank of earth on the interior. The towers had to be very much enlarged to receive the guns; they thus expanded into bastions. The walls, though lowered, were still exposed to being breached from a distance; outworks were therefore thrown up in front of them.

The Italians being in advance of the rest of Europe in all the arts, it was with them that the first great changes originated—Verona was surrounded by a bastioned enceinte in 1527—though the first modern writer was the celebrated German painter, sculptor, and architect, Albert Dürer, whose book is dated 1527. His ideas showed great originality and sagacity. He provided casemates, and flanked the faces of his polygon by enlarged towers, which he called bastions, though they rather resembled the caponnière than the modern bastion. The second great name in the modern art is that of Daniel Speckle, also a German, b. in 1536 at Strasburg, which city he fortified. He enunciated the principles that masonry must not be exposed to the distant view of the enemy, and that the nearer the general direction of the line fortified shall be to a straight line, the better. The first prominent French writer was Errard de Bar-le-Duc, whose book is dated 1594. He enunciated the principles that the minimum salient angle shall be 60°, and that the outworks must be seen into and commanded by the works in rear. His work was followed by that of De Ville in 1629, who made some improvements in details. Following Errard and De Ville, the next master was the count de Pagan, whose work is dated 1645. He greatly increased the size of the demilune, and regulated the dimensions of the bastions and the distance between them, and improved the direction of the flanks and other details.

Vauban was born in 1633. Taking the method of Pagan, he enlarged the demilune, and provided it with an interior redoubt, invented the tenaille, enlarged the re-entrant places of arms, and constructed traverses along the covered way. Vauban restored 300 old fortresses, built 35 new ones, and besieged 53. He displayed extraordinary talent in adapting his works to the site, and he brought the bastioned system to a high degree of perfection. Coehorn was a contemporary of Vauban's, and adapted the system in a peculiar manner to the low lands of Holland. Vauban was followed by Cormontaigne, b. in 1696, who enlarged the demilune still further, introduced redoubts in the re-entrant places of arms, and made other improvements, leaving the system substantially as it is to-day.

The bastioned system was considered the only proper manner of fortifying until the latter part of the eighteenth century, when Montalembert, a French general of cavalry, produced his bold and original work. This "most intrepid of writers on fortification," as he has been styled, abandoned the bastioned trace, made large use of casemates, and used caponnières for flanking purposes, thus developing the ideas produced 250 years before by Dürer. He also advocated the tenailled system. It is upon the ideas of Dürer and Montalembert that the modern polygonal system is based, which is now receiving such general employment throughout Europe, except in France. For sea-coast fortification the casemates of Montalembert had a singular applicability. He is the first engineer who invented special designs for works "for the defence of ports," and he should be regarded as the originator of the casemated batteries subsequently so extensively employed by all nations.

(The literature of fortification is very large. For a technical study of the subject the reader is referred particularly to ZASTROW'S *History of Permanent Fortification*, originally published in German, but translated into French and published at Paris in 1856; FALLOT'S *Cours d'Art Militaire*, Paris, 1857; and the following works by COL. A. BRIALMONT, now major general of the Belgian staff: *Études sur la Défense des États et sur la Fortification*, Paris, 1863; *Traité de Fortification Polygonale*, Paris, 1869; and *Fortifications à Fossées Secs*, Brussels, 1872.) (For attack and defence of fortifications see SIEGE.)

O. H. ERNST.

Fort Independence, a pentagonal bastioned work with exterior open barbette batteries, located on Castle Island, Boston harbor, Mass.; commenced 1832. It forms

one of the defences of the inner harbor of that port, being distant about 3 miles from the city.

Fort Jack'son, a v. of Hopkinton tp., St. Lawrence co., N. Y., has manufactures of cooperage, lumber, starch, etc.

Fort Jackson, Savannah River, Ga., an open barbette battery, about 4 miles below Savannah, designed to defend the main channel and the passages which come into the river by the S.

Fort Jackson, a pentagonal bastioned and casemated brick work, with glacis and wet ditch, on the Mississippi River, 78 miles below New Orleans, at what is known as the "Plaquemine Bend." The designing of such a work on this soil was bold but successful; the considerable "settlement" has done no serious injury. In conjunction with Fort St. Philip, it defends New Orleans against maritime attack by the river. Mainly built from 1824 to 1832, though extensively repaired, enlarged, and modified since 1841. The forcing of the passage of these works and their capture by the fleet of Farragut constitutes the first great naval exploit of that commander. (See FARRAGUT, ADMIRAL.)

Fort Jef'ferson, Garden Key, Tortugas, Fla., an enclosed hexagonal casemated work, designed to command the harbor lying in this group of keys; commenced 1846.

Fort Kear'ney, a military post and v. of Kearney co., Neb., on the S. bank of the river Platte, and on the Burlington and Missouri River R. R., 125 miles W. of Lincoln, and nearly opposite Kearney, on the Union Pacific R. R.; lat. 40° 33′ N., lon. 99° 6′ W.

Fort Kent, post-v. and tp. of Aroostook co., Me., 126 miles N. by W. of Houlton, on the St. John River, has extensive water power and manufactures lumber. Fort Kent was a fortification erected in 1841. Pop. 1034.

Fort Knox, an enclosed pentagonal work on the Penobscot River at the Narrows, opposite Bucksport, Me., intended for the protection of Bangor and the numerous flourishing towns on the Penobscot.

Fort La Fayette, a battery erected on Hendrick's Reef in the Narrows, New York Bay, under the guns of Fort Hamilton. During the late civil war it was used as a government prison for civilian offenders. It has since been partly burned.

Fort Lar'amie, a military post and post-v. of Laramie co., Wy., near the N. Fork of the Platte, on the Big Laramie, 89 miles from Cheyenne.

Fort Lar'ned, a military post and post-tp. of Pawnee co., Kan., 106 miles W. of Newton. Pop. 179.

Fort Leav'enworth, a U. S. military post and post-v. of Leavenworth co., Kan., on the Missouri River, 2 miles above Leavenworth. It was established in 1827. It is situated on a bluff 150 feet high. The U. S. reservation is 6 miles long and 1 mile broad. It is well laid out, and was until recently one of the most important of the U. S. military stations. Pop. of reservation, 1975.

Fort Lee, post-v. of Bergen co., N. J., on the Palisades of the Hudson River, opposite 160th street, New York City. It was once a military station, and fell into the hands of Gen. Cornwallis Nov. 18, 1776, who here captured large amounts of military stores.

Fort Liv'ingston, Grand Terre Island, entrance to Barataria Bay, La., an enclosed work with brick scarp and counterscarp and casemates, designed to guard the approaches to New Orleans by the numerous "bayous" which head near the margins of the Mississippi River and communicate with the sea by Barataria Inlet; commenced 1840.

Fort Ly'on, post-v. and military post of Bent co., Col., on the N. side of the Arkansas, 92 miles E. of Pueblo and 1 mile from Las Animas. The reservation has an area of 9 square miles. It is the chief military station in Colorado.

Fort McCla'ry, an enclosed pentagonal casemated work in Portsmouth harbor, N. H., for the defence of that port and the U. S. navy-yard therein; commenced in 1841, on the site of an old work of that name.

Fort McHen'ry, an enclosed bastioned pentagon, with exterior batteries, on the W. side of the Patapsco River, forming one of the defences of the channel of approach to Baltimore, Md. It is an old work (second system), built prior to 1812; an attack during the war of 1812–15 furnished the theme for the well-known words of the *Star-Spangled Banner*, by F. S. Key.

Fort McKav'ett, a military post and post-v. of Menard co., Tex.

Fort Mac'kinaw, a U. S. fort on Mackinaw Island, Mackinac co., Mich. It is 200 feet above the town of MACKINAW (which see).

Fort Macomb', Chef Menteur Pass, La., an enclosed work commenced in 1822. (See FORT PIKE.) Fort Macomb was formerly known as Fort Wood.

Fort Ma'con, an enclosed work on Bogue Island, entrance to Beaufort harbor, N. C.; commenced 1826.

Fort McPher'son, a U. S. military post of Lincoln co., Neb., on the S. side of the Platte, near Cottonwood Springs, and connected by a bridge with McPherson Station on the Union Pacific R. R. Lat. 41° N., lon. 100° 30′ W.

Fort McRee, a brick casemated battery, commenced in 1833 on "Foster's Bank," now a tongue of the mainland, at the entrance to Pensacola harbor, and opposite FORT PICKENS (which see). The sea has encroached on the site, and the work, when reoccupied in 1863 by the U. S. forces, was found to be in a ruinous condition.

Fort Mad'ison, city, the county seat of Lee co., Ia., on the Mississippi River, 23 miles below Burlington, and on the Chicago Burlington and Quincy, the Burlington Fort Madison and South-western, and the Fort Madison and North-western R. Rs. It is opposite Niota, Ill., with which it is connected by ferries. It is the site of a fort built in 1808, and captured by the Indians in 1818. It is the seat of one of the State penitentiaries; has a fine academy, a court-house, jail, manufactures of sash, doors, blinds, castings, machinery, beer, flour, furniture, lumber, ploughs, leather, and other goods. It has a large trade, 9 churches, 5 public schools, a park, a public library, and 2 weekly newspapers, and occupies a beautiful and healthful site. Pop. 4011. J. G. WILSON, PROP. OF "PLAIN DEALER."

Fort Madison, an old work on the left bank of the Severn River, Annapolis harbor, Md.

Fort Ma'rion, St. Augustine, Fla., an old enclosed work built by the Spaniards more than 100 years ago. It is the oldest fort in possession of the government, and is from its antiquity an object of attraction to strangers visiting St. Augustine. It is of not much value, but is kept in order to prevent its falling into decay.

Fort Mif'flin, one of the inner line of defences of the port of Philadelphia, Pa., located on Mud Island, Delaware River, below the mouth of the Schuylkill. It is one of the older (or second) system of works; built prior to 1812. Has since been modified and repaired.

Fort Mill, post-tp. of York co., S. C. Pop. 2473.

Fort Mit'chell, tp. of Russell co., Ala. Pop. 2032.

Fort Monroe', a fortification located on Old Point Comfort, Va., for the defence of Hampton Roads and the water-approach to Norfolk and the Gosport navy-yard. It stands on the N. side of the channel, Fort Wool (formerly Fort Calhoun) being on the S. side, about 1 mile distant. Fort Monroe might properly be called a fortress or fortified place, as it encloses a large area, and contains within it a number of detached buildings, such as officers' quarters, offices, barracks for soldiers, storehouses, a portion of the workshops of an arsenal, the artillery school of the service, a chapel, etc. etc. It was commenced in 1817, and was originally designed to mount 371 guns in casemates and *en barbette*, inclusive of mortars, field-pieces, and flanking howitzers. In plan it is an irregular hexagon, on two sides of which, comprising the three channel fronts, the armament is arranged in two tiers, one in casemates and one in barbette. On the other four sides, each being one front, the ramparts are solid, with the exception of some of the flanks, which are casemated. The work is bastioned, although unaccompanied by the usual outworks of the regular bastioned system. It is surrounded by a tide-water ditch, 8 feet deep at high water, exterior to which there is a casemated battery on the channel front to the left of the casemates of the main work, and a quadrilateral redoubt on the N. side, commanding the approach down the peninsula. This redoubt, like the main work, is surrounded by a wet ditch. The scarp-wall of the main work rises to the height of 17 feet above high water. The entire fort covers an area of 80 acres, and the distance around it, exterior to the ditches of main work and redoubt, is $1\frac{6}{10}$ miles. In its construction there has been expended $2,818,000. When certain modifications now in progress or approved are completed, it will mount 118 guns and 18 flank howitzers in casemates, and 51 heavy guns of modern calibres *en barbette*. Inasmuch as the exceptional magnitude of Fort Monroe, as compared with our other works of coast and channel defence, has been the subject of frequent, and sometimes of severe and perhaps not unjust, criticism, it may be said, in explanation, that this work was designed under the inspiration of Gen. Simon Bernard, a foreign engineer of eminence called into our service soon after the close of the war of 1812–15, with all the exaggerated ideas of warfare which the close proximity of belligerent nations in Europe had produced and rendered orthodox. But the more moderate opinions of our own mili-

tary engineers, moulded solely upon local circumstances and the necessities of our own country, so far prevailed as to restrict the introduction of a foreign system to the single case of Fort Monroe. We have no other work at all like it in any essential particular, and the error in this instance relates solely to magnitude, not to strength.

Q. A. GILLMORE.

Fort Montgom'ery, Rouse's Point, N. Y., an enclosed pentagonal work, commenced in 1841, constituting the defence of the outlet of Lake Champlain.

Fort Mor'gan, an enclosed casemated and bastioned pentagon of brick, with exterior batteries, located on the W. end of Mobile Point, Ala., at the entrance to anchorage in Mobile Bay; commenced 1819 on the site of old Fort Bowyer. An historic interest attaches to the latter work as having borne an important part in the war of 1812–15. It then consisted of only a small redoubt. In pursuance of the plan adopted by the British, "to destroy and lay waste all towns and districts of the U. S.," the Indian war was renewed on the southern frontier, and on Sept. 15, 1814, a combined naval and land attack was made upon Fort Bowyer, which at this time was but a small redoubt mounting 20 guns, and with a garrison of 120 men, officers included. The British force comprised 4 armed vessels, 590 men, and 90 guns, and a land force exceeding 700 men, of which 600 were Indians. The engagement, which lasted three hours, resulted in the total loss to the British of 1 ship and 232 men. The work was, Jan. 11, 1815, taken by the British.

Fort Moultrie, on Sullivan's Island, entrance to Charleston harbor, S. C. A rude work of palmetto logs and earth, mounting 26 guns, was unsuccessfully attacked in 1776 by the British fleet of nine vessels (270 guns), under Sir Peter Parker, and thenceforth bore the commander's name, Col. William Moultrie. It was subsequently rebuilt in masonry with an imperfectly bastioned tracé, and described in official reports as a "work of some strength, but with scarp wall so low as to oppose no serious obstacle to escalade." And such it was, essentially, at the time when (Dec. 26, 1860), abandoned by Major Anderson, it fell into Confederate hands, and in consort with batteries on Morris Island fired the first guns of the civil war upon the Star of the West, Jan. 9, 1861. (See FORT SUMTER.) The work in Confederate hands was reinforced by earthen batteries extending the whole length of Sullivan's Island. Since the war it has been very much modified to adapt it to receive modern heavy guns, protected by earthen traverses and parados.

Fort Niag'ara, N. Y., an enclosed work commanding the entrance into the Niagara River, at the mouth of which it is located. The old work of this name bore a prominent part in the war with Great Britain in 1812–15, and was the scene of stirring events, being surprised and captured in 1813 and most of its garrison slain.

Fort Onta'rio, an enclosed work on the right bank of the Oswego River, at its mouth, intended to protect the city of Oswego, N. Y., against naval attack. It occupies the site of old Fort Oswego, which in the war of 1812–15 was the scene of many exciting struggles, and was once captured by the enemy. The city has now, however, grown to such an extent as nearly to surround the present fort.

Fort Osage, tp. of Jackson co., Mo. Pop. 1695.

Fort Pick'ens, an enclosed casemated and bastioned pentagonal brick work, on Santa Rosa Island, Pensacola harbor, Fla., which harbor and the U. S. navy-yard at Warrington it is intended to defend. In Jan., 1861, Maj. Adam Slemmer abandoned the small work, FORT BARRANCAS (which see), opposite, and transferred his command to Fort Pickens, which he succeeded in holding until reinforced, thus saving to the government this important work. The navy-yard and works on the mainland, including Fort McRee, fell into Confederate hands, and desultory operations were carried on for some time between the two shores, exhibiting at one time the singular spectacle of two forts (Pickens and McRee) cannonading each other.

Fort Pike, Rigolets Pass, La., an enclosed brick casemated work, commenced in 1819, designed to defend, with Fort Macomb, the water-approaches to the rear of New Orleans by the two passes, Rigolets and Chef Menteur, leading from Lake Borgne to Lake Pontchartrain.

Fort Plain, post-v. of Montgomery co., N. Y., on the Mohawk River, the Erie Canal, and the New York Central R. R., 56 miles W. of Albany. It has 1 national bank, a seminary, a weekly newspaper, a spring and axle manufactory, 4 hotels, and a number of stores. Pop. 1797.

CHARLES BOWEN, ED. "MOHAWK VALLEY REGISTER."

Fort Por'ter, a small enclosed work, commenced in 1842, on the right bank of the Niagara River, at Black Rock, 2 miles below Buffalo, N. Y. It is a tower, and surrounded by a barbette battery, intended to command the entrance into Niagara River and the shore and anchorage in front of Buffalo.

Fort Preb'le, an old enclosed work situated on Preble Point, Cape Elizabeth, Portland harbor, Me., partly surrounded by a line of open barbette and casemated batteries.

Fort Pulas'ki, a fortification constructed on Cockspur Island, Ga., for the defence of Tybee Roads and the Savannah River approach to the city of Savannah, commenced in 1829. It is a brick work of five faces, casemated on all sides; walls 7½ feet thick at the base and 25 feet high above high water; mounting two tiers of guns, one in casemates and one *en barbette*. The gorge-face is covered by an earthen outwork (demilune) of bold relief. A tide-water ditch surrounds both main work and demilune, and separates the two. At the beginning of the civil war, in 1861, the work had cost $988,859, and was finished in all essential particulars, but had never been garrisoned or armed. It was originally designed to mount 150 guns of all calibres. The secession of the State of Georgia occurred Jan. 2, 1861, and her military at once took possession of Forts Pulaski and Jackson, the only defences on the Savannah River. On Nov. 29, 1861, the writer, then holding the position of chief engineer to the expeditionary corps commanded by Brig.-Gen. T. W. Sherman, made a military reconnaissance of Fort Pulaski, and pronounced "the reduction of that work practicable by batteries of mortars and rifled guns established on Big Tybee Island." Its capture having been determined upon, the island was occupied by the Union forces early in December. In order to invest the place, batteries were established in the marsh about 4 miles above the fort, commanding the Savannah River—one upon Venus Point, and another nearly opposite, on Bird Island. Another battery was placed upon a hulk anchored in Lazaretto Creek, S. of the fort.

"On Feb. 21, 1862, the first vessel with ordnance and ordnance stores for the siege arrived in Tybee Roads. From that time until the 9th of April all the troops on Tybee Island, consisting of the 7th Connecticut Vols., the 46th New York Vols., two companies of the Volunteer Engineers, and, for the most of the time, two companies 3d Rhode Island Vol. Artillery, were constantly engaged in landing and transporting ordnance, ordnance stores, and battery materials, making fascines and roads, constructing gun and mortar batteries, service and dépôt magazines, splinter and bombproof shelters for the relief of cannoneers off duty, and drilling at the several pieces.

"The armament comprised 36 pieces. No one except an eye-witness can form any but a faint conception of the herculean labor by which mortars of eight and a half tons weight, and columbiads but a trifle lighter, were moved in the dead of night over a narrow causeway bordered by swamps on either side, and liable at any moment to be overturned and buried in the mud beyond reach. The stratum of mud is about twelve feet deep, and on several occasions the heaviest pieces, particularly the mortars, became detached from the sling-carts, and were with great difficulty, by the use of planks and skids, kept from sinking to the bottom. Two hundred and fifty men were barely sufficient to move a single piece on sling-carts. The men were not allowed to speak above a whisper, and were guided by the notes of a whistle.

"The positions selected for the five most advanced batteries were artificially screened from view from the fort by a gradual and almost imperceptible change, made little by little every night, in the condition and appearance of the brushwood and bushes in front of them. No sudden alteration of the outline of the landscape was permitted. After the concealment was once perfected to such a degree as to afford a good and safe parapet behind it, less care was taken, and some of the work in the batteries requiring mechanical skill was done in the daytime, the fatigue-parties going to their labor before break of day and returning in the evening after dark. The batteries opened fire on the 10th of April." (For further particulars see GEN. GILLMORE'S *Report on the Siege and Reduction of Fort Pulaski, in Professional Paper No. 8 of the Corps of Engineers.* See also article BOMBARDMENT, by GEN. J. G. BARNARD, U. S. Army.)

Q. A. GILLMORE.

Fort Ran'dall, a military post and post-v., county-seat of Todd co., Dak., on the S. W. bank of the Missouri River.

Fort Recov'ery, post-v. of Recovery tp., Mercer co., O. Pop. 89.

Fort Ri'ley, post-v. and U. S. military post in Davis co., Kan., on the Kansas Pacific R. R., 68 miles W. of Topeka, at the junction of the Smoky Hill and the Republican rivers, and on the U. S. military road. It is in a delightful region. The reservation is of 20,000 acres. The Republican is here bridged. Pop. (garrison), 560.

Fort Royal, the capital of the island of Martinique, in the French West Indies, on whose W. side it is situated on a bay of the same name. It is the residence of the French governor. It is fortified, and has a pop. of about 12,000.

Fort St. Phil'ip, nearly opposite FORT JACKSON (which see), on the Mississippi River. The old river front, with low brick scarp and wet ditch, was built by the Spaniards. The "Plaquemine Bend" offers the lowest favorable locality for defending the river, though it is 15 miles above the mouths and 30 above the "Head of the Passes." The work was wholly enclosed by the U. S. authorities during the war of 1812-15, but is, like nearly all works of that and earlier date, of rude design both in trace and relief. Since 1841 it has undergone extensive repairs and modifications. Falling into the hands of the Confederates in 1861, it was, with Fort Jackson, recaptured by Farragut's fleet, Apr., 1862. The name of Fort St. Philip is familiar to the public through its vicinity to a proposed ship-canal for avoiding the shoals which bar the river mouths. (See NEW ORLEANS.)

Fort San'ders, a military post in Albany co., Wy., on the Union Pacific R. R., 3 miles S. E. of Laramie. Lat. 41° 13′ 4″ N., lon. 105° 40′ W.

Fort Scam'mel, an old enclosed barbette battery, located on House Island, Portland harbor, Me.; extensively repaired and modified since 1841.

Fort Schuy'ler, one of the defences of New York against maritime attack by the East River entrance, an enclosed pentagonal casemated masonry work with exterior batteries, situated on Throg's Neck, at the junction of the East River with Long Island Sound; commenced 1833.

Fort Schuyler, a small stockade on the site of the city of Utica, N. Y., was built in 1756. The place was called by this name until 1798, when it took the name of Utica.

Fort Schuyler, the name given in 1776 to the old Fort Stanwix which stood on the site of the present city of Rome, N. Y. It was unsuccessfully besieged by St. Leger's Tories and Indians in 1777, and was destroyed by fire and freshet in 1781. The building of Fort Stanwix cost the British government £60,000; it was built in 1758.

Fort Scott, city, capital of Bourbon co., Kan., 380 miles W. of St. Louis and 98 miles S. of Kansas City, Mo., on the Marmaton River and on the Missouri Kansas and Texas and the Missouri River Fort Scott and Gulf R. Rs. It has 2 national banks, 1 iron-foundry and machine-works, 1 grain elevator, 3 large flour-mills, 1 woollen mill, 1 paint and cement works, a match manufactory, a cracker and candy manufactory, 3 newspapers, and 267 business firms. Coal is found in this vicinity, 15 companies mining and shipping from this point. Hydraulic cement and mineral paints, umbers, yellow ochres, Spanish brown, Indian red, etc. are found in large quantities. Pop. 4174.

J. W. ALLAIRE, ED. "PIONEER."

Fort Sel'den, post-v. of Doña Aña co., N. M.

Fort Sev'ern, an old work on the left bank of the Severn River, Annapolis harbor, Md.

Fort Shaw, post-v. of Lewis and Clarke co., Mon.

Fort Sill, post-v. of the Choctaw Nation, Ind. Ter.

Fort Smith, city, one of the caps. of Sebastian co., Ark., at confluence of Arkansas and Poteau rivers, on the Indian Ter. border, 150 miles W. of Little Rock. It has 9 churches, good schools, 1 bank, 3 newspapers, 4 hotels, machine-shops, wagon-factories, saw and grist mill, cotton-gin, planing-machine, a Masonic lodge, chapter, council, and commandery, an Odd Fellows' lodge and encampment, and lodge of K. P. Its principal trade is in cotton, hides, pelts, furs, lumber, corn, wheat, and coal. It is the head of navigation, and has several railroads projected to it. Pop. 2227.

J. H. SPARKS, ED. "HERALD."

Fort Snel'ling, an old U. S. military post in Hennepin co., Minn., at the junction of the Minnesota and Mississippi rivers, opposite Mendota, and 2 miles below the Minnehaha Falls. It was founded in 1820, and is the oldest settlement in what is now Minnesota. It is a post-v. on the Milwaukee and St. Paul R. R.

Fort Spring, tp. of Greenbrier co., West Va., on the Chesapeake and Ohio R. R. Pop. 901.

Fort Stock'ton, post-v., cap. of Pecos co., Tex. P. 158.

Fort Sul'livan, an old work on Dudley's or Treat's Island, designed for the defence of the harbor of Eastport, Me.

Fort Sul'ly, a military station and post-v., cap. of Sully co., Dak., on E. bank of Missouri River. The old Fort Sully is lower down, on the same side of the river, in Hughes co.

Fort Sum'ter, Charleston, S. C., is noted for being the place where the American civil war was inaugurated, Apr. 12, 1861, and as the scene of several severe military and naval conflicts during that war. The work, begun in 1829, is located upon a shoal on the S. side of the entrance to the inner harbor, distant about 1 statute mile S. W. from Fort Moultrie, and 3½ miles from Charleston city. The land nearest the work is Cummings Point, on the N. end of Morris Island, about ¾ of a mile distant, in a southerly direction. The fort was built of brick on a rip-rap foundation, the exterior wall being 38 feet high and 7½ feet thick, and was designed to mount 136 guns arranged in three tiers, two in embrasure and one *en barbette.* It never received its entire armament, as none of the embrasures of the second tier were finished when the civil war broke out. The openings left for them were therefore walled up with brick, in order to render the work as strong as possible to resist the threatened attack of the Confederates. Up to that time a little more than $1,000,000 had been expended upon it, and its armament comprised 6 24-pounders, 41 32-pounders, 10 8-inch Rodman guns, 10 42-pounders, 3 10-inch columbiads, and 8 8-inch sea-coast howitzers.

South Carolina formally seceded Dec. 20, 1860, in the midst of the wildest rejoicing and exultation throughout the South. The entire force of U. S. troops in Charleston harbor at the time consisted of two companies of the First U. S. Artillery and 9 musicians, a total of 75 enlisted men, under the command of Major Robert Anderson. This handful of men, which had hitherto occupied Fort Moultrie in consequence of the unfinished condition of Fort Sumter, was quietly transferred to the last-named work during the night of Dec. 26th—an event at once followed by the seizure, by the State authorities, of all the other forts in the harbor, and the U. S. arsenal, post office, and custom-house in Charleston city. The construction of batteries on Morris Island was begun, the coast and harbor lights were extinguished, and the buoys removed from the channel to prevent the sending of reinforcements and supplies to Fort Sumter. On Jan. 9, 1861, the steamer Star of the West arrived in the harbor with provisions and 250 Federal soldiers. In attempting to reach Fort Sumter she was fired into and struck from batteries on Sullivan's and Morris islands, and abandoned the enterprise. As Major Anderson's provisions would be exhausted on the 15th of April, official notice was conveyed to Gov. Pickens of South Carolina on the 8th that supplies would be conveyed to the fort at all hazards. Its surrender was demanded by Confederate general Beauregard at 2 P. M. on the 11th, and declined. To another communication of the same date, Major Anderson replied that the work would be evacuated on the 15th unless "controlling instructions" or "additional supplies" were received by that time. This response not being deemed satisfactory, Major Anderson was notified at 3.20 A. M. on the 12th that fire would be opened on the fort in one hour, and the cannonading began at the appointed time. At noon on the same day a fleet of vessels from New York, with provisions for the garrison, appeared off the harbor and exchanged signals with the fort, but made no attempt to land any supplies, without which the contest must necessarily be of brief duration. On the afternoon of the 13th terms were arranged, under which the garrison marched out on the 14th with the honors of war, saluting the flag with fifty guns.

The brick buildings erected inside the fort for quarters and barracks were burned down during the action by hot shot from the enemy's batteries, but the work itself had received no material injury. Contemporaneous opinion, outside a somewhat restricted military circle, very generally conceded the difficulty, if not the impracticability, of throwing reinforcements and supplies into the fort during the attack, but in the light of subsequent events such an enterprise loses most of the elements of extreme hazard. The lower embrasures, 41 in number, and each nearly 2 feet wide and 3 feet high, were only 4 feet, in many places not over 3 feet, above the enrockment at the foot of the outer wall, and not more than 10 feet distant from the water, which encircled the fort on every side. If 30 or 40 small boats carrying rations and soldiers, and manned by such men as a call for volunteers would bring out in any fleet of U. S. merchantmen, had attempted to make a landing simultaneously on all sides of the work during the night of the 12th, a large proportion of them would doubtless have succeeded. The opposition, if any, would have come from boat-parties similarly organized, which, at the worst, would only place the combatants on a footing of theoretic equality, in which the best men and the best weapons would win.

The Confederates, upon getting possession of Fort Sumter, at once proceeded to augment its offensive and defensive strength. Rifle-guns were added to the armament; many of the casemates were filled up with sand; sand traverses were constructed between the barbette guns; and the magazine walls were strengthened. They held undisturbed possession for a period of two years.

On Apr. 7, 1863, a gallant attack was made upon the fort by a naval force of nine iron-clads, carrying 23 guns, under command of Rear-Admiral S. F. Dupont. The vessels engaged were the Weehawken, Passaic, Montauk, Patapsco, New Ironsides, Catskill, Nantucket, Nahant, and Keokuk. The combat lasted one hour and forty minutes, when the

View of Fort Sumter from Morris Island, Aug. 16, 1863.

fleet withdrew, at 4 P. M., with the intention of renewing the engagement the next morning. The monitors had received so much injury, however, that the project was abandoned. The Keokuk, a thin-armored, double-turreted monitor, sunk the next day from the injuries received in her hull, although she had been under fire only thirty minutes. She had been struck 90 times, and 19 shots pierced her through at and below the water-line. In this engagement the ranges varied from 550 to 2100 yards. The fleet, armed almost exclusively with 11-inch and 15-inch smoothbores, with a few 150-pounder rifles, fired only 139 times. Of these, 54 15-inch shells, 43 11-inch shells, 22 11-inch solid shot, and 5 150-pounder rifle projectiles were fired at Fort Sumter, and the rest at Forts Wagner and Moultrie. Fort Sumter was subsequently bombarded, its batteries destroyed, and the walls upon two of its faces demolished, from batteries established by the Union land forces on Morris Island. The first fire from the breaching batteries opened Aug. 17, 1863. At 12 P. M. on the night of Sept. 8th the fort was assaulted by a naval column of 500 men in small boats, which was repulsed with heavy loss. A preliminary summons for its surrender had been made by Admiral Dahlgren, and declined.

A prominent historian of the war asserts, on the alleged authority of the naval commander, that co-operation from the army was expected in this assault, in accordance with previous arrangement. Such is not the case. On the contrary, although an assault had been ordered by the commander of the land forces the same night, the admiral was informed that the column could not start from the creek W. of Morris Island until midnight, in consequence of low tide. The naval column left the fleet at 10 P. M., and by midnight had been repulsed and withdrawn. The only arrangement between the navy and army commanders consisted in the adoption of a watchword to prevent unpleasant collisions on the water between the two forces. Each enterprise was organized with ample strength to act alone, and was intended to be entirely independent of the other, and no reference whatever to any expected co-operation from the army was made by the admiral or by any of his subordinates in their official reports of the action.

The Fort Sumter garrison subsequently constructed additional shelters, galleries, and quarters within and under the ruins, and maintained possession until the final evacuation of Charleston and all its defences, Feb. 18, 1865.

The work is now being rebuilt on a modified plan. When completed it will mount — large guns *en barbette* and — guns in casemate. (For demolition of Fort Sumter see GEN. GILLMORE'S *Report on Engineer and Artillery Operations against Charleston*; also article BOMBARDMENT, by GEN. J. G. BARNARD, U. S. Army.) Q. A. GILLMORE.

Fort Tay'lor, an enclosed casemated pentagonal brick work in Key West harbor, Fla.; commenced 1845.

Fort Tomp'kins, on the W. side of the Narrows, entrance to New York harbor, has a fixed white light; lat. 40° 36′ 1″ N., lon. 74° 2′ 56″ W. (See STATEN ISLAND.)

Fort Trum'bull, one of the defences of New London harbor, Conn., on the W. bank of the Thames River; it is an enclosed pentagonal work with exterior barbette batteries; commenced 1838 on the site of an old work of that name.

Fortu'na [Gr. Τυχη], the goddess of good-luck, worshipped at many places of Italy, Greece, and Asia Minor. She is often represented holding in her hand a rudder or the horn of plenty, with a ball or globe at or under her feet—sometimes with a wheel. But she was especially honored at Rome, where she had several temples and bore many surnames.

For'tunate Islands (*Fortunatæ Insulæ*, Μακαρων νῆσοι), an ancient name for a group of supposed islands of the ocean stream, whose happy climate is celebrated by Homer. The geographers identified them with what are now called the Canary Islands, but the term in a wide sense seems to have included the Azores, Madeira, and the Cape Verde group. The delightful climate of all but the most southerly group of these islands justifies the name.

Fortunatia'nus (ATILIUS), a Roman grammarian, author of a treatise on metres, and especially on the metres employed by Horace. The work is compiled from previous writers for the use of a young Roman of senatorian rank, to whom the author recommends the careful study of Horace. In order to explain for him the metres of the poet, Fortunatianus gives first a summary of the different kinds of feet and the principal metres, with some of the leading rules of prosody. He then takes up and analyzes the Horatian measures. The work is given in Gaisford's *Script. Lat. Rei metricæ*, Oxford, 1837, and in the new edition of the Latin grammarians by Keil. H. DRISLER.

Fortuna'tus, the hero of an old romance, the first known edition of which appeared in German at Frankfort in 1509, the second in 1530. Fortunatus, after great sufferings, receives an inexhaustible purse and a wishing-cap, which finally proves the ruin of him and his sons. Another popular character, Fortunio, is believed to have been at first identical with him. The story of Fortunatus was dramatized by Hans Sachs, *Der Fortunatus mit dem Wunschseckel* (1553), and by Dekker, *Pleasant Comedie of Old Fortunatus* (1600). The principal European languages have the tale in various forms. Its authorship is not known, but some of its materials are very old. The "inexhaustible purse" of Fortunatus forms one of the prominent features of the strange tale of *Peter Schlemil* (by Chamisso), who for it sold his shadow.

Fortuna'tus (VENANTIUS HONORIUS CLEMENTIANUS), bishop of Poitiers at the close of the sixth century, a Latin poet of the transition period, wrote on a great variety of subjects; owes his reputation mainly to three or four beautiful Latin hymns. He was b. in Northern Italy, in the neighborhood of Ceneda and Treviso, about 530 A. D., but received his education at Ravenna, where he studied grammar, rhetoric, and jurisprudence, devoting considerable attention also to eloquence and poetry. About 564 he left Italy for France, where he spent the rest of his life. He was favorably received at the court of Siegbert, king of Austrasia, in honor of whose marriage with Brunhilda he composed an epithalamium, and resided there for some time as a sort of court-poet. After visiting Tours in fulfilment of a vow to St. Martin, he repaired to Poitiers, where he met Radagunde, the queen of Clotaire I., who was living in a cloister which she had founded in the vicinity, and attracted her attention and regard. He here took orders, became a presbyter, and almoner and chaplain of the queen, and under her patronage devoted himself to ecclesiastical studies and literary production. On the death of the bishop of Poitiers, Fortunatus succeeded to the episcopate (probably in 599), which office he retained till his death, about 609. His works are very numerous in prose and verse, consisting of lives of distinguished

men, bishops, confessors, and others; explanation of the Lord's Prayer and of the Creed; an epic poem in four books on the life of St. Martin, chiefly copied from the narrative of Sulpicius Severus; and nearly 300 poems, collected in eleven books, on a great variety of subjects and in different metres. Fortunatus stands on the border line, as it were, of the old classical poetry and the mediæval accentual (of which he was one of the first writers, if not the first), adopting in his poems both varieties, and showing no great regard for Latin quantities. His works were published by Brower, Fulda, 1603; the best edition by Luchi, Rome, 1786, 2 vols. 4to. His beautiful hymn, *Vexilla regis prodeunt*, was adopted by the Church, and has been translated into several modern languages—into English by J. M. Neale in *Mediæval Hymns*, and by Mrs. Charles in *Christian Life in Song*. It, with several others, appears in the greater collections, but is made generally accessible in Trench's *Sacred Latin Poetry*, London, 1874, 3d ed., and in March's *Latin Hymns*, New York, 1874. (See BORMANN, *Ueber das Leben d. lat. Dichters Ven. Fortunatus*, Fulda, 1848; GUIZOT, *History of Civilization*, 18th lecture; EBERT, *Gesch. d. Christlich-Lateinischen Literatur*, Leipsic, 1874, pp. 194–516.) H. DRISLER.

For'tune, port of entry and fishing-town of Burin district, Newfoundland. Pop. 805.—Another Fortune, on the "French Shore," N. F., has a fine harbor. Pop. [illegible].—Still another place, called Fortune Harbor, on the N. E. coast of N. F., 28 miles from Twillingate, has a pop. of 230.

Fortune (ROBERT), English author and botanist, b. in Berwickshire in 1813; educated at a village school in the Merse, selected horticulture as his occupation, and was employed in the botanical gardens of the Scotch capital, then in those of Chiswick. In 1842 was made collector of plants for the Botanical Society of London in Northern China; in 1847 published *Three Years' Wanderings in China*. Visiting China in 1848 to make investigations concerning the tea-plant for the East India Company, he published, after an absence from England of three years, his *Two Visits to the Tea Countries of China*. *Residence among the Chinese Islands, on the Coasts, and at Sea, being the Third Visit, from 1853 to 1856*, followed. Has also contributed to the *Athenæum*, and in 1859 collected in China, for the U. S. government, the seeds of the tea-shrub and other plants.

Fort U'nion, a military station and post v. in a beautiful valley of Mora co., N. M., 18 miles E. of Mora.

Fortu'ny (MARIANO), a Spanish artist, b. in Reus, Catalonia, June 11, 1839; d. in Rome Nov. 21, 1874. Fortuny was one of the leaders in the circle of artists who have made themselves famous under the title of the French Spanish school—a title that needs, however, both to be enlarged and explained. The school includes, besides French and Spanish artists, many Italians, and it is not, in any formal or deliberate sense, a school at all, but only a protest, half unconscious, on the part of several young men of genius of different nationalities, who found themselves in Rome pursuing their studies, against the classical traditions that inherit from David, and that have so long bound the French and Germans hand and foot. It declared war, too, with the literary and anecdotic art so much the fashion in our time—the art of the costumer and of the *bric-à-brac* shop—and rallied a small band, few in number, but strong in youth and zeal, to the support of a more manly style. The inspiration of these new men has come not from Raphael, nor indeed from any Italian, either directly or indirectly, but from Velasquez and Goya and the gold and azure of the Spanish air. If any Italians moved Fortuny and Regnault, they were Titian and Tintoretto and Giorgione, but they forgot them all in the presence of Velasquez, and called him alone master and lord. Fortuny's training began in the Academy of Barcelona, where the pale traditions of Overbeck held sway, Claudio Lorenzales, the director of the academy, having been one of Overbeck's pupils; but academies and imitators could not teach Fortuny anything, and it is said that some lithographs by Gavarni gave him the first living impulse. In 1856 he gained the academy prize, which entitled him to live and study in Rome for a certain number of years at the expense of the state; and once established there, he deserted the galleries and the old masters for the streets, and found his subjects in the life that swarmed about him in the osterias and in the lanes and alleys, filling his sketch-books with the original but certainly far from aristocratic types that abound in that region. In 1859 he joined his compatriot, Gen. Prim, count of Reus, in his expedition to Morocco, and in Africa he was taken captive by the charm of that splendid barbarism, in which Regnault, too, found such delight as made him forget Italy; and he returned to Europe with a world of studies, which were afterward, whether as studies or as pictures, to make him fame and fortune. In Madrid he had studied Velasquez and Goya, and when, on his return from Morocco to Rome, where he finally fixed his home, he visited Paris, he was strongly attracted by the pictures of Meissonier, and the influence of that master is marked in his works, in spite of the wide difference in the technics of the two men. A German critic (*Zeitschrift für Bildende Kunst*, vol. ix., 1874) not unhappily calls Fortuny "a link between Goya and Meissonier." The reputation of Fortuny dates from the year 1866, when he came to Paris. Here he entered into most profitable business arrangements with the house of Goupil, who introduced his works to the whole art-loving world, not only in Europe, but in America. In 1869 several of Fortuny's pictures were exhibited in Paris, and in the Salon of 1870 Regnault's *Salome* and the *Education of a Prince* by Zamacois made the names of these three young men known as the founders of a new school—a school that within four years was destined to be deprived of their illustrious leadership. Regnault died first, Zamacois next, and now that Fortuny has gone, new triumphs must wait for a new leader, since no one of equal power and originality is left to carry on their work. In 1868, Fortuny married Mademoiselle Madrazo, a sister of Madrazo the artist, and a daughter of the distinguished director of the Royal Museum of Madrid, himself an artist and come of a family of artists. Madame Fortuny accompanied her husband on all his journeys, easily and happily suiting herself to his artist life and delighting in his success. In the pictures which he painted after his marriage we often find her face and figure. Two children are the fruit of this marriage. The names of Fortuny's best-known pictures are *A Spanish Marriage*, *The Serpent Tamer*, *The Amateur of Prints*, *A Fantasia at Morocco*, *The Sword Sharpener*, *The Academicians of Arcadia*. The sketches made by Fortuny in Morocco, in Spain, in Italy, and even in the environs of Paris, count by hundreds. He acquired a great reputation as an etcher, and many of his most remarkable works in this kind have been reproduced by the heliogravure process, and published by Goupil & Co. Fortuny's death was the result of a gastric fever brought on by imprudently working out of doors in the autumnal rains. He left two unfinished pictures on his easel—*The Sea-shore at Portici* and *The Interior of a Village Meat-shop*. Fortuny worked with great difficulty, composing and painting with extreme care. He thus produced comparatively little, and his pictures were much sought for. *The Spanish Marriage* was sold by him for 75,000 francs, and many of his water-colors fetched 15,000 or 18,000 francs. One of his best pictures, *The Serpent-Tamer*, is owned by Mr. A. T. Stewart of New York. CLARENCE COOK.

Fort Val'ley, post-v. of Houston co., Ga., on the South-western R. R., 29 miles S. W. of Macon, at the junction of the Columbus Eufaula and Perry branches. It is a centre of business in agricultural products, and is a fine cotton market. It has a bank, agricultural works, 2 churches, 2 hotels, 2 newspapers, male and female schools, and about 25 stores. P. 1333. W. T. CHRISTOPHER, ED. "MIRROR."

Fort'ville, post-v. of Vernon tp., Hancock co., Ind., 15½ miles S. W. of Anderson, on the Columbus Cincinnati and Indianapolis R. R. Pop. 387.

Fort Wadsworth. See STATEN ISLAND.

Fort Wagner. See MORRIS ISLAND, by GEN. Q. A. GILLMORE, U. S. Army.

Fort Wal'lace, post-v., tp. and U. S. military post, built of handsome stone, in Wallace co., Kan., on the Kansas Pacific R. R., 353 miles W. of Topeka. Pop. 396.

Fort Wal'la Walla, a military post in Walla Walla co., Wash. Ter., N. of the village of Walla Walla. The old Fort Walla Walla was a Hudson's Bay Company's post on the Columbia, at the mouth of the Walla Walla River.

Fort War'ren, George's Island, Boston harbor, Mass., a large pentagonal casemated work, with exterior batteries in cover-face and ravelin; commenced 1833. It forms the outer defence of Boston harbor. It was designed and built under the supervision of the late Bvt. Brig.-Gen. Sylvanus Thayer.

Fort Wash'ington, suburban village of New York City, on the Hudson River and the Hudson River R. R., in the N. part of Manhattan Island. During the Revolution it was an important point. It was taken, with 2600 prisoners, by the British Nov. 16, 1776, after a gallant defence. The fort stood between what are now 181st and 186th streets, on the highest land upon the island. Some remains of it still exist.

Fort Washington, Potomac River, Md., an old enclosed work with open exterior batteries, intended for the defence of the channel approaches to Washington, D. C.; commenced 1816.

Fort Wayne, city, cap. of Allen co., Ind., at the con-

fluence of the St. Mary's and St. Joseph rivers (which form the Maumee), 94 miles from Lake Erie. The city is regularly laid out in well-paved streets, and covers an area of nearly 10 square miles. The religious and educational advantages are represented in 19 public and parochial schools, 27 churches, 2 colleges, and 1 academy. There are 2 well-appointed libraries, containing 6000 volumes; also 3 daily, 1 tri weekly, 1 semi-weekly, 5 weekly, and 1 monthly newspaper. Three national and one private bank represent a capital of $1,500,000. Railroads leave the city in eight directions. The extensive shops of the Pittsburg Fort Wayne and Chicago and the Toledo Wabash and Western R. Rs. are located here. The Wabash and Erie Canal also passes through the city. The city has 144 manufacturing establishments, is lighted with gas, and has street railroads running in various directions six miles. It is surrounded by a fine agricultural community, and is one of the leading cities of Northern Indiana, drawing trade from Michigan, Northern Indiana, and Northern Ohio. The number of the different business-houses is about 1600, which includes wholesale establishments. Average mortality for the last ten years, 1 in 55. Pop. 17,718. W. FLEMING, ED. "SENTINEL."

Fort Wayne, a U. S. fortification in Springfield tp., Wayne co., Mich., just below Detroit. It is intended to command the navigation of the Detroit River.

Fort Wil'liam, an important trading-post of Algoma district, Ontario, Canada, on the N. shore of Lake Superior, 143 miles from Duluth, and at the mouth of the river Kaministiquia; lat. 48° 25' N., lon. 89° 27' W.

Fort Wil'liam Hen'ry, a fortress near the head of Lake George, N. Y., erected in 1755 by the British forces under Sir William Johnson. It became an important strategic point in the last French war in the colonies, and was captured by the French and Indians in 1757. It was in the present tp. of Caldwell, Warren co., N. Y. Its site is occupied by a hotel. Fort George, half a mile to the E., was built in 1759 by Gen. Amherst.

Fort Winneba'go, tp. of Columbia co., Wis. P. 709.

Fort Win'throp, one of the defences of Boston harbor, Mass., on Governor's Island, the former site of old Fort Warren. It is a small enclosed quadrangular work, with exterior open barbette batteries; commenced 1844.

Fort Wood. See BEDLOE'S ISLAND.

Fort Wool, a large unfinished enclosed casemated work on "rip-rap" foundation, formerly called Fort Calhoun, designed for the defence of Hampton Roads, Va.

Fort Worth, post-v., cap. of Tarrant co., Tex., has an altitude of 1108 feet above the sea, 109 above Trinity River, on the S. bank of which it is situated, at the junction of the Texas Pacific, the Trans-Continental, and the Fort Worth and Denver City R. Rs. It has a number of stores, shops, etc., 2 banks, 3 newspapers, 2 churches, 4 schools, and 5 hotels. Pop. about 2300.
B. B. PADDOCK, ED. "FORT WORTH DEMOCRAT."

Fort Yu'ma, a military post in San Diego co., Cal., on the Colorado River, almost opposite Arizona City, and near the S. E. corner of the State. Pop. 331.

Fo'rum [etymologically connected with *forare* and the Greek πόρος, and so originally a "passage-way"] was applied first to the open space before a tomb, as appears from one of the laws of the Twelve Tables. It was also the designation of an open space in the Roman camp of early times, close to the prætorium, or general's tent. The term was usually applied to an open place in Rome, like the Greek ἀγορά, for the assembly of the citizens for business, for legal transactions, for the administration of justice, and for the sale and purchase of goods. With the growth of the city the necessities of the people required more than a single forum, and convenience separated them into those devoted to public affairs (*fora civilia*) and those which were more strictly markets or bazaars (*fora venalia*). The Roman forum differed in shape from the ἀγορά of the Greeks, for while the latter was usually square, the former was oblong, the length exceeding the width by one-third, according to Vitruvius. The most celebrated and the most important of the *fora civilia* was the Forum Romanum, sometimes called Magnum, and from its pre-eminence simply Forum. This was the earliest, and for a time the only one, and was situated in the valley between the Capitoline and Palatine hills, and with it is associated very much of the interest of the public and private life of early Rome. It was the very heart of the city, the centre of all its life and activity, and in it were gathered daily those whom business summoned, the orators and public men of the day with their bands of clients, as well as the idlers who sought only to be amused, with trains of quacks and mountebanks, so pleasantly described in Horace. (For a description of the buildings in and around the Forum, see ROME.) Immediately adjoining this a new forum was erected at great expense by Julius Cæsar, which was called from him Forum Julium, and was dedicated B. C. 45, after the battle of Pharsalus. It contained a temple of Venus Genitrix, in allusion to his descent from the goddess. This still failing to accommodate the increasing pressure of the business of the courts, Augustus constructed still another, which received from him the name Forum Augusti. It contained within it a temple of Mars Ultor, which Augustus had vowed to erect on avenging the death of his adoptive father. This forum was more contracted than Augustus had designed, on account of the refusal of some owners of houses to part with their property. These three are sometimes distinguished as the *tria fora.* Still other fora were erected by the later emperors, partly to facilitate business, but chiefly to adorn the city. Among these may be named the Forum Transitorium (so called because a passage-way ran through the whole length of it leading to the Forum) or Forum Nervæ, begun by Domitian and completed by Nerva; and the most magnificent of all, the Forum Trajani, or Ulpium, immediately adjoining the Forum Julium and Forum Augusti, and having connected with it the Basilica Ulpia and the famous Columna Trajani, still standing. The second class of fora was devoted to market transactions, and they derived their names from the articles sold in them—*e. g. forum olitorium*, the vegetable market; *forum piscarium*, the fish market; *forum boarium* (cattle), *forum suarium* (swine), etc. The word forum was applied in the latter sense of a market, and also of a place at which the prætor held his circuit, administering justice to villages or stations in the provinces of Italy (like the use of the term "court-house" in Virginia), from which grew up in time even flourishing towns; such were, among others less important, Forum Appii in Latium on the Appian Way; Forum Aurelii or Aurelium in Etruria; Forum Cornelii in Cispadane Gaul, now Imola; Forum Gallorum in Cisalpine Gaul, now Castel Franco; Forum Julii or Julium in Gallia Narbonensis, now Fréjus; and another, or Forojulium, in the country of the Carni, now Cividale; Forum Sempronii in Umbria, now Fossombrone.
H. DRISLER.

Forum, in law, a court or judicial tribunal; a place where a remedy is sought. The Roman Forum was the place where the courts were held, and the name was, from this circumstance, introduced into the English law to denote a place of trial, and has been retained as a convenient designation in certain phrases until the present time. Thus, the phrase *lex fori*, in which the term is most generally employed, means the law of a place or court where an action is instituted. (See LEX FORI.) *Forum contractus* is the court of the place where a contract is made. *Forum domicilii* is used to denote the court or place of a person's domicile; *forum rei sitæ*, the tribunal where the property in litigation is situated. There are various other phrases embodying the term, which it would be useless to enumerate. In all of them the word is used in the same general meaning. GEORGE CHASE. REVISED BY T. W. DWIGHT.

For'ward, tp. of Allegheny co., Pa. Pop. 1300.

Forward, tp. of Butler co., Pa. Pop. 1025.

Forward (WALTER), American lawyer and Congressman, b. in Connecticut in 1786, removed to Pittsburg, Pa., in 1803, and studied law, commencing its practice in 1806; began to edit the *Tree of Liberty*, a Democratic newspaper, at Pittsburg in 1805. He was M. C. from Pennsylvania in 1822–25. In 1824–28 he supported John Quincy Adams, and was thence identified with the Whig party. He was active in the convention of 1837 to revise the constitution of Pennsylvania; in Mar., 1841, was appointed first comptroller of the U. S. treasury; was secretary of the U. S. treasury in 1841–43; in 1849–52 U. S. *chargé-d'affaires* to Denmark, and then presiding judge of the district court of Allegheny co., Pa. D. at Pittsburg, Pa., Nov. 24, 1852.

Forward (WILLIAM A.), a native of New York, served in the Canadian insurrection of 1836–38, for which he was imprisoned and banished; removed in 1845 to Florida, where he held various public positions; was a judge of a State circuit court 1852–57, and of the supreme court of Florida 1859–65. D. at Pilatka, Fla., Oct. 19, 1865.

Forwarding, in commerce. See WAREHOUSEMAN, by PROF. T. W. DWIGHT, LL.D.

Foscara'ri (EGIDIO), b. at Bologna Jan. 27, 1512; became a Dominican; in 1544 was made a prior and inquisitor at Bologna, and later bishop of Modena. He was frugal, modest, and austere, and devoted much time and money to the poor and to the reclamation of the vicious classes. Paul V. imprisoned him for heresy, but Pius IV. vindicated him, and in 1561 he entered the Council of Trent, in which he assisted Forerius and Leonardo Marini in preparing the Catechism and correcting the Missal and Breviary. D. at Rome Dec. 23, 1564.

Fos'cari (FRANCESCO), doge of Venice 1423–57, b.

1372; warred with the duke of Milan in 1426 (peace concluded Apr. 26, 1433), 1438 (peace again Nov. 20, 1441), and 1452 (peace Apr. 9, 1454). The Venetians obtained possession of Crema, Bergamo, and Brescia, but Foscari was deposed by the Council of Ten Oct. 23, 1457, and d. Nov. 1, 1457. His sufferings and those of his son, who was banished as a traitor in 1445, are the subject of Byron's *Two Foscari*.

Fos'colo (Niccolò Ugo), b. at Zante Jan. 26, 1777; was in the Lombard Legion in 1799; in the French army in 1805; was professor of Italian eloquence at Pavia in 1808; returned to Milan in 1813; visited England in 1816. D. near London Oct. 10, 1827. His remains were exhumed June 7, 1871, and reinterred at Florence, Italy, June 24, 1871. Wrote *I Sepolcri*, elegiac poem, in 1807, besides *Ricciardo*, tragedy, *Discourse on the Text of Dante* (1826), *Essay on Petrarch*, *Letters of Jacopo Ortis*, etc.

Fos'dick (William Whiteman), American poet, b. at Cincinnati, O., Jan. 28, 1825; graduated at Transylvania University in 1845; practised law in Covington, Ky., but soon settled in Cincinnati, where he wrote *Tecumseh*, drama. *Malmiztic the Toltec* and *The Cavaliers of the Cross*, novels, were published in 1857, after two years' travel in Mexico in 1847–49. From 1851 to 1858 practised law in New York City, publishing in 1855 *Ariel, and Other Poems*. Edited *The Sketch Club* in Cincinnati, O., and d. there Mar. 8, 1862.

Foss (Archibald Campbell), a Methodist divine of note, b. at Phillipstown, Putnam co., N. Y., Mar. 6, 1830; graduated at Wesleyan University in 1852 with the highest honors of his class, and at once joined the New York Conference of the Methodist Episcopal Church, of which his father, Rev. Cyrus Foss (who d. in 1849), had been a member. Archibald served several important churches, and in 1858 became associate pastor with Dr. John McClintock at St. Paul's, New York City. In 1860–62 he occupied the chair of Latin and Hebrew in his alma mater; from 1863 to 1866 was presiding elder of the Poughkeepsie district; in 1867 was offered, but declined, the professorship of biblical exegesis in the Drew Theological Seminary, then presided over by his former associate, Dr. McClintock; in 1868, while preaching at Sing Sing, his health failed, and he travelled in Italy and Switzerland, and d. at Clarens, Switzerland, Mar. 30, 1870. He possessed genuine character and individuality, and was eminently successful as a minister, because he had great literary taste and qualification, coupled with an enlivening geniality. J. H. Worman.

Foss (Cyrus David), D. D., LL.D., b. at Kingston, N.Y., Jan. 17, 1834, a brother of A. C. Foss; graduated at Wesleyan Univ. in 1854; taught mathematics in Amenia Seminary, N. Y., 1854–55, and was its principal 1856; entered the Methodist Episcopal ministry, and has held important pastorates, chiefly in New York and Brooklyn, 1859–74; was a delegate to the General Conference of his Church in 1872; became president of Wesleyan University, Middletown, Conn., 1875; elected bishop in M. E. Church May 12, 1880. His brother, William Jay Foss, was b. at Verbank, N. Y., Nov. 23, 1835; graduated at Wesleyan University in 1856; was a tutor there 1857; became a preacher of much promise in the M. E. Church. D. June 1, 1859.

Fos'sa Maria'na, a famous canal or system of canals cut by the great Marius (B. C. 102) from the Rhone to near the Gulf of Stomalimne (L'Estouma). There was, as late as the fourth century, a port "Fossæ Marianæ," at the sea-terminus, and this port was in face of the modern village of Foz. "The camp of Marius having been at Arles, it follows that the *fossa* must have been conducted, parallel to the Rhone, to this place. It might, however, and even must, have struck the river by a more direct course. Desjardins delineated its junction as about 6 English miles above the ancient, and 15 above the present, Rhone-mouth, and about 16 miles from its sea terminus." (*Aperçu historique sur les embouchures du Rhône*, E. Desjardins, ouvrage couronné par l'Académie.) "The mouths of the Rhone, on account of the obstacle opposed by the sea, accumulate a great quantity of detritus, thrown back by the waves into (or upon) the deep mud, rendering the entrance difficult and even dangerous. To occupy his army while encamped here, Marius caused a large canal to be dug, into which he diverted a large part of the river, conducting it to a place on the sea-shore safe and commodious." (*Ibid.*, and Plutarch, *Life of Marius.*) G. C. Simmons.

Fossa'no, town of Northern Italy, in the province of Cuneo, on the left bank of the Stura. It has two annual fairs and a considerable trade in agricultural produce, and is a bishop's see. Pop. 7279.

Fos'sil [Lat. *fodio, fossum*, to "dig"]. A fossil is the body or any known part or trace of an animal or plant buried by natural causes in the earth. The moulds of shells, the impressions left by the feet of animals in walking, implements of stone or metal and other works of human art which have been accumulated naturally into rubbish-heaps, are thus strictly fossils. Perhaps the marks of rain, wind, waves, and shrinkage through heat should be included. Early writers believed fossils the result of certain laws of nature, and never animated; others suggested they might be relics of the Noachian deluge; but it is now generally conceded that they indicate the nature of the life of numerous successive periods in the earth's history from the *Eozoic*, or the *dawn* of life, to the latest vessel sunk in the chalky depths of the ocean. A few fossils have been preserved entire, like the elephants and rhinoceroses found encased in frozen mud and sand in Siberia. The relics are usually *petrified*, or rendered stony through the infiltration of mineral matter. The organic particles are slowly replaced, through chemical forces, by mineral atoms, but arranged in the same manner, so that the characteristic structure of the plant or animal is preserved. Microscopic sections show unmistakably the peculiar internal features of the pine, oak, or palm, though the substance is changed to flint. Fossils indicate the former existence of organic races now entirely extinct; that, as a whole, each successive period contained more highly organized structures than its predecessor; that tropical forms once flourished in the polar regions; that each epoch was characterized by peculiar groups. Hence, formations are identified in new countries by means of fossils. C. H. Hitchcock.

Fos'sil Bot'any. The study of fossil botany presents peculiar difficulties to the palæontologist, from the fragmentary character of most plant-remains, and from the incomplete preservation of their perishable tissues. Of many extinct species of trees, in which the individuals may have been 100 feet in height, the only traces yet obtained are a few leaves, of which the outlines and the nervation are imperfectly preserved. All botanists know how variable the leaves of trees are; and since they often find much difficulty in discriminating between genera and species when many entire individuals, complete in root, stem, leaf, flower, and fruit, are before them, it is not surprising that they have little faith in the deductions made from a few variable and incomplete organs. No doubt the inherent difficulties of the subject have favored hasty generalization—have, in fact, led fossil botanists into many errors—and should inspire a proper caution; yet many fossil plants have been discovered, and the preservation of some of them is so complete, that they afford material for legitimate and important deductions in regard to the history of plant-life on the globe; indeed, we may say that the generalities of this history are already pretty well established.

The study of fossil plants was hardly begun before the commencement of the present century, but since then many sagacious, conscientious, and learned scientists have devoted their lives to it, with such success as not only to add largely to our knowledge of the vegetable kingdom in the present as well as in past ages, but to win for themselves lasting fame.

A brief sketch of the groups of fossil plants of which the remains have been discovered, and of the different floras which have flourished on the earth's surface during the successive geological ages, is given below.

The table in the article Botany of the present work (first volume) shows the principal groups into which plants have been divided; but a sixth class, called Protophytes, and containing microscopic cryptogamous plants, often forming siliceous frustules, is generally recognized. Such plants are the Diatoms and Desmids.

On comparing the plants of the groups as given in the table alluded to, they will be found to form a series of which the members increase in complexity of structure from the Protophytes to the Angiosperms, and, as in the animal kingdom, the simplest forms are reckoned to be lowest, the most complex highest, in the scale. In the life-history of plants, as in that of animals, we also find that the lower forms appear first, their remains being found in all the oldest fossiliferous formations, the higher groups coming in successively in the later geological ages, and the present flora, like the present fauna, being the most highly organized of all. In further comparing the records from which we attempt to make up the past history of animals and plants, it should be remembered—1st. That plants have power to assimilate inorganic substances—a power which animals do not possess. Hence, the animal kingdom is dependent on the vegetable for its support, and in fact rests upon it as a base. Plants must therefore have preceded animals on the globe, or at least must have appeared simultaneously with them. 2d. The sea is the mother of continents, and, with the exception of a few fresh-water deposits, all our fossiliferous strata are sediments deposited from the sea. Hence, aquatic species of animals and plants are far more likely to be preserved than those which do not inhabit the water, and the spec-

mens we have obtained of extinct faunas and floras give but a partial view of the life of each period, from the fact that the aquatic species are much more fully represented than the terrestrial. 3d. In all the later geological ages the flora has been mostly terrestrial, while the fauna has been more largely aquatic. Animals have also, more generally than plants, some hard and imperishable organs, and hence the extinct faunas are more complete than the floras. 4th. The remains of the marine fauna of the globe which are exposed to our inspection are contained in sediments laid down by the sea in successive invasions of the land; and these invasions were followed by periods of retirement —periods of immense duration—during which no record was made except in the depths of the sea-basins, or in other countries where submergence took place at the same time. Hence, for any one country the records of marine life constitute a series of chapters separated from each other by long blank intervals. The genetic relations of the different extinct marine faunas are, therefore, necessarily obscure, and will perhaps never be fully determined, since we have not access to those portions of the record which form the connecting links in the chain of being. On the other hand, the succession of land-plants on any continent may have been unbroken; at least its continuity has been greater than that of the marine fauna accessible to us. As a consequence, we may expect that, though having its peculiar imperfections, to which reference has been made, the record of plant-life contained in the shore-deposits and old lake-beds of our continents, when carefully studied, will throw important light on the great questions of evolution and the origin of species. Extreme care will be necessary, however, in prosecuting this study, to gather as much and as complete material as possible, and to read from it only such lessons as it may clearly and unmistakably teach. The progress of science has been much retarded by hasty generalization from collections of imperfectly preserved fragments of plants. From their lower position in the scale, plants are less instinct with life than animals, and their organs or fragments of organs are much less significant than the better preserved and more characteristic portions of animal structures from which so much has been learned.

Life-History of the Different Groups of Plants.—Combining the observations made by fossil botanists in various countries, we are able to deduce some interesting facts in regard to the history of the different orders of plants. Premising that much of the evidence is negative, and that future observation may extend the range of some of the groups upward or downward, the following brief sketch is offered as a summary of our present knowledge on the subject.

1st. The Protophytes have not been certainly identified in any but the more recent deposits. This has created some surprise, from the *a priori* probability that the lowest forms of plant-life would be fully represented in the oldest formations, and from the fact that thick and widespread strata, mainly composed of the shields of Diatoms, are found in the Tertiary and beneath our present peat-beds. The absence of Protophytes from the Palæozoic rocks may be explained, however, by the fact that only such as secreted calcareous or siliceous crusts or shields could under any ordinary circumstances be preserved. These may have been few in the earlier geological ages, or, what is more probable, their minute and delicate shells have been obliterated by solution. We know that the shields of Diatoms are more soluble than most forms of silica, and it is highly probable that many of the older beds of flint and chert have obtained their material from this source. It is also true that some of the minute plants which secrete lime, and which have usually been classed as Algæ, may be more properly considered Protophytes. These abound in our present seas, and probably did so in those of former ages; and they may have contributed largely to the formation of the great beds of non-fossiliferous limestones which make up so much of the Palæozoic series of rocks, their individual forms being here entirely lost. Some of the most important Tertiary deposits composed of the shields of Diatoms are those of Bilin and Planitz in Bohemia, Richmond, Va., and Monterey, Cal. The Desmids, which are not siliceous, are frequently found in flint, dating as far back as the Cretaceous age, but Diatoms are much more rare in such circumstances. The minute organic forms found in the chert of the Corniferous limestone, figured by Dana, and considered Protophytes, are thought by some microscopists to be rather animal than vegetable.

2d. Thallogens.—The Algæ now abound in all seas, and their remains are found in rocks of all ages from the Lower Silurian to the present time. In the Lower Silurian strata sea-weeds are the only plants of which we find unmistakable traces. The discovery of plants of higher organization in the Lower Silurian, and even in the Cambrian rocks, has been announced, but the evidence on this point is at least doubtful. A large number of fossil sea-weeds have been described, but since the cellular tissue of which they were composed has almost uniformly disappeared, and nothing but the casts of their external forms are preserved, their relations to living sea-weeds are obscure. The plants found in the Cambrian rocks have been described as species of the genus *Eophyton*. In the Potsdam sandstone what seem to be fossil sea-weeds are met with (*Palæophycus*, etc.), but their true nature is yet doubtful. In the limestones of the Trenton period are many Algæ, described under the names of *Palæophycus*, *Licrophycus*, *Buthotrephis*, *Phytopsis*, *Sphenothallus*, etc.

In the Upper Silurian sea-weeds are common, the most important one being *Arthrophycus Harlani*, a characteristic fossil of the Medina sandstone. In the Upper Silurian also begins the remarkable genus of Fucoids called *Spirophyton*, which runs through the Devonian and Carboniferous systems, and is well known as the *Cauda-galli*, or cocks-tail Fucoid.

In the Upper Devonian and Lower Carboniferous rocks is found a singular group of organisms which have been described by Prof. Hall under the name of *Dictyophyton*, and another no less remarkable, called *Uphantænia* by Vanuxem. The true relations of these fossils are still doubtful, though they are generally thought to be Algæ. They were usually conical in form, frequently peculiarly angled and tuberculated, and have the surface marked by a strong rectangular reticulation.

In the later geological formations the Algæ become more numerous, and approach more nearly in character to those of the present day. About 50 genera, including more than 150 species, of these fossils have been described by different authors. To these should be added 39 species of Chara, plants allied to, and sometimes classed with, the Algæ, and which secrete lime in their tissues. These latter are abundant in the present day, and from their power to resist decay should be perfectly preserved in the fossil state; but all the fossil species known, except one or two doubtful ones, are Tertiary, and the peculiar group which they form had probably no existence previous to that age. The seeds of Chara—minute spherical or oval bodies marked with spiral ridges—are very common in the Tertiary beds, but similar bodies found in the Corniferous limestone, and considered to be the seeds of Chara, are more likely to prove Foraminifera.

The Lichens, so abundant at the present day, are hardly known in the fossil state. This is somewhat remarkable, as many of them have hard tissues and distinctly defined forms, such as would naturally be well preserved. They are, however, exclusively terrestrial, and on that account were much less likely to be fossilized than the aquatic Thallogens. It is also true, as suggested by Schimper, that, producing no deciduous foliage which could be carried by the wind into lake or stream, they are not likely to be found except on the trunks of trees to which they were attached. Probably careful search will lead to the discovery of many more lichens attached to fossilized tree-trunks, but it is quite certain that if these plants had been as abundant in the forests of the Coal period as in those of the present day, they would have been found in connection with the perfectly preserved impressions of the external surfaces of trees in our coal-mines. We are therefore justified in concluding that the lichens were much less abundant in the Carboniferous age than at the present time. The only fossil lichens known are a few species found in amber and in the Tertiary lignites. Those from the amber are very perfectly preserved, and belong to the same genera, and in some instances to the same species, with the lichens most common in Europe and America at the present time.

Fungi are almost as rare as lichens in the fossil state; possibly, for the reason that they are all terrestrial, and most of them are soft and perishable. There must be other reasons, however, why they are so rare, or we should have frequently found them attached to the tree-trunks so abundant in the coal-strata. Quite a large number of Fungi have been described by Unger, Goeppert, Heer, etc., chiefly the smaller forms which encrust leaves. These are almost exclusively from the Tertiary, but three species have been found on the leaves of ferns and cycads in the Rhætic beds of Franconia, and as many more attached to ferns and in the Coal formation of Saxony. A few small species have also been found in the amber. The fossil described by Lindley and Hielton under the name of *Polyporites Bowmani*, found in the coal-strata, and thought to be a fungus, is almost certainly the scale of a ganoid fish. *Gyromyces ammonis* of Goeppert, a minute flattened spiral organism very common in the coal-measures of Europe and America, and considered a fungus by Goeppert and Lesquereux, is undoubtedly a shell, and has been described as such with the name of *Spirorbis*.

Anogens.—The plants of this group—which include the mosses and Hepaticæ—form a most conspicuous feature in the present vegetation of the world. The mosses especially, with their immense number of genera and species, and with their beautiful and varied forms, are, in the tropical and temperate climates, hardly exceeded in numerical force or interest by any other group of plants. They cover like a carpet millions of square miles of the surface, and as they produce almost unaided the beds of peat which stretch continuously through great areas of the temperate zone, they have much economical as well as scientific importance. The liverworts are less abundant than the mosses, but they too are scattered over the entire habitable globe, and form a long list of genera and species. Such being their development in the present flora, it has been a matter of much surprise that no traces of the Anogens are found in any of the older geological formations. Both mosses and liverworts occur in considerable abundance in the Tertiary strata, especially in the amber and lignite, to the formation of the latter of which they seem to have contributed largely. The species of mosses and liverworts found in the amber are so perfectly preserved that their generic and specific characters may often be determined with accuracy; and it is an interesting fact that all the species so determined are closely allied to, and some are identical with, those now growing in Europe. The *Marchantia polymorpha*, a liverwort, is perhaps the most widely distributed of all living plants. This would indicate that the species has been long in existence, but it has not been certainly recognized as fossil except in extremely modern travertine. An Eocene species, however (*Marchantia Sezannensis*), closely resembles it, and may have been its progenitor.

The entire absence of Anogens from the older floras proves that these plants, though so low in the scale, are of quite modern date—a fact not without interest and significance in the history of plant-life on the globe.

Acrogens.—Although the Ferns, Lycopods, and Equiseta are numerously represented in our present flora, they are perhaps nowhere predominant forms of vegetation, and generally hold not only a subordinate but an insignificant place in the local living floras. These plants are, however, worthy of great respect, if, as in human families, age can make them respectable, since we have reason to believe that they constituted the first forms of terrestrial vegetation which existed on the globe. Like many other ancient families, too, they have seen better days, for both in numbers and dimensions they are now but ignoble representatives of the varied and beautiful flora which their progenitors formed on the continents of Devonian and Carboniferous age. They then developed into families, genera, and hundreds of species altogether unknown at the present day, many of which held individuals that in dimensions and beauty are scarcely exceeded by our most majestic forest trees. Of the three great orders united in this class, the Lycopods seem to have been the first in point of time, as also in their subsequent development. These are now represented by the species of *Lycopodium* (ground-pine), of which all are small. The first traces of Lycopods are found in the Upper Silurian rocks of Canada, England, Germany, and Bohemia. These were the forerunners of the Lepidodendra, the great scaly-trunked trees of the coal-flora. In the Devonian age the Lycopods were excelled both in numbers and size by the ferns and conifers, but in the coal-flora they overshadowed all other forms of vegetation. The Lepidodendrads, of many genera and species, were here associated with perhaps as many kinds of Sigillariæ, whose fluted and reticulated stems attained equally gigantic dimensions. There were also Lycopods, but of high organization, approaching the Gymnosperms in structure. At the close of the Paleozoic ages the Lycopods seem to have nearly disappeared, as no important member of the group has been found in the Mesozoic or Tertiary rocks. The ferns first made their appearance in Devonian strata, where, without any preliminary history now known to us, they suddenly acquired greater relative and absolute importance than they have at the present day. In the Middle and Upper Devonian tree-ferns were already numerous, and attained greater dimensions than any now living. We find traces also here of considerable variety among them, as shown by the structure of their trunks. The smaller ferns were also probably abundant in the Middle Devonian, though circumstances were not favorable to their preservation, the trunks of the tree ferns, wave worn and floated far from their places of origin, alone remaining to represent the flora of which they formed part. Of the ferns of the Upper Devonian and Carboniferous several hundred species have been described; and everything indicates that they formed a much more highly organized, diversified, and beautiful group of plants than the fern-flora of the present day. In the Mesozoic and Tertiary rocks the remains of ferns abound wherever circumstances favored their preservation, though we nowhere find in these later formations anything like the number and variety obtained from the coal-measures. This is doubtless in part due to the peculiar conditions under which the coal-beds were formed—conditions which caused a large part of the then existing species to be preserved; and yet in the Mesozoic and Tertiary strata coal-beds exist which rival the more ancient ones in thickness and extent, but the number of species of ferns found in them is comparatively small. The poverty of the roof-stones of the Cretaceous and Tertiary lignite-beds in fern impressions, as compared with these overlying the coal-strata, will strike the most superficial observer. We may therefore conclude that the Ferns, like their associates, the Equiseta and Lycopods, reached their golden age in the Carboniferous period. The Equiseta—of which we now have a few humble forms in our scouring-rushes—almost universal in distribution, but all small, attained in the Devonian and Carboniferous ages nearly the dimensions of forest trees, and also numerically formed one of the most important elements in the flora. These were the *Calamites*, so abundant in the coal-strata, and the allied *Asterophyllites*, *Sphenophyllum*, *Annularia*, etc. In the Mesozoic ages species of the genus *Equisetum* seem to have existed, and, we may say, to have flourished, since their trunks sometimes attained the diameter of five or six inches, but the Calamites and their allies had then altogether disappeared—destroyed by the same influences, doubtless, that ended the existence of their Carboniferous associates, *Lepidodendron* and *Sigillaria*. In Tertiary times the Equiseta were larger and more numerous than now, but had already shrunk to be an altogether unimportant portion of the flora. The history of the order Acrogens, so far as we can trace it, is in strong contrast with that of the other groups of Cryptogams, as they seem to have begun at a very early period in the world's history with a degree of development—as regards numbers, magnitude, and rank—far beyond what they have at the present day; and after maintaining their importance through two great geological ages, they lost it as suddenly as it was acquired. In later times they have fallen lower and lower, until they now have comparatively few representatives, and these have degenerated, not only in size and in numbers, but in botanical rank.

Endogens.—The great group of endogenous plants, among which are the palms, the lilies, and the grasses, now includes some of the most beautiful forms of vegetable life. They give character to the vegetation of many parts of the earth's surface, and, since they include the cereals, we must consider them as of as great value to man and animals as any other botanical group. This interesting flora, in striking contrast with the last mentioned, is of comparatively modern date, and is now at its period of greatest development. Some doubt has been expressed in regard to the date of the appearance of monocotyledonous plants on the globe, but up to the present time very few traces of them have been found in Palæozoic rocks. That this order existed and contained flowering plants in the Carboniferous age, seems proven by the discovery of a flower-spike, called *Pothocites*, in the coal-measures of Scotland. In the Triassic, Jurassic, and Cretaceous formations they are represented by many genera belonging to the families of the yuccas, the screw-pines, and the palms, while the Gramineæ and Cyperaceæ—the great inferior families of the order—do not appear earlier than the Tertiary. Palms appear in the Cretaceous, and have been found in strata of this age in various parts of America and Europe. The oldest representatives of the family are fan palms, of the genus *Sabal*, similar to those growing in our Southern States. In the Tertiary age the monocotyledonous flora rapidly expanded until it assumed great importance, and we find there remains of a large number of species of grasses, sedges, lilies, etc., together with the earlier appearing and higher groups already mentioned. We thus see that the Endogens are not only of modern date, but that they begin in, and continue through, the Mesozoic ages, represented only by their highest groups, the inferior families coming in at a later date.

Exogens.—Full descriptions of all known exogenous plants could not be given in this entire work, as they make up much the greater volume of the present vegetation of the globe. The time-history of this group may, however, be much more briefly written, as they for the most part belong to the present or to a very recent geological age. Of the higher division of the Exogens—the Angiosperms—no unquestionable traces have been found in rocks older than the Cretaceous. There they came in—as it appears to us, suddenly and in great force and variety—and before the close of the Cretaceous age they had become the predominating type of vegetation, and the flora of the world had assumed nearly its present aspect. During the Tertiary epoch considerable additions were made to the group; among which are to be numbered some of the most beauti-

ful and useful of flowering and fruit-producing plants, and such as were best adapted to supply the wants of the great mammalian fauna that came on to the stage with them, and finally of man, the last and crowning member of the class. The inferior order of Exogens—the Gymnosperms, which include the conifers and cycads—have had a very different history, and one that offers another striking exception to the general order of progress which has prevailed in the organic world—viz. from the lower to the higher, the simple to the more complex. The conifers apparently began their existence among the first terrestrial plants, perhaps as far back as the later epochs of the Upper Silurian age. In the Devonian they existed in considerable numbers and attained large size, as numerous silicified trunks of coniferous trees have been found in the lower sandstones of Gaspe and in the Middle and Upper Devonian rocks of New York and Ohio. These have been described under the names of *Prototaxites*, *Dadoxylon*, *Nematoxylon*, *Ormoxylon*, etc.; the first of these is supposed by Dr. Dawson—as its name indicates—to have an affinity with the modern Taxineæ. *Dadoxylon* is allied, by the peculiar character of its dotted tissue, to the Araucarias, which, it may be said, constituted the most important group of conifers in both Palæozoic and Mesozoic times. Prof. Dawson refers the fossil woods found in the Upper Silurian rocks of both England and Canada to his genus *Prototaxites*, but by Mr. Carruthers these are considered as more probably the remains of Fucoids. In the Carboniferous age Araucarian conifers were abundant, and probably covered the highlands surrounding the coal-marshes with forests not unlike the pine forests of the present day. In the Mesozoic ages, *Walchia* of the Permian, *Voltzia* of the Triassic, and *Cunninghamites*, etc. of the Jurassic and Cretaceous, brought down the Araucarian line to the Tertiary, where the Sequoias in their great development formed the culminating group of this series. The few living species of *Sequoia* and *Araucaria*, such as the "red-wood" and "mammoth trees" of California and the Norfolk Island pine, afford us some indication of the grandeur and beauty of the forests which in ancient times were formed by this group. The pines and the firs (*Pinus* and *Abies*) apparently began in the Cretaceous age, since when they have been constantly increasing in importance, until they now constitute by far the larger part of the coniferous vegetation of the earth. Of the history of the other groups of conifers our limited space forbids more than the briefest notice. The yews made their appearance in the Tertiary, where the remains of four or five species have been found. *Podocarpus*—a genus now represented by 60 species inhabiting the tropics—began in the Mesozoic ages, and was quite abundant during the Tertiary. The genus *Larix*, of which there are eight living species, began in the Tertiary, and acquired there, at least, as great importance as it has now. *Taxodium* began in the Middle Tertiary, apparently with the two species that are now so widely spread over the North American continent. The arbor-vitæ (*Thuya*), with its allies, *Biota*, *Thujopsis*, etc., began in the Mesozoic ages, where, as in the Tertiary, they constituted a striking and important feature in the flora. *Glyptostrobus*, one of the most beautiful and widespread conifers of the Tertiary, is now represented by a single species growing in China. *Salisburia* (the ginko, one of the most remarkable of living conifers) began in the Cretaceous, and was apparently widespread and flourishing in the Tertiary age. It has now but a single representative.

The Cycads, which apparently connect the conifers with the palms and ferns, made their first appearance in the Carboniferous. To this group the very abundant coal-plants known as *Noeggerathia* and *Cordaites* probably belonged, and we have reason to believe that the flowers and fruit of the latter are known as *Antholithes* and *Cardiocarpon*. In the Mesozoic ages the Cycads became, if not the predominating, at least the most characteristic, forms of vegetation. They then replaced the gigantic Acrogens of the coal-flora, and reached their golden age, which in botanical history is called the "age of Cycads." This extends from the beginning of the Triassic to the middle of the Cretaceous age, when the Cycads were overshadowed and almost exterminated by the development of their congeners the conifers, and the advent of the Angiosperms. In Tertiary time the Cycads filled the same subordinate position in the vegetable world that they now occupy.

Angiosperms.—The details of the history of this highest, most modern, and prevailing type of vegetation would occupy far more space than the necessary brevity of this article will allow. This subject, indeed, more properly belongs to recent botany, and will be found referred to elsewhere. As has already been mentioned, the Angiosperms make their appearance abruptly in great numbers in the upper part of the Cretaceous formation. The minor and herbaceous elements in this flora have left almost no traces, and our view is limited mainly to the arborescent vegetation. This we find to have assumed at once nearly the aspect of that of the present day. A large number of living genera formed part of the first broad-leaved forests of which we have any knowledge. *Quercus*, *Populus*, *Platanus*, *Salix*, *Fagus*, *Sassafras*, *Liriodendron*, *Magnolia*, *Liquidambar*, *Betula*, *Ficus*, *Acer*, *Juglans*, and a number of other living genera, were here well represented. Special interest attaches to certain members of this group—namely, *Magnolia*, *Platanus*, *Liriodendron*, *Sassafras*, and *Liquidambar*—as the living species of the genera, though few in number and restricted in their range, include some of the noblest and most beautiful of living trees, and they were formerly much more numerous, and were spread over North America, Europe, and perhaps Asia. *Liriodendron* has but one living species, but the genus began in the Cretaceous in America, and in the Miocene Tertiary age a species hardly different from our tulip tree grew in Greenland, Iceland, and on the continent of Europe as far south as Italy. *Sassafras* has now but two living species—one growing in North America, the other in Java; but this is also a genus that dates back to the Cretaceous, and was the associate of the tulip tree during the Tertiary in Europe and the Arctic regions. The *Magnolias* have been a marked feature in the American forests ever since the advent of the Angiosperms in the Cretaceous. They were also common in Europe during the Tertiary, and traces of them have been found there in the Upper Cretaceous rocks, but none are now living there unless introduced. America has now two "planes," both noble trees, but species of *Platanus* were growing here in the Cretaceous age, and in the Tertiary were other species, two of which had leaves sometimes eighteen inches in diameter; and they must have been much more imposing than those now living. Hence, we see that, like our grandest conifers, the Sequoias, some of the most beautiful of our broad-leaved forest trees are only the lingering remnants of a splendid arborescent flora which covered our continent in past ages.

Floras of the Different Geological Ages.—In the preceding notes the life-history, so far as it is known, of each of the more important groups of plants has been briefly sketched. A few words are yet needed, descriptive of the grouping of plants in the different geological ages, in order to convey a definite idea of the changes that have taken place in the vegetation of the globe.

Eozoic Flora.—No distinct traces of plants have yet been found in the Eozoic rocks, and it is doubtful whether any such will ever be discovered, since their metamorphism is so complete that their fossils of all kinds have been pretty much obliterated. We find, however, in the Laurentian rocks beds of graphite which rival in magnitude the coal-beds of later date, and everything indicates that, like beds of coal, they have been formed from vegetable tissue. Whether the plants from which this carbon was derived were terrestrial or aquatic, we have no means of determining, but the purity of the deposits is in some cases such that it seems almost impossible that they could have been marine. Prof. Hunt has suggested that these beds of graphite may be of animal origin, but we have no example in subsequent geological history of the accumulation of animal carbon in anything like such quantity and purity.

Cambrian Flora.—Many so-called Fucoids occur in the Cambrian rocks of England, but they are for the most part casts of annelid burrows. In the "fucoidal sandstone" of the Lower Cambrian of Sweden and in the Arenig rocks of Wales unmistakable plant-remains are found which have been described as Exogens, and given the name *Eophyton*. The true character of these fossils is, however, very doubtful, and they afford no satisfactory proof of the existence of higher plants than sea-weeds in this age.

Lower Silurian Flora.—As has been mentioned, all the plants of the Lower Silurian, so far as yet known, are Fucoids. These are quite abundant, but generally show no traces of structure, and their affinities cannot be definitely determined. Certain casts, apparently of plant-stems, found in the Lower Silurian rocks near Cincinnati, have been pronounced by Lesquereux to be species of *Sigillaria*, but this conclusion is not sustained by any evidence yet adduced. Carbonaceous matter is extremely abundant in some portions of the Lower Silurian system, especially in the Utica slate, but it is there apparently derived from Fucoids, or perhaps from animal organisms. In the Lower Silurian rocks of Ireland beds of anthracite occur from one to twelve feet in thickness, sufficiently pure to be used as fuel, but no distinct plant-impressions are associated with them.

Upper Silurian Flora.—Up to the present time most of the plants taken from the Upper Silurian strata are unmistakably sea-weeds. Prof. Dawson has, however, reported the discovery of *Psilophyton* in the Gaspé limestones, and this genus, which is largely developed in the Devonian, is either a Lycopod or a connecting link between the Lyco-

pods and Ferns. Lycopodiaceous plants have been discovered by Geinitz in the Upper Silurian of Lobenstein, Germany, and by Barrande in Bohemia; so that we have satisfactory evidence of the existence of land plants near the close of the Silurian age.

Devonian Flora. Fucoids are abundant in the Devonian rocks, and some of them have been already referred to (*Spirophyton*, *Dictyophyton*, *Aphantomma*, etc.). In the Corniferous limestone of Ohio several tree-ferns and branches of *Lepidodendron* have been found, which were probably floated from an island situated where Cincinnati now is. These indicate the existence of a highly organized acrogenous flora on the land at that time; and it is almost certain that these arborescent plants were associated with many smaller species of which no traces have yet been discovered. In the Middle and Upper Devonian the remains of an abundant and varied flora have been met with in different countries, especially in New York and Canada. From these localities Prof. Dawson has obtained and described more than 100 species, which include various conifers already enumerated, and species of most of the genera of plants found in the coal-flora. Devonian plants have also been found at Perry, Me., at Lewis's Tunnel, W. Va., and at various localities in Ireland and Scotland. The most striking features in this Devonian flora are the many genera of conifers and tree-ferns, and especially the species of *Psilophyton*, the latter nowhere occurring in rocks of later date. The species of *Lepidodendron*, *Sigillaria*, *Sigillariodendron*, etc. are comparatively few and small, and it is evident that in the Devonian flora the Ferns constituted a much more important element than the Lycopods, both as regards numbers and size. From the Hamilton beds of Western New York, Prof. Dawson has received specimens of fossil wood which he has described under the name *Syringoxylon*, and has referred to the Angiosperms. Further observation is required, however, before the existence of plants of this order in the Devonian age can be considered as proven.

Carboniferous Flora. The flora of this age is now so well known that no detailed description of it is here necessary. Including stems, leaves, and fruits, the number of species of plants already described from the Carboniferous system exceeds 500. Of these by far the larger part are Ferns, of which, however, the arborescent forms seem to have been rare. The next group in importance, and far exceeding the Ferns in dimensions, are the Lycopods, represented by *Lepidodendron*, *Sigillaria*, etc. After these come the *Equiseta*, including the genera *Calamites*, *Calamodendron*, *Asterophyllites*, *Sphenophyllum*, *Annularia*, *Volkmannia*, *Huttonia*, etc. Some of this group were arborescent in their habit, while others were aquatic, either immersed or floating. These singular plants must have constituted a peculiar and beautiful feature in the Carboniferous flora, and one of which we can get no adequate idea from our little scouring-rushes. The Cycads were apparently represented in the coal flora by *Cordaites*, *Noeggerathia*, *Whittleseya*, etc.; the Endogens by a few flowering plants. The conifers were unquestionably abundant during the Carboniferous age, and grew to the size of our pines. They belonged, however, to the Araucarian branch of the family. They were for the most part confined to the highlands, where their trunks and leaves were rarely preserved; but in the sandstones of the coal measures—which mark periods of inundation—their silicified trunks are not unfrequently met with. The fossil fruits found with the coal-plants are often exceedingly numerous, and mainly belong to the genera *Trigonocarpon* and *Cardiocarpon*. Of these, the first has been compared to the fruit of *Salisburia*, and hence has been supposed to belong with some coniferous plant; but no known conifer is correspondingly abundant, and these nuts were probably borne by some of the species of *Sigillaria*, which, as has been stated, seems to be intermediate between the Lycopods and Gymnosperms. The *Cardiocarpa* were probably the seed vessels of *Cordaites*, a Cycad.

The Permian flora is essentially a continuation of that of the Carboniferous period, and no palæontological reasons exist for separating the two formations.

The Triassic Flora. Passing from the Palæozoic to the Mesozoic ages, we enter a new world, both as regards plants and animals. The most noticeable trees of the Trias are the peculiar conifers *Albertia* and *Voltzia*. They are both Araucarians, but quite different from those which preceded and followed them. Ferns were numerous in the Triassic age, but, as we infer from the collections made in the coal basins of Richmond and Los Bronces, they were for the most part of different genera from those found in the Carboniferous rocks. They were also very much less numerous. The *Calamites* of the Carboniferous age have a feeble representation in the Triassic, but these die out and give place to true *Equiseta*. The great Lycopods of the coal period seem to have all perished at the close of the Palæozoic ages, as we find no traces of them in the Triassic. The most conspicuous and characteristic feature in the Triassic flora is the great development it exhibits of the family of Cycads. These were so numerous, so varied and showy, that they have caused the chapter of botanical history which includes the Triassic and Jurassic ages to be entitled the "reign of Cycads." The flora of the Trias has, as yet, been imperfectly studied in America, but large collections of Triassic plants have been made in the coal-basins of Richmond, Va., Deep and Dan Rivers, N. C., at Los Bronces, Sonora, and at Abiquiu, N. M. Descriptions of these have not yet been published, but they form a flora essentially like that of the Trias in the Old World, being composed of the same genera, and in part of the same species. The most striking of American Triassic plants are Cycads of the genera *Otozamites*, *Podozamites*, and *Pterozamites*, and also the great monophyllous Ferns (*Taeniopteris*). Silicified trunks of coniferous trees are in some places exceedingly abundant in the American Trias, and show that forests of gigantic trees covered portions of the continent in that age. Not a trace of an Angiosperm has, however, as yet, been found among all the Triassic plants.

The Jurassic Flora. No Jurassic plants have yet been met with in America, but in the Old World a long list of genera and species has been made from those taken from the Lias and Oolite of England and the Jura of the Continent. In all its most characteristic features the Jurassic flora resembles the Triassic, and their differences are too much matters of detail to be enumerated here.

The Cretaceous Flora. During the first half of the Cretaceous age the Cycadaceous flora of the Trias and Jura seems to have continued without marked change. At the period of the deposition of the Lower Cretaceous strata of America—equivalent to the Middle Cretaceous of Europe—a revolution had, however, taken place in the plant-life of the globe, and the "reign of Angiosperms" had been inaugurated. In the Lower Cretaceous sandstones of New Jersey, Kansas, and the Far West, the remains of at least 100 species of arborescent Angiosperms have been found, and with these scarce a trace of Cycads, and very few Ferns. This formation is the result of the invasion of the continent by the sea, and the accumulation along the advancing shore-line of beds of sand which included leaves and tree-trunks, washed from the neighboring land. We have, therefore, in this deposit proof that between the time of deposition of the Upper Triassic strata and the formation of the first of our series of Cretaceous rocks, the continent was overspread with forests of broad-leaved trees which, in size and variety, rivalled the forest growth of the present day; and also that in this ancient forest were oaks, sycamores, magnolias, beeches, willows, and other genera which are among the most common and characteristic trees of our present flora. The origin of this great group of Angiospermous trees is, as yet, entirely unknown to us. Possibly, connecting links will yet be discovered between the floras of the Trias and Cretaceous, but as far as our observation yet extends the transition is sudden from the Cycadaceous forests of the Trias, in which not a trace of an Angiosperm has been found, to the Angiospermous forests of the Cretaceous, which, so far as yet known, contain no Cycads. The Upper Cretaceous strata of the Far West—Colorado, Wyoming, Utah, etc.—contain important beds of lignite, and associated with them a large number of fossil plants. Some 250 species have been described from this formation, mostly from detached leaves. The aspect of the flora they represent is so modern that the strata which contain it have been considered by Lesquereux as Eocene Tertiary; but, aside from the fact that no plants from these beds are certainly identical with Eocene species, the plant-bearing strata are intercalated with, or overlaid by, others which contain so many well-marked Cretaceous mollusks and vertebrates that there can be no reasonable doubt of their Cretaceous age. The coal strata of Vancouver's Island also contain many impressions of angiospermous leaves, and these, too, have been pronounced Eocene by Lesquereux. The evidence is, however, overwhelming that they are Cretaceous. One of the most distinctly marked plants found on Vancouver's Island is *Sequoia Reichenbachi*, a well known European Cretaceous plant. It also occurs in Alameda co., Cal., associated, as on Vancouver's Island, with *Baculites* and *Inoceramus*.

The Tertiary Flora. The Angiosperms predominate in the Tertiary flora, and the generalities of its features have been already given in what has been said of the life-history of that group. The flora of the Tertiary is also so varied that any detailed description of it would carry this article far beyond its prescribed limits. A few general conclusions, drawn from the observations made on the Tertiary flora, are therefore all that can with propriety be added to the notes already given.

1st. Everything indicates that the flora of the Tertiary was directly derived from that of the Cretaceous age, and

has in turn given birth to the flora of the present day; the most common genera of the Cretaceous Angiosperms having living representatives, and some of these running back into the Tertiary; *e.g. Onoclea sensibilis, Taxodium distichum, Corylus Americanus*, etc.

2d. No traces have been found in America of the Indo-Australian flora which flourished in Europe in the Eocene period; such plants as have been obtained from our Eocene strata belonging to the temperate flora which has prevailed over so much of America since the Cretaceous age.

3d. Fan-palms grew in the Miocene period as far N. as the line of the British possessions, indicating a climate as warm as that of New Orleans at the present time.

4th. In the Miocene Tertiary luxuriant vegetation covered the northern portions of the continent, even to the Arctic Sea, and at least 100 species of arborescent plants have been obtained from the Miocene beds of Alaska, British America, and Greenland.

5th. So large numbers of the Arctic American Miocene species are found in European deposits of the same age that we are compelled to infer a land connection between the two continents in this age; also this community of character has been considered indicative of the colonization of Europe by the American Angiospermous flora in the Miocene age. The similarity of the flora of Japan to that of Eastern America would seem to indicate a connection also between America and Asia in the Tertiary.

6th. The Pliocene flora of Central and Eastern America shows no marked changes from the Miocene, but approaches more to the vegetation of the present time, the proportion of living species becoming greater. In Europe also the Pliocene flora resembles the present European flora more than does the Miocene flora, but the difference is due to the gradual disappearance of the American types common there during the Miocene, and the substitution of probably Asiatic forms better suited to a cooler climate.

7th. With the approach of the Glacial period the temperate flora of the Tertiary was driven southward, where it could retreat; where it could not, it was destroyed, and even the lowlands were occupied by an arctic vegetation. When, however, the climate ameliorated after the Ice period, the boreal plants moved northward, or climbed mountains where they found a permanent arctic temperature. This is proven by the distribution of alpine species, and in the community of character exhibited in the detached and often widely separated colonies of arctic plants.

General Divisions of the History of Plants.—If we now take a retrospective view of the ground gone over, and combine the facts briefly stated on the preceding pages, we shall find that the history of plant-life is susceptible not only of a division into epochs, as we have already divided it, but also into ages. Of these there are four, each of which is characterized by the prevalence and predominance of one of the great groups of plants. Following the example of the palæontologists who have traced the history of animal life, we can designate each of the great botanical ages by the name of the reigning type of plants, as follows:

1st. *The Reign of Thallogens.*—This includes the Cambrian and Silurian divisions in geological history. During this age the sea-weeds were the prevailing and almost the only existing type of plants.

2d. *The Reign of Acrogens.*—This includes the Devonian and Carboniferous ages, and was marked by the great development of Ferns, Lycopods, and Equiseta, which were not only the highest and most prevalent forms of vegetable life, but attained greater dimensions and higher rank than they did at any subsequent period.

3d. *The Reign of Gymnosperms.*—This reaches from the beginning of the Triassic to the middle of the Cretaceous, and during this botanical age the Cycads and conifers overspread the earth, and acquired greater relative and absolute consequence than at any time before or since.

4th. *The Reign of Angiosperms.*—This is marked by the sudden advent and rapid expansion of the Angiosperms at the middle of the Cretaceous age; since when they have maintained their supremacy on the surface of the globe, apparently increasing in numbers and perfection of organization to the present day.

The exceptions to the general rule of progress expressed in the above table should not be here forgotten, as they have an important bearing on the question of the cause of this advance which seems to have prevailed in plant-life considered as a whole, and on the origin of the almost infinite diversity which we see in the flora of the present day. These exceptions are, briefly—1st, the early appearance of the conifers, which came in at the close of the Silurian or in the beginning of the Devonian age, and have since held on the "even tenor of their way;" 2d, the rapid development of the Acrogenous flora of the Devonian, and its attainment of higher rank in the Devonian and Carboniferous ages than any Acrogens have held since; 3d, the introduction of the Endogens at the close of the Carboniferous or beginning of the Mesozoic age, with the highest groups of the order, the lower appearing subsequently; 4th, the modern date of mosses, liverworts, lichens, and fungi, when all these hold a low place in the scale, and in regular order should have appeared in the earlier geological ages.

J. S. Newberry.

Fossil Fishes. Like most other aquatic animals, fishes at death are often buried in the sediments which accumulate at the bottom of the water in which they live. Here their remains are almost beyond the reach of change, and are indefinitely preserved. Hence, like mollusks, radiates, and crustaceans, fishes are frequently found in the stratified rocks, which are consolidated sediments that in former ages accumulated at the bottom of salt or fresh water. Already many hundred species of fossil fishes have been obtained from the strata of the different geological formations, and they constitute an exceedingly interesting and important element in the life-history of the globe.

The sediments which accumulate at the bottom of the open sea are calcareous, and these contain the remains of pelagic fishes—sharks, etc.—while along the shores, and in bays, rivers, and lakes, mechanical sediments—clay and sand—are deposited, and fishes and other marine animals, on sinking to the bottom, will be here preserved in what subsequently become strata of shale and sandstone.

Since all the organisms possessing hard parts—like shells, bones, teeth, and spines—are sure to leave some record of their existence in the sediments of the medium in which they live and die, we ought to find traces of fishes in the strata deposited during all the ages in which fishes existed. It is indeed probable that we have done so, since the remains of fishes have been found in all of the geological formations of more recent date than the Lower Silurian. The rocks of that age seem to afford a very full record of the fauna then existing; but though the most minute and careful search has been made in many countries, no well-marked remains of fishes have been anywhere found in them. We therefore conclude that no fishes lived in the Lower Silurian seas.

In ascending the geological scale traces of fishes are first met with in the upper portion of the Upper Silurian system. In America the Upper Silurian rocks have as yet yielded no fish-remains, but fishes have been found in strata of this age in England, Russia, Germany, and Bohemia. In the deposits of later date the remains of fishes become more and more abundant as we approach the present time, and the study of this series of fossils has thrown much light on the life-history of the globe. As is the case in other departments of palæontology, most fossil fishes are different from those now living, and they form many orders, families, genera, and species which are now extinct.

As among mollusks, crustaceans, radiates, and vertebrates of other classes, the most ancient fossil fishes are most unlike those living at the present time, and the sequence of forms which the fossil fishes of the different ages present has an interesting and important bearing upon the great questions of the origin and development of life which now occupy the attention of scientific men. The study of fossil fishes has only recently been taken up, our knowledge of them is yet very imperfect, and every year sees some important additions made to it. The conclusions deduced from it are therefore to a certain extent provisional, and such as are liable to be considerably modified by future discovery. The revelations which have been made through the labors of Agassiz—who should be considered the father of fossil ichthyology—of Hugh Miller, Pander, Owen, Egerton, Huxley, Lutken, and others are, however, of the greatest interest and value, and are such as permit us to indicate the generalities at least of the history of ichthyic life on the earth. The knowledge we have gained on this subject may be briefly summarized as follows:

1st. Fishes constitute the lowest group of vertebrate animals, and they are the first of vertebrates to make their appearance in geological history.

2d. The earliest traces of fishes are found in the Upper Silurian rocks of the Old World, and, according to our present knowledge, in the Devonian strata of America. The next higher group, amphibians, appear first in the Lower Carboniferous, true reptiles in the Upper Carboniferous and Permian, mammals in the Trias.

3d. The oldest fishes known were of small size and few in number as compared with the associated forms of life. They belong to two groups—viz. the Elasmobranchs (sharks, etc.) and the Cephalaspids, or buckler-headed fishes, a group long since extinct, and which will be described farther on.

4th. The seas of the Devonian age were well stocked with fishes, some of which attained a size scarcely inferior to the largest now living. They belonged to the sub-classes of the Elasmobranchs, Placoderms, and Ganoids. The De-

vonian fishes collected in America are mainly from open sea deposits, are as yet comparatively few in number, and are mostly of large size. In the Old World the fishes obtained from Devonian rocks include a great number of genera and species, are generally imbedded in mechanical sediments, are for the most part small, and were probably the inhabitants of rivers, bays, and other shallow waters In consequence of the abundance of fishes found in the Devonian rocks, this chapter in the life history of the globe has been called the "Age of Fishes."

5th. In the Carboniferous age fishes were numerous and varied in structure, but they were no longer the monarchs of the animal world, as the sceptre here passes from them to the amphibians, into which they pass by insensible gradations. In the open seas of the Carboniferous age sharks existed in large number and attained great size, the great Placoderms and Ganoids of the Devonian age, to which the Elasmobranchs had been subordinate, having mostly disappeared. In the rivers, lakes, and bays of the Carboniferous continents numerous Ganoids, large and small, existed, among which may be mentioned the huge carnivorous *Megalichthys* and *Rhizodus*, and their prey, the small, elaborately ornamented Ganoids, *Palæoniscus*, *Cœlacanthus*, *Amblypterus*, and *Eurylepis*.

6th. In the Trias the fishes were altogether subordinated to the amphibians, but from the nature of the Triassic deposits we have a very imperfect view of the fish-life of the period. The rivers, lakes, and bays were, as we know, inhabited by shoals of small Ganoids—*Palæoniscus*, and the allied genera, *Catopterus*, *Ischypterus*, and *Dictyopyge*—for we find their remains in the lagoon and estuary deposits of Richmond, New Jersey, the Connecticut Valley, etc. In the Old World the Trias has furnished, with many other fishes, the teeth of *Ceratodus*, supposed to be generically identical with barramunda, a Dipnoan of Australia.

7th. The fishes of the Jurassic were sharks and Ganoids, and were very numerous. The sharks were mostly Cestracionts, allied to *Cestracion Philippi*, the Port Jackson shark; the Ganoids had rhomboidal scales and tails but slightly vertebrated. Of these there were many genera and species. They were mostly small, but the largest (*Lepidotus*) was six feet in length and very robust.

8th. The Cretaceous age is marked in the history of fishes by the appearance of the great sub class of the Teleosts, or true bony fishes, such as the salmon, pike, etc. They constitute the majority of the fishes of the present day, and are generally placed at the summit of the class of fishes. In these we find the vertebral column bony throughout, and tail equally lobed.

9th. In the Tertiary age the Teleosts gradually superseded the Ganoids, while the sharks attained dimensions unknown before or since, the largest (*Carcharodon megalodon*) having attained a length of 50 to 60 feet, with cutting teeth as large as one's hand.

10th. In the present age the Teleosts have almost entirely replaced the Ganoids, and have become the prevailing type of ichthyic life. The Ganoids, if we exclude from them the Dipnoi, are now reduced to seven genera—viz. *Acipenser*, *Lepidosteus*, *Amia*, *Scaphirhynchus*, *Polyodon*, *Calamichthys*, and *Polypterus*; of these, the first is common to all parts of the northern hemisphere, the succeeding four are exclusively North American, while the last two are African. If we accept Dr. Gunther's classification, and unite the Dipnoi with the Ganoids, we must add two more to the list of the living genera—viz. *Lepidosiren* and *Ceratodus*, the three species which represent these inhabiting, one South America, one Africa, and one Australia.

The classification of fossil fishes is a matter of considerable difficulty: their soft parts have always disappeared, and generally more or less of the bony structure is wanting. Hence, it is often impossible to determine their exact relations to each other or to living species. There are also so many missing links in the chain of succession that the origin of the diversified forms which we find in the class is beyond the reach of our present (and it may be of all our future) knowledge. The fauna of the sea contained in each of the great geological formations is a single chapter in a long history, and one which is not only disconnected with those which precede and follow it, but is perhaps separated from them by long intervals of which we have as yet no record. Could we follow the seas in their ebbs and flows, and thus get a connected history in the sediments deposited from them, we should doubtless there learn what was the true origin of the class of fishes, and by what influences the little group of pioneers, of which we have discovered the remains in the Upper Silurian rocks, became so much expanded and diversified in after times. The oldest of fishes known to us, though comparatively few and small, and having a less complex (and, as we may say, less perfect) organization than most of the fishes of the present day, are still much more highly organized than some living fishes, if we include *Amphioxus*, *Petromyzon*, and *Myxine* in the class, and are certainly far from being embryonic in character. It may also be said that they are so far removed from the crustaceans and mollusks with which they are associated as to offer no suggestions of relationship or derivation. So, too, in tracing the subsequent history of fishes, the new forms with which we meet seem to come in and go out abruptly; that is, the evidences of transmutation are wanting, so that, however probable it may be from extraneous considerations that the later forms are all derivations from the earlier, the proof of genetic relationship is yet wanting. A large part of the missing links may be hidden in the blanks of the record, but, as we now see it, the "genealogical tree" of fishes looks more like a bundle of independent shoots rooting at different levels than a single trunk with divergent branches. A certain progress is, however, distinctly discernible in the successive phases of fish life presented in the different geological ages. For example: as a general, and perhaps universal rule, in all the older fishes the spinal column was cartilaginous, while at the present day nearly all fishes have bony vertebræ. So all the ancient fishes have vertebrated tails—that is, the vertebral column was prolonged over or through the caudal fin—while in most modern fishes the spinal column terminates abruptly in a semicircular bone from which the fin-rays radiate equally. The Teleosts of the present time generally have the spinal column composed of bone, but they are for the most part destitute of the cumbrous offensive and defensive armor with which the older fishes were loaded. This is an evidence of superiority, as it indicates the substitution of sentient nerve for insensible bone. The active and intelligent Teleosts were more than a match in the struggle of life for the sluggish and heavy armed Ganoids and Placoderms, just as man unarmed is the superior of brutes, however well furnished with weapons. There are, however, some facts in the history of fishes which cannot be explained through any suggestions yet made by material philosophy. These are—1st. The Elasmobranchs have continued to exist in great numbers since the Silurian age, and are now perhaps as numerous and powerful as ever, while they have apparently undergone no considerable change of structure, but have retained their embryonic features of a cartilaginous skeleton and vertebrated tail unmodified. 2d. The living Ganoids, such as our sturgeons, gar-pikes, etc., though few in number, counting genera and species, are in individuals numerous, powerful, and apparently prosperous. These, however, we find to have so far followed the prevailing fashion as to have substituted bony vertebræ for the cartilaginous spines of their predecessors, and to have adopted in some cases homocercal instead of heterocercal tails. 3d. The Dipnoi (*Lepidosiren*, etc.) are, judging from their organs of respiration and circulation, the highest of fishes, and are apparently a connecting link between fishes and amphibians, but in them the vertebral column is cartilaginous.

Several different systems of classification of fossil fishes have been suggested, of which the first and simplest is that of Agassiz. He divided the class of fishes into four orders, distinguished by the character of their scales—viz. *Placoids* (sharks, rays, etc.), *Ganoids* (fishes with bony and enamelled scales and plates, including Ganoids proper, Placoderms, *Cephalaspis*, and Acanthodians), *Cycloids* (fishes with smooth circular scales, like the salmon), *Ctenoids* (fishes with serrated scales, like the perch). Subsequently, Müller, Owen, Huxley, Lutken, Gunther, Cope, and Gill have proposed systems of classification of fishes including more or less of the fossil forms.

The orders into which Huxley divides the class PISCES are as follows: 1, PHARYNGOBRANCHII (*Amphioxus*); 2, MARSIPOBRANCHII (lamprey and hag); 3, ELASMOBRANCHII (sharks, rays, and chimeras); 4, GANOIDEI (Ganoids); 5, TELEOSTEI (bony fishes); 6, DIPNOI (*Lepidosiren*, etc.).

Some of the more recent writers on the classification of fishes exclude the Pharyngobranchii and the Marsipobranchii from the class PISCES; and as they do not occur in the fossil state, they need not be further considered here. Of the four remaining orders of Huxley, Dr. Gunther unites the Dipnoi with the Ganoidei, being led to this conclusion by his studies of the barramunda, with which he associates *Ceratodus* of the Carboniferous and *Dipterus* of the Devonian. He also unites all the Ganoids of Agassiz, including the Dipnoi with the Elasmobranchs in one group, *Palæichthes*, which includes all the Palæozoic fishes. He also suggests that the Elasmobranchs were the *marine* Palæichthes, while the Ganoids were the *fresh-water* Palæichthes. To this rule there are, however, some marked exceptions, as the huge Ganoids (*Dinichthys*, *Onychodus*, etc.) inhabited the Devonian seas, while in the sediments of the lakes, rivers, and bays of the Carboniferous age we find the spines of sharks which must have been of great size (*Gyracanthus*, *Ctenacanthus*, *Edestus*, etc.). The truth seems

to be, that in the Devonian age the Ganoids—including Placoderms—were greatly developed, inhabiting and ruling alike deep and shallow, salt and fresh waters, while in the Carboniferous the Elasmobranchs correspondingly predominated, and the Ganoids were driven from the sea, and even in lakes, rivers, and bays maintained with the Elasmobranchs and amphibians an unequal struggle.

The following schedule will represent the more detailed classification of fossil fishes according to the present state of our knowledge:

CLASS PISCES.

Sub-class Elasmobranchii.

Order 1, Squalidæ.	3, Chimæroidei.
2, Raidæ.	

Sub-class Ganoidei.

Order 1, Amiidæ.	6, Placodermi.
2, Lepidosteidæ.	7, Acanthodidæ.
3, Crossopterygidæ.	8, Pycnodontidæ.
4, Chondrostidæ.	9, Dipnoi.
5, Cephalaspidæ.	

Sub-class Teleostei.

Order 1, Physostomi.	4, Pharyngognathi.
2, Acanthini.	5, Lophobranchii.
3, Acanthopteri.	6, Plectognathii.

1. *Elasmobranchii.*—As has been stated, the Elasmobranchs seem to be represented in the oldest remains of fishes known, and they have continued to exist in large numbers from the Devonian and Carboniferous ages to the present day. The earliest Elasmobranchs seem to have been sharks. Some of them had very much the structure, and probably the habits, of our living sharks, but much the larger number belonged to families nearly or quite extinct, such as the *Petalodonts*, *Hybodonts*, and *Cestracionts*; the latter represented in the living Port Jackson shark. The Rays began with the Carboniferous, and have been increasing in importance up to the present time. The Chimæroids are now represented by two genera only, *Chimæra* and *Callorhynchus*, of which there are but three or four species living. Until recently the Chimæroids were supposed to have begun in the Jurassic, and to have attained their maximum development in the Tertiary, but the discovery of the teeth of the genus *Rhyncodus* in the Corniferous limestone of Ohio proves that they date back to the Devonian age.

2. *Ganoidei.*—This group, as at present constituted, includes among its living and fossil genera a multitude of forms which seem to have but little in common, and since the soft parts of the fossil species have disappeared, it may never be possible to determine with accuracy the precise relations of the different fishes which are now grouped under this name. All those now associated together have these characters in common, however—that the head is roofed with bony plates covered with enamel; the body is usually protected with scales or plates, also covered with enamel; the tail is vertebrated, and the vertebral column is altogether or in part cartilaginous. The scaled Ganoids are divided into two groups, one of which has round, imbricating, and the other rhomboidal scales. In most instances also the tails of Ganoids are very unequally lobed, the vertebral column being prolonged into the upper lobe. The older Ganoids have this character most distinctly marked, while in some of the Mesozoic and modern species the tail is very slightly vertebrated, and has nearly the same form as in the Teleosts. In the living sturgeons it is, however, exceedingly heterocercal. In a peculiar extinct family of Ganoids, the *Cœlacanthini*, the tail is equally lobed, but the vertebral column is prolongated through its centre, and a minute supplemental caudal fin is borne by its extremity. The sub-class Ganoidei is divided into the following orders:

1. *Amiidæ.*—In this group are included Ganoids which have cycloidal scales, a præoperculum, a single median jugular plate, branchiostegal rays, non-lobate paired fins, and heterocercal tails. The vertebral column is ossified. The Amiidæ have but a single living representative (*Amia*), which inhabits the rivers of North America. During the Tertiary age several species of *Amia* lived in the great lakes then existing in the western part of this continent. Some of these were much larger than any now living. No more ancient traces of this order have been detected.

2. *Lepidosteidæ.*—This order includes the greater number of Ganoids known. They have rhomboidal and enamelled scales, a præoperculum, branchiostegal rays, non-lobate paired fins, and usually heterocercal tails. *Lepidosteus* (the gar-pike) is the living type of this group. Several species of this genus now inhabit the rivers and lakes of North America, and the remains of others have been found in Tertiary rocks. In the Cretaceous, Jurassic, and Triassic strata the Lepidosteidæ are represented by numerous genera—*Dapedius*, *Lepidotus*, *Æchmodus*, etc.—and in the Palæozoic formations by *Palæoniscus*, *Amblypterus*, and *Eurylepis* in the Carboniferous, and perhaps by *Cheirolepis* in the Devonian.

3. *Crossopterygidæ.*—This order has recently been described by Huxley. Its most striking character is found in the lobate paired fins which have their central portions covered with scales. The scales of the fishes of this order may be cycloid or rhomboid. The dorsal fins are either two in number, or very long, single, or composed of many subdivisions. There are no branchiostegal rays. The jugular plates are two principal, with sometimes several supplementary ones. The tail is heterocercal or traversed centrally by the vertebral column (diphycercal). The living members of this order are *Polypterus* of the Nile, and *Calamichthys* of Western Africa, but many of the genera represent the Crossopterygidæ in the Devonian and Carboniferous formations—viz. *Osteolepis*, *Megalichthys*, *Holoptychius*, *Rhizodus*, the American genus *Onychydos*, and some others. A remarkable family included by Huxley in this order is the Cœlacanthini. These are represented in the chalk by *Macropoma*, in the Jurassic by *Undina*, in the Permian and Carboniferous by *Cœlacanthus*. All this family of fishes have hollow fin-rays—whence their name—elliptical jugular plates, two dorsals sustained by palmated interspinous bones, and diphycercal tails, through which the vertebral column extends, and bears at its extremity a minute supplementary caudal fin.

4. *Chondrostidæ.*—In the fishes of this order the body is generally protected by bony plates, though sometimes naked. Neither the pectoral nor ventral fins are lobate. The branchiostegal rays are few or wanting; the tail is heterocercal, the teeth small or absent. The living members of this order are the sturgeons (*Acipenser*), which inhabit the rivers of all the northern hemisphere, and *Polyodon* and *Scaphiorhynchus*, found only in North America and Eastern Asia. In the Jurassic rocks the sturgeons are represented by *Chondrosteus*, and probably in the Devonian by *Macropetalichthys*.

5. *Cephalaspidæ.*—These form a remarkable group of small fishes which occur only in the Devonian and Upper Silurian rocks, and include the oldest fishes yet known. They have the head and the anterior part of the body covered with a bony shield, and the posterior portion with scales. The type of this order is *Cephalaspis*, and its other members are *Pteraspis*, *Auchenaspis*, *Scaphaspis*, *Menaspis*, etc. The relations of the Cephalaspids to living fishes are uncertain. Huxley has pointed out their resemblance to the Chondrosteans, comparing *Cephalaspis* with *Scaphiorhynchus*, and *Pteraspis* with *Polyodon* (*Spatularia*). Excepting one species of *Cephalaspis* (*C. Dawsonii*), found by Prof. Dawson in the Devonian rocks of Gaspé, none of the Cephalaspidæ have been found in America.

6. *Placodermi.*—This is the name given by Pander to a group of fossil fishes called Placoganoids by Owen, which includes *Coccosteus*, *Pterichthys*, *Asterolepis*, and *Heterosteus*, and also the gigantic fishes recently found in the Devonian rocks of Ohio, *Dinichthys* and *Aspidichthys*. In the Placoderms the head and anterior portions of the body were protected by a buckler or carapace composed of thick bony plates, which had the external surface studded with points of enamel. Behind this the body was either naked or covered with angular enamelled scales. The vertebral column was generally cartilaginous, but a *Coccosteus* with bony vertebræ is reported by Murchison to have been recently discovered. (*Siluria*, p. 478.) The affinities of the Placoderms are still matters of doubt and discussion. Huxley and Owen have both suggested their relationship with the living Siluroids, some of which have similar bony carapaces. Their dentition is, however, quite different, and that of *Dinichthys* and *Coccosteus* considerably resembles that of the Dipnoi. The Placoderms are eminently characteristic of the Devonian age, and the larger members of the group were not only the most highly organized, but were from their size and armament the most formidable, of then existing animals. In *Dinichthys*, the largest of the Placoderms yet discovered—of which two species have been found in the Huron shale of Ohio—was the most remarkable of all known fossil fishes. In dimensions it was gigantic, and it was furnished with offensive and defensive armor of the most formidable and effective character. Its size may be conjectured from the fact that a single plate occupying the centre of the back was more than two feet long and broad. The head was about three feet in diameter and length, the mandibles were two feet in length by six inches in depth, solid bone throughout.

7. *Acanthodidæ.*—These were small fusiform fishes, of which the remains are not rare in the Palæozoic rocks of the Old World, but have not yet been met with in America. Their geological range is from the base of the Devonian to the Permian. A large number of species

have been described by Agassiz, Sir Philip Egerton, and others in the genera *Acanthodes*, *Diplacanthus*, *Climatius*, *Parexus*, etc. The Acanthodians derive their name from the spines which are set at the anterior margins of the fins and elsewhere on the body. These spines are planted in the integuments like those of sharks. The surface of the body in the Acanthodians was covered with closely set, shagreen like scales. The vertebral column was cartilaginous, the cranium mostly so. By Prof. Agassiz the Acanthodians were regarded as Ganoids. Mr. James Powrie considers them as Elasmobranchs, while Prof. Huxley suggests that they are connecting links between the two.

8. *Pycnodontidæ*.—These, like the Acanthodians, are of somewhat questionable relations, though generally considered as Ganoids. In some points of structure they resemble the Plectognaths, Teleosts, *Balistes*, *Cestracion*, etc., but the spinal column was cartilaginous, and the dentition consisted of a series of bony and enamelled bosses set in a kind of pavement, and adapted to crushing mollusks and crustaceans. The Pycnodonts range from the base of the Carboniferous to the Tertiary, but are now all extinct. Though not uncommon in the Old World, few Pycnodont fishes have as yet been found in the rocks of America. *Platysomus* has been obtained from the coal-measures of Illinois, and *Pycnodus* from the green sand of New Jersey.

9. *Dipnoi*.—This order has among living fishes but three known representatives—viz. *Lepidosiren* (*Protopterus*) *paradoxa* of South America, *Lepidosiren annectens* of Africa, and the recently discovered *Ceratodus Fosteri* (the barramunda) of Australia. These are, however, of great zoological interest, as they seem to be a sort of connecting link between fishes and amphibians. They were, in fact, until recently, classed with the Amphibia, and were considered as the lowest order of this class. They are now, however, placed among fishes, of which they are regarded as the highest order. In their anatomical structure they exhibit a mingling of high and low characters. The heart has two auricles and one ventricle. The respiratory organs are double, consisting of gills in a branchial chamber, and also of true lungs in the form of a double cellular air bladder. The body is fusiform and fish-like, covered with cycloid scales. The fins in *Lepidosiren* are slender, many-jointed rods, of which the pectorals only have a narrow membranous fringe: in *Ceratodus* they are broader, and are all bordered with membranes. In contrast with the amphibian character which they present, the Dipnoans have a cartilaginous vertebral column, such as is found in the lowest groups of fishes. The interest of the Dipnoi has been increased by the researches of Dr. Günther, who seems to have proved that the barramunda is generically identical with *Ceratodus* of the Trias, and also that quite a number of much more ancient fishes—such as *Ctenodus* of the coal measures and *Dipterus* of the old red sandstone—also belonged to this group. Should this conclusion be confirmed, it will produce quite a revolution of opinion as to the classification of some of the older fishes.

Teleostei.—In the Teleosts the endoskeleton is well ossified. The cranium is largely bony, and the mandible is present. The gills are free, and a bony gill-cover and branchiostegal rays are always developed. A bulbus arteriosus exists at the base of the branchial artery, but this is never rhythmically contractile, and only a single row of valves separates it from the ventricle. None of the true Teleostei are proven to have existed before the Cretaceous age. Since that time, however, they have been constantly increasing in numbers and relative importance, until in the present age they outnumber all other forms of fishes. As the fossil Teleosts closely resemble the fishes of the present day, they can be best studied in connection with them, and therefore but few words will be given to them here.

Among the Cretaceous Teleosts one of the best known forms is *Beryx*, a Percoid genus which occurs in the Tertiary, and is now living in the Atlantic. *Osmeroides* is another common Cretaceous Teleost, of which we have no living representatives. It is supposed to be allied to the salmons. Of the most important living groups, the Clupeidæ (herrings) begin in the Cretaceous period. The Murænidæ (eels) appear for the first time in the Eocene. The Cuprinidæ (carp, etc.) commence in the Tertiary, and were numerous in the fresh-water lakes of that period. The Salmonidæ (salmon and trout) are of modern date, scarce any representative of the family being found in strata older than the Post-Tertiary. The Siluridæ (cat-fishes) are also nearly without representatives in the fossil state, unless, as has been suggested, the Placoderms were their progenitors. The Gadidæ (cod family) begin in the Eocene Tertiary. The Pleuronectidæ (flat fishes) have one representative in the Eocene, but are rarely found fossilized.

Of the Percoid fishes (Acanthopteri), the perches, mullets, mackerels, gurnards, etc., nearly all the families and genera appear first in the Tertiary, but the Cretaceous date of *Beryx* has been already noticed.

The Plectognathi, which include the trunk-fishes, file-fishes, and globe-fishes, have some of the characters of the Ganoids, as the vertebral column is often cartilaginous and the exoskeleton consists of ganoid plates, scales, or spines. Of the Lophobranchii, which includes the singular pike-fishes and sea-horses, some Tertiary representatives are known, but they belong mainly to the present fauna.

J. S. NEWBERRY.

Fos'sil Foot'prints. Soft mud that receives impressions made by the feet of animals in walking will retain the markings when the sediment has become hardened into stone. The first scientific notice of such impressions appeared in *Trans. Roy. Soc. Edinburgh* in 1828, by Dr. Duncan. The principal European localities are the worm-burrows of the old red sandstone of Forfarshire, and various English Carboniferous sandstones; the trails on Cambrian rocks; crustacean imprints in the Devonian flagstones of Scotland; fish-spine marks upon the Scottish Carboniferous rocks; reptilian and other tracks upon the Triassic of Great Britain and Saxony; crustacea in the Wealden, etc. In America are the crustacean impressions of Canada of Cambrian age; reptilian tracks in the Pennsylvania Carboniferous; crustacea and worms in the Clinton group in New York; and others. The best known are the 153 species of Ichnites described in the Massachusetts geological reports. First noticed by Pliny Moody in 1800, seen by Simeon Draper of Greenfield (Mass.) in 1835, thought by Dr. James Deane from their form and succession to be the footprints of birds, they were first described in print by Pres. E. Hitchcock in 1836. Those in the Connecticut Valley may be thus grouped: 1 marsupial; 17 thick-toed birds; 17 narrow-toed birds (?); 21 ornithic reptiles, the *Dinosaurs* of English writers, and the *Hoppobats*; 25 reptiles and amphibia; 17 batrachians; 6 chelonians; 2 fish; 24 insects; 21 larval and lower articulata; and at least 2 mollusca. The largest bird agrees in size and race with the *Dinornis* of New Zealand, discovered about 1839. The track of the *Otozoum*, the largest batrachian, is 20 inches long, and resembles the impression made by the *Cheirotherium* of England, save in the absence of one toe. One species of batrachian is named from the resemblance of saucer-shaped hollows, crowded together promiscuously, to the mud-nests made by living tadpoles. Some that seemed avian at first are now referred to the Dinosaurs. The Hitchcock Ichnological Museum at Amherst, Mass., contains over 20,000 ichnites, including the type-specimens of all the New England species. It was founded by Pres. E. Hitchcock, and now belongs to Amherst College.

C. H. HITCHCOCK.

Fos'sil For'ests. Petrified forests are frequently referred to in the notes of travellers taken in different countries, but it is more than doubtful whether any of the collections of petrified tree-trunks really deserve the name applied to them, as they generally, perhaps universally, consist of trees which have been buried in earth or rock, there silicified, and subsequently exposed by the washing away of the material which once surrounded them. The most celebrated of the fossil forests of which we have any record are those of Egypt near Cairo, of Nubia, of Silesia, and of the island of Antigua in the West Indies. Other accumulations of silicified wood are known to occur in the interior of Chili, in New Zealand, and in Abyssinia. It is also true that in the interior of our own continent, in Oregon, Nevada, and Arizona, as great and remarkable collections of silicified tree-trunks exist as any found in other parts of the world. On the banks of the Little Colorado, in Arizona, for example, not less than 1000 cords of silicified wood may be seen piled up in one locality. Here we find trunks, of all sizes up to six feet in diameter, most perfectly and beautifully preserved. Sometimes they are simply replaced by white silica, which shows the woody structure as distinctly as it could have been seen in the living tree; in other cases the trunks are now masses of solid jasper, looking like huge sticks of red sealing-wax; in other cases still, the wood is opalized or agatized, or filled with chalcedony or crystallized quartz, stained with the most brilliant colors. In this region the history of the vast accumulation of silicified tree-trunks is easily read, and it will probably serve to explain many similar cases. The banks of the Little Colorado are formed of Triassic marls, here more than 1000 feet in thickness. These contain immense numbers of silicified trunks of coniferous trees. As the marls are very soft, they have been extensively eroded, leaving the silicified wood either on the surface—where trees 40 to 60 feet in length may often be seen, with all their parts in contact—or accumulated at the bottom of the slopes bordering the valleys from which the marls have been removed. Hot water has much greater

power than cold to dissolve silica: and it is probable that thermal waters have had much to do with the silification of the tree-trunks in the localities where they are found in great numbers. In our own country we know that volcanic phenomena have been displayed on a grand scale throughout all the region where we find the fossil wood; and it is also a district in which thermal springs carrying large quantities of silica are still numerous, and are now displaying their petrifying powers. We have reason to believe that in the later geological ages hot springs were even more abundant, and we may conclude they were more potent than they now are. What we know of the geology of the island of Antigua is confirmatory of the view that thermal waters have played an important part in the silification of the fossil wood found there; and this will very likely prove true in regard to the other cases cited.

In the drift deposits of Southern Ohio is found an old soil in many places thickly strewed with interlaced prostrate trunks of trees which grew upon it; and in a few cases these are found buried erect. This old forest was plainly submerged by the sinking of a land-surface or the elevation of the water-level over it, resulting in its burial beneath many feet of gravel and sand. As yet, the trees here are not mineralized, and have the appearance of partially decayed wood; but if the subsidence had been occasioned by volcanic action, and hot water had been poured out freely, we should undoubtedly have found the trunks silicified, as we do at the Cascades of the Columbia, where a volcanic outburst at a much later date buried quantities of trees and changed them to masses of silica.

J. S. Newberry.

Fossil Fruits. See Fossil Botany, by Prof. J. S. Newberry, M. D., LL.D., M. N. A. S.

Fossombro'ne (a corruption of the ancient *Forum Sempronii*), small town of Central Italy, in the province of Pessaro-Urbino, on the left bank of the Metauro. Its silk is considered the best in Italy. Pop., with surroundings, 8164.

Fos'ter, county in the N. E. of Dakota, traversed by the Shyenne and James or Dakota rivers. Area, 1764 square miles.

Foster, post-v. in Bracken co., Ky., on the Ohio River. Pop. 191.

Foster, tp. of Faribault co., Minn. Pop. 304.

Foster, tp. of Luzerne co., Pa. Pop. 2999.

Foster, tp. of Schuylkill co., Pa. Pop. 1001.

Foster, post-tp. of Providence co., R. I., on the Connecticut State line. In has considerable manufacturing interests. Pop. 1630.

Foster (Abiel), b. at Andover, Mass., Aug. 8, 1735; graduated at Harvard in 1756; was pastor of a Congregational church, Canterbury, N. H., 1761–79; was sent in 1780, and often afterwards, to the legislature; was in the U. S. Congress 1783–84, 1789–91, and 1795–1803. In 1784 became a judge, and afterwards chief-justice, of the common pleas court of New Hampshire. D. at Canterbury, N. H., Feb. 6, 1806.

Foster (Benjamin), D. D., b. at Danvers, Mass., June 12, 1750; graduated at Yale 1774; was minister of the Baptist church in Leicester, Mass., 1776–82; preached two years in Danvers, Mass., and in Jan., 1785, was called to the First church in Newport, R. I.; after the autumn of 1788 was pastor of First Baptist church in New York City, where he d., in consequence of his labors during the prevalence of yellow fever, Aug. 26, 1798. Published *The Washing of Regeneration*, *Primitive Baptism Defended*, and a *Dissertation on the Seventy Weeks of Daniel*.

Foster (Birket), English artist, b. at North Shields, Northumberland, in 1812, was educated at Hitchen, Herts, and at sixteen was placed with Mr. Landells, wood-engraver. At the age of twenty-one he started for himself, illustrating several children's books and drawing for *The Illustrated London News*. He has since illustrated Longfellow's *Evangeline*, Beattie's *Minstrel*, Goldsmith's *Poetical Works*, etc., and especially a volume devoted to English landscape, with letter-press from Tom Taylor (1863). In 1860 was chosen a member of the Water-Color Society, and has been very successful in that branch of art; has some distinction also as a wood-carver.

Foster (Dwight), b. at Brookfield, Mass., Dec. 7, 1757, and graduated at Rhode Island College in 1774; became a lawyer at Brookfield; was a prominent legislator of Massachusetts, and judge, and afterwards chief-justice, of the court of common pleas; was in Congress 1793–99, and a U. S. Senator 1800–03. Was a son of Judge Jedediah Foster (1726–79).

Foster (Jedediah), American judge, b. at Andover, Mass., Oct. 10, 1726; graduated at Harvard University 1744; practised law at Brookfield, Mass.; was in the Worcester county convention Aug., 1774, and delegate to the Provincial Congress 1774–75; he was negatived as a councillor by the English general Gage in 1774, but re-elected in 1775; was judge of the superior court in 1776, then judge of probate, and a justice of the court of common pleas of Worcester co., Mass.; also a member of the convention which formed the constitution of Massachusetts. D. Oct. 17, 1779.

Foster (John), English essayist and moralist, b. at Halifax Sept. 17, 1770. He was a weaver in his youth, but, having been educated at Bristol College (Baptist), preached to Baptist congregations at Chichester (1797), at Downend, near Bristol, and at Frome. In 1817 resigned the ministerial office and devoted himself thenceforth to literature, having indeed begun to write for the *Eclectic Review* in 1806. *Essays in a Series of Letters to a Friend* (1805)—1, *On a Man's Writing Memoirs of Himself*; 2, *On Decision of Character*; 3, *On the Application of the Epithet Romantic*; 4, *On Some of the Causes by which Evangelical Religion has been rendered Unacceptable to Persons of Cultivated Tastes*—gave him his especial reputation as an original thinker. Wrote also on *The Evils of Popular Ignorance*, etc. Sir James Mackintosh called him one of the most profound and eloquent writers that England has produced. D. Oct. 15, 1843.

Foster (John Gray), an American officer and general of volunteers, b. in Whitefield, Coos co., N. H., May 27, 1823; graduated at West Point July 1, 1846, and entered the U. S. army as second lieutenant of engineers. During the war with Mexico (1847–48) he served with a company of sappers and miners, participating in the siege of Vera Cruz and the battles of Contreras, Churubusco, and Molino del Rey, in which latter he was severely wounded; engaged in construction of fortifications and on coast survey duty 1848–54; assistant professor of engineering at West Point 1855–57; as engineer in construction of Forts Sumter and Moultrie, S. C., and works in North Carolina 1857–61. On the outbreak of the civil war he was chief engineer of the fortifications in Charleston harbor (rank of captain), being at Fort Sumter during its bombardment and at its surrender; appointed brigadier-general of volunteers Oct., 1861, and commanded brigade on Gen. Burnside's expedition to North Carolina, distinguishing himself at the capture of Roanoke Island, Feb., 1862, Newbern, and Fort Macon, N. C.; appointed major-general of volunteers July, 1862, and assigned to command of department of North Carolina (18th army corps); conducted various expeditions, and engaged in the battle of Kinston, siege of Washington, attack on Newbern, N. C., etc.; raised to command of department of Virginia and North Carolina July, 1863, and that of the army and department of Ohio Dec., 1863; department of the South May, 1864; and of department of Florida 1865; mustered out of volunteer service Sept., 1866. Returning to duty with his corps, he was placed in charge of works for the preservation and improvement of Boston harbor, and construction of defences of Portsmouth harbor, N. H. His submarine engineering operations in removing rocks from the channel of entrance to Boston harbor were conducted with much ability and professional skill. General Foster had risen through the successive grades to be lieutenant-colonel of engineers 1867. For gallant and meritorious conduct in battle in Mexico he was brevetted first lieutenant and captain; for similar services during the civil war he received all the brevets from major to that of major-general U. S. A. Author of *Notes on Submarine Blasting in Boston Harbor;* also article Blasting in this work. D. at Nashua, N. H., Sept. 2, 1874. George C. Simmons.

Foster (Col. John Wells), LL.D., b. at Brimfield, Mass., in 1815; studied at Wesleyan University, Middletown, Conn., and in 1836 removed to Zanesville, O., where he became a lawyer. He assisted in the Ohio geological survey of 1837, and wrote a report of his labors; went in 1845 to the copper-region of Lake Superior, and with Prof. J. D. Whitney made a survey of that region, a government report of which was published 1850–51. Removed next to Massachusetts, and then (1858) to Chicago. He published *The Mississippi Valley* (1869) and *Pre-historic Races of the U. S.* (1873), and many scientific papers. He was for some time land commissioner of the Illinois Central R. R., and president of the Association for the Advancement of Science. D. at Chicago June 27, 1873.

Foster (Lafayette Sabine), LL.D., b. Nov. 22, 1806, in Franklin, Conn., was the son of Capt. Daniel Foster, who was present at the battle of Saratoga and with Washington at White Plains. His paternal grandmother was Hannah Standish, a descendant of Miles Standish. He was educated at Brown University, and graduated there in 1828 with the highest honors; studied law with the Hon. Calvin Goddard of Norwich, and was admitted to the bar in 1831.

Repeatedly elected to the General Assembly of Connecticut from Norwich, he was Speaker of the house of representatives in 1847, 1848, and 1851; mayor of Norwich in 1851 and in 1852, receiving on his last election every vote cast. In 1854 was elected U. S. Senator for six years, and at the close of that term was re-elected for six years longer. While in the Senate he served on the committee of Revolutionary pensions, on private land claims, on public lands, on pensions, on the judiciary, and on foreign relations, occupying for some time the second place. On the last named committee he was chairman a considerable portion of the war. In Mar., 1865, he was elected president *pro tem.* of the Senate. When Mr. Johnson, the Vice-President, became President by the death of Mr. Lincoln on Apr. 14, 1865, Mr. Foster became acting Vice-President of the U. S., and held that position for two years. In 1870 he was again elected to represent Norwich in the general assembly of Connecticut, and was chosen Speaker of the house of representatives. Subsequently during the same session he was elected a judge of the supreme court of errors and the superior court of Connecticut. For this office he received every vote in the senate, and 197 out of 202 in the house. D. at Norwich, Conn., Sept. 19, 1880. J. WATTS DE PEYSTER.

Foster (LEMUEL), a Presbyterian minister, b. at Hartland, Conn., Nov. 24, 1799; graduated at Yale 1828; at the New Haven Divinity School 1831; labored in Bloomington, Ill., 1833–39; at Bethel, Ill., 1839–46; at Upper Alton, Ill., 1846–54; at Atlanta, Ill., 1854–59; at Onarga, Ill., 1859–63; at Blue Island, Ill., 1863–70; at Washington Heights, Ill., 1870–72. Mr. Foster was highly successful in building up new churches and schools, and was not only a preacher, but a school-teacher and journalist. D. at Washington Heights, Ill., Apr. 1, 1872.

Foster (NATHANIEL GREENE), a celebrated jury lawyer in Georgia, b. in Greene co. in that State, Aug. 25, 1809; graduated at the State University in 1830; admitted to the bar in 1831; commanded a company in the Seminole war in 1836; was then solicitor-general of Ocmulgee circuit; five years member of the State senate; and member of Congress from 1857 to 1859. D. in 1871. His residence was Madison, Ga. He was famous for the many humorous and apt anecdotes he interwove in his speeches before juries. Some of "Foster's stories" will long be remembered in Georgia. He became a Baptist minister before he died. A. H. STEPHENS.

Foster (RANDOLPH S.), D. D., b. at Williamsburg, O., Feb. 22, 1820; studied at Augusta College, Ky., and in 1837 entered the Methodist Episcopal ministry; held important stations in the Western States; was transferred in 1850 to the New York Conference; chosen in 1856 president of North-western University; in 1858 became a professor in Drew Theological Seminary; and in 1872 was elected a bishop in his Church. Residence, Cincinnati, O. Author of *Objections to Calvinism*, 1849; *Christian Purity*, 1851; *Ministry for the Times*, 1855; *Theism*, 1872. ABEL STEVENS.

Foster (STEPHEN), b. at Andover, Mass., Feb. 15, 1798; graduated at Dartmouth College in 1821, and at Andover (Mass.) Theological Seminary in 1824; ordained in Oct., 1824, he was minister at Greenville and Knoxville, Tenn.; then professor of Latin and Greek, and afterwards president of the College of East Tennessee at Knoxville. D. there June 11, 1835.

Foster (STEPHEN COLLINS), b. at Pittsburg, Pa., July 4, 1826; produced many popular melodies—*Oh, Susannah*, *Nelly was a Lady*, *Old Uncle Ned*, *Camptown Races*, *Old Folks at Home* (for which he received $15,000), *Willie, we have Missed You*, *Come where my Love lies Dreaming*, *Old Dog Tray*, etc.—and d. in New York City Jan. 13, 1864. Of these he produced both words and music. His songs were mostly simple and unambitious productions, but were highly popular at home and abroad.

Foster (STEPHEN SYMONDS), American anti-slavery agitator, b. at Canterbury, N. H., Nov. 17, 1809; graduated at Dartmouth College in 1838; studied theology, and married Abby Kelley Dec. 21, 1845. He published *The Brotherhood of Thieves, a True Picture of the American Church and Clergy*, and many articles on the slavery question. D. Sept., 1881.

Foster (THOMAS F.), a lawyer and politician of distinction in Georgia, was b. in Greensborough, Ga., Nov. 23, 1790; graduated at the State University in 1812; studied law at Litchfield, Conn., and was admitted to the bar in his native town in 1816, where he continued to reside until his death in 1847. He was for many years a distinguished member of the State legislature, and was member of Congress from 1829 to 1835 and from 1841 to 1843. A. H. STEPHENS.

Foster (WILLIAM S.), b. in New Hampshire, was appointed lieutenant of infantry Mar., 1812; captain Mar., 1813; brevet major for "gallant conduct in the defence of Fort Erie," Aug. 15, 1814; major of 4th Infantry July 7, 1826; lieutenant-colonel June 8, 1836; and brevet-colonel for service in Florida, particularly at the battle of Okeechobee, Dec. 25, 1837. D. at Baton Rouge, La., Nov. 26, 1839.

Fos'ter's Bar, tp. of Yuba co., Cal. Pop. 524.

Fos'ter's Chap'el, tp. of Blount co., Ala. Pop. 310.

Fos'ter's Store, tp. of Tuscaloosa co., Ala. Pop. 1104.

Fosto'ria, post-v. of Seneca co., O., 13 miles W. of Tiffin, on the Lake Erie and Louisville, the Baltimore Pittsburg and Chicago, and the Mansfield Coldwater and Lake Michigan R. Rs. The Atlantic and Lake Erie and the Columbus and Toledo R. Rs., not yet completed, are to pass through it. It has a private bank, a weekly newspaper, several mills, foundries, and machine-shops, 4 hotels, 5 churches, etc. Agriculture is the leading pursuit. Pop. 1733. J. V. JONES, ED. "REVIEW."

Foucault (JEAN BERNARD LÉON), French natural philosopher, b. at Paris Sept. 18, 1819, had his attention turned to optics by the invention of Daguerre, and in 1844 invented an apparatus by which electric light is used in optical experiments, microscopic researches, etc. He demonstrated the earth's rotary motion on its axis by the pendulum and gyroscope in 1851, was physicist to the Imperial Observatory (1854), and a member of the French Institute. In 1855 obtained the Copley medal of the Royal Society for measuring the velocity of light. D. Feb. 13, 1868.

Fouché (JOSEPH), Napoleon's minister of police, b. at La Martinière, near Nantes, May 29, 1763. His delicate constitution prevented him from following the profession of his father, who was a sea-captain. He studied theology, but did not take holy orders. After living for some years as a teacher of philosophy, he became an advocate, married, founded a republican club in Nantes, and was elected a member of the National Convention in 1792. As such, he voted for the death and immediate execution of Louis XVI., and followed Collot d'Herbois to Lyons, where he partook with great gusto in the butcheries which were deemed necessary to reduce the city to obedience. On his return he was chosen president of the Jacobin Club, but after the execution of Robespierre (July 28, 1794), when he felt that the time of terrorism had nearly run out, he gave up his career as a furious revolutionist, and tried to excuse his violences and cruelties by ascribing them to orders from Robespierre. He was nevertheless driven out of the Convention as a terrorist Aug. 9, 1795, and even for some time held in arrest. After being restored to liberty by the general amnesty of Oct. 26, 1796, he bought Barras, whom he resembled in many respects and surpassed in all, even in treachery, by betraying Babeuf, and was sent as ambassador, first to the Cisalpine Republic, and then to Holland, whence he was called to Paris and made minister of police July 31, 1799. In this position he was of great service to Napoleon, but in the beginning of his career Napoleon felt aversion to traitors and distrust of mercenary characters; he watched Fouché, and suddenly dismissed him, Dec., 1802, at the same time rewarding him by making him rich. In two years, however, Napoleon learned to feel otherwise, and (July 10, 1804) Fouché was made minister of police for the second time. Reconciliation had now become his great idea, and the interior quiet and order in France during the empire were no doubt due to him to a great extent. He had an unfailing eye for any breach in a man's character or in the state of society, and an unerring hand in finding the real causes of personal actions and social movements. Napoleon appreciated his talents, made him duke of Otranto, and gave him a large pension. Nevertheless, he dismissed him once more (June 3, 1810). At that time Napoleon had opened secret negotiations with the English court, and Fouché happened to thwart and spoil his plans. He often happened to do so, and although Napoleon speaks somewhat haughtily about him in his memoirs, he seems to have feared him. He tried to keep him away from France even when he was compelled to use him. In 1813 he made him governor of Illyria, and sent him to Italy to watch Murat. Nevertheless, Fouché became minister of police a third time on Napoleon's return from Elba, and he played a very conspicuous part in all the proceedings which led to the final abdication of the emperor, the formation of a provisional government, and the re-establishment of the Bourbons. He remained in office under Louis XVIII., but his position between the liberal and the ultra-reactionary party was untenable. On Sept. 19, 1815, he went to Dresden as ambassador. The law of Jan. 16, 1816, however, which exiled all who had voted for the death of Louis XVI., affected also him, and deprived him of his office. During the remainder

of his life he resided in Linz, and in Trieste, where he d. Dec. 25, 1820. In private intercourse he was smooth, eloquent, sometimes fascinating. But he was only an egotist, and his egotism made him treacherous. He was not a common scoundrel, however. He wished to serve the greatest, and never betrayed a man until the man began to degenerate. CLEMENS PETERSEN.

Fouche Lefave, tp. of Perry co., Ark. Pop. 403.

Fougères, town of France, in the department of Ille-et-Villaine, at the junction of the Nançon and the Couesnon. It is famous for its dyeing, especially of scarlet, whose delicate tints are due to certain qualities of the waters of the Nançon. Pop. 9470.

Fou'la, an island in the Atlantic, belongs to the Shetland group, but lies solitary 20 miles W. of it. It is a granite block rising 1369 feet above the sea, and inhabited by 250 persons, who carry on some fishing, farming, and hunting of wild-fowls. It is supposed to be the ancient *Ultima Thule*. Lat. 60° 9′ N., lon. 2° 6′ W.

Foulard [Fr.], a light fabric of silk, sometimes containing cotton, and used principally for ladies' dresses. It is chiefly of French manufacture, but represents a class of goods largely made in Japan, India, etc.

Fould (ACHILLE), French statesman, b. at Paris Nov. 17, 1800, was in the Chamber of Deputies in 1842 and 1846, in the Constituent Assembly in 1848, and in July, 1849, was a member of the Legislative Body. Prince-President Louis Napoleon made him minister of finance Oct. 31, 1849, but he retired in Oct., 1851, filling the position, however, for a second period from Dec. 2, 1851, to Jan. 25, 1852; then made senator, minister of state and of the house of the emperor in 1852; commander of the Legion of Honor Dec. 8, 1852; then a third time finance minister from Nov. 12, 1861, to Jan. 1, 1867. D. near Tarbes Oct. 5 of the same year. He was of Hebrew stock.

Fou'lis (ROBERT and ANDREW), Scotch printers, brothers, b. at Glasgow—Robert, Apr. 20, 1707; Andrew, Nov. 23, 1712; began business in 1740, and became printers to the University of Glasgow in 1743. Andrew d. Sept. 18, 1775, and Robert in 1776. They made fortunes by printing, and lost them in founding an academy of painting and sculpture at Glasgow, the collection of paintings being sold by auction in 1776. Their editions of Greek and Latin classics were noted for accuracy and elegance.

Foul in the Foot, a contagious disease of sheep, characterized by ulcers and granulations between the toes. Caustic and stimulant applications, such as oil of turpentine, followed by tarry applications, are generally curative. The cause and nature of this disease are not well understood.

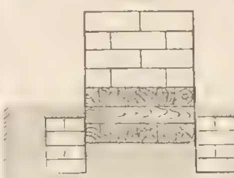
Founda'tion [Lat. *fundatio*; Fr. *fondation*], that upon which the main structure rests. The *body of the foundation* consists of the main part of those masses of masonry or timbers of which it is formed. The *bed of the foundation*, which is sometimes referred to as distinct from the foundation proper, is the prepared surface on which the foundation rests. It may be a grillage, or pounded stone, or a body of cement, or simply of pounded earth. There are many examples to which the term cannot properly be applied. When the foundation is made upon rock the surface should be properly prepared. The rock should be tested as to its soundness and its supporting power, and if it is to be exposed to the elements the effect of such action should be determined. If it is sound, it should be so dressed that its surface will be normal to the line of pressure. As the pressure in most cases is vertical, the surfaces should generally be horizontal. Where it costs too much to reduce the whole to a single horizontal surface, it may be cut into steps, as was done in the celebrated Eddystone lighthouse in the English Channel. But the method of steps should be avoided wherever it can be, for all artificial structures will settle more or less, and if there is a great difference between the highest and lowest steps, there may be unequal settling to such an extent as to damage the work. One of the early English engineers made a foundation for a bridge partly upon rock and partly upon sand, but the sand was washed out and the foundation destroyed. If the rock is unsound, being loose or porous, the upper part should be removed until suitable rock is reached. If the rock is very porous, it may be filled with cement to form the bed of the foundation. Large cavities may be arched if necessary.

In determining whether the supporting power is sufficient, the load to which it is to be subjected must be known. If it is found upon trial that it is not sufficient, the bed of the foundation should be enlarged, so that the pressure per square foot will be diminished. Some rocks decompose under the action of the weather. In such cases the surface-rocks should be removed, so that the bed of the foundation will be below the action of the frost.

Many expedients are resorted to in making foundations on soils. Most soils are so yielding in their nature that they must be confined to prevent spreading, as well as settling, when they are loaded with masonry. An instance is cited where borings were made for the site of Fort Livingston, La. The surface, but 2 or 3 feet elevated above tide-water, was fine sand, and apparently incompressible. The boring showed this stratum to be 15 or 20 feet thick, beneath which was a soft, saturated blue clay. It was considered that this soil needed no preparation, but very great settlement ensued. The amount depended more upon aggregate total masses imposed than upon the actual pressure (per square foot) of different parts. The sand (like all sands) was believed to be nearly incompressible, and the yielding doubtless took place in the clay. In such a case, if (as in the case of a fort) there are masses (earth and masonry) to be imposed covering a great area, neither piling nor grillages are likely to avail, and a previous *loading* before masonry is commenced seems indispensable if *settlement* cannot be tolerated.

When the foundation is composed of masonry, it is desirable to have the bed horizontal over the whole surface; and if the soil is yielding, it must be confined so as not to spread laterally (Fig. 1). Sometimes a grillage forms the bed. It is made by placing timbers or planks close to each other directly upon the soil, so as to form a kind of floor, and directly upon these is placed another layer, on which the timbers are placed crosswise of those immediately below. In many cases grillages and platforms have failed, either from the decay of the timber or from unequal settling of the soil beneath them, so that in many recent structures an "area" has been substituted with good results. An "area" consists of a mass of masonry, usually of uniform thickness, laid over the whole surface which is to be occupied by the foundation. The foundations of the capitol building at Albany, N. Y., are laid upon a large "area." The soil was excavated to a suitable depth, and the soil beneath thoroughly beaten. The surface was covered with small broken stone to a uniform depth of about six inches, and thoroughly grouted with cement. Successive layers of about the same thickness followed, each being thoroughly grouted, until a suitable thickness was secured. The large blocks of stone which form the foundation of the piers so nearly covered the whole bed as to prevent any upheaval of the soil and bed between the pieces.

FIG. 1.

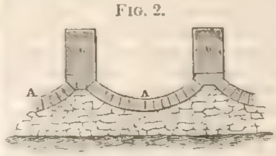


When the masonry is of rubble stone, it is better to form a bed of small stones of uniform size, well grouted, than to place large stones directly upon the earth, even if the spaces between them are filled with small ones; for the construction is not so homogeneous as when they are small, and there are not so many points of support on the earth. If, however, the stones have a flat-bearing surface, their size will make but little difference. Sometimes the base of the foundation may be spread out so much that even a mushy soil will sustain a very heavy load. The piers of a railroad bridge on the Montezuma Swamps in New York were so spread at the base that the pressure per square foot was about 300 pounds, or between 2 and 3 pounds per square inch, while the load on the pier was 130 tons.

When there are springs in the soil, the water must be prevented from washing out the cement, especially before it firmly sets. This may sometimes be done by a proper drainage, and sometimes by the use of heavy canvas which has been made impervious to water. One of the foundations of the Rochester bridge, England, was upon large cylinders, which were sunk 42 feet below the bed of the river and filled with masonry. The river, being tidal, rose and fell twice each day, and this action caused the water to flow in and out of the cylinder at the bottom, washing out the cement of the concrete. It was difficult at first to keep the water out, but at length a piece of stout canvas was cut one foot larger than the base of the cylinder, and when the water had subsided it was fitted all around the inside of the cylinder, and the concrete put on; which expedient proved successful.

When a heavy structure rests upon isolated pillars or columns, and the soil beneath is compressible, the bases of the columns may be connected by inverted arches, as shown in Fig. 2, so as to distribute the pressure over the whole surface, and prevent the soil from rising between the piers.

FIG. 2.



The use of wooden piles is one of the most common elements in the preparation of the foundation in marshy soils. A grillage is often combined with the use of piles. The piles may be as long as they can be cut from a tree; and if they are not then long enough, they are driven farther by placing other piles on the tops of them and the driving continued. The second piece is called a punch. Formerly iron shoes (Fig. 3) were placed on the lower end of the piles to assist in penetrating the soil, but experiment has shown that this is a needless expense, as they will drive quite as well if simply sharpened, and in many cases they can be driven nearly as easily if the end is square.

Fig. 3.

When practicable, piles should be driven through the muddy soil to a firm subsoil beneath, but there are numer**ous cases where this is impracticable. When the end of the** pile does not rest on a firm subsoil, the supporting power **of the pile depends upon its friction between its surface** and the soil, which friction may be sufficient to sustain im**mense structures. The supporting power of piles in practice, when they are held by friction, is usually determined** by empirical rules. If we use the following notation—

W = the weight of the ram in tons;

H = the height in inches through which the ram falls for the last blow;

h = the distance in inches that the pile is driven by the last blow;

W_1 = the weight of the pile; and

P = the load which the pile will safely bear in tons—

then Major Sanders's formula becomes

$$P = \frac{H}{3h} W.$$

Molesworth's rule is

$$P = \frac{1}{8}\frac{H}{h} W,$$

which is of the same form as the preceding when the weight of the pile is neglected.

McAlpine's rule, as deduced from his observations on the **pile-driving at the Brooklyn navy-yard, is**

$$P = \frac{80}{3}\left(W + 0.228\sqrt{\frac{H}{12} - 1}\right).$$

In this case the pile was driven to stoppage, as will be explained hereafter.

Weisbach's rule, as deduced from theoretical considerations, considering both the ram and pile as non-elastic, is

$$P = \frac{H}{h} \cdot \frac{W^2}{W + W_1} (W + W_1);$$

and if the weight of the pile be neglected, this becomes

$$P = \frac{H}{h} W.$$

An investigation of pile-driving when both the ram and pile are considered elastic, as developed by Airey, astronomer royal of England, is given in Mosley's *Mechanics and Engineering.*

The following rule for regulating the "load" to be imposed is given by Rankine (*Rules and Tables*):

Rock, moderately hard (strong as the strongest red brick)	9 tons per sq. ft.
Rock, of the strength of good concrete	3 " " "
" very soft	1.8 " " "
Earth, firm, hard clay; clean dry gravel; clean sharp sand prevented from spreading	1 to 1.5 tons "

Experiments at New Orleans give about 1500 pounds per square foot as a safe load for that alluvial soil, but there **will be *settlement* in such plastic soils with very slight loads.**

The following is a short abstract of the results of some experiments made by John Roy in the soils of New Orleans, La., in 1851–52:

Area pressed, inches	Weight applied, pounds	Weight per square inch, pounds	Sinkage in inches	Duration of the experiment, days
1 × 1 = 1	102	102	11	30
1 × 2⅞ = 2⅞	293¼	102	26⅞	30
4 × 4 = 16	1632	102	78	30
1 × 16 = 16	1632	102	33	30
4 × 4 = 16	1632	102	120	161
1 × 1 = 1	18	18	⅝	3
¾ × 1 = ¾	13½	18	⅝	3
5 × 16 = 40	642	16$\frac{1}{20}$	⅞	99
12 × 12 = 144	2452	17$\frac{1}{36}$	⅝	107

The larger surfaces sink more in proportion to their area than smaller ones. This is probably due to the fact that **the lateral surface is less in proportion. Thus, in a piece which is 1 inch square the perimeter is 4, and in one which** is 4 inches square it is 16; hence their perimeters are as 1 to 4, while their areas are as 1 to 16. The friction on the **lateral surfaces is an important element.**

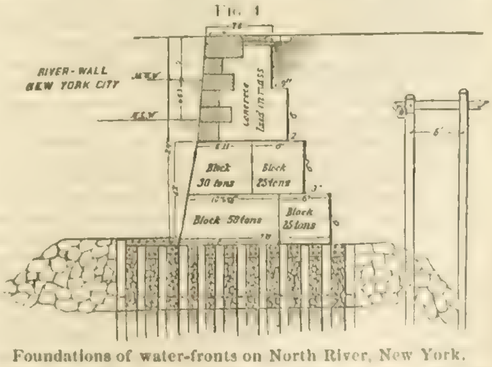
The several piers of the railroad bridge at Havre-de-Grace, on the Susquehanna River, were established in different ways. For pier No. 3 piles were driven into the soil, and sawed off at a uniform level of 40 feet below the surface of the water. A platform or grillage of timber, strongly ironed, upon which the pier was to rest, was con**structed near the site and floated over the piles, and placed between two substantial construction piers. Six lowering** screws, each 3½ inches in diameter, were attached to the **platform and to the construction piers, for the purpose of lowering the grillage. An iron caisson was constructed upon the grillage, and the masonry begun within, and the whole gradually lowered by means of the screws. When the masonry had nearly reached the top of the caisson another section was added, and so continued until the grillage rested upon the heads of the piles.**

The foundations for the Grimsby docks on the Humber, begun in 1846, rest on piles which were generally driven 5 feet between centres, but in some cases only 4 feet, over **the whole surface. When the pile moved but ⅛ of an inch from the blow of a ram which weighed 1 ton, falling through 12 feet, it was considered sufficiently driven; the piles were cut off at a uniform level, and the ground removed to a depth of two feet below their upper ends, and** the space filled with concrete. A grillage was constructed **upon this to receive the masonry.**

The following are the recommendations of the lighthouse board (1868) for the construction of the foundations of lighthouses about the Passes of the Mississippi: As no solid natural base can be secured at these points, it is proposed to wedge the soil full of wooden piles which shall be about 50 feet in length, not less than 12 inches square at **the head, and not less than 10 inches diameter at the lower end, driven into the soil with a hammer of not less than** 1800 pounds weight, with a final fall of 45 feet. The piles should be driven in rows, 3½ feet from centres, throughout the entire surface of the site to be occupied. If it seems **advisable, piles should be driven at the intersection of the diagonals of the squares marked out by the first set of** piles. The piles to be cut off 2½ feet below the lowest water for the first set and 1½ feet for the second row, and the soil to be excavated to a depth of 4 feet below the lowest water, **and the space rammed full of concrete. The tops of the piles are to be connected with timbers, and the space between them filled with concrete. A grillage should be constructed upon the piles to form a floor for receiving the masonry.***

The system of water-fronts and piers which has been adopted for New York City, and which are now being constructed, is intended to be permanent. (Fig. 4.) Where

Fig. 4.



Foundations of water-fronts on North River, New York.

rock cannot be reached, piles are driven as close to each other as possible, and sawed off at a uniform level, about **15 feet below low water. A grillage is made upon these, and the masonry built upon it. The lower part of the masonry is made of large blocks of cement (artificial stone), composed at first, by volume, of 1 part of Portland** cement, 2 of sand, and 5 of stone (Bergen trap). After wards they were composed of 1 part of cement, 2½ of sand, **and 6 of broken stone. The upper part of the wall is faced with granite, backed with concrete. The piles are** protected in many cases, both on the land and water sides.

* The notion of "wedging the soil" may be considered questionable without detriment to the use of the piles, while extremely *yielding*, the soil thoroughly *saturated with water*, and composed of clay, extremely fine sand, and a minute quantity of vegetable matter, is probably as *incompressible* in the proper sense of the term as anything we know of. (In the article LIGHTHOUSE CONSTRUCTION the actual foundation of the new S. W. Pass lighthouse will be described.)

by masses of rubble stone. Some of the piles in the piers in the wharves of Jersey City were drawn in by hand. A rope was attached to the upper end of a pile and passed off in opposite directions, passing under a pulley near the surface of the water. The pile was erected in place, and several men took hold of the rope, and as soon as the pile was dropped they ran directly away from the pile, pulling on the rope as hard as they could until the pile came to rest. These piles were sufficiently firm, and did good service. The foundation of an ore-dock at Milwaukee, Wis., rests on piles that were not driven to stoppage. At a depth of about 30 feet they struck a firmer substratum, but one which could be easily penetrated. If the pile passed this substratum it could then be driven 75 feet as easily as it was the first 25 feet. The piles generally were driven only to the firmer substratum. The dock, not being uniformly loaded, settled unequally. The foundations of a grain-elevator in the same city were made on similar soil, but it settled unequally. The tracks of many railroads in this country where they cross marshes rest on piles that were driven lightly, for fear that full blows of the hammer would drive them too far, but in all such cases there will be settling. Such examples should not be followed in making permanent works where it is possible to avoid them. Where a firm substratum cannot be reached screw-piles have been used with good success. The blades are made broad, so as to give a large area for support, and the end of the pile is pointed to aid the penetration. They are forced into the soil by turning them like an auger. (Fig. 5.) They have been used in the construction of many lighthouses on the sea-coast. On one railroad in Brazil they were used in the construction of bridges in fifteen out of seventeen river-crossings, with

Fig. 5.

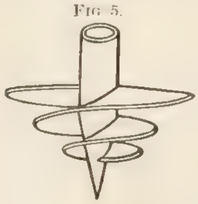
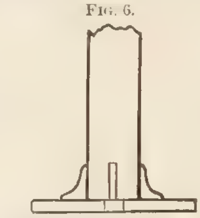


Fig. 6.



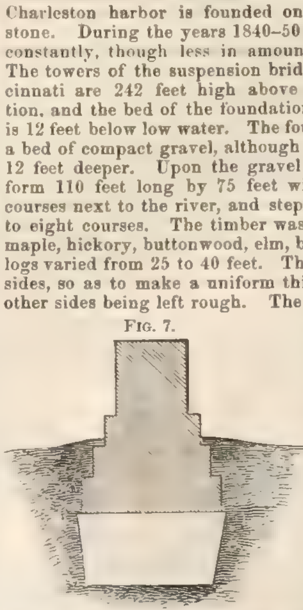
Elevation of a Disk Pile.

good success. Piles having a disk (Fig. 6) at their lower ends for the purpose of giving greater supporting area have been successfully used in India. The foundation for the dry dock of the Brooklyn navy-yard has many points of interest. It was engineered by J. W. McAlpine. It was begun in 1841 and completed in 1851. It contains 13,837 cubic feet of masonry, resting upon 38,532 cubic feet of piles. The foundation was made 42 feet below the surface of the ground and 37 feet below mean tide. Borings to the depth of 60 feet brought up sand and clay and fresh water, but there was relatively only a small amount of clay. The first 10 feet were composed chiefly of vegetable decomposition. When confined, and not mixed with water, it was very firm and unyielding, presenting a strong resistance to penetration. When saturated with water it became a semi-fluid. A coffer-dam was constructed and the soil excavated to a depth of 10 feet below low water. Springs of fresh water were discovered near the bottom of the foundation, which proved to be very troublesome. The upward pressure of the water was so great as to raise the foundation, however heavily it was loaded. The first indication of undermining by these springs was in the settling of the piles which supported the pump-well. The well was changed to another place, but the spring followed and compelled another change. This spring was driven away from the old well by driving piles until it was filled up, but it immediately burst up among the foundation piles of the dock near by. In a day it made a cavity in which a pole was run down 20 feet below the foundation timbers. Into this hole were thrown 150 cubic feet of stone, which settled 10 feet during the night, and 50 cubic feet more were thrown in the following day. This drove the spring to another place, where it burst through a bed of concrete two feet thick. This new cavity was filled with concrete, but the precaution was taken of putting in a tube, so as to permit the water to escape; still it burst through, and the operation was repeated several times, until it finally broke out through a heavy body of cement 14 feet distant. In this place it undermined the foundation piles. These were then driven deeper by means of followers, and a space of 1000 square feet around the spring was then planked, forming a floor on which was laid a layer of brick in dry cement, and on that a layer of brick set in mortar, and the foundation was completed over all. Several vent-holes were left through the floor and foundation for the escape of the water. There were 6549 bearing piles, averaging 32 feet 7 inches long. They were driven 3 feet from centre to centre, and afterwards as many driven as could be forced into the soil. Whenever a pile was driven more than 3 inches by the last blow of a 2000-pound hammer falling 35 feet, another was driven by the side of it. In many cases the foundations are made upon a grillage without the use of piles. The St. Charles Hotel in the city of New Orleans was laid on a grillage of heavy flatboat gunwales of 60 to 80 feet in length, 20 to 30 inches in width, and 6 to 12 inches thick, laid about 6 feet below the sidewalk. It was destroyed by fire in 1857, and during its existence of fourteen years previous it settled two feet. It was immediately rebuilt on its old foundations, and it settled one foot more during the next fifteen years. The grillage which was made for the foundations of Fort Jackson, La., was exceedingly strong—one of the strongest in the South-west. The subsoil is very compressible, and thoroughly saturated with water to the depth of 11 feet below the natural level of the country—the depth of the foundation. The earth at the bottom of the excavation was covered with a plank floor, and timbers 12 inches thick and 15 to 24 inches wide were laid edge to edge close to each other, forming a solid floor. Crossing these were other timbers of the same size as those in this floor, laid 3 feet from each other, centre to centre, and the spaces between filled in with brick masonry and concrete. The grillage and foundations of the casemates were constructed in the same manner, but the settling was so uneven that at the end of seven years it was necessary to make some parts of the structure lighter and load other parts more heavily. The tower of the First Presbyterian church, New Orleans, was founded on a grillage, and settled $5\frac{1}{2}$ inches in eleven years. The custom-house at New Orleans, La., is founded upon a plank flooring laid 7 feet below the street pavement. A timber grillage is laid upon the floor, consisting of logs 12 inches in diameter laid side by side, over which are similar logs placed transversely, 2 or 3 feet apart in the clear. The spaces are filled with concrete, and an additional thickness of 1 foot of concrete placed over the whole. The walls of the interior subdivisions rest upon inverted arches, thus using the entire surface included within the outer walls for supporting the building.

Those walls which are 2 ft. 6 in. thick rest on grillage 10 ft. wide.
" " " " 4 ft. " " " " 15 ft. "
" " " " 9 ft. " " " " 20 ft. "

The building was commenced in 1848, and progressed from time to time until 1860, when the granite walls were 75 feet above the concrete base to the architrave line of the entablature, and all the iron floor-beams of the fourth story finished. From 1848 to 1851 the maximum settlement was 22.57 inches, and the minimum in the same time was 15.63 inches, making a difference in the settlement of the various parts of 6.94 inches. During the year 1857–58 the maximum settlement was 3.50 inches, and the minimum 0.66 inches; and in 1858–59 the maximum settlement was 2.63 inches, and in some places nothing. In 1864 the walls varied 3 inches from a level. The grillage covers a surface of about 300 feet square, but it failed to secure an even settlement of the walls. The noted Fort Sumter in Charleston harbor is founded on an artificial island of stone. During the years 1840–50 it was observed to settle constantly, though less in amount each succeeding year. The towers of the suspension bridge over the Ohio at Cincinnati are 242 feet high above the bed of the foundation, and the bed of the foundation on the Cincinnati side is 12 feet below low water. The foundation was made upon a bed of compact gravel, although limestone rock was only 12 feet deeper. Upon the gravel was laid a timber platform 110 feet long by 75 feet wide, composed of twelve courses next to the river, and stepped off on the land side to eight courses. The timber was composed of pine, oak, maple, hickory, buttonwood, elm, beech. The length of the logs varied from 25 to 40 feet. They were flattened on two sides, so as to make a uniform thickness of 12 inches, the other sides being left rough. The courses crossed at right angles, and each stick was secured by rag-bolts 1 inch in diameter. All the spaces between the timbers were filled with clean gravel and broken stone. The pressure upon the timber foundation for the loaded bridge is, according to computation, less than 55 pounds per square inch. Timber constantly submerged in fresh water is nearly indestructible. This foundation was made by the late John

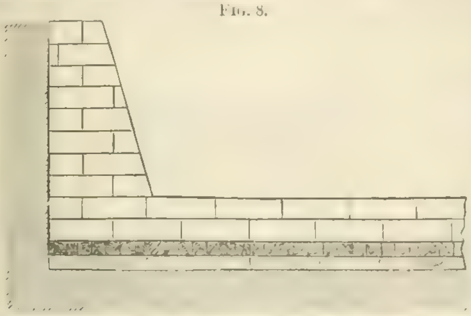
Fig. 7.



A. Roebling, who had a high opinion of timber foundations when resting upon soil and the timber constantly submerged.

In some cases sand answers a good purpose in forming the bed of the foundation. It readily adjusts itself to the inequalities of surface and of pressure, and causes the pressure to be uniform over the whole surface. If there is unequal settling, the sand easily adjusts itself to the new bed. It should be confined laterally, and should be moistened before the masonry is placed upon it. Yielding soils may

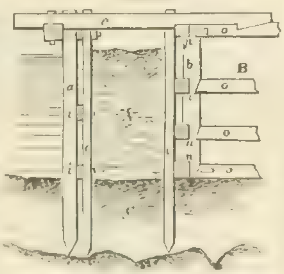
Fig. 8.



be prevented from rising to such an extent as to damage the structure by loading the soil for some distance outside of the foundation. It is nearly equivalent to making a very broad foundation. The soil may be covered with a grillage and loaded with soil or masonry, or an inverted arch may be used, as in Fig. 9. In making foundations under water a coffer-dam is often used for excluding the water during the progress of the work. This is an old and successful device where it can be used. To construct it, a row of piles is first driven, and their tops are connected so as to prevent them from spreading from the inward pressure, and braced to prevent their being crowded inward by the pressure of the water from the outside. Other piles or planks, called sheeting-piles, are driven firmly into the soil as close to each other as possible, and their upper ends secured to the frame of piles previously formed. Another row of sheeting-piles is then formed, so as to leave a space of from 5 to 15 or 20 feet between them, depending upon the depth of the water and the quality of the puddling material. The space between the two rows of sheeting-piles is then filled with clay, or a mixture of clay and sand, put down in layers and thoroughly puddled. One of the most serious difficulties to be contended with is the leakage underneath the dam. It may not be possible in loose soils to stop this entirely, but in all cases the main piles, and especially the sheeting-piles, should be driven to a firm soil, and all the loose soil should be removed before the puddling is put in. When the water is deep, in order to give additional security a row of piles may be placed entirely outside the dam, and the space filled in with suitable puddling material. But when the

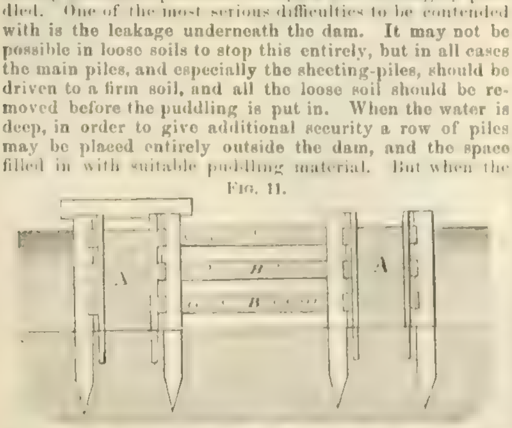
Fig. 9.

Fig. 10.



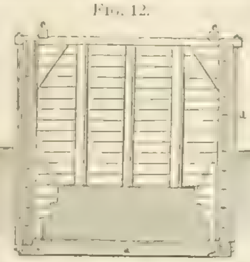
Section of coffer-dam: *a*, main exterior piles; *b*, strong square beams, corresponding to *a*, on which the wales *n*, *n* are notched and bolted; *c*, sheeting-piles; *e*, cross-pieces; *oo*, horizontal shores buttressing opposite sides of dam, A, puddling, B, interior space; C, mud, etc.

Fig. 11.



depth is considerable, there is danger of the dam being forced inward by the pressure of the water from the outside. One of the best means of preventing such a result is to place heavy timbers within the dam which shall reach from side to side, and serve as struts for supporting the sides. Thus, A A (Fig. 11) are the sides of the dam, and B B the timbers which support the sides. They should be placed so as to be out of the way of the masonry as much as possible. It may be necessary to remove them as the work progresses, but in that case the dam can be supported by props extending from the masonry to the walls of the dam. A *caisson*, or water-tight box, has been resorted to in some cases. Where a coffer-dam cannot be constructed, and where it is considered safe to have a timber bed rest directly on the soil in the bed of the stream, it may properly be used. The bottom of the caisson should be composed of strong timbers, which should be sufficiently numerous to support the structure which is to be placed upon it. If the soil is yielding, it may be best to make the whole bottom of planks, forming a grillage. The last courses must be water-tight. The sides are so constructed that they may be easily removed after the foundation is completed, but when the box is completed it should be nearly or quite water-tight. It is floated to the place where the foundation is to be made, and the masonry is begun on the inside, and built up in the same manner as if on a solid bottom. When the caisson is sufficiently loaded by the masonry it will sink to the bottom. If it does not rest evenly on the bottom, it may be desirable to raise it again and remove the obstructions underneath. To facilitate this process, it is advisable to have some side-gates, so as to let water in and cause it to settle before it is fully loaded; in which case the gates may afterwards be closed and the water pumped out, and the box again floated. After the foundation is carried above the surface of the water the sides may be removed. The foundations of the Victoria tubular bridge in the St. Lawrence River near Montreal furnish an example in which both coffer-dams and caissons were used in making a foundation for a pier. The stream is quite rapid and deep, and the bottom was covered with large boulders, so that it appeared quite difficult to secure a good bed for the foundation. A caisson, A, was brought to the proper place and sunk and securely anchored. At the corners were strong posts. Holes were made through them, and the holes continued by drilling into the rock, and a strong 2-inch iron bar put into it, as shown in the cross-section (Fig. 14). The space A was a box having a tight bottom, and a floor at about half its height from the bottom for receiving stone for sinking it and keeping it in place. It had a strong flat deck for receiving the machinery. The sides of the caisson were vertical, but had a sharp point projecting

Fig. 12.



Cross-Section and Interior View of a Caisson.

Fig. 13.

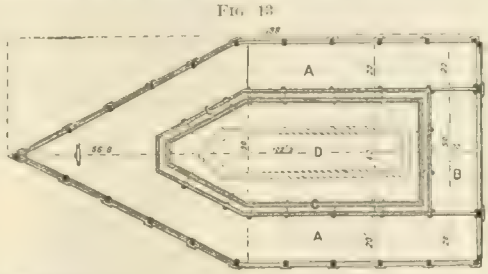
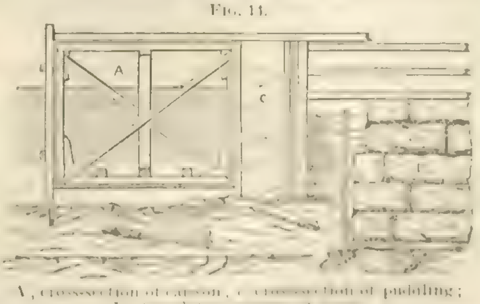


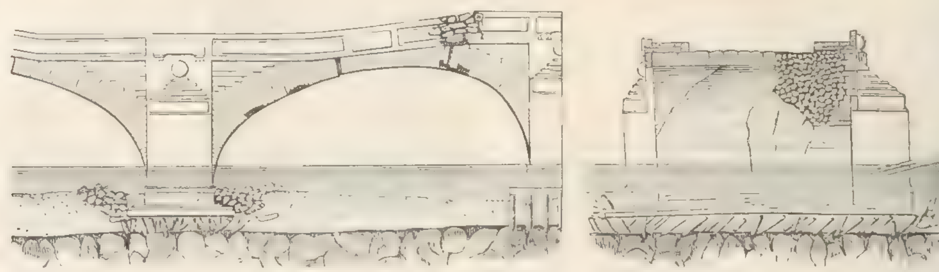
Fig. 14.



A, cross-section of caisson; C, cross-section of puddling; D, foundation courses of piers.

up stream, as shown in the figure, to serve as a breakwater. The space C, which was about 4 feet wide, was filled with puddled material, so as to prevent the water from running into the inner space D. The water was then pumped out of the space D, and the bed prepared for the masonry. The rectangular piece B was so constructed that it could be taken out and floated off. The bridge at Tours, France, is one of the most interesting structures of the last century. It is composed of fifteen stone arches, each having a span of 75 feet, a versed sine of 25 feet, and a thickness at the crown of 4 feet. The intrados has 11 centres, thus making it approximate closely to the arc of an ellipse. The entire length of the bridge between the abutments is 436.58 mètres. It was begun in 1716, and was over five years in process of erection. (*Ponts et Chaussées*, 1839, 2d semestre, p. 86.) Several of the central piers were made on pile foundations. The piles were cut off at a uniform level and capped with a grillage. The eighth pier, which was one of those thus constructed, on Aug. 28, 1777, sunk suddenly 1.12 mètres on the up-stream side, and 1.44 mètres on the down-stream side, and moved up stream 0.92 of a mètre for the part up stream, and 0.325 of a mètre for the part down stream. This produced a great and serious distortion, as shown in Fig. 15. The pier at its base spread 0.595 of a mètre

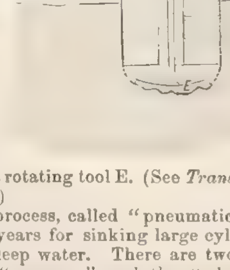
Fig. 15.



Tours Bridge.

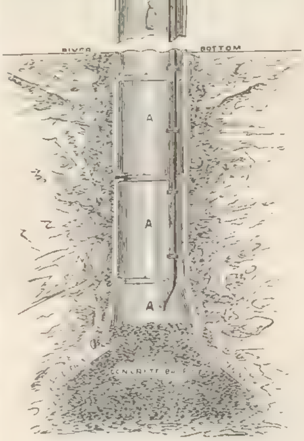
in the movement up stream, and the longitudinal view appeared like a rampant arch. The accident was doubtless due to the overturning of the piles, although Inspector-General de Limay expressed the opinion that the more immediate cause was due to the failure of the piles on account of their exposure in the yard too long before they were used. The bridge was immediately inspected by the noted engineer Perronet, and in accordance with his recommendation several of the other piers were surrounded with piles some distance from the foundation, and the space filled in with large stones. The eighth pier was immediately reconstructed upon the ruins of the old one. Perronet also suggested that the piles be relieved of a portion of their weight by building masonry under the edge of the foundation. He also showed that the piers might have been relieved of 400,000 kilogrammes by making the intrados the arc of a circle, instead of elliptical. The bridge settled unequally at other points, and was the source of great expense in repairs. Since 1835 several of the pile foundations have been injected with concrete. The unequal settling broke the parapet walls, so that they had to be renewed. The failure to make a suitable foundation for this heavy structure is too evident to make comment necessary. On the Eastern Bengal R. R., where it crosses the Gorai River, piers were constructed of two cylinders, forming two large piers, which were 37 feet 6 inches apart. The first cylinder was sunk 80 feet below low water, or 40 feet into the bed of the river; but as the scour was very deep the others were sunk 98 feet below low water. The earth within the cylinder was raised by a flow of water. C is a tube reaching down to the earth, B the level of the water in the stream, and A the height of the water in the cylinder. The depth of E below A was a head for producing the flow. The earth was stirred by a rotating tool E. (See *Trans. Inst. Engineers*, vol. xxiv. p. 8.)

Fig. 16.



A novel but successful process, called "pneumatic," has been largely used of late years for sinking large cylinders and inverted caissons in deep water. There are two general methods — viz. the "vacuum" and the "plenum." The vacuum process consists in exhausting the air from the cylinder, thus using the pressure of the atmosphere upon the top to force it down. Exhausting the air causes the water to flow into the cylinder past the lower edge, thus loosening the soil and causing the cylinder to sink rapidly. By reversing the process the water may be forced out, and then by suddenly relieving the pressure the pile will sink again. The plenum process consists in forcing air into the cylinder or vessel, so as to exclude the water, and forcing the pile down by a load which is placed upon it. A cage or air-lock, as hereafter described, is connected with the main vessel in a suitable way, and so constructed that men may pass through it into the main vessel. This process enables the workmen to remove not only the soil, but any obstructions, such as logs or boulders. It also enables the engineer to have complete control of the sinking, as will appear from the examples hereafter cited. The pneumatic process (vacuum) was first used by M. Triger in sinking a cylinder 65 feet on the Loire in France. It was for a shaft for mining purposes. (See *Comptes Rendus de l'Académie des Sciences*.) Dr. Potts of England has the credit of being the inventor of the vacuum process for sinking piles for bridges, for which he took out a patent in 1848. Lord Drummond took out the first patent in England for the *plenum* process, although the French engineers had used an air-lock as early as 1838.* The vacuum process was chiefly used at first, but in many cases the plenum process was resorted to in order to remove obstacles which were met with in the process of sinking, until it was found that it possessed so many advantages over the former as to entirely supersede it. The general principles involved in the plenum process are shown in Fig. 17. A A is a large iron cylinder which is represented as already sunk some depth into the earth. B B is a tube through which the compressed air passes into the cylinder. E is an air-lock, or small compartment, which has two doors, both opening inward. When the cylinder A A is filled with compressed air, it will keep the door F closed, and a free passage may be had through the door C. If F is opened and C closed, the pressure of the air inside will keep the latter closed, and a free passage may be had through the former. The main object of filling the lower part with compressed air is to force the water out, and keep it out, so that men may work inside the cylinder. To do this it is only necessary to make the pressure of the compressed air per square inch equal to that of the water outside. When this is done the upward pressure of the air may prevent the pile from sinking, and it will be necessary to place a load upon it to force it down. In many cases, as will appear hereafter, permanent masonry

Fig. 17.



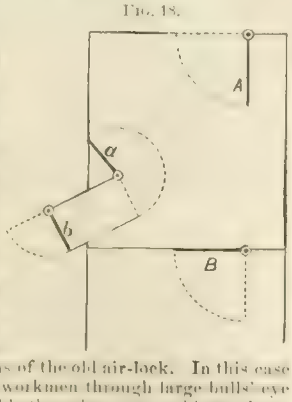
* According to *Engineering* (Apr., 1872), the first use of "compressed air" in sinking cylinders for foundations was about 1852, at the Rochester bridge, England.

is built upon the column whilst it is being sunk. To enter the tube, the lower door F of the air lock is closed, whilst the lower part of the cylinder is filled with compressed air, and by means of a stopcock or other suitable device the compressed air from the upper part is permitted to flow out; and when the internal air is reduced to the atmospheric pressure, the door C is easily opened and the workmen may pass in. After they have passed in the door is closed, and by opening another stopcock the air is allowed to flow from the lower part of the cylinder A into the space E; and as soon as equilibrium is restored, the door F is easily opened, and workmen may then pass freely into the lower part and proceed with their work. The excavated material may be raised in any suitable way into the upper chamber E, and then by closing the door F and opening the outer passage C, it may be discharged. Other methods will be given in the following examples.

When the pneumatic cylinder cannot be extended down to rock, or even to unyielding soil, its supporting power may be greatly increased by enlarging the foundation at its base. This is accomplished by removing the soil from under the edge of the cylinder and filling the space with concrete. The foundation of the Harlem bridge in New York City was enlarged in this way. The soil was sandy and very loose, and the workmen found it difficult to remove any portion of the soil without its caving in and immediately filling the space which they had excavated; but after a few experiments they learned to manage it. They found that by forcing in some polling-boards, and removing the soil underneath them as quickly as possible, and then quickly filling the space with concrete, they could do it successfully. They would remove and fill only a small space at a time; and instead of removing the adjacent earth immediately, they would go to some other portion of the base and repeat the operation. In this way the whole base was enlarged from 6 feet in diameter to 10 feet. In a similar way the foundation of the London Chatham and Dover railroad bridge at Blackfriars, England, was enlarged from 18 feet to 21 feet in diameter.

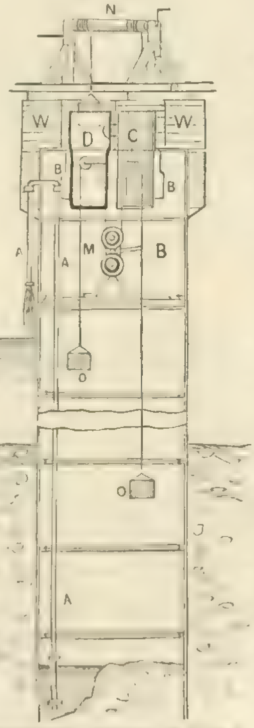
In the Harlem bridge the piles were 6 feet in diameter, and cast in lengths of 10 feet. The air-lock was of the same diameter as the cylinder, and 6 feet high. The valves or man-holes were 20 inches in diameter. The piles were sunk 50 feet below the surface of the water, and 30 feet below the surface of the river-bed. A tank, which consisted of the shell of a steam boiler, was placed on the shore to serve as a reservoir for the compressed air. This was connected with the cylindrical pile by means of flexible pipe. The air in the pile was permitted to discharge freely at certain times through stopcocks, causing a rapid sinking of the pile. By means of a stopcock in the pipe leading from the tank the movement could be quickly checked when desired, by letting the air flow from the tank into the cylinder. In a pneumatic foundation in the Savannah River, on the line of the Charleston and Savannah R. R., the work was carried on similarly to that at Harlem, but the progress of the work was greatly facilitated by the use of a secondary air-lock which was designed by the engineer in charge. This was so designed that the excavated material which was brought into the main air-lock could be discharged at any time, and the work go on without interruption. The secondary air-lock was inclined like a spout, and had an outside and an inside door. By closing the outside door and opening the inside one, it could be filled with material; and by closing the inside and opening the outside one, the material would slide out. In this way the discharge could be almost continuous, and the progress which was made in excavating and sinking was nearly three times that which was made by means of the old air-lock. In this case light was supplied to the workmen through large bulls' eye glasses which were placed both in the upper and lower floors of the air lock. The progress of the work was further facilitated by forcing the sand up through a tube by means of the pressure of the air in the pile. It having been found that the pressure of the air was sufficient to force the material above the surface of the water, a pipe was extended from the upper end of the pile downward to near the soil at the bottom, and terminated with a kind of telescopic tube, so that it could be extended or shortened as was necessary in order that the lower end could lie continually under the sand as the pile moved downward. It was necessary to reduce the section of the mouth of the pipe at the lower end, so as to prevent anything from entering it which could not pass freely through the pipe. This method of removing the soil was used in making the foundations of the Omaha and Leavenworth bridges, and to some extent in the East River bridge. It is sometimes difficult to keep the pneumatic piles vertical as they are being sunk. As soon as they begin to incline, efforts should be made to bring them to an erect position. This may sometimes be done by driving wedges under the lowest edge of the cylinder, and then suddenly relieving the air-pressure. The wedges form an obstruction, so that when the pressure is relieved the lower side will sink slower than the other. But this is not always effectual. The engineer of the Omaha bridge, in order to bring the tube to an erect position, adopted the ingenious plan of boring several holes on the upper side of the tube and letting the compressed air flow through them, thus loosening the soil on that side, and relieving it of friction, and thus permitting that side to sink the fastest; but this did not always effect the desired object. In the Omaha bridge strong levers were tried for the purpose of drawing the tube into an erect position. A heavy pull was thus brought to bear whilst the pile was sinking, but with very little effect. While sinking one of the piles in the Savannah River holes were bored on the upper side, as in the Omaha bridge, and levers used at the same time, without bringing it to an erect position; but at the same time that both these appliances were used the upper end was beaten with a ram, and the erect position was quickly secured. The jar produced by the ram appeared to loosen the soil, and gave great effect to the other means which were used.

Fig. 18.



It has been ascertained that concrete will harden very slowly under great pressure, and it has been questioned whether it will ever become very hard. The hardening has been greatly facilitated in such cases by using a porous brick in a dry state, instead of stone, as was done at Szegedin, Hungary; and also by inserting in the body of the concrete $\frac{1}{2}$-inch gas-pipes, as was done by the chief engineer, McAlpine, at the Harlem bridge, the object being to permit the compressed air to diffuse itself throughout the mass of the concrete. In some cases in Europe double air-locks have been used, such as at the Szegedin bridge over the river Theiss, Hungary (Fig. 19), for the purpose of saving time; but as they are not as serviceable as the supplementary air-lock used in the Savannah River, it is only necessary to refer to them as an historical fact. Each air-lock is substantially the same as the single ones before described. The material is lifted into them alternately, and discharged from one whilst the other is receiving its load. In the bridge over the river Theiss at Szegedin each pier was composed of two piles or columns filled with beton, and each supports one track of the railroad. The soil was alluvial, in alternate layers of sand and compact clay for an indefinite depth. The piles were sunk about 30 feet below the surface of the bed, or 40 feet below the surface at low water. Twelve piles were driven into the bottom of the columns to the depth of 20 feet below the bottom. To provide against scour, sheeting piles were driven about 2 feet from the pier and completely around it, and the space filled with concrete, and in addition a large quantity of stones was put outside the piles, extending outward

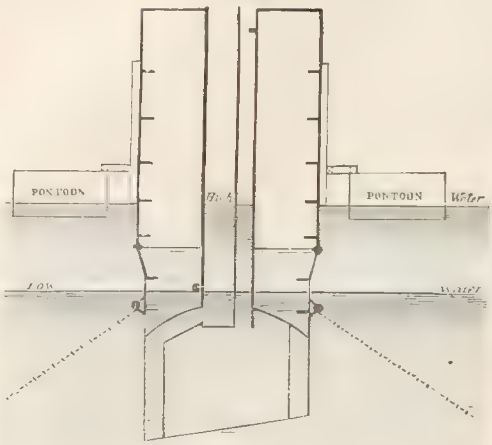
Fig. 19.



Longitudinal Section of Pile A, bell or working-chamber B, and air-locks C, D, used on the bridge at Szegedin over the river Theiss, Hungary. A, water discharge pipe; B, equilibrium tubes of air-lock; C, elevation of air-lock; D, longitudinal section of air-lock; M, hoisting-gear in the bell; N, hoisting-gear for air-lock; W, counterpoise to compressed air.

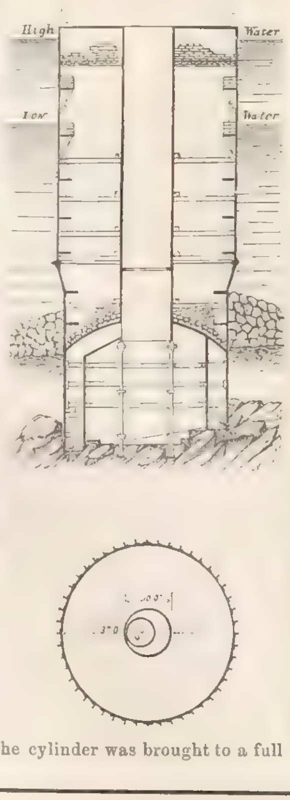
about 10 feet from the piles. The concrete for this structure was mixed by mechanical means. A wooden cylinder about four feet in diameter, which was firmly hooped on the outside and lined with sheet iron on the inside, was supported on an axis which was inclined $\frac{1}{13}$th to the horizon, and made to revolve by means of a belt from a steam-engine, making from 15 to 20 revolutions per minute. The cylinder was fed through a hopper at the upper end, and its contents discharged at the lower end thoroughly mixed.

FIG. 20



The centre pier of Saltash bridge, on the Cornwall Railway, England, was sunk to a greater depth by the plenum process than any pier which had been previously sunk by this method. This bridge crosses the river Tamar at Saltash, about 3 miles above Plymouth. The site for this bridge was selected in 1845, but the bridge was not begun until 1853. The two river-spans are each 455 feet. The centre pier (Figs. 20 and 21) carries one-half of each of these spans. It consists of a column or circular pillar of solid masonry 35 feet in diameter, and 96 feet high from the rock on which it rests to above high water. Upon this are placed four octagonal columns of cast iron 10 feet in diameter, carried up to a height of 100 feet above high-water mark. The pressure on the bottom of the pier is about 10 tons per square foot, including the load upon the bridge. The character of the bed of the stream and the slope of the rocky bottom were determined by means of 175 borings made through a cylinder which was 6 feet in diameter and 85 feet long. The cylinder was used on account of the great velocity of the stream and the rise and fall due to the tides. It was slung between two gun-brigs, and when in the desired place it was sunk a few feet into the mud, and kept in position whilst the borings were made. In this way it was found that the surface of the rock where the pier was to be established was very irregular, but had a general slope, as shown in Figs. 20 and 21. A wrought-iron cylinder of boiler plates, 37 feet in diameter and 90 feet in length and open at the bottom, was constructed on the shore, floated to the place where the pier was to be made, and sunk through the mud to the rock. It was with some difficulty that the cylinder was brought to a full bearing and to an upright position. Within the large cylinder was a 10-feet cylinder, placed concentrically with the former, and the two thoroughly connected by means of tie-rods; and within this was a 6-feet cylinder. The lower end of the cylinder was provided with an annular space about four feet wide and divided into 13 air-tight compartments which were connected with the 6-feet air-cylinder extending through and to the top of the 10-feet cylinder. The lower compartments were covered with a dome-like partition at about the height of the mud. It was supposed that the mud would prevent the inflow of water, but it was found necessary to resort to air-pressure to keep it out. The water and mud were first removed from the air-space, and a ring of granite ashlar masonry 4 feet thick and about 7 feet high was put in place, as shown in Fig. 23. In attempting to pump out the water and mud from beneath the dome, it was found that there was a leak of such magnitude that it was necessary to use air-pressure again. The rock was finally reached, and dressed to a level surface. Before the air-pressure was applied, about 750 tons of ballast was put upon the cylinder to prevent its floating, part of which was placed above the dome, and a part on the upper deck, as shown in the figure; and to add to the security in case there was a sudden inflow of water, the cylinder was anchored vertically to the rock by means of tie-rods and lewis bolts. The masonry was then built up to the springing line of the dome, after which the dome was cut away, as well as the lower part of the 10-feet cylinder, and the masonry was carried upward, having a diameter about 2 feet less than that of the upper part of the cylinder. When the masonry reached the height of the surface of the water, the upper section of the cylinder was unbolted from the lower, and the upper portion was removed, leaving the lower portion undisturbed.

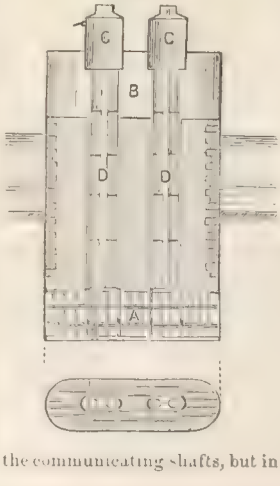
FIG. 21.



The foundation of the Korono bridge in Russia is similar to several others which were built on the railway between Warsaw and St. Petersburg. The materials being mostly shipped from foreign countries, economy in the plans was especially studied. The air-chamber D was made as small as possible, and all the cylinder above it was made water-tight by having all its joints packed with rubber. The air-chamber was made of wrought-iron inverted plates, and the cylinder above it of cast iron, and where they were exposed to shocks they were 2½ inches thick. The diaphragm was made in sections, so that it could be easily removed. This bridge had four piles, each 11 feet 6 inches in diameter, sunk to a depth of 39 feet below low water through granitic sand. The two upper piers are to support an ice-breaker. The cylinders which compose the pile were generally made of cast iron, bolted together in sections. In the construction of the Hermitage wharf on the Thames, England, aponite (Ransom's artificial stone) was used. It was made into cylinders 8 feet in diameter and 9 inches thick. It cost from one-half to three-fourths as much as iron, and was used with good success.

Pneumatic Caissons.—The essential difference between the pneumatic pile, as above described, and a pneumatic caisson, is one of degree rather than one of quality, the latter being sufficiently large to envelop the entire masonry of the pier. In ordinary cases the pier is sunk to the required depth before it is filled with concrete or masonry, but in the caisson the masonry is built upward while the whole pier is being sunk downward, the masonry thus forming the load for forcing the caisson into the soil. The general arrangement of the parts is shown in Fig. 22. The lower portion, A, is a large compartment in which the laborers excavate the earth. The outside wall is strong enough to resist the inward pressure of the water and soil. Its lower edge is made comparatively thin, so as to force itself more easily into the soil. The roof is sufficiently strong to support all the masonry which will be put upon it. The air-bells C C contain double air-locks, as before explained. D D are cylindrical passages to form a communication between the air-bells and the lower compartment. The workmen pass up and down the passages D D. The air-locks are not always placed at the upper end of the communicating shafts, but in many important structures

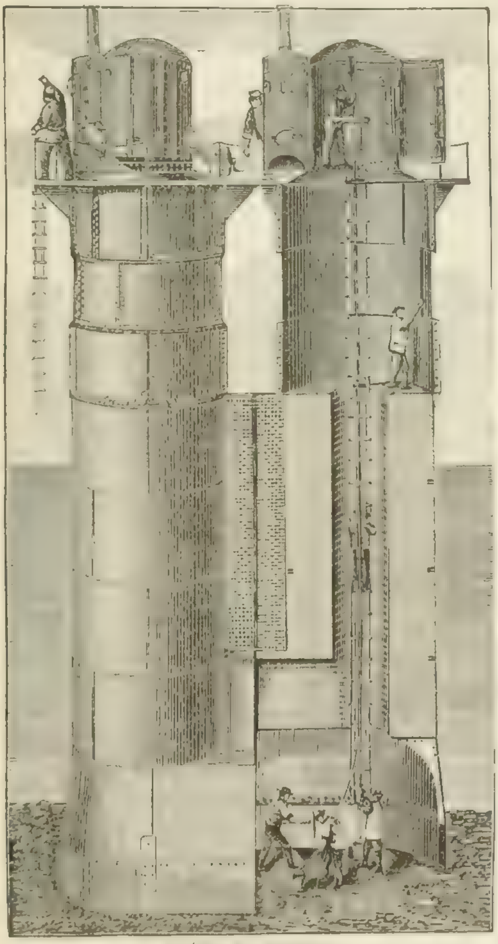
FIG. 22.



of recent date they have been placed at the lower end of the passage, and are made to open directly into the lower compartment. The excavated material is sometimes raised through shafts which are designed especially for that purpose. In a bridge at Nantes each air-lock was divided into three compartments—one for the workmen to pass through, which would contain four at a time; one for the barrows by which the excavated soil was removed; and one for the concrete which was to fill up the lower working chamber after the excavation was completed. In the bridge at L'Orient, over the Schorff, the caissons were made of sheet iron, in zones which decreased in thickness from the top to the bottom, but as they were not properly braced, they became distorted on account of the external pressure of the water. The caissons were about 40 feet long and 12 feet wide. The bells or air locks were 10 feet high and 8 feet in diameter. The lower compartment was about 10 feet high, and the cylinders which formed the communication with it were 2½ feet in diameter.

Tay Bridge.—This English bridge, built in 1873, has 89 spans, and is 10,320 feet from shore to shore. The pier

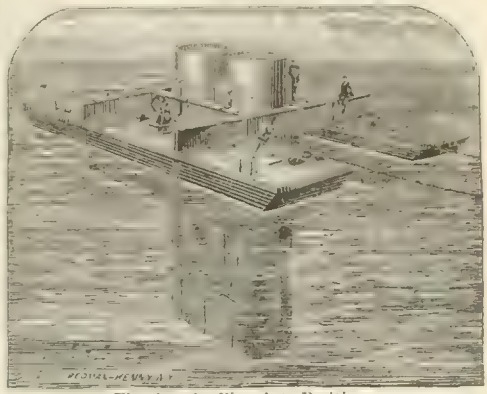
FIG. 23.



Sinking the Caissons.

shown in Fig. 23 is composed of two columns, which are so joined at the bottom as to form one large compartment under the whole pier. At first, single columns were used, and sunk separately, but their bases were so narrow that several of them overturned whilst they were being sunk; but no such difficulty was experienced after their bases were joined as shown in the figure. The base of the lower chamber is made of wrought iron, and is 22 feet 7 inches long, 10 feet 6 inches wide, and 3 feet high. This is surmounted by a conical cast-iron frame 5 feet high, and forming a flange 2 feet 6 inches wide, upon which the masonry was built. The body of the cylinders is made of cast iron, ⅞ of an inch thick, 9 feet 6 inches in diameter, and in sections about 4 feet long. These were surmounted with air-locks which had supplementary locks for discharging the material. One set of air-locks was made to answer for all the piers by removing them from one to the other as needed. A space of about 2 inches was left between the masonry and the inside of the cylinder, which was afterwards filled with concrete. A cylindrical space of about 4 feet diameter was left inside, through which the workmen passed from the lower chamber, and through which also the excavated material was raised. After the pier was sunk to a permanent position, the lower chamber was filled with concrete, in the proportion of 1 of sand to 3 of broken stone. Concrete was run in, so as to thoroughly fill all the space about the flanges carrying the masonry, after which the cylindrical passage was filled. The piers were first built up 15 feet high near the shore,

FIG. 24.



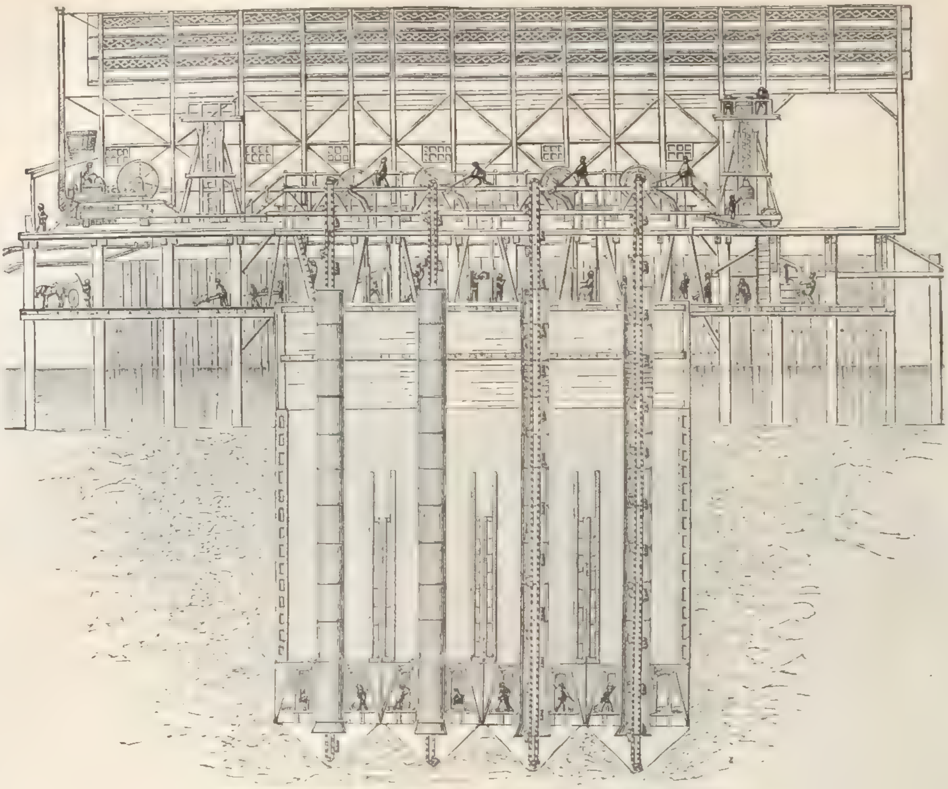
Floating the Piers into Position.

and the pontoons, which carried a set of girders, floated over them at high tide; and as the tide lowered the girders were left hanging upon brackets which were attached to the piers, and the pontoons were floated away. The piers were then built upward to such a height that the top would be above water when the piers rested upon the bottom. The girders were then connected by the wrought-iron lowering chains to the wrought-iron links near the bottom, as shown in the figure. The pontoons were then floated under the girders at low tide, and as the tide raised the whole were floated, and towed to their permanent position. The pontoons were then anchored, and the piers were gradually lowered by means of hydraulic rams which were placed on the girders. These rams had a stroke of 12 inches. As the lowering proceeded, links which were about 4 feet long were added. The lowering took place during ebb tide, and as it sunk into the bottom it was carefully watched to see if it retained its vertical position. If it did not, the hydraulic pumps were set to work to bring it into the proper position. As it moved downward it was steadied by chains which were attached to the last pier which was finished, and extended to the one being sunk, and also by means of two hydraulic telescopic legs.

Kehl Bridge.—The foundations of the bridge built in 1859 over the Rhine at Kehl (Figs. 25 and 26) were made upon four caissons, which in the first foundation were independent, but afterward they were bound together, so as to make one caisson having four compartments. Each of these compartments had their tubes leading upward, the central one being nearly 5 feet in diameter, and kept constantly full of water; and the other two, each 3 feet 3 inches in diameter, were supplied with ladders and winches, and served merely as passages for the workmen. The air-tubes were used alternately—one being used whilst the other was being lengthened. The compressed air kept the water out of the caissons, whilst workmen, passed down and standing upon temporary floors, excavated the material and fed it under the central tube, where it was dredged and raised to the surface. Each of the piers was sunk to the depth of 65 feet and 9 inches below low water. The first was put down in [illegible] working days, the second in [illegible], the third in 25, and the last in 24. In some of the caissons the wrought iron forming the rim was buckled by the external pressure. This was provided against by brick arches which were built between the sides. The masonry was advanced so that its weight was kept slightly in excess of the friction. The plan adopted in making these foundations was found to be a very great improvement, in regard to cost and facility of construction, over that of separate tubes, and marks a new era in the construction of pneumatic foundations. In making the foundations of the bridge over the Rhone at La Voulte the working chamber was a single compartment, instead of being divided into several. The materials were raised by a single dredge placed at the centre of the pier. In this bridge, as well as in the Kehl, the caissons were regulated in their descent by means of chains and screws which were attached to the external frame.

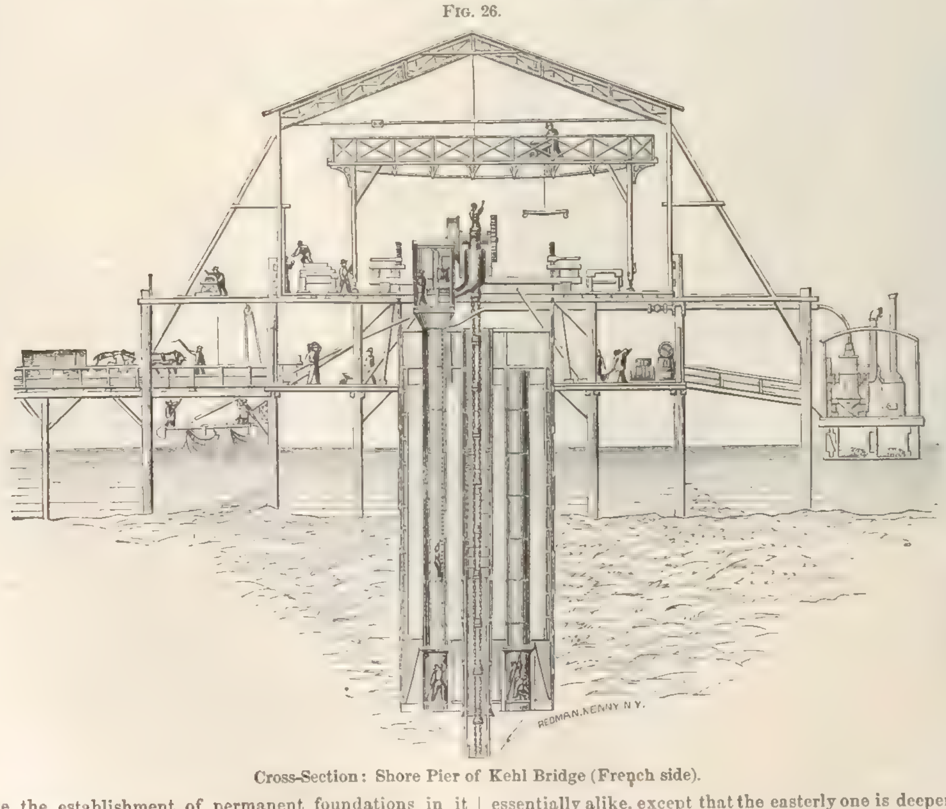
St. Louis Bridge.—The shifting character of the bed of the Mississippi River, and the great depth of the scour,

Fig. 25.



Longitudinal Section: Shore Pier of Kehl Bridge (French side).

Fig. 26.

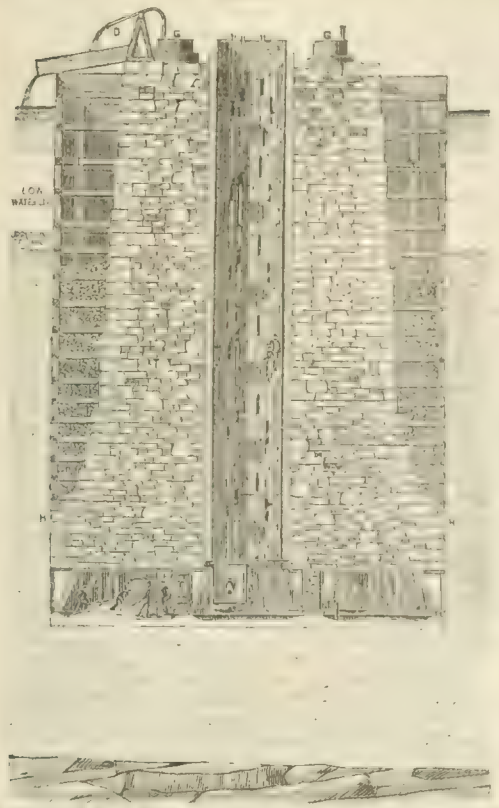


Cross-Section: Shore Pier of Kehl Bridge (French side).

make the establishment of permanent foundations in it very difficult. The rock underlying the river opposite St. Louis dips to the eastward, the depth at the W. abutment being only 15 feet below extreme low water, while at the E. abutment it is 94 feet, and 136 feet below high-water mark. There are two piers in the body of the stream, which are essentially alike, except that the easterly one is deeper than the other. (See Bridges.) They were built in a large caisson (Fig. 27), having one large air-compartment in the base, where the workmen excavated the material. This compartment was 9 feet high, the sides being of $\frac{3}{4}$-inch plate iron for the larger, and $\frac{5}{8}$-inch for the smaller pier.

Two massive timber beams or piles C C were built up from the sand for supporting the roof of the chamber. The roof

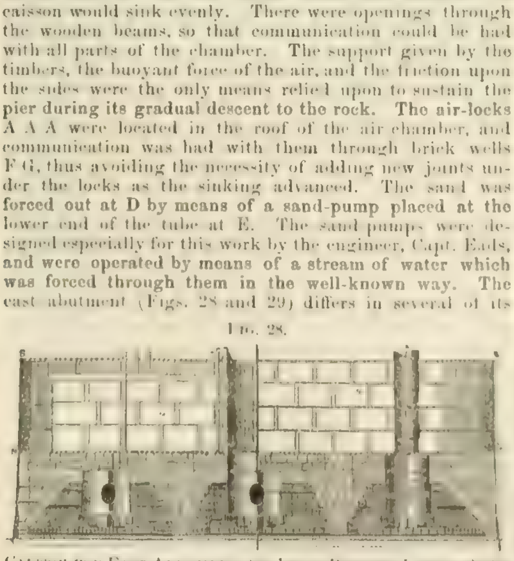
Fig. 27.



Section of East Pier and Caisson, showing the interior of the main entrance-shaft and air-chamber, and the working of one of the sand-pumps, Illinois and St Louis Bridge. A, air-locks; B, air-chamber; C, timber girder; D, discharge of sand-pump; E, sand-pumps; F, main entrance-shaft; G, side shaft; H, iron envelope; I, bracing for shell.

was composed of ½-inch plate iron. Over this, and running transversely to the timber beams, are thirteen iron girders, L, which are riveted to the roof. The masonry rests upon the girders. The bottom was excavated as evenly as possible all over, so that the timber beams and sides of the caisson would sink evenly. There were openings through the wooden beams, so that communication could be had with all parts of the chamber. The support given by the timbers, the buoyant force of the air, and the friction upon the sides were the only means relied upon to sustain the pier during its gradual descent to the rock. The air-locks A A A were located in the roof of the air chamber, and communication was had with them through brick wells F G, thus avoiding the necessity of adding new joints under the locks as the sinking advanced. The sand was forced out at D by means of a sand-pump placed at the lower end of the tube at E. The sand pumps were designed especially for this work by the engineer, Capt. Eads, and were operated by means of a stream of water which was forced through them in the well-known way. The east abutment (Figs. 28 and 29) differs in several of its

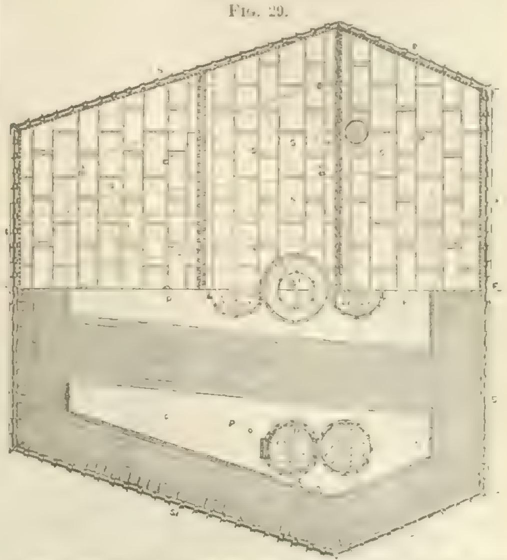
Fig. 28.



Caisson for East Abutment, St Louis Bridge: I, main shaft; K, side shafts, L, pipes for air and sand-pumps; M, iron girders, N N, iron deck, O, air-locks, P, air-chamber, Q, timber girders, R, timber deck, S S, iron envelope, T, timber sides

details from the piers. It is especially noted as being the deepest foundation ever constructed by the pneumatic process. When it touched the rocky bottom it was 110 feet below the upper surface of the water in the river. The main shaft had two air locks at its lower end, each 8 feet in diameter, having about four times the capacity of those used in the piers. There were also two other shafts and air-locks, which were used for additional security. Every

Fig. 29.

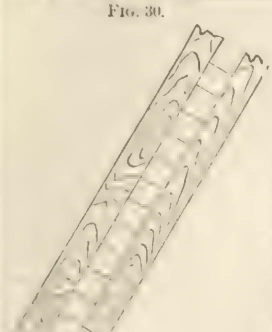


Caisson for East Abutment on the Illinois and St Louis Bridge. I, main shaft, K, side shafts, L, pipes for air and sand-pumps, M, iron girders; N N, iron deck; O, air-locks; P, air-chamber, Q, timber girders; R, timber deck, S S, iron envelope; T, timber sides.

precaution was taken to secure the safety of the workmen. Telegraphic communication was established between the top of the masonry in the pier and the large compartment at the base. Previous experience had raised a doubt in the minds of many whether workmen could endure a pressure of over three and one-half atmospheres above that of the ordinary atmospheric pressure; but it was found that by making frequent changes, not keeping them in the compressed air for more than one hour at a time, they suffered but little inconvenience. But several who remained in several hours under a much less pressure were paralyzed, and a few died from the effects of the confinement.

In all the preceding cases to which we have referred the walls of the caisson which enclosed the masonry were extended upward so as to exclude the water, but in the E. pier and E. abutment they were extended upward only 12 or 15 feet above the roof of the air chamber. The sides of the roof of the chamber having been made practically water-tight, it was only necessary to make the shafts water-tight to exclude water from the chamber. This was done by lining them with white pine pieces, which were arranged like the staves of a cask, and were 10 inches thick at the lower end, and gradually diminished to 3 inches at the top. Candles and oil lamps burned much more rapidly in the compressed air than usual, and it was very difficult to extinguish them. It was found, also, that if the clothes of the workmen caught fire, it was difficult to extinguish them, although they were of woollen material. It was therefore thought advisable to enclose the lamps in a very strong glass case or vessel which communicated freely with the external air, and then admit compressed air into the vessel through an air cock, so that the supply could be limited. A cock in the tube leading to the external air enabled them to prevent the escape of the air whilst changing a lamp or supplying oil. After the E. pier reached the rock the air chamber was filled with concrete. In the E. abutment all depressions in the rock were filled with concrete, so as to make an even bearing surface, and it was continued up, so as to prevent the possibility of water ever reaching under it; and then the entire space was filled with wet sand nearly up to the roof, and the re-

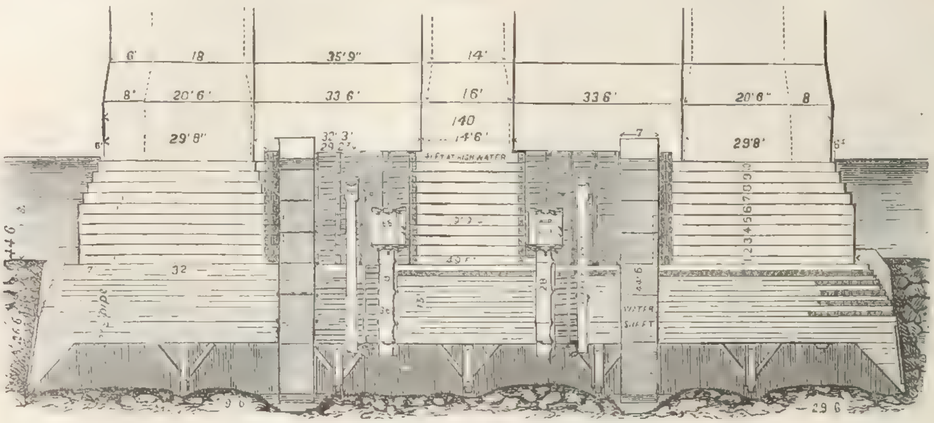
Fig. 30.



maining space was rammed full of concrete. This greatly cheapened the process of filling, and it was supposed to be as good as if it were all concrete. The piers of the iron bridge over the Missouri River at St. Joseph, Mo., were sunk to solid rock by the pneumatic process—a depth of 50 feet below the surface of the water. The walls of the caisson were composed of three layers of timbers. In the outer layer the timbers were nearly vertical, and placed close side by side. In the next layer they were horizontal, and terminated 1 foot higher at the bottom than the outer ones. The inner layer had its timbers parallel to the other, but terminated 2 feet above the outer ones. These were firmly bolted to each other. This arrangement of stepping at the lower edge enabled them to regulate the descent better than if it were square on the bottom. If the material was hard, they would excavate under the edge, so that it could force its way more easily. If it was soft, they would leave more material under the edge, thus giving it a broad bearing surface to check its progress.

East River Bridge. (For a description of this bridge see EAST RIVER BRIDGE.) The foundations on the Brooklyn and New York sides are substantially alike. Each was built upon a large caisson and sunk by the pneumatic process. The Brooklyn caisson is 168 feet long by 102 feet wide. The New York one is 172 feet long by 102 feet wide. The lower edges of the sides are V-shaped, and are 9 feet thick

FIG. 31.



where they join the roof, sloping down to a round edge. The inner slope is 45°, and the outer is 10°. The lower edge, or shoe, is formed by a semicircular casting, protected by a sheet of boiler plate, extending up 3 feet on the sides. A heavy oak sill, 2 feet square, rests directly on this casting. The succeeding three courses are of yellow pine, and are laid lengthwise; after which the alternate ones are heading courses. The whole V is thoroughly held together by means of screw-bolts and drift-bolts. In addition there are heavy angle-irons uniting the V to the roof. The immediate roof is composed of five courses of 12 inch square yellow pine sticks, laid close together, bolted sideways and vertically, and having a set of bolts running through the whole of the five courses. The caisson was made air-tight, as far as practicable, by completely covering it with tin between the third and fourth courses, and extending it down on the sides to the shoe. The tin on the outside was protected by a sheeting of yellow pine. Before the tin was put on, the seams were caulked inside and out for a depth of 4 inches. The space between the timbers was filled with hot pitch and grout, and the inside of the air-chamber was coated with an air-tight varnish. The excavated material was mostly raised through water-shafts. There were two of these in each caisson, 7 feet by 6 feet 6 inches, made of $\frac{3}{8}$ boiler plate properly stiffened. They were open at the top and bottom, the lower ends being 21 inches below the edge of the caisson, and the upper end being kept constantly above the upper surface of the masonry. The pressure of the air within the caisson kept the column of water in the shafts at the same height as the water in the river. The excavated material was thrown by the workmen into the depression beneath the water-shaft, from whence it was taken by a clam-shaped dredge and raised through the water-shaft to the top of the masonry, from whence it was removed. Much material was blown out through vertical pipes by the pressure of the air in the caisson, as before described. The air-locks were placed at the lower ends of the entrance shafts, and were constructed in the usual manner. As soon as the caisson was put in place, several courses of stone were built upon it to sink it to the bottom. Air was then forced in to expel the water. As the tide rose it would tend to float the caisson; one end would rise and let a quantity of air escape, which would permit the caisson to sink again, but would leave a foot or more of water on the bottom. The air would soon expel the water, and the operation would be repeated. The soil was very full of boulders, most of them so large that they had to be split before they could be removed. After the caisson was sunk a depth of 25 feet, they were blasted by means of gunpowder without damage. Boulders under the shoe were sometimes removed by drilling a hole through them, and putting in a charge of powder and blowing them bodily into the chamber. Boulders were found 14 feet long and 5 feet in diameter. On the Brooklyn side the dredges which worked in the water-shafts were unable to dredge the native soil at the bottom of the shaft. Whenever this occurred, the shaft was closed at the top and the air entered above the water, driving it down into the air chamber, and a pit with sloping sides was excavated by hand-labor. The pit was then filled with water, and the air in the shaft allowed to escape gradually, until the column of water balanced the pressure of the air. Once the dam about the pit washed away, and let the water fall below the end of the shaft, and all the compressed air suddenly escaped from the caisson. It took with it water, mud, and stones, and produced a frightful noise, but caused no damage. The roof of the Brooklyn caisson once caught fire. The compressed air caused it to burn vigorously, and it was found impossible to extinguish it by ordinary means. Carbonic acid gas produced but little effect upon it, and it was found necessary to completely fill the caisson with water; which was safely done. After the caissons were sunk to the depth required, they were filled with concrete, consisting of 1 part of Rosendale cement, 2 of sand, and 4 of small-sized gravel. The sand and cement were mixed above and passed through one shaft, and the gravel through the other. The cement was built up in bulkheads all around, only 4 or 5 feet in thickness, and as they approached the roof they were filled up on the back side first, leaving a sloping upper surface, and the remaining space thoroughly rammed full with flat-faced iron rammers. The Brooklyn caisson was founded on a firm, compact subsoil at a depth of 50 feet below the surface of the water, and the New York one also rests on a very compact stratum, 2 or 3 feet thick on the bed-rock at a depth of 78 feet. The effect of compressed air was so serious upon the men that before the New York caisson reached the proper depth the hours of labor had to be reduced to two for a shift. A few deaths occurred from the effects of being in the compressed air, and scarcely any escaped without being affected by intense pain in the limbs, or by a temporary paralysis of the arms and legs, from which, however, they soon recovered. The pneumatic caisson is not considered as cheap as other modes of making foundations where other processes can be used. But in rapid streams and under deep water no plan has been devised which enables the engineer to have such complete control of the work in passing obstructions in the soil and securing with certainty an even foundation upon solid rock, or upon a firm substratum when rock cannot be reached. (See *Trans. Inst. Civ. Engineers*, Eng.: *Notes on Foundations*, by GEN. DELAFIELD, U. S. A.; MAHAN'S *Civ. Eng.; Report Illinois and St. Louis Bridge; Rep. East River Susp. Bridge; Jour. Frank. Inst.; Annales des Ponts et Chaussées.*)

DE VOLSON WOOD.

Foundation, in law. In its most enlarged legal signification the term "foundation" is used to denote the establishment of a corporation of any kind, and in this sense

the sovereign or state is said to be the founder of all corporations, since their original creation is due to royal charter or legislative grant, express or implied. But in its narrower, yet more usual and important meaning, *foundation* refers to the establishment of eleemosynary or charitable corporations or institutions by private endowment; and it is sometimes, though less commonly, by a natural transfer of application, used to indicate the endowment itself. A large variety of the most beneficial institutions which have been created for the common welfare of society, and have contributed largely to the promotion of civilization, have owed their origin and maintenance entirely to private munificence. Such are colleges and seminaries of learning, hospitals and asylums, and the various associations for the relief of the aged, the destitute, and the afflicted which exist at the present day in such abundance. There is vested at common law in the creator of such charities the right to exercise a power of supervision over the management of the corporate revenues and the methods of corporate action and government. This is called "a power of visitation," and is judicial in its nature, but not legislative. It corresponds to a great degree with the right of control exercised by government over civil corporations through the agency of the courts, which is also sometimes termed a power of visitation. Such a prerogative vested in an individual founder is regarded as the bestowal of a just and reasonable jurisdiction over the disposal of his own property, and the power is one which descends to his heirs. (See VISITATION.) But the visitorial authority is not generally retained at the present day by founders of corporations, but is vested in boards of trustees. In the Andover Theological Seminary this visitorial authority is still retained, a board of visitors—three persons—having a certain control—whose terms are fixed in the original foundation of the seminary—over the trustees. In the U. S. the appointment of boards of trustees is the more common practice, so that the rights and privileges consequent upon a charitable "foundation" are now exercised by such governing bodies, and are quite generally defined by the act of incorporation. Charitable purposes may also be accomplished without any corporate authority, through the medium of trustees appointed by the founder either by deed or will. These trusts are under the supervision of the courts of chancery. The same remark is applicable to the funds of charitable corporations, which may be called to account for a breach of trust. (See CORPORATIONS and TRUSTS.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Found'er (*Laminitis*), an inflammation primarily attacking the laminæ of the horse's foot. This disease may follow overdriving, exposure to cold when perspiring, overfeeding, or giving food or drink too soon after hard work; long-continued driving on pavements or on frozen ground and bad shoeing are fruitful causes. The fore feet are usually affected alone, but the fore legs and chest-muscles sometimes share in the disease; and these muscles undergo a sort of atrophy (chest-founder) in consequence of its long continuance. The disease resembles rheumatism in many respects. Like that, its acute form is attended by great fever and pain. Bleeding is admissible in a young strong horse suddenly foundered. The shoes should be taken off, the hoof covered with a hot poultice. Litter the stall heavily, and in severe cases sling the horse up from the floor. After the acute stage is over put the horse to pasture if possible, and let him run as long as you can spare him, except in severe weather, when he should be housed. A foundered horse can be detected by his mincing gait, by his resting his fore foot upon the toe, by a hot or contracted hoof, and by delicate signs recognized with difficulty by any except practised observers. For an established founder there is no possible cure.

Found'ling Hos'pitals, institutions for the reception and support of infants and children that have been abandoned by their parents or guardians. Such institutions are maintained by government appropriations or by private or sectarian associations. Children found abandoned are known as foundlings, and the cause of their desertion is in most cases illegitimate birth, though not a few are born in wedlock and are abandoned by parents unable to provide for them. The necessity of providing for such children, and restraining infanticide, long since led to the establishment of foundling institutions by most civilized nations. Amongst the ancients, from the power given by the laws to male parents over the life of their offspring, it is undoubted that infanticide, as amongst some Eastern nations at present, was the prevailing means of solving the difficulty which the establishment of foundling hospitals was intended to meet. In Rome and Athens infanticide is known to have been practised, and in the former there is ground for believing that deformed children were put to death by law. By the ancient Egyptians, however, infanticide was punished by a law compelling the guilty parent to pass three days and nights embracing the body of the child, which was fastened to the parent's neck. Where infanticide was not resorted to on account of the stringent laws against it, desertion was largely practised, and prevailed extensively in all the states of ancient Greece excepting Thebes, where both the abandonment and destruction of offspring were forbidden. Both Athens and Rome at an early period had institutions for the reception and education of foundlings. In the former the abandoned children were exposed in the *Cynosarges*, and in the latter at the *Columna lactaria*, a pillar in the public market-place. Foundlings were generally the property of those who took them under their protection, and were generally educated and treated as slaves.

As early as the sixth century a species of foundling hospital existed at Treves, where a marble basin was located in front of the cathedral, in which parents could deposit children they wished to abandon, the care of such foundlings being given by the bishop to members of the church. In Rome also, in the sixth century, public institutions existed for the reception of foundlings, called by Justinian *brephotrophia;* and in the seventh century similar ones existed at Anjou in France. One was established at Milan in 787 by an arch-priest named Datheus, for the object of preventing infanticide. The children received at this institution were nurtured by hired nurses until the age of seven, when they were discharged as free born. In 1070 a foundling hospital was established at Montpellier, and a second one in 1180, known as the Hospital of the Holy Ghost. In 1200 one was established at Eisenbeck, and in 1212 one in Rome. In Florence a magnificent one, the Spedale degli Innocenti, still in existence, was established in 1317. Similar institutions were founded in Nuremberg in 1331, in Paris in 1362, and in Vienna in 1380. The Hôtel Dieu of Lyons, founded in 1523, was one of the first in France where foundlings were not only received, but were educated; and in 1536 a similar one was established by Francis I. In Paris in 1563 a foundling hospital was established by the Church, and managed by an association of priests. In this children received a careful education, many of the boys being trained for the priesthood. The refusal of this institution to receive illegitimate children necessarily left those unfortunates to become the victims of misery. Recognizing the necessity of providing for abandoned infants, Saint Vincent de Paul, by his eloquent pleadings, collected funds sufficient to establish a new foundling hospital in 1640; which during his lifetime was managed by a committee of ladies. In 1670 this hospital was converted into a public one by Louis XIV., and subsequently it was enlarged, and received annually about 2000 foundlings, who were chiefly from the provinces. After 1789 the French republic assumed the charge of foundlings, and in 1793 the terrorists declared them all to be *enfants de la patrie*. An imperial decree in 1811 continued the arrangement by which foundling hospitals had become government institutions and the foundlings children of the state. It further ordered the establishment of such hospitals in each arrondissement of France, the children to be suckled and weaned in the institutions, and kept in them until six years of age, when they were to be entrusted to respectable persons, who received a stipend for their support and education. This stipend is yearly reduced until the children attain the age of twelve, when the able-bodied boys are placed at the disposal of the minister of the marine, while delicate ones are provided with suitable work. All foundlings are the property of the state, and if not taken into public service at the age of twelve are apprenticed. It was not many years before the facilities for the disposal of children afforded by the law produced a great increase in the number of foundlings in France. In 1784 the number was estimated at 40,000; in 1811, at 69,000; 1819, at 99,346; 1825, at 117,305; 1830, at 118,073; 1833, at 129,699. Prior to 1811 the reception of foundlings was public, but by the decree of that year each hospital was provided with a turning-box in which the child could secretly be deposited. After 1834 most of the hospitals had suppressed the turning-boxes, from a conviction that the great increase in the number of foundlings since 1811 was due to their use. In 1852, however, M. Ulysse Ladet wrote a series of papers advocating their restoration, but was opposed on the ground that they encouraged parents to abandon their offspring. On the other hand, the statistics of infanticide are decidedly favorable to the turning boxes. The question of the public or secret reception of abandoned children, and consequently of the use or suppression of turning-boxes, is one that must be decided by considerations aside from infanticide, and is at present receiving careful attention in most countries. In most of the Roman Catholic countries of Europe the same system as that in force in France for the care of abandoned children was adopted, and in many exists to the present

day. Prior to the separation of Holland and Belgium, 19 foundling hospitals were in existence. In 1815 they maintained 10,739, and in 1826, 13,220 foundlings. In 1859 the number of children abandoned in Belgium exceeded 8000, or 1 child to every 18 born, notwithstanding that since 1834 the turning-boxes have been abolished, though foundling hospitals for the open reception of children are very numerous. In France likewise, since 1834, the secret reception of foundlings has been declared illegal, and consequently the turning-boxes abolished. In 1784 a large foundling hospital was established in Vienna by Joseph II. In 1759 a similar institution was opened in London by Thomas Coram; since 1760, however, this institution has been open only for the reception of poor illegitimate children of known parentage. In 1762 a foundling hospital was founded in Moscow by Catharine II., being afterwards greatly enlarged, so as to include a lying-in department and schools. In 1859 the entire number of its inmates was 25,000, of which 600 were infants, with about 5000 children farmed out to the peasantry, women receiving about five rubles a week for caring for a child. The Vospitatelnoi Dom in St. Petersburg was founded in 1772, also by Catharine II., as a branch of the one in Moscow, and like the latter has since been greatly enlarged, and has a lying-in department and a school. In 1790 it contained 300 children, and in 1837 about 25,000. In 1859 it annually received about 7000 foundlings, many of whom are brought as far as from Siberia and Bessarabia. On this account the mortality amongst the infants has been large, many being received in a dying condition from exposure. According to the laws of Russia, all foundlings are the property of the government, and the army and navy are largely recruited from this class. Owing to the prevalence of the crime of infanticide in China, a foundling hospital was established about 1856 in Canton, but the number of children received has been exceedingly small in proportion to the births. In the city of Mexico there has long been a *cuna* or foundling hospital capable of accommodating 600 children. It is maintained solely by private means, and receives the supervision of certain ladies. The infants are kept in the institution one month, and are then sent to the country or villages in charge of a nurse, who is responsible to some party in the neighborhood. These children after a certain age are generally adopted by respectable persons. In the foundling hospital in Rio de Janeiro all the male children are apprenticed at maturity to trades, and the girls are educated to make able and useful wives. At each anniversary men desiring to marry attend, and after due certification of their characters are allowed to select one of the marriageable girls, with whom a small dowry is given from the hospital funds. The great hospital of Santo Spirito in Rome has a foundling department capable of holding 3000 children, and it annually receives about 800, many of whom are farmed out in the country. At Naples the foundlings receive more attention than in any other Italian city. Its hospitals receive annually about 2500 infants, of whom a large number are of legitimate birth, abandoned on account of poverty. The Dei Trovatelliale Annunziata in Naples, which was founded in the thirteenth century, has an educational establishment which annually costs 400,000 lire. This institution alone receives 1900 foundlings annually in the turning-box. Every foundling received has a number fastened around its neck to aid in future recognition. Two infants are given in charge of one out-door wet-nurse, and on attaining the age of eighteen months are entrusted to the nuns for further care; 37 per cent. of the nurslings are thus cared for, 19 per cent. are paid for by the institution, and others are taken charge of by their parents. Only 12 per cent. are returned again to the institution, the rest being retained by those having them in care; especially is this the case with the boys, as they can be made useful after the seventh year. All the children remaining in the institution after the age of seven are transferred to the orphan asylum, where they are taught some trade. Every infant received in the foundling hospital of Florence is farmed out, the wet-nurses receiving ten francs a month, and a further gratuity if they retain the foundlings until their eighteenth year. The girls on being married receive 235 francs. From 1855 to 1865, 1403 received this reward. In 1867 there were 83 organized foundling hospitals in Italy; from 1863 to 1866 these institutions received 33,222 foundlings—3.85 per cent. of the whole number of births in the kingdom. Of these 33,222 children, a large number were of legitimate parentage. The foundling institution in Rome is at present conjoined with the large institution for the poor and sick, and is conducted in like manner as the one in Naples. Almost all the infants are farmed out, only the weakly ones being retained, numbering about 60 or 70. For the infant farmed out under one year of age the institution pays the wet-nurse a small sum, and arrangements are made for the permanent care of some. From 1830 to 1840 the average yearly number of foundlings was 834, while from 1860 to 1865 it reached 1116. In the Madrid hospitals the infants are also farmed out until seven years of age, when they are transferred to the college of the "Forsaken" (*Desamparados*) to be educated. In Portugal the number of illegitimate children exceeds that in Spain, and consequently the number of abandoned infants is great. The Santa Casa de Misericordia in Lisbon contains an immense foundling department, conducted in a manner similar to those in Spain. The foundling hospitals of St. Petersburg are divided into the following departments: 1, the nursery; 2, twelve country districts, to which the foundlings are sent to be educated; 3, a hospital in the city for the crippled and incurable; 4, a country institution for the residence of children of legitimate parentage. In 1864 the number of foundlings amounted to 6181, of which 422 were legitimate. A large majority of the infants were but a week old. The number of foundlings received in the Moscow institution from 1862 to 1864 was 35,387, of whom 10,000 died in the same period. The infants are cared for by wet-nurses selected carefully from those offering their services. The foundling hospitals in Vienna and Lower Austria receive infants on the following conditions: declaration of the community to which the infant or mother belongs, of her religion, and proof of its illegitimacy in case it is to be received permanently. Admission is free to infants born in hospitals. Admission is granted to illegitimate children on payment of a stipend by the relatives or townships of the mothers. The infant's maternity is known only to the authorities, and such information is given on presentation of the certificate given the child's mother on its admission. The institutions provide for the children until their tenth year, after which its support must be assumed by its native village or town. While in charge of the institution the children are raised either within or outside the buildings: in both cases they are universally wet-nursed. During the five years from 1863 to 1868 the Vienna foundling hospital received over 54,478 infants. In the Prague foundling hospital the children are only kept a short time, and are then farmed out in the country, only those being kept in the institution who are feeble, and for whom nurses cannot be found outside. Those given in charge to outside parties are still claimed by the institution, and at their sixth year they receive a free schooling. At the age of ten years the institution relinquishes all claim to the child, when the village or town of the mother must provide for its support, or its own mother may reclaim it on proving her ability to provide for it. In Munich the following rules for the care of illegitimate children are strictly enforced: It is a misdemeanor to take charge of such children under eight years of age without approval of the police authorities, and such permission is refused unless the character, circumstances, and locality of the petitioner are satisfactory. The infants given in charge of nurses are first examined by medical men, and no women are allowed to receive foundlings to the neglect of their own children. In France at the present time the same rules are observed as laid down in the decree of the emperor Napoleon in 1811, of which a portion is already noticed. Reclamations are not frequent, the majority being boys. In 1853 the number reclaimed in all France was 4390. The management of the London Foundling Hospital at present is as follows: The governors meet once a week to receive petitions for the admission of children. A child can only be received upon personal application of the mother, who is obliged to state the circumstances requiring her to abandon her child, and to give her name, residence, age, date of child's birth, sex, father's name and occupation. Shortly after admission the infants are sent into the country, where they remain until their fifth year, when they are returned to the institution, where they are educated. At the age of fifteen the girls are apprenticed out as domestic servants until the age of twenty. The boys are apprenticed at the age of fourteen as mechanics until they attain the age of twenty-one years. In both cases those to whom they are apprenticed are held to a strict accountability for their physical and moral well-being. After the termination of the period of apprenticeship the institution ceases to exercise any control over the foundlings. At the present day in England the boarding-out system for foundlings is being extensively tried, and meeting with great approval. The advantages claimed for this method are that the children are removed from pauperizing tendencies, and are put upon an equal footing with other children. It is claimed that foundlings thus brought up have in most instances become good men and women. In Scotland the boarding-out system has been widely adopted, and from its marked success has won universal approval. In the U. S. the care of foundlings in institutions is the universal system, and most of the larger cities have their foundling hospitals, either under control of and supported by private and sectarian associations, or the State government. The

city of New York has a large foundling hospital on Randall's Island, capable of receiving 1200 infants yearly. It is under municipal control. Within a few years the large foundling hospital of the Sisters of Charity has been established in New York City from money received from the State and other sources. It is wholly under control of the Roman Catholic sisterhood, and is most admirably managed. Boarding-out the infants to responsible women is largely practised by this institution, and with good results. At both institutions the infants are secretly received, no questions being asked of those bringing the infants to the hospitals. The opinion of those who have given the subject their careful attention is adverse to large asylums for infants, and statistics show that under such circumstances the mortality is larger than among the poorest people. B. F. DAWSON.

Foun'dry, an establishment for shaping metallic figures by pouring the molten material into moulds in which it cools and is solidified. The operation is called casting or founding. Metal casting was successfully practised in ancient Assyria, Babylonia, Phœnicia, and Greece; and the Chinese and Japanese have long excelled in casting both iron and bronze. In modern times in more highly civilized lands casting has attained great perfection. Iron founding, brass, bronze, and type founding are special forms of the art. Of especial importance is the formation of the mould, within which, if the casting be hollow, a *core* is placed. The mould is in general formed of loam, moulding-sand, plaster, or even, for some articles, of metal. For small and nice objects pounce, or powdered cuttle bone, is sometimes used for making the mould. The core is always of some material which will yield during the contraction of the metal. Type-foundries employ steel moulds. In the iron-foundry the metal is generally melted in a furnace of the form called *cupola;* coke, charcoal, and in this country anthracite, are employed in melting the iron. For many forms of nice casting, requiring clean edges and well-defined lines, bog iron, which is often heavily charged with phosphorus, is preferred, since it is more perfectly liquid when in a molten condition than most other kinds of iron. The variety of articles now manufactured in the foundry is very great. The principle employed in all kinds of casting is very obvious and simple, but the practical details are very numerous, and can be properly learned only by experience. (See PRINTING.)

Foun'tain [Fr. *fontaine*, from Lat. *fons*, a "spring of water"] is strictly the name of any spring of water, but in this sense it is now generally applied to famous or historic springs, as the fountain of Arethusa, of Cyane, of Bandusia, or of Vaucluse. More often at present it designates an artificial basin and jet for the flow of water from aqueduct-pipes. Fountains are designed not only for use, but for decoration, and hence they are often elaborately fashioned after artistic designs.

Fountain, county in the W. of Indiana. Area, 400 square miles. It is bounded on the W. by the Wabash River. It is generally level, has a black fertile soil, and abundance of fine timber. Block coal and iron ores abound. Cattle, grain, and wool are produced. There are considerable manufactures of carriages, wagons, boots, and shoes. It is traversed by the Indianapolis Bloomington and Western R. R. Cap. Covington. Pop. 16,389.

Fountain, tp. of Monroe co., Ill. Pop. 2977.

Fountain, post-tp. of Fillmore co., Minn. Pop. 1037.

Fountain, tp. of Juneau co., Wis. Pop. 599.

Fountain City, post-v. of Buffalo co., Wis., on the E. bank of the Mississippi River, 10 miles N. W. of Winona, Minn., in a rich agricultural district. It has 2 large steam saw-mills, 1 steam flour mill, 1 machine shop, 1 newspaper, several stores, 3 churches, and 5 hotels. Pop. 867. JOSEPH LEICHT, ED. "REPUBLICAN."

Fountain Creek, tp. of Iroquois co., Ill. Pop. 503.

Fountain Green, post-tp. of Hancock co., Ill. P. 1475.

Fountain Prairie, tp. of Columbia co., Wis. P. 1286.

Fouqué (FRIEDRICH HEINRICH KARL), BARON DE LA MOTTE, German poet and novelist, b. at Brandenburg Feb. 12, 1777; served in the campaigns of 1792 and 1813; retired from the army, on account of ill-health, as major, and resided at Paris, at Halle, and on his estate of Nennhausen. *Undine* was written in 1813, *Corona*, poem, in 1814, *Der Zauberring* ("The Magic Ring") in 1816, *Eginhard und Emma*, drama, and *Bertrand du Guesclin*, epic poem, in 1821. D. at Berlin Jan. 23, 1843.

Fouqué (HENRI AUGUSTE), BARON DE LA MOTTE, Dutch general, b. at The Hague 1698, served in the Prussian army against Charles XII. of Sweden 1715; acquired the friendship of the Prussian prince royal, afterwards Frederick the Great, and received a command from him in 1740; rose to the rank of a general (1759) in the wars of Frederick: was wounded and taken prisoner at the battle of Landshut in 1760; and d. at Brandenburg May, 1774.

Fourchambault, town of France, in the department of Nièvre, on the Loire. It has very extensive iron-smelting furnaces and forges. Pop. 5348.

Fourche, tp. of Pulaski co., Ark. Pop. 601.

Fourcroy, de (ANTOINE FRANÇOIS), COMTE, French chemist and politician, b. at Paris June 15, 1755; became M. D. in 1780; from 1784 to 1809 was professor of chemistry at the Jardin du Roi; in 1785 was admitted to the Academy of Sciences; was a member of the National Convention in 1792, and of the Committee of Public Safety in 1794; of the Council of Ancients in 1795; appointed minister of public instruction Sept. 15, 1802. D. at Paris Dec. 16, 1809. *System of Chemistry* (11 vols. 8vo) was issued in 1801, *The Philosophy of Chemistry* in 1792.

Four Evan'gelists, The, four small islands at the entrance of the Strait of Magellan, which, together with eight other small islands running 15 miles farther out in the Pacific, form the group called "The Twelve Apostles."

Fourier (FRANÇOIS MARIE CHARLES), the founder of the social system called Fourierism, b. Apr. 7, 1772, in Besançon, and educated in the college of his native city. He had both talent and inclination for studies, especially for mathematics, music, geography, and natural history, but when he was eighteen years old his father put him into the office of a merchant in Lyons as a clerk, and commerce became his business in life, very much against his will. In 1793 he inherited a fortune from his father, but lost it the same year on account of the revolutionary disorders in Lyons, in which he became entangled. He was imprisoned first in Lyons, then in Besançon, and he escaped only by becoming a dragoon in the Revolutionary army. Having been discharged from the military service in 1795 on account of ill-health, he returned to his commercial pursuits, residing in Marseilles till 1825, in Lyons till 1832, and then in Paris, where he d. Oct. 10, 1837. He lived very retired, held always inferior positions, and had only miserable salaries. In his few leisure hours he wrote his books, and with his scanty spare money he published them. They made no sensation, they hardly attracted any attention, and yet every single day of his life, on returning home from his office, he expected to find some enthusiastic millionaire waiting for him, ready to invest his millions in a social experiment according to the new theory. His first book, *Théorie des quatre mouvements et des destinées générales*, was published in 1808; his second and most important, *Traité de l'association domestique agricole*, in 1822; and a sort of compendium of both, *Nouveau monde industriel et sociétaire*, in 1829; but they found only very few readers. It was not till 1831, when the social schemes of St. Simon and of Robert Owen were much discussed, that Fourier attracted any attention for his own ideas by his savage attacks on these two reformers, *Pièges et Charlatanisme des Deux Sectes Saint Simon et Owen, promettants l'Association et Progrès.* From that time several talented disciples gathered around him—Madame Clarisse Vigoreaux, Victor Considerant, Cantagrel, Hennequin, and Mennier. A monthly paper, *La Phalange*, was issued, and later on even a weekly, *La démocratie pacifique.* In England and the U. S. Fourierism found warm adherents in Hugh Doherty and Albert Brisbane, and practical experiments were made both in France and America. They failed, however, and at present the whole idea seems to have lost its hold on the public interest.

The negative side of Fourier's writings, his criticism, is very brilliant. It is bitter, but it is acute, often strikingly true, and always full of noble suggestions. But the positive side of his system is theoretically a failure, and where it also has proved a failure practically the reason is hardly that the experiments have been made with insufficient means, but that the fundamental idea is incompatible with human nature and human destiny. Fourier considers our civilization, in its present shape, as the root of all our vices and the cause of all our miseries; and his views and arguments on this point carry a kind of conviction with them in all their critical details. But the remedy he prescribes, his ideal of a new civilization, his social system, is fantastic, and, what is worse, no remedy at all. Its speculative part, the foundation of the system in the nature of the universe and the human soul, is awkward and insufficient, and its practical part, the phalanstery, where 1800 people live, work, and enjoy together in one building, is a dream, which perhaps would do away with much vice and misery, but which certainly would also do away with much virtue and all heroism. In order to gain freedom in a comfortable but narrow sense of the word, Fourier cuts it off in its large and dangerous but inspiring sense. In order to secure to each individual a certain amount of enjoyment, he cuts off from mankind the prospect of an infinite degree of happiness.

In order to get rid of the errors, crimes, and horrors in which human destiny is involved, he lowers this destiny to an eating, drinking, dancing, and sleeping mediocrity. He is not at war with morals and religion, but he has no use for them. He acknowledges property as a reward to labor and talent, but does not understand it as a necessary complement to the human personality. His phalanstery is the monastery of the Middle Ages revived. To some people it means an asylum, but to others an iron cage. As a critical ferment, however, the value of the works of Fourier and his disciples is considerable. CLEMENS PETERSEN.

Fourier (JEAN BAPTISTE JOSEPH), BARON, French mathematician and natural philosopher, b. at Auxerre Mar. 21, 1768, was a moderate friend of the popular cause in the Revolution, but was twice imprisoned by the ruling party. He was sub-professor in the Polytechnic School 1794–98; accompanied Bonaparte to Egypt as savant in 1798; was prefect of Isère at Grenoble Jan., 1802-15; in 1816 was admitted to the Institute, in 1817 to the Academy of Sciences, and to the Académie Française in 1827. The same year he was president of the council of the Polytechnic School. D. at Paris May 16, 1830. His *Théorie Analytique de la Chaleur* was published in 1822, and he left an *Analysis of Determinate Equations*, published in 1831.

Fourier (PIERRE), known as THE BLESSED PETER FOURIER, b. at Mirecourt, in Lorraine, Nov. 30, 1565, became a Premonstratensian monk, and in 1595 parish priest of Martaincourt, where he founded the congregation of Notre Dame (see NOTRE DAME, CONGREGATION OF), or "Ladies of the Congregation;" and soon after instituted a reform in the Premonstratensian order. D. at Gray Dec. 9, 1640, and was beatified 1730.

Four Lakes, in Dane co., Wis., discharge their waters into Catfish River. They are situated in a beautiful and fertile region. First Lake is 3 miles long and 2 miles wide. Second Lake, the next above, is rather longer. Third Lake (Lake Monona) is 6½ miles long and 2 broad. Fourth Lake (Lake Mendota) is the highest: it is 6 miles long and 4 broad. Between the last two lakes stands Madison, the capital of the State. These lakes are deep, clear, and cold, and are largely fed by springs.

Four Mile, tp. of Wayne co., Ill. Pop. 1817.

Four Mile, tp. of Polk co., Ia. Pop. 531.

Four Mile, post-tp. of Dunklin co., Mo. Pop. 830.

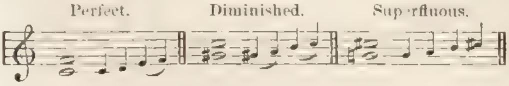
Four Mile, post-tp. of Otoe co., Neb. Pop. 571.

Four Mile, tp. of Barnwell co., S. C. Pop. 1935.

Fournet (VICTOR), b. at Paris May 15, 1801; d. at Lyons Jan. 8, 1869. Was educated at the French School of Mines; graduated doctor of science, and rendered great services to dynamical geology, metallurgy, and mineralogy; demontrated *Fournet's law*, establishing the exact order of the metals as regards their "sulphurability;" was an industrious meteorologist and observer of physical phenomena; introduced great improvements in the treatment of lead ores; was a member of many learned societies, and author of numerous scientific papers of value.

Fourth, in music, an interval comprising four degrees of the scale, or the distance, *e. g.*, from C to F, D to G, etc. Fourths vary in quality or compass according to their place on the scale, numbering from four to six semitones. They are regarded as threefold—viz. the perfect (or major), containing two whole tones and one semitone; the diminished, one whole tone and two semitones; and the superfluous (or augmented), three whole tones; thus:

Perfect. Diminished. Superfluous.



In harmony, the fourth is regarded as a consonance when it occurs as the complement of the perfect fifth, as in the second inversion of the triad. In other cases it is treated as an imperfect dissonance. (See INTERVAL.)

WILLIAM STAUNTON.

Fourth, tp. of Richland co., S. C. Pop. 7687.

Fouvent-le-bas, a v. of France, in the department of Haute-Saône. In 1800, Cuvier discovered in three large grottoes situated in the vicinity a great number of fossil bones of quadrupeds, and in 1827, Thirria determined some of these bones as remains of the rhinoceros, elephant, hyæna, lion, etc.

Fowl [Ger. *Vogel*, a "bird"], in its original meaning as a synonym of *bird*, is antiquated and nearly obsolete, except as a name for domesticated birds of the sub-class Cursores and order Gallinæ. This order contains the common domestic fowl (*Gallus domesticus*), the peacock, guinea-fowl, turkey, etc., all of which are noticed under the proper heads. The domestic fowl is of probable Asiatic origin, but recent observers report the discovery of the bones of the domestic fowl in European kitchen-middens of supposed pre-historic date. (See COCK for some notice of its probable descent.) It was well known to the Greeks, Romans, Etruscans, and, as Cæsar says, to the ancient Britons also. There are innumerable breeds and varieties, among which may be mentioned the Dorking, the game-fowl, the black Spanish, the tall Chinese breeds, the Polish, the Crèvecœur, the Houdan, the little Bantams, the Leghorn, etc. They are valued for the number and excellence of their eggs, and for their flesh, which is excelled by that of no domestic bird except the turkey. The breeds differ much in color, disposition, hardiness, size, and fattening and laying qualities.

Fowle (DANIEL), b. about 1715 at Charlestown, Mass., became a printer of Boston in 1740; published various periodicals, and with Gamaliel Rogers issued the first American edition of the New Testament: was arrested in 1755 on suspicion of printing *The Monster of Monsters*, a severe political brochure, and after a short imprisonment left Boston, and in 1756 began to publish the *New Hampshire Gazette* at Portsmouth, where he d. June, 1787.

Fowle (WILLIAM BENTLEY), b. at Boston, Mass., Oct. 17, 1795; became a bookseller, and in 1821 engaged with success in teaching; became in 1842 publisher of the *Common School Journal*, which he edited 1848–52; published several text-books for schools. D. Feb. 6, 1865.

Fow'ler, post-v., cap. of Benton co., Ind., on Cincinnati Lafayette and Chicago R. R., 28 miles N. W. of Lafayette; has a weekly newspaper.

Fowler, post-tp. of St. Lawrence co., N. Y., has four churches, and beds of iron-ore. Pop. 1785.

Fowler, post-tp. of Trumbull co., O. Pop. 871.

Fowler (CHARLES H.), D. D., LL.D., American Methodist clergyman, b. in Upper Canada in 1837; came with his parents to the U. S. in 1840, graduated at Genesee College, N. Y., in 1859, and studied at Garrett Biblical Institute, Evanston, Ill. In 1861 he entered the Methodist ministry, preaching in Chicago, Ill., until 1872, when he was chosen president of the M. E. North-western University at Evanston, Ill. Editor of *Christian Advocate*, N. Y., 1876–80. He was appointed sec. of missionary society June, 1880.

Fowler (JOHN), b. in 1817; was pupil of J. F. Leathes, hydraulic engineer; at the age of twenty-seven was selected as engineer for the construction of the large group of railways known as the Manchester Sheffield and Lincolnshire. Settling in London, he has been continuously employed in laying out railways, docks, etc. in the United Kingdom and on the Continent. He is the constructor of the Metropolitan Inner Circle (underground) Railway in London, with its peculiar locomotive engines and plant, consulting engineer to the Manchester Sheffield and Lincolnshire Railway, etc., and engineer-in-chief to the government of Egypt; was at one time president of the Institution of Civil Engineers, London.

Fowler (JOSEPH SMITH), b. at Steubenville, O., Aug. 31, 1822; graduated at Franklin College 1843, and was four years a mathematical professor there; studied law in Kentucky, but removed to Tennessee; resided in Springfield, Ill., 1861–62, on account of the proclamation of Jefferson Davis; in 1862 comptroller of Tenn. under the governorship of Andrew Johnson; U. S. Senator from Tenn. 1866–71.

Fowler (Rev. LITTLETON), a distinguished minister of the Methodist Episcopal Church, South, b. in Tennessee Sept. 12, 1802; was licensed to preach in Kentucky Sept. 30, 1826. After filling responsible stations in Kentucky, Tennessee, and Alabama, he went in 1837 as missionary to Texas, and in 1838 was made superintendent of the Texas mission, which extended all over the republic. He was a delegate to the General Conference which met in New York in 1844, and was a member of the Louisville convention at which the M. E. Church, South was organized; shortly after which he d. He was an eloquent and a successful preacher. T. O. SUMMERS.

Fowler (LORENZO NILES), b. in Cohocton, Steuben co., N. Y., June 23, 1811, was for many years the business-partner of his brother, O. S. Fowler, and is the author of several books upon subjects of the same class with those treated of by his brother. He has also lectured extensively in the U. S., Canada, and Great Britain. In 1863 he became a resident of London.—His wife, LYDIA FOLGER, b. at Nantucket, Mass., in 1823, graduated at the Syracuse Medical College, and has lectured on physiology, phrenology, and the diseases of women. She is the author of several popular scientific works.

Fowler (ORIN), b. at Lebanon, Conn., July 29, 1791; graduated at Yale 1815; entered the Congregational ministry; became a missionary in the West; settled in 1819 as pastor at Plainfield, Conn.; was twenty years a minister of

Fall River, Mass.; often in the State legislature; in Congress 1848–52; distinguished as a temperance and anti-slavery orator; author of a treatise on *Baptism* (1850); *Historical Sketch of Fall River* (1841). D. at Washington, D. C., Sept. 3, 1852.

Fowler (Orson Squire), b. at Cohocton, Steuben co., N. Y., Oct. 11, 1809; graduated in 1834 at Amherst College, and with his brother, L. N. Fowler, became widely known as a lecturer, and as writer, editor, and publisher of books and periodicals upon phrenology, health, self culture, education, and social reform; retired in 1863 from his business in New York, and removed to Boston, Mass., still continuing to write and lecture; is the author of numerous well-known works upon the subjects indicated above.

Fowler (William Chauncey), LL.D., b. in Clinton, Conn., Sept. 1, 1793; graduated at Yale in 1816; was tutor 1819–23; pastor of a Congregational church at Greenfield, Mass., 1825–27; professor of chemistry and natural history in Middlebury College, Vt., 1827–38; professor of rhetoric and oratory in Amherst College 1838–43; a son-in-law of Noah Webster, and editor of the University edition of Webster's *Dictionary* (1845); author of a treatise on *The English Language* (1850); of two English grammars; of *The Sectional Controversy* (1863); *Chauncey Memorial* (1856); *History of Durham, Conn.* (1866), etc. Resided in Durham. D. Jan. 15, 1881.—His daughter, Mrs. Emily Ellsworth Ford, published a volume of poems in 1872.

Fow'lerite, crystallized rhodonite from Franklin, N. J.

Fowler's Solution [named from Dr. Thomas Fowler of Stafford, England (1736–1801), its inventor], a solution of arsenite of potash in water, flavored and colored with compound tincture of lavender. Each fluidrachm contains the equivalent of half a grain of arsenious acid. The dose is five or ten drops once, twice, or thrice daily. It is used in many diseases, especially skin diseases and malarial fevers and their sequelæ, and is sometimes very useful in epilepsy and neuralgia. It is a powerful tonic, and should be used only under the eye of a competent physician.

Fowles (James H.), Episcopal clergyman in the U. S., b. at Nassau, N. P., in 1812; graduated at Yale College, New Haven, Conn., in 1831; was licensed by the New York presbytery in 1833, and afterwards ordained by Bishop Bowen of South Carolina. In 1845 settled as rector of the church of the Epiphany, Philadelphia, Pa. D. in 1854. Wrote *Protestant Episcopal Views of Baptism*, etc. (1846), *Thirty Sermons*, published after his death with memoir.

Fowl'ing, the taking of wild fowl either as a sport or as a means of livelihood. The term in the ordinary use would hardly include the shooting of grouse, pheasants, quails, and other land-birds, but is limited to the hunting of wild ducks, geese, and other water fowl, and perhaps the shore-birds, such as the rail and plover. Not the fowling-piece alone, but also nets, snares, stalking-horses, bird-lime, punts, screens, sneak-boats, decoys (living or artificial), and the like, are legitimate means of fowling. The water-spaniel is the best retriever for this work. Fowling, as pursued in Great Britain, has a strange and complicated vocabulary of its own, which it is incumbent upon gentlemen sportsmen to employ. Fowling as a means of livelihood is an important industry, chiefly in cold latitudes. In the Orkneys and other smaller British islands, as in Labrador, birds are pursued not only for their flesh and eggs, but for their feathers, which constitute an important article of commerce. This kind of fowling is a very arduous and dangerous pursuit. In many parishes of the east of England fowling-rights are attached to many rectories and other church livings, which derive hence no small part of their revenue. But this is far less prevalent now than formerly.

Fowl'ing-piece. See Sporting-arms, by Gen. P. V. Hagner, U. S. A.

Fowl Meadow Grass, an excellent grass for hay—the *Poa serotina* of the U. S., Canada, and Europe—growing in wet lands. The *Glyceria nervata* of the Northern States is called by the same name. It grows in wet land, and resembles the former in appearance and value.

Fownes (George), F. R. S., b. 1815; was professor of practical chemistry in the University College, London. D. Jan., 1849. Author of the Actonian prize essay on *Chemistry as exemplifying the Wisdom and Beneficence of God* (1844), and several popular works on chemistry.

Fox [Ger. *Fuchs*], the common name of those forms of the family Canidæ which are externally distinguished by a slender muzzle, vertical pupil, and an elongated bushy tail. Several distinct genera are thus confounded which differ from each other in some remarkable characters. Of these forms one genus (*Vulpes*) is common to the entire northern hemisphere, and has also numerous representatives in Asia and Africa. The most familiar species is the common or red fox of Europe and North America, and embraces several varieties, of which the most characteristic is the prairie or long-tailed fox (*Macrurus*) of the South-western U. S. Another related species, of smaller size, is the swift or kit fox (*Vulpes velox*) of the Western prairies. A third congeneric species with strongly-marked characters is a native of the Arctic circle, and has hairy feet, whence it is called *Vulpes lagopus*. The genus *Vulpes* is very closely related to *Canis*. Another genus (*Urocyon*) has much external similarity to *Vulpes*, but is distinguished from it by several very important anatomical characters. It is peculiar to North America, and embraces a single well-determined species (*Urocyon virginianus*); but there is an insular and tropical race which is much smaller, and has been considered as a distinct species, and named *Vulpes littoralis*. Theo. Gill.

Fox, tp. of Kendall co., Ill. Pop. 1265.

Fox, tp. of Black Hawk co., Ia. Pop. 812.

Fox, tp. of McDonald co., Mo. Pop. 529.

Fox, tp. of Carroll co., O. Pop. 1119.

Fox, tp. of Elk co., Pa. Pop. 1188.

Fox, tp. of Sullivan co., Pa. Pop. 443.

Fox (Sir Charles), English civil engineer, b. at Derby in 1810, was designed by friends to follow the medical profession, but studied engineering and was first employed by Ericsson. At the commencement of the construction of the London and Birmingham Railway Company's line he was appointed its assistant engineer by Robert Stephenson, and remained with the company five years, or a year subsequent to the opening of the railway. Then he joined the late Mr. Bramah in establishing the firm of Bramah, Fox & Co., afterwards Fox, Henderson & Co. He drew the plans for the building for the Great Exhibition in Hyde Park in 1851, spending eighteen hours per day in their execution for seven weeks, and being knighted for the work. He constructed the Sydenham Crystal Palace and many extensive railway and engineering works, and was senior partner in the firm of Sir Charles Fox & Sons, civil engineers. D. June 17, 1874.

Fox (Rt. Hon. Charles James), the second son of Henry, Lord Holland, by Georgiana Carolina, daughter of the duke of Richmond, a descendant of Charles II., was b. in London Jan. 24, 1749, and educated at Eton and at Hertford College, Oxford. He did not graduate, but travelled 1766–68 upon the Continent, where he acquired a lifelong fondness for Italian literature. In 1768 he took a seat in Parliament for Midhurst, from which borough he was elected before he came of age. In 1770 he became a junior lord of the admiralty, and in 1773 a lord of the treasury, whence he was dismissed in 1774 by Lord North on account of his independent spirit. From this time he stood by the side of Burke and the Liberals, and assailed with most brilliant and effective eloquence the administration of Lord North, foretelling the eventual defeat of the British arms in North America. In 1780 he was chosen to represent Westminster in Parliament. In 1782 he was secretary of state for foreign affairs under the marquis of Rockingham, and in 1783 was secretary of state in the Portland ministry. In 1783 he introduced his India bill for the relief of the inhabitants of British India, but the East India Company, the king, and the House of Lords combined to defeat him, and he resigned. He stood again for Westminster, and was elected, but was unseated through the influence of the ministry. He entered Parliament for a Scottish burgh, and punished the offending magistrates of Westminster by a successful suit at law. He now became the prime leader of the Liberal party, from which Burke was so soon to secede; joined heartily in the prosecution of Warren Hastings; opposed with all his powers the policy of Pitt and his interference in continental affairs; supported Wilberforce in his efforts for the abolition of the slave-trade; and hailed from the first the French Revolution as the harbinger of a new era of freedom. Between Napoleon and Mr. Fox there was a mutual respect, which amounted almost to a personal friendship. From 1797 to 1802 he absented himself from Parliament completely. In 1806 he entered the ministry as secretary for foreign affairs, and in a personal note addressed to Napoleon offered peace, but did not live to see it effected. D. at Chiswick Sept. 13, 1806. He left no legitimate children. Mr. Fox was brought up by his father to a loose way of private life. An inveterate gambler, a hard drinker, the greatest spendthrift of his day, he was still a man of most generous and noble impulses and of kindly and genial disposition. To the consummate excellence of his oratory Burke, Mackintosh, Parr, Franklin, and all the best critics of his time bear the amplest testimony. His political views were always liberal and progressive, always far in advance of his time. His incomplete *History of the Reign of James II.* was published in 1808, and some minor works, and six volumes of his speeches appeared in 1815.

Fox (CHARLES JAMES), b. at Antrim, N. H., Oct. 11, 1811; graduated at Dartmouth 1831; was law-partner with Hon. Daniel Abbot of Nashua, N. H., in 1834; member of the New Hampshire legislature in 1837; county solicitor 1835–44; member of a commission to revise the New Hampshire statutes in 1841–42; went to Egypt in 1843, and to the West Indies in 1844; compiled with Rev. Samuel Osgood, D. D., *The New Hampshire Book of Prose and Poetry* (1842), published the *History of Dunstable* (1846), and the *Town Officer* (1843). D. at Nashua, N. H., Feb. 17, 1846.

Fox (CHARLES RICHARD), English general, natural son of the third Lord Holland, b. in 1796, was in the navy from 1809 to 1813; served at the sieges of Cadiz and Tarragona; entered the 85th regiment in 1815, and was for years aide-de-camp to Sir F. Adams, at Corfù. He commanded the 34th regiment in America; was then in the grenadier guards, and aide-de-camp to King William IV. and to Queen Victoria. He sat in Parliament for Calne in 1831, and afterward for Tavistock, Stroud, and the Tower Hamlets, and was for some time surveyor-general of the ordnance under the Whig government. Became a general in 1863. D. 1873.

Fox (GEORGE), founder of the Society of Friends, b. at Drayton-in-the-Clay (now Fenny Drayton), Leicestershire, July, 1624, was the son of pious Christopher Fox, weaver, called among his neighbors "righteous Christer." His parents were both members of the Church of England. Fox was early bound apprentice to a shoemaker and glazier, but in 1643 abandoned this occupation, and in 1647–48 began itinerant preaching. For this he was repeatedly arrested and imprisoned from 1649 to 1666, but submitted as one ready to lay down his life for his faith. In 1652 he formed congregations in Lancashire. In 1669 he married Margaret, widow of the Welsh judge Thomas Fell, and in 1671 visited America. At Barbadoes, on this journey, he drew up a paper setting forth the belief of the Friends as to the fundamental doctrines of Christianity. In Mar., 1673, he embarked for England. He was soon imprisoned again in Worcester jail, remained in confinement a year, and was freed through the influence of Sir Matthew Hale. In 1677 and 1681 he visited the Friends in Holland, and established monthly, quarterly, and yearly meetings there. He returned to England, and d. in London Jan. 13, 1691, having continued his public addresses to within a few days of his death. His writings were published in three vols. folio—viz. 1, *Journal of his Life, Travels*, etc., 1694; 2, *Collections of many Select and Christian Epistles, Letters, and Testimonies written by George Fox* (1698); 3, *Gospel Truth Demonstrated in a Collection of Doctrinal books given forth by George Fox, containing Principles Essential to Christianity and Salvation held among the people called Quakers* (1706). (Consult SEWELL'S *History of the Quakers*; JOSIAH MARSH'S *Life of Fox*, 1848; JANNEY'S *Life of Fox*, etc., 1853; C. H. SPURGEON'S *George Fox*, an address to the Society of Friends, London, 1866; TALLACK'S *George Fox, The Friends and the Early Baptists*, London, 1868; H. WEINGARTEN'S *Revolutionskirchen Englands*, Leipsic, 1868; and for a full account of Fox's writings and publications, JOSEPH SMITH'S *Catalogue of Friends' Books*, BARCLAY'S *Apology*, London, 1678, and T. EVANS' *Exposition of the Faith of the Religious Society of Friends* (Philadelphia, 1828), for determination of the doctrinal views of Fox and the early Quakers.)

Fox (GUSTAVUS V.), b. at Saugus, Mass., June 13, 1821; midshipman U. S. navy in 1838, and served for nineteen years on different stations, in the Coast Survey, in command of mail-steamers, and in the war with Mexico. Resigned in 1856, and became agent of the Bay State Woollen Mills at Lawrence, Mass. In Feb., 1861, was sent for by Gen. Scott, at the instance of Postmaster-General Blair, in reference to throwing supplies and troops into Fort Sumter; but Pres. Buchanan refused at that time to allow the expedition. Subsequently, Mr. Lincoln approved the plan, sending Capt. Fox to Fort Sumter to communicate with Maj. Anderson, and on his return directed him to carry out his plan, which was, however, virtually thwarted by the withdrawal of the Powhatan for another expedition, that of reinforcing Fort Pickens. The expedition, thus mutilated, could only proceed to Charleston harbor, where the Confederates, learning of its departure, had already opened fire upon the fort it was destined to relieve, but for which it was shorn of its essential strength. It could only serve to bring away Maj. Anderson's command after his surrender. Communication with Washington being cut off, Capt. Fox then applied to William H. Aspinwall and W. B. Astor, who fitted out a steamer (the Yankee), of which he was appointed an acting captain, and in which he sailed for Chesapeake Bay, the occupation of which he deemed vital. Mr. Lincoln now conferred upon Capt. Fox the appointment of assistant secretary of the navy, which position he held till the close of the war. In this capacity he is thus mentioned to the writer by a prominent member of Mr. Lincoln's cabinet: "Fox was, in my opinion, the really able man of Lincoln's administration. . . . He planned the capture of New Orleans and the opening of the Mississippi, and generally the operations of the navy. He had all the responsibility of removing the superannuated and inefficient men he found in charge. . . . He selected Farragut. Gen. Grant constantly consulted him. . . . Not the least meritorious part of his services is, that he sought only to make them useful, claiming neither then nor now the fame due to his services." Nor does this imply any disparagement of the secretary (Mr. Welles), whose department, the most perfectly managed in this supreme crisis of any of the great government departments, improvised a navy and never failed to meet all requirements. Soon after the close of the war Congress created an additional assistant secretary of the navy to enable the government to send Capt. Fox to Russia to present to the emperor Alexander II. the congratulations of the American Congress on his escape from menaced assassination. This mission marks the high estimate formed of Mr. Fox's talents and services during the war by the government. Russia alone, of the great powers of Europe, having taken a decided stand for the American Union, the mission was of great importance. Regardless of self, he had declined to ask an admiral's commission, which he might have obtained, accepting the Russian mission as his sole reward, and on his return resigned his official appointments and resumed the charge of extensive woollen manufactories in Lowell. More recently he has become a member of an important business house in Boston. J. G. BARNARD.

Fox (JOHN), b. at Boston, Lincolnshire, England, in 1517; entered Brasenose College, Oxford, in 1533; chosen a fellow of Magdalen College in 1543; became a Protestant, and in 1545 was deprived as a heretic; was tutor to the children of Sir Thomas Lucy, and later (1547–53) to those of the earl of Surrey; was ordained deacon by Ridley 1550; lived at Bâle during Mary's reign; returned in 1559; became a prebendary of Sarum 1563; and d. in London Apr. 18, 1587. He is chiefly remembered as author of the *Acts and Monuments* (1563), well known as Fox's *Book of Martyrs*.

Fox (LUKE), an English navigator who in 1631 commanded an expedition in search of a north-west passage. He discovered Cumberland Island and other important points of Arctic America.

Fox (WILLIAM JOHNSON), b. at Uggeshall Farm, near Wrentham, Suffolk, in 1786. His father was a weaver. The boy gave early evidence of remarkable ability, and was sent to Homerton College (Hackney), then under the care of Dr. Pye Smith, to be educated for the Christian ministry among the Independents. But his opinions led him away from that connection; he became a preacher of Unitarianism, till, departing still farther from the accepted belief, he separated from all denominations, and took an isolated position as a rationalist preacher in South Chapel, Finsbury, London. Here he attracted attention by the speculative boldness of his views, his innovations on the ordinary customs of worship, and the secular tone of his discourses. His audiences, though never very numerous—the chapel was a small one—were composed of people remarkable for intelligence and influence on the world of mind. He was a powerful teacher, with a strong infusion of the social agitator. His interest in politics made him a leader among the Liberals. No abler speaker addressed the meetings of the Anti-Corn-Law League; no abler writer took up the pen for the most extreme measures of the "party of progress." His *Letters of a Norwich Weaver Boy*, which were printed in the newspapers, did powerful service. His *Lectures to the Working-Classes* were widely read, and did much to prepare the way for present movements. In 1847, Mr. Fox was elected to Parliament from Oldham, was defeated in 1852, and re-elected the same year to fill a vacancy caused by death. At the general election in 1857 he was again defeated. D. in London June 3, 1864. The writings of Mr. Fox are comprehensive and vigorous. Three volumes of sermons show what he was as a pulpit-orator; a book on *The Religious Ideas* shows the cast of his philosophic thought. Mr. Fox was warmly interested in American institutions, and cordial in his welcome to leaders of American thought. In religious belief he resembled the Transcendental Unitarians. He was a theist and an idealist. The two points of his creed were "the perfection of divinity—the immortality of humanity." O. B. FROTHINGHAM.

Fox'boro', post-v. and tp. of Norfolk co., Mass., 21 miles S. W. of Boston, on the Boston and Providence and Mansfield and Framingham R. Rs. It contains a large straw-hat and bonnet manufactory, carpet-lining, box, soap, and spring-bed factories, 1 furnace, a granite-quarry, and several minor industries. It has 2 local papers, 1 savings bank, a public library, public buildings worth

$90,000, 5 churches, and 2 hotels. Principal business, manufacturing. Pop. 3057.

ROBT. W. CARPENTER, ED. "JOURNAL."

Fox'burg, post-v. of Richland tp., Clarion co., Pa., on the Allegheny River and the Allegheny Valley R. R., 58 miles below Oil City.

Fox Creek, tp. of Clay co., Ala. P. 839.

Fox Creek, tp. of Randolph co., Ala. Pop. 972.

Fox'croft, post-v. and tp. of Piscataquis co., Me., 60 miles N. N. E. of Augusta, has manufactures of machinery, farming tools, lumber, flannels, mouldings, carriages, etc., and is the seat of an academy. Pop. 1178.

Foxglove. See DIGITALIS.

Fox'hound, a variety of the dog, bred principally in Great Britain and Ireland, and adapted to the national sport of fox-hunting. The foxhound is a cross of the bloodhound, whence it derives its keen power of scent; the greyhound, which gives its speed; and the bulldog, which has conferred upon its descendant its own courage and persistency. At present, however, the breed of foxhounds is regarded as well established, requiring no further cross with either of the original stocks. This is about two feet high.

Fox-Hunting, one of the national sports of England, is a very different pastime from what is called by that name in the Northern States of America. Here the acquisition of the fur is a principal object; the fox is followed by one or more hounds and by the huntsman, often alone and on foot, and he shoots the fox with a rifle. But in England the fox is followed by a pack of from 40 to 120 dogs, and by a large number of gentlemen and ladies on horseback. As they ride in the chase the party are under the charge of a master, the hounds being in the care of a huntsman and "whippers-in" or whips. The bolder members of the hunt leap their horses over fences, gates, and hedgerows, and all feel at liberty, when necessary, to rush headlong through grain-fields and other growing crops—an outrage which seems to be justified by public opinion. The fox is not shot, but when caught by the dogs the huntsman cuts off his brush (tail), pads (feet), and mask (face), which are given as trophies to those who may be present, or "in at the death," as it is called. The flesh is cut up and given to the dogs, to be devoured on the spot.

Fox Indians, called by themselves **Outaga'mie** (that is, "Foxes"), **Musqua'quink,** "red clay men," a tribe of North American aborigines of Algonkin stock, have, ever since known to white men, been intimately associated with the Sac (or Sauk) tribe, and the two together are always spoken of as SACS AND FOXES (which see).

Fox Islands, in Lake Michigan, are two in number, the North and South Fox. They belong to Chandler tp., Manitou co., Mich. Pop. 44.

Fox Islands, Pacific Ocean. See ALEUTIAN ISLANDS.

Fox Lake, post-v. and tp. of Dodge co., Wis., is located upon the outlet of a small, beautiful lake 60 miles N. W. of Milwaukee, and is connected by horse-railroad with the Milwaukee and St. Paul R. R. It is the seat of the Wisconsin Female College, has a graded public school, 5 churches, 1 State bank, 1 newspaper, 1 hotel, a foundry, a flouring mill, a brewery, Odd Fellow, Masonic, Good Templar, and Granger lodges, and the usual number of stores and shops. Pop. of v. 1086; of tp. 1916.

JOHN HOTCHKISS, ED. "FOX LAKE REPRESENTATIVE."

Fox Mills, tp. of Wilcox co., Ala. Pop. 720.

Fox River, a stream rising in Green Lake co., Wis., and, taking a S. and S. W. direction, approaches to within 1½ miles of the Wisconsin River, with which it is connected at Portage City by a canal. It flows then by a circuitous N. and N. E. course to Green Bay, Wis., into which it falls at the town of that name. The improvement of this river by lock and dam navigation, and by jetties, is being carried on by the U. S. government as the connecting-link of communication between the Atlantic and the great system of internal navigation furnished by the Mississippi and its tributaries. The route leads from the Mississippi by way of Wisconsin River, the Upper Fox, Lake Winnebago, and Lower Fox River to Green Bay, and thence by way of the lakes to the Atlantic Ocean, and is one of the great routes set forth by the Senate committee on cheap transportation.

Fox River rises in Waukesha co., Wis., flows S. and S. W., emptying into the Illinois River at Ottawa, Ill. It furnishes abundant and well-improved water-power.

Fox River, post-v. of Fox tp., Gaspé co., Quebec, Canada, has a shallow harbor, much resorted to during westerly winds by American mackerel-vessels. It has a court-house, thriving cod fisheries, and a good soil. Pop. 450.

Fox River, tp. of White co., Ill. Pop. 1867.

Fox River, tp. of Davis co., Ia. Pop. 1256.

Fox Shark, or **Thresher,** the *Alopias vulpes*, a shark of the Atlantic and Mediterranean, is twelve to eighteen feet long, the tail about as long as the body. It boldly attacks the whale, striking fearful blows with its tail; whence it is called thresher. It devours great numbers of small fishes.

Fox Shark.

Foy (MAXIMILIEN SÉBASTIEN), b. at Ham, France, Feb. 3, 1775; entered the army in 1791; served with distinction in the republican wars; was in Massena's and Moreau's Swiss and German campaigns, but his known coldness towards Napoleon tended to check his promotion. In Italy and the Peninsula he so skilfully and valiantly supported the cause of France that in 1810 he was made a general of division. At Waterloo he received his fourth wound in battle. In 1819 he was sent to the Chamber of Deputies, where he appeared in a new *rôle*, that of a liberal orator; but the toil and excitement of public life, joined to the effects of his old wounds, soon wore out his strength, and the disinterested patriot, the able and fearless soldier, the gifted champion of liberty, d. at Paris, Nov. 28, 1825. The people subscribed freely for his children, whom he left poor. He left *Speeches* (2 vols., 1826) and *History of the Peninsular War* (unfinished, 4 vols., 1827).

Foy'ers, or **Fyers,** a river of Scotland. It rises in the Monadleadh Mountains in Inverness-shire, and after running 12 miles N. it falls into Loch Ness. It forms two falls—an upper one of 30 feet, and a lower one of 90 feet, of which the latter is the finest fall in Great Britain.

Foyle, a river of Ireland. It is formed at Lifford by the junction of the Finn and the Mourne, and after a course of 14 miles it falls into Lough Foyle, an inlet of the Atlantic on the northern coast of Ireland. It is famous for its salmon-fisheries, and is navigable for vessels of 600 tons to Londonderry, 4 miles from the Lough.

Frac'tions [Lat. *frango, fractum*, to "break"]. If an integral unit is divided into any number of equal parts, each part is called a *fractional unit*. If the integral unit is divided into *two* equal parts, each part is called a *half;* if into *three*, each part is called a *third;* if into *four*, each is called a *fourth;* and so on. These units are written $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc. A fraction is a fractional unit or a collection of fractional units. Thus, *one-half, two-thirds, four-ninths*, etc. are fractions; they may be written $\frac{1}{2}$, $\frac{2}{3}$, $\frac{4}{9}$, etc.

Every fraction consists of two parts—a *denominator*, which shows the value of the fractional unit, and a *numerator*, which indicates the number of times this unit is taken. Thus, in the fraction $\frac{a}{b}$ (read a divided by b), the denominator is b and the numerator is a. The denominator shows that the integral unit 1 is divided into b equal parts to form the fractional unit $\frac{1}{b}$, and the numerator shows that a of these parts are taken. The fraction $\frac{a}{b}$ is therefore equivalent to a times the quantity $\frac{1}{b}$.

Fractions are divided into two classes—*vulgar* or *common fractions*, and *decimals*. Vulgar fractions are those in which the denominator is expressed; decimals are those in which the denominator is simply indicated. The denominator of a common fraction may be any quantity whatever; the denominator of a decimal is always some power of 10. The denominator of a decimal may be written out in full, in which case it is a decimal fraction, which differs in no respect from a common fraction.

VULGAR FRACTIONS.—Vulgar fractions are expressed by writing the numerator over the denominator, with a line between them, as $\frac{a}{b}$. This is one of the methods of indicating division; a fraction is, in fact, equivalent to the quotient of the numerator by the denominator.

The two parts of a fraction are called *terms*, and according to their relative values the fraction is said to be *proper* or *improper;* if the numerator is less than the denominator, the fraction is *proper;* if the numerator is greater than the denominator, the fraction is *improper*. A proper fraction is always less than 1, and an improper fraction is always greater than 1. It may happen that the terms of a fraction are equal; in this case the expression is equal to 1, and is fractional only in *form*.

Fractions are *similar* when they have a common denominator—that is, when they have the same unit; they are *dissimilar* when they have different units. Thus, $\frac{3}{7}$ and $\frac{5}{7}$ are similar—$\frac{3}{7}$ and $\frac{4}{5}$ are dissimilar. Dissimilar fractions can be made similar as follows: find the least common multiple of the denominators for a common denominator of the required fraction; divide this by the denominator of each fraction, and multiply the quotient by the corresponding numerators for the numerators of the required fraction. This transformation, as well as many others, depends on the general principle that we may perform the same operation on both terms without changing the value of the fraction.

Fractional Expressions are those that contain a fraction in any form, They may be mixed, complex, or compound. A mixed fraction, or mixed number, is composed of an integral and a fractional part, as $3\frac{1}{8}$, $5\frac{2}{7}$. A complex fraction is one in which at least one of the terms is fractional as $\frac{3\frac{1}{2}}{5}$, $\frac{2\frac{1}{4}}{3\frac{1}{5}}$, $\frac{3}{5\frac{1}{7}}$. A compound fraction is a fractional part of a fraction or mixed number, as $\frac{1}{2}$ of $\frac{2}{5}$, $\frac{1}{3}$ of $5\frac{1}{4}$. Any one of these may be reduced to the form of a simple fraction—that is, to a form in which both terms are entire—by means of the general principle already given.

1. *To Reduce a Mixed Fraction to a Simple Form.* Multiply the entire part by the denominator of the fractional part, and to the result add the numerator of the fraction; then place the result over the denominator of the fractional part. Thus, $a + \frac{b}{c} = \frac{ac + b}{c}$; also $2\frac{1}{4} = \frac{9}{4}$. By reversing the preceding rule simple fractions may sometimes be transformed into mixed fractions. In this case we perform the indicated division, continuing the operation as far as possible: we then add to the quotient a fraction formed by writing the remainder over the divisor. Thus, $\frac{9}{4} = 2\frac{1}{4}$.

2. *To Reduce a Complex Fraction to a Simple Form.*—Reduce both terms to simple fractions having a common denominator; then suppress the denominator. Thus,

$$\frac{7\frac{2}{5}}{9\frac{3}{4}} = \frac{\frac{37}{5}}{\frac{39}{4}} = \frac{\frac{148}{20}}{\frac{195}{20}} = \frac{148}{195}.$$

3. *To Reduce a Compound Fraction to a Simple Form.*—Reduce the component parts of the fractions to simple forms, and then multiply the numerators together for a new numerator, and the denominators together for a new denominator. Thus, $\frac{2}{3}$ of $\frac{4}{5}$ of $5\frac{3}{4} = \frac{2}{3}$ of $\frac{4}{5}$ of $\frac{23}{4} = \frac{184}{60}$. If a fraction has any factors common to both terms, they may be struck out. The resulting fraction is then said to be in its simplest form. In this case the terms are prime with respect to each other.

Fractional quantities can be added and subtracted, multiplied and divided, with the same facility as entire quantities. In what follows we shall suppose every fractional expression to have been reduced to a simple form.

1. *To Add Fractions.*—Reduce them to a common denominator; then find the sum of the numerators, and write it over the common denominator. Thus,

$$\frac{3}{4} + \frac{5}{7} = \frac{21}{28} + \frac{20}{28} = \frac{41}{28}; \text{ also } \frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}.$$

2. *To Subtract one Fraction from another.*—Reduce them to a common denominator; then subtract the numerator of the subtrahend from that of the minuend, and write the difference over the common denominator. Thus,

$$\frac{5}{9} - \frac{3}{7} = \frac{35}{63} - \frac{27}{63} = \frac{8}{63}; \text{ also } \frac{a}{b} - \frac{c}{d} = \frac{ad - bc}{bd}.$$

3. *To Multiply one Fraction by another.*—Multiply the numerators together for a new numerator, and the denominators for a new denominator. Thus,

$$\frac{3}{5} \times \frac{4}{7} = \frac{12}{35}; \text{ also } \frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}.$$

4. *To Divide one Fraction by another.*—Invert the divisor, and proceed as in multiplication. Thus,

$$\frac{3}{5} \div \frac{4}{7} = \frac{3}{5} \times \frac{7}{4} = \frac{21}{20}; \text{ also } \frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}.$$

Entire quantities may be regarded as fractions having a denominator equal to 1. Hence, the rules for operating on fractions include the case in which some of the quantities are entire.

The rules above given may often be simplified by striking out factors that would otherwise be common to both terms of the result.

Decimal Fractions and Decimals.—A decimal fraction is a fraction whose denominator is some power of 10. When the denominator is expressed, it differs in no respect from a common or vulgar fraction; when the denominator is indicated, but not expressed, it is called a *decimal*. Decimals differ from common or vulgar fractions only in their mode of expression. A decimal may be expressed by writing its numerator, and then placing a *decimal point* (.), so that the number of figures following it shall be equal to the number of ciphers in its denominator. Thus, the fractions $\frac{3}{10}$, $\frac{145}{1000}$, $\frac{2564}{10000}$ may be written .3, .145, .2564. If the number of ciphers in the denominator is greater than the number of figures in the numerator, the requisite number of ciphers must be prefixed to—that is, written before—the numerator. Thus, $\frac{3}{100} = .03$, $\frac{7}{10000} = .0007$. If the number of ciphers in the denominator is less than the number of figures in the numerator, the result consists of an integral part and a decimal. Thus, $\frac{118}{10} = 11.8$. Such expressions are called *mixed decimals*.

Decimals may be read as common fractions, or they may be read like whole numbers:

1. When read as common fractions, we disregard the decimal point and prefixed ciphers, and read the given figures as a numerator; we then supply the denominator, remembering that it is equal to 1 followed by as many ciphers as there are places of figures in the given decimal. Thus, the decimal .014 is read *fourteen-thousandths*.

2. When read as whole numbers, we commence at the decimal point and separate the decimal into periods of three figures each, annexing ciphers, if necessary, to complete the last period; we then read each period in order, calling its name as in whole numbers. The name of the first period is *thousandths*, that of the second period is *millionths*, that of the third *billionths*, and so on. The decimal .01406, for example, when pointed off becomes .014,060; it is then read 14-*thousandths* and 60-*millionths*. This method of reading decimals is entirely the same as that of reading whole numbers; this should be the case, since both are formed according to the same general laws.

Decimals may be transformed and operated on by means of the following principles:

1. Moving the decimal point one place to the right is equivalent to multiplying the decimal by 10.
2. Moving the decimal point one place to the left is equivalent to dividing the decimal by 10.
3. Annexing ciphers, or striking out terminal ciphers, does not change the value of a decimal.

The rules for addition and subtraction of decimals are the same as in whole numbers; the rules for multiplication and division differ only in the method of pointing off the result.

1. *To Multiply one Decimal by another.*—Neglect the decimal points and multiply as in whole numbers; then point off as many decimal places in the product as there are in both factors. Thus, $2.5 \times 4.16 = 10.400 = 10.4$.

2. *To Divide one Decimal by another.*—Annex as many ciphers to the dividend as may be desirable; divide as in whole numbers, and point off from the right of the result as many decimal places as the number of such places in the dividend exceeds that in the divisor. Thus, $1.38483 \div 60.21 = .023$.

To convert a decimal into an equivalent vulgar fraction, neglect the decimal point and all the ciphers that precede the first significant figure, and take what remains for a numerator; then write 1, followed by as many ciphers as there are places of figures in the given decimal for a denominator. Thus, $.0036 = \frac{36}{10000}$.

To convert a vulgar fraction into an equivalent decimal, reduce the fraction to its simplest form, and to the resulting numerator annex as many ciphers as may be necessary; then divide the result by the denominator, and point off from the right of the quotient a number of decimal places equal to the number of annexed ciphers. There may be two cases: 1. The denominator may contain no prime factor except 5 or 2. In this case the fraction is of the form $\frac{a}{5^m \times 2^n}$. If $m > n$, annex m ciphers to the numerator, which is equivalent to multiplying it by 10^m, or $5^m \times 2^m$; if $m < n$, annex n ciphers to the numerator, which is equivalent to multiplying it by 10^n, or $5^n \times 2^n$; then will the result be exactly divisible by the denominator, and the number of decimal places will be equal to the highest exponent of 5 or 2. Such decimals are called *terminating decimals*. 2.

The denominator may contain some other factors besides 5 and 2. In this case the fraction is of the form $\frac{a}{5^m \times 2^n \times c}$. After annexing a suitable number of ciphers to the numerator, we can divide out the factors 5^m and 2^n, but the factor c will remain, and there will result a fraction in which the denominator is prime with respect to the numerator, and also with respect to all powers of 10. Hence, no matter how many ciphers we annex to the numerator, the result will not be exactly divisible by the denominator. But if the division is carried sufficiently far, we shall, after exhausting the significant figures, find a remainder equal to some preceding one, and from this time forward the figures of the quotient will be repeated in the same order as before, and so on continually. Such decimals are called *repeating decimals*.

In all cases a vulgar fraction is equivalent either to a terminating or to a repeating decimal; and *conversely*, every terminating or repeating decimal is equivalent to some vulgar fraction.

Rational Fractions.—A rational fraction, in analysis, is one in which all the exponents of the variable or variables are whole numbers. The coefficients of the different powers of the variables may be either rational or irrational, entire or fractional, positive or negative. Every rational fraction that is a function of one variable may be reduced to the form

$$\frac{Ax^m + Bx^{m-1} + Cx^{m-2} + \dots + K}{A'x^n + B'x^{n-1} + \dots + K'}.$$

If $m > n$, the operation of division may be applied and continued till the highest exponent of x in the remainder is at least 1 less than in the denominator, and the fraction will then take the form

$$X + \frac{A''x^{n-1} + B''x^{n-2} + \dots + K''}{A'x^n + B'x^{n-1} + \dots + K'},$$

in which the entire part is a rational fraction of x. The fractional part can be resolved into *partial* fraction —that is, fractions whose denominators are either binomial factors of the first degree with respect to x, or some integral power of such factors—whenever the denominator can be resolved into such factors. This resolution is of much use in the integral calculus. The following are the methods of resolving fractions of this kind into partial fractions:

1. *When the Binomial Factors of the Denominator are Real.*—Write the given fraction equal to the sum of as many partial fractions as there are units in the highest exponent of the variable in the denominator, whose numerators are constants to be determined, and whose denominators are the different powers of the factors of the first degree, from the m^{th} to the 1st inclusive, m being the number of times that any factor enters; then clear the equation of denominators, and equate the coefficients of the like powers of the variable in both members; from these equations find the values of the constants, and substitute them in the assumed partial fractions: the resulting fractions will be the partial fractions required. Thus, let it be required to separate the fraction

$$\frac{x^3 + x^2 + 2}{x^5 - 2x^3 + x}$$

into partial fractions. The factors of the denominator are $x(x+1)^2$ and $(x-1)^2$. Hence, by the rule

$$\frac{x^3 + x^2 + 2}{x^5 - 2x^3 + x} = \frac{A}{x} + \frac{B}{(x+1)^2} + \frac{C}{x+1} + \frac{D}{(x-1)^2} + \frac{E}{x-1}.$$

Clearing of denominators, and equating the coefficients of like powers of x, we obtain a set of equations from which we find $A = 2$, $B = -\frac{1}{2}$, $C = -\frac{5}{4}$, $D = 1$, and $E = -\frac{3}{4}$. Hence,

$$\frac{x^3 + x^2 + 2}{x^5 - 2x^3 + x} = \frac{2}{x} - \frac{1}{2(x+1)^2} - \frac{5}{4(x+1)} + \frac{1}{(x-1)^2} - \frac{3}{4(x-1)}.$$

2. *When the Factors of the Denominators are all Imaginary.*—In this case we suppose the denominator to be resolved into factors of the second degree, each of which, when placed equal to 0, will give two imaginary roots. We then write the given fraction equal to the sum of as many partial fractions as there are single factors of the second degree in the denominator, their numerators being of the form $Mx + N$ (M and N being constants to be determined), and their denominators being the different powers of the factors of the second degree from the m^{th} to the 1st inclusive, m being the number of times any factor is taken. We then proceed as before.

Vanishing Fractions.—A vanishing fraction is a fraction that reduces to $\frac{0}{0}$ for a particular value of the arbitrary quantity that enters it, in consequence of the existence of a common factor in both terms, which factor reduces to 0 for that particular value. Thus,

$$\frac{x^2 - a^2}{x^3 - a^3} = \frac{(x-a)(x+a)}{(x-a)(x^2 + ax + a^2)}$$

is a vanishing fraction, which reduces to $\frac{0}{0}$ when $x = a$: the common fraction which produces this result is $x - a$. If we strike out this factor, and then make $x = a$, we find for the true value of the fraction,

$$\frac{a + a}{a^2 + a^2 + a^2} = \frac{2a}{3a^2} = \frac{2}{3a}.$$

Every vanishing fraction may be considered as a particular case of the fraction

$$\frac{M(x-a)^n}{N(x-a)^m},$$

in which M and N are functions of x that do not contain the factor $x - a$. This fraction becomes $\frac{0}{0}$ for the value of $x = a$ in consequence of the existence of the factor $x - a$ in both of its terms. To find the true value of such a fraction, we must get rid of the factor $x - a$ in one or both terms, and then make the supposition that $x = a$. There may be three cases:

1. If $m > n$, the fraction can be reduced to the form

$$\frac{M}{N(x-a)^{m-n}},$$

which, for $x = a$, becomes ∞.

2. If $m = n$, the fraction can be reduced to the form of M divided by N, which, for $x = a$, becomes

$$\left(\frac{M}{N}\right)_{x=a} = \frac{A}{B}, \text{ a finite quantity.}$$

3. If $m < n$, the fraction can be reduced to the form

$$\frac{M(x-a)^{n-m}}{N},$$

which, for $x = a$, becomes 0.

These are the only cases that can arise; hence, the true value of a vanishing fraction, for the particular value of the variable that reduces it to $\frac{0}{0}$, is either *infinite*, *finite*, or *zero*.

The method above indicated enables us to find the true value of the fraction when the factor that vanishes is obvious; if this factor is not obvious, the true value of the fraction may be found by either of the following methods:

1. Substitute for the variable that value which reduces the common factor to 0 *plus* a variable increment; reduce the result to its simplest form; and then make the increment equal to 0. Thus, to find the true value of $\frac{x - x^4}{1 - x}$ when $x = 1$, we make $x = 1 + h$; this gives

$$\frac{1 + h - (1 + 4h + 6h^2 + 4h^3 + h^4)}{1 - (1 + h)},$$

which reduces to $3 + 6h + 4h^2 + h^3$; making $h = 0$, we have the required value, equal to 3.

2. Differentiate both terms of the fraction, and in the results make the particular supposition; if both do not reduce to 0 or ∞, what the first becomes, divided by what the second becomes, is the true value of the fraction. If both reduce to 0, find the second differentials of the two terms, and substitute as before; continue this operation until two differentials of the same order are found that do not both reduce to 0 or ∞; then what the first becomes, divided by what the second becomes, is the true value of the fraction. Thus, in the example just given the differential of the numerator is $dx - 4x^3dx$, and the differential of the denominator is $-dx$, neither of which reduces to 0 when $x = 1$. The first becomes $dx - 4dx$, and the second becomes $-dx$, when $x = 1$. Hence, the true value of the fraction under the hypothesis $x = 1$ is 3, the same as before.

There are many functions which can be reduced to the form of a vanishing fraction, and treated accordingly. The most important of these are the following:

1. Let $\frac{p}{q} - \frac{r}{s}$ be an expression in which p, q, r, and s are functions of x, such that for $x = a$ both q and s reduce to 0; then will the given expression reduce to $\infty - \infty$ for the same value of x. If we reduce the given fraction to a common denominator, we have after reduction $\frac{ps - rq}{qs}$, which is a vanishing fraction for $x = a$.

2. Let $\frac{p}{q}$ be a fraction such that both p and q reduce to ∞, for $x = a$; then for the same value of x the given expression will become $\frac{\infty}{\infty}$. The given fraction is equal to $\frac{1}{q} \div \frac{1}{p}$, which for $x = a$ is a vanishing fraction.

3. Let pq be a function such that for $x = a$, p reduces to 0, and q to ∞; then for the same value of x the given expression will become $0 \times \infty$. The given product may be written $p \div \frac{1}{q}$, which for $x = a$ is a vanishing fraction.

W. G. PECK.

Frac'ture [Lat. *fractura*, from *frango*, *fractum*, to "break"], a rupture of a solid body, usually caused by violence. (1) In mineralogy, the appearance of the fresh surface when a mineral breaks, disclosing its texture, and furnishing a characteristic by which it may be identified. Thus, the fracture is said to be *even* when it forms a face or plane of some extent; *uneven*, when the surface is rough and unequal; *conchoidal*, or shell-like, when concave on one side and convex on the other; *splintery*, when the surface presents the appearance of numerous thin-edged scales; and *hackly*, when covered with numerous fine sharp points or inequalities. (2) In surgery, the term fracture is used to indicate a rupture, or solution of continuity, occurring in osseous tissue, or in rare cases in cartilaginous tissue partly ossified. The separation, in early life, of two portions of the same bone, held together by cartilaginous tissue, is not accounted a fracture. Fractures may be *simple*, *compound*, *complicated*, or *comminuted*; *complete* or *incomplete*; *oblique*, *transverse*, or *longitudinal*. By *simple* fracture is meant one in which no wound exists admitting air to the seat of fracture. A *compound* fracture is one in which such a wound does exist. A *complicated* fracture is one in which some other serious injury is inflicted, at or near the site of the fracture, other than the rupture of the osseous tissue, or in which, from the situation of the rupture, the healing process cannot progress as favorably as is usual; as when a large blood-vessel or nerve-trunk is torn by the broken bone, or when the fracture extends into a joint-cavity. A *comminuted* fracture is one in which the bone is broken into several small pieces at the point of rupture, and is rarely produced except by direct violence, as by a blow or crushing force. A *complete* fracture is one in which the rupture extends through the whole thickness of the bone, while if only a portion of the fibres are broken, as sometimes happens in children, the fracture is called *incomplete*, or the "green-stick fracture" of some writers, from its resemblance to the fracture produced by bending a stick of green wood until some of the fibres give way. The terms *transverse, oblique*, and *longitudinal* refer to the direction of the rupture in relation to the long axis of the bone, the great majority of the fractures of the long bones belonging to the second class. The term *stellate* is applied to a series of fractures radiating from a centre, as seen sometimes in fracture of the skull from a wound produced by a pointed instrument.

Causes of Fracture.—These may be *external*, from violence adequate to break a normal bone, or *internal*, the bone being too fragile to resist ordinary forces. External causes embrace *direct violence*, where the rupturing force is applied opposite the point where the bone breaks (as a blow or crushing force which fractures the bone at the point of contact); and *indirect* violence, where the bone is bent beyond the power of its elasticity to restore itself, and gives way, usually at some distance from the point of application of the fracturing force (as when a fall upon the shoulder fractures the collar-bone). *Muscular* force is generally acknowledged as a cause of fractures, especially in particular situations—*e. g.* fracture of the point of the elbow or of the knee-pan. The *internal* or predisposing cause is a brittleness of the bones called "fragilitas ossium," which occurs sometimes in early or middle life as a result of disease (although it may occur in those otherwise healthy), and almost universally in advanced life from the preponderance of earthy and deficiency of elastic matter.

The signs of fracture are *pain*, *swelling*, and *tenderness* at the point of fracture, *change in shape* of the limb, *false point of motion*, and *crepitation*, though any, or even all, of these signs may be absent. The pain comes from laceration of some nerve-filaments and pressure upon others by the broken bone, or by the blood escaping from torn vessels, which gives rise to the swelling that occurs at first, the subsequent swelling being due to products of inflammation or of the reparative process. The change in shape is due partly to this swelling, and partly to displacement of the broken bones, either by muscular action or by movements of the patient. The false point of motion comes of course from the want of continuity of the bone, and the crepitation is a fine grating elicited when the ends of the broken bone are gently rubbed together, and which may be appreciated by the ear or touch. If the fracture be *impacted*—that is, if the broken ends are firmly locked together, as sometimes happens—none of these signs may be present in a marked degree, and some of them, such as crepitation and false motion, not at all.

Fractures generally unite by the deposition of bony material between and around the broken ends of the bone, forming an exception to the rule that prevails for most other structures, that union after rupture is effected by means of fibrous or connective tissue; and the reason is apparent, since fibrous tissue does not form a sufficiently rigid bond of union to enable the bone to perform its functions, as we see in cases of so-called "ununited fracture," when the union is of a fibrous nature. The union of a simple fracture consists of two processes—one to accomplish a temporary purpose, the other for the permanent union; the former to support and bind together the fragments, while the latter consolidates them. A few days after the fracture the bone, its periosteum (membrane surrounding the bone), and the neighboring tissues pour out a quantity of plastic material around and between the broken ends, which gradually hardens, and at the end of the fourth week consolidates the fragments. This is called the "provisional callus," and the hardening process continues until it is converted into bony tissue. The plastic material effused *between* the fragments is much slower in ossifying than that which is internal or external to it; and this, which is destined to form the permanent bond of union, is called the "definitive callus." While the definitive callus is forming the provisional callus is gradually being absorbed; and finally, many months after the fracture, the provisional callus entirely disappears, and the fragments are united by the definitive callus alone, which is true bone; and the site of the fracture may be indicated only by a slight enlargement at that point. The union of *compound* fractures is entirely different. In these the provisional callus is almost or quite absent, and the definitive callus is formed by a process of granulation from the ends of the fragments, the granulations being gradually converted into bony tissue. It is a process requiring several months, or sometimes years, and is attended with a greatly increased amount of danger from exhaustion through long-continued suppuration and absorption of purulent material. The difference in the mode of union seems to be due to the irritation produced by the air, or something conveyed by the air to the wound.

The *treatment* of fractures consists essentially in restoring the fragments to their original position, and holding them there by some form of rigid apparatus which shall not cause discomfort or injury to the patient. Of course general treatment is to be employed also if the circumstances require; but simple fracture in a healthy individual requires no special medication or system of dieting, as the old modes of practice were wont to inculcate. The rigid apparatus used to retain the fragments in their proper position is called a splint, which consists of two kinds—padded and moulded. If the splints are made of straight, inflexible material, they cannot be adapted to the irregularities of the limb without more or less padding at certain points; while if made of material which at the time of its application is soft and pliable, it may be moulded to the shape of the limb, and, becoming hard and rigid, will serve to support and retain the fragments. Splints of the first variety are made of wood, sheet iron, tin, zinc, etc., while gutta-percha, felt, sole leather, starch, soluble glass, or plaster of Paris are used for the second class. Fractures sometimes fail to unite, and are called ununited fractures. This may be the consequence of faulty position of the fragments, or of something interposed between the broken ends, impeding union, but it more frequently arises from some constitutional defect. The location of the fracture may prevent union, especially if either fragment be poorly supplied with blood, as in certain fractures of the neck of the thigh-bone, which frequently unite only by fibrous tissue. Ununited fractures may often be made to unite by irritating the parts at the site of fracture, as by rubbing the bones together, drilling them by means of a long needle, or by wiring the bones together. SAMUEL ST. JOHN.

Fra Dia'volo ("Brother Devil"), the Italian sobriquet of Michele Pezza, a Calabrian goatherd, b. 1760, who became successively a stockinger, a soldier, a monk (with the name of Fra Angelo), and the leader of a band of atrocious robbers. He took service in 1799 against the French, and held a colonel's commission; was captured by the French and hanged in 1806 as a robber, notwithstanding his pardon and commission from the king of Naples. The Fra Diavolo of Auber's opera has little or nothing in common with the historical character.

Fra'ga, town of Spain, in the province of Huesca, on the Cinca. Pop. 7229.

Frail'ey, tp. of Schuylkill co., Pa. Pop. 1322.

Frailey (JAMES MADISON), U. S. N., b. May 6, 1809, in Maryland, entered the navy as a midshipman May 1, 1828; became a passed midshipman in 1836, a lieutenant in 1841, a commander in 1861, a captain in 1866, a commo-

dore in 1870; retired in 1872. Commanded the steamer Quaker City, South Atlantic blockading squadron, in 1862–63, and the steam sloop Tuscarora, North Atlantic blockading squadron, in 1864–65, taking part in the engagement between the blockading squadron and the iron-clads off Charleston Jan. 31, 1863, and in both attacks on Fort Fisher in 1864–65. D. Sept. 26, 1877. FOXHALL A. PARKER.

Fra'mingham, post tp. of Middlesex co., Mass., is 22 miles W. of Boston, on the Boston and Albany R. R., about halfway between Boston and Worcester. It contains three thriving villages—Centre and South Framingham and Saxonville. It has a national and a savings bank, the oldest normal school in North America, a weekly newspaper, a first class carriage manufactory, large factories of straw goods, shoes, etc., the extensive Saxonville woollen-mills, several churches, a soldiers' memorial library building, with a valuable town library, etc. South Framingham is at the junction of five railroads, and is an important business-centre. The town contains some of the best farms in the county, and the agricultural interests are important. Pop. 4968. C. M. VINCENT, ED. "GAZETTE."

Fra Morea'le [so called because he was once a brother of St. John of Jerusalem], the title of MONTREAL D'ALBANO, a gentleman of Provence who distinguished himself as a condottiere in the service of Louis I., king of Hungary, in his Neapolitan wars (1347–51). After the close of the war Montreal remained in Naples at the head of a "company of adventure," a body of brigands afterwards styled "The Great Company," which from Montreal's skilful combination of license and discipline soon won a terrible fame. Following the example of the duke of Athens and the German Werner (known as Duke Guarniari, the self-styled "enemy of God, of pity, and of mercy," who had led 2000 German *barbute*, or armored *horsemen*, in Northern Italy), Montreal, in 1353, entered upon a course of wholesale brigandage. Queen Joanna I., to rid the kingdom of such a pest, sent a force which besieged him at Aversa, 9 miles N. of Naples. He was compelled to give up his plunder and leave the kingdom. With a small body of followers he took service under John of Vico, lord or tyrant of Viterbo and Orvieto. He also wrote letters to all the "constables" commanding "companies of adventure" in Italy, offering them regular pay and stipulated service, with every form of the license then permitted to soldiers of fortune. By these promises he brought to his standard 1500 men-at-arms, making his whole force probably equivalent to 9000 cavalry, for 1500 heavy-armed horsemen were accompanied by 3000 mounted archers; 1000 *coutilliers*, or esquires, and 1000 pages, light-armed horsemen; besides 2000 footmen. With this band he marched in 1353 against Malatesta, tyrant of Rimini, who had commanded Joanna's troops against him at Aversa in 1352. Montreal appointed secretaries, treasurers, councillors, and justiciaries to maintain order, and a rigorous system of internal justice among his men, while against the inhabitants of the states he ravaged every license was permitted. All booty was divided among his followers according to a fixed system. A certain part was sold to merchants who followed his camp under Montreal's safeguard. He became the terror of Italy, and the soldiery flocked from every quarter to his service. Bulwer's picture of him in *Rienzi* is not exaggerated. Having ravaged Malatesta's lands, and compelled him to pay a heavy ransom, he formed an alliance with Perugia, which he meant to take for his base of operations against the other Tuscan towns. Sienna was forced to give him provisions and free transit, Florence to pay him 28,000 florins, and Pisa 16,000. He afterwards entered the pay of a Lombard league against the archbishop of Milan, Visconti the Terrible, one of the most powerful of the Italian "kinglings." Montreal contemplated the establishment of a permanent dominion, perhaps with Rome itself for his capital. He left his main force under the self-styled Count Conrad Londo, a Suabian, and with a small force he went to Perugia and Rome, probably to make arrangements for removing his force to the south of Italy. But at Rome he was arrested by command of Cola di Rienzi, one of the few who really owed Montreal a debt of gratitude, for the latter had been his steady friend in time of need. Accused and convicted of acts of high-handed brigandage, he was beheaded on Aug. 29, 1354. Thus perished a great military organizer, disciplinarian, and statesman, worthy of mention as one of the ablest of the condottieri—men who, with all their terrible crimes, have been justly called memorable as furnishing one of the links which connect the swift decline of the military discipline of antiquity with its regeneration under Charles VII. and Louis XI. of France. The fate of the "Great Company" is interesting. Londo was defeated July 24, 1358, and made prisoner at the Pass of the Scalella by the Apennine mountaineers, to whom he paid a great ransom. Next he led 20,000 men against Florence, but was killed in a battle near Novara in 1363. His brother Lucius took service as a mercenary in the Florentine "war of liberty" (1376–77) against the pope. Here the remnant of the "Great Company" did excellent service. J. WATTS DE PEYSTER.

Franc, the unit of account in the monetary system of France, adopted under the republic in 1795; also, the silver coin representing the same unit. In the general reform of French metrology which took place in the year above mentioned, the following were the governing principles: 1st, to derive the units of measure, weight, and value, mediately or immediately, from the linear unit called the mètre, which is the base on which the whole system rests; 2d, to derive the higher and lower denominations in each series from the corresponding unit by decimal multiplication and division. The unit of capacity was derived immediately from the basic unit of length; the unit of weight from the unit of capacity; and the unit of value, the *franc*, from the unit of weight. (See METRIC SYSTEM.) The franc is divided into 10 *décimes* and 100 *centimes*; the denomination *decime* has fallen into disuse. The copper coins which represent this value are stamped *"ten centimes."* The coinage in silver consists of single francs and pieces of five francs and of fifty and twenty centimes. The gold coins are pieces of five francs, ten francs, and twenty francs; the latter commonly, but not legally, called napoleons. The copper coins are of ten centimes, five centimes, and a very pretty but rather useless little piece of one centime. The one-centime pieces are hardly seen except at the post-offices.

The monetary system of France was adopted by Switzerland May 7, 1850, and on Dec. 23, 1865, a quadripartite treaty was entered into between France, Belgium, Switzerland, and Italy, which makes this system common to all those countries until Jan. 1, 1880, if not sooner repealed. Austria has assimilated her system to that of France by making her ten-florin piece equal to twenty-five francs. Spain, Sweden, and Greece have shown a disposition to conform their coinage to the same system. A silver coin of the value of half a franc has been struck by the Spanish mint, and the mint of Sweden seven or eight years ago issued a carolin of the value of ten francs in gold. This was merely experimental, and is not at present coined. The principality of Roumania has adopted the French system in full. Ten years ago there seemed to be a possibility, and even a probability, that the franc would become, before the close of the century, the monetary unit for all continental Europe. The occurrence of the Franco-German war, bringing with it the consolidation of the German states, and the adoption for the empire of a new monetary unit, out of harmony equally with those of France, England, and the U. S., has not only extinguished this prospect, but rendered hopeless every other scheme which had been imagined for the unification of the monetary systems of the world.

The weight of the silver franc is five grammes = $77\frac{1}{6}$ grains troy. It is composed of an alloy consisting of 9 parts by weight of silver and 1 part base metal (copper). Twenty silver francs therefore weigh 100 grammes; and as the French law makes both the gold and the standard silver coins equally legal tenders for all sums, and fixes arbitrarily the relative value of the two metals for equal weights in the ratio of 1 to $15\frac{1}{2}$, it follows that twenty francs in gold weigh $6\frac{451}{1000}$ grammes, very nearly; and this is the weight of the gold napoleon. But inasmuch as the relative value of gold and silver bullion has been till recently represented by a ratio of about 1 to $15\frac{38}{100}$, it follows that 100 grains of silver in bullion have been during this period equivalent to $6\frac{502}{1000}$ grains of coined gold; that is to say, have been worth more than a gold napoleon. Silver bullion therefore brought more in the market of France than silver coin. Hence, silver coin of standard fineness long ceased in that country to be a part of the circulating medium. The standard silver franc and half franc has consequently ceased to be struck; and in order to provide a currency of small coin for daily use in petty transactions, the government of France and the other parties to the quadripartite treaty of 1865 resorted to a debased coinage, composed of an alloy containing only 835 parts of silver in the thousand, instead of 900. This is a legal tender only for sums below five francs.

The name *franc* did not originate with the monetary system of 1795. It has been in use since the fourteenth century, and applied to coins of very different values, both gold and silver, at different times. The legal monetary unit in France before the introduction of the franc was the *livre Tournois* of Tours. It was slightly less in value than the coin by which it was superseded, 81 livres being equal to 80 francs. F. A. P. BARNARD.

France. I. BOUNDARIES, GEOGRAPHICAL POSITION, DIMENSIONS, AREA, DEPARTMENTS.—France extends in Western Europe over a space of 13° 20′ lon.; in lat. 42° 20′ to 51° 5′ N. (See Map of Europe in Vol. I. of this work.) It

is bounded N. by the German Ocean, the Strait of Calais, and the English Channel, which separate it from England; W. by the Atlantic Ocean; S. by the Pyrenees, which separate it from Spain; S. E. by the Mediterranean; and E. by the Alps, where the frontier runs along the principal ridge from Colla Lunga to Mont Dolent, the utmost point of the group of Mont Blanc. The boundary-line then descends to the Lake of Geneva, and, curving around the territory of Geneva, it follows the ridges of the Jura Mountains to the pass at Belfort, traversing which it follows the ridge of the Vosges. S. of the Donon, the principal peak of the Lower Vosges, it leaves this ridge, and ceases to depend upon natural lines, following an arbitrary one, which, passing between Nancy and Metz, proceeds to Longwy, keeping S. of the tortuous Semois, and reaches the North Sea, crossing the Maas N. of Givet, the Sambre N. of Maubeuge, and the Scheldt N. of Condé. Thus, France touches Spain on the S., Italy on the S. E., Switzerland, the German Empire, Luxembourg, and Belgium on the E., and the Netherlands on the N. The greatest extension of the country, from N. to S., is 936.5 kilomètres (581.0 miles), from E. to W., 891 kilomètres (554 miles); the greatest diagonal, from Finistère to Mentone, is 1078 kilomètres (670 miles). Its area is over 528,000 square kilomètres (203,900 square miles), Corsica included: the area of France represents $\frac{1}{18}$th part of Europe and $\frac{1}{250}$th part of the land-surface of the earth.

Annexed to France are Corsica and Algeria, which latter comprises a large territory S. of the Mediterranean, with an area of 250,000 square kilomètres (96,530 square miles). The colonies of France are not numerous; the French have no talent for colonization. France possesses in Africa, besides Algeria, Senegal, the small establishments of Côte d'Or, Gaboon, the island of Mayotte and its dependencies, Nossi Bé, Sainte Marie de Madagascar and Réunion (Ile Bourbon); in Asia, the five cities of Mahé, Karikal, Pondicherry, Yanaon, and Chandernagore in Hindostan; in Indo-China, French Cochin-China; in Oceanica, New Caledonia, the Marquesas, and the Society Islands (under French protection); in South America, French Guiana; and in the West Indies, Martinique and Guadaloupe; to which must be added the two small islands, St. Pierre and Miquelon, situated N. of Newfoundland. The total area of the territories belonging to France is not far from 1,000,000 square kilomètres, and, together with France proper, 1,500,000 square kilomètres, or 580,000 square miles—viz. nearly $\frac{1}{95}$th part of all the land of the globe.

II. Physical Geography. 1. *The Surface.*—The surface of France, considered in general, presents a plane, gently inclined from S. W. to N. W.; that is, from the Alps and the Pyrenees to the Atlantic Ocean. To the E. a long depression cuts this plane; it is the valley of the Rhone, on whose western side rise the Cévennes, from which the waters of the three great basins of France flow in an almost parallel direction. Thus, the orographic system of the country is composed of—1, an outer belt of chains, comprising the Vosges, Jura, Alps, and Pyrenees; 2, an inner belt, comprising the Cévennes and their continuations: and 3, the ramifications issuing from the Cévennes, and comprising the group or central plateau separating the basins of the rivers which flow to the Atlantic.

The *Vosges* stretch from N. to S., parallel with the Rhine, for a length of 260 kilomètres. Their summits are rounded, and generally covered with turf; now and then the rock juts through. Their sides are clad with magnificent forests of beech and fir. The southern part of the Vosges is the highest; its average elevation is 1000 mètres: the highest peaks are Guebwiller (1426 mètres) and Giromagny (1250 mètres). The northern part, from the neck of Saverne to the group of the Palatinate, rises hardly more than 600 mètres; the principal passes of this chain are those of Saverne, Sainte Marie aux Mines, Bussang, and the picturesque Schlucht. The Vosges are separated from the Jura Mountains by a considerable depression, with the vale of Valdieu, which the strategists call the pass at Belfort, and which forms one of the principal thoroughfares by which to pass the frontier of France.

The *Jura Mountains* are principally composed of limestone, called Jurassic; they are only partially French. Less rude and not so richly wooded as the Vosges, they have more plastic grandeur. Instead of the rounded summits, we meet here long, parallel ridges, which support three galleries of plateaus. The general direction of these ridges is a curve concentric with the general curve of the Alps, and on the line of this curve are found the depressions of the lakes of Leman, Neuchâtel, and Bienne; which circumstance has given rise to the belief that the Jurassic regions were lifted and wrinkled by the same force which made the Alps emerge. These wrinkles present along their course many traverse breaks, forming picturesque fissures which are called "cluses," and which serve as outlets for the streams which form in the intervals between the wrinkles. The Jura group rises from France towards Switzerland; its highest peaks, from which the view extends uninterruptedly to the splendid snow-curtain of the Alps, are the Crêt de la Neige (1723 mètres), the Reculet (1720 mètres), the Dôle (1681 mètres), and the Great Credo (1690 mètres); its length from the Rhône to the Rhine is 300 kilomètres (124 miles).

The *Alps* form the great arc of a circle which surrounds Northern Italy on three sides. The French part of the Alps has a length of about 450 kilomètres (280 miles), and consists of the Pennine, Graian, Cottian, and Maritime Alps. The Pennine Alps, whose Celtic name means "the high Alps," extend from St. Gothard to Mont Blanc, whose beautiful group supports 28,200 hectares of glaciers, and whose highest peak, white with snow, rises 4810 mètres, and surpasses all other mountains in Europe, not only in height, but also in beauty. The Graian Alps, whose Celtic name means "the rocky tops," contain the Little St. Bernard and terminate at the road of Mont Cenis, which formerly was the principal passage across the Alps, but which now has been superseded by the remarkable tunnel through Mont Cenis (12,200 mètres long). The Cottian Alps extend to the pyramid of Mont Viso (3810 mètres), and form an acute angle, at whose head stands Mont Thabor (3212 mètres). The Maritime Alps terminate at Col di Tenda, after describing a large arc of a circle, with the concavity turned towards Italy.

Towards Italy the slopes of the Alps are abrupt. In France they project long and powerful arms toward the Rhône—namely, the Alps of Valais, whose nucleus is formed by the Buet; the Alps of Faucigny and Chablais; the Alps of Savoy, with the beautiful group of the Great Chartreuse; the Alps of Dauphiné, which communicate with the Pelvoux and its immense glaciers, whose highest peak is called, quite poetically, La Barre-des-Ecrins (4103 mètres), and with Devoluy, a dull and gloomy group; the Alps of La Maurienne; and finally the Alps of Provence, which contain Mont Ventoux in the N., the mountains of Les Maures, with their pine-covered summits, and those of L'Estérel, which are of volcanic origin, and overlook the beautiful city of Nice.

The *Pyrenees* are inferior to the Alps; they are one-third lower, not so vast, and quite of a different aspect. They stand like high walls, with sharp, conical summits, separated by very high passes; they extend from W. to E., and to the N. project a regular series of buttresses and vales, one very similar to the other. The ridges, generally insuperable, are more pointed and more austere than those of the Alps; eternal snow, however, is more rare. The principal peaks, most of which are outside of the line of the watershed, are, in the eastern Pyrenees, Mont Canigou (2786 mètres); in the central Pyrenees, Pic de Corlette (2920 mètres), Cylindre du Marboré (3322 mètres), Maladetta (3404 mètres), the highest peak in the whole chain, Mont Perdu, and the Pic du Midi de Bigorre (2909 mètres); and in the western Pyrenees, Vignemale (3298 mètres) and Pic du Midi d'Ossau (2967 mètres).

The main body of the Pyrenees, composed of granite, schist, and limestone, extends over a length of 350 kilomètres (217 miles), and with a breadth of 100 kilomètres (60 miles) in the centre, and of 50 kilomètres at the extremities. From the centre proceed the long ranges of hills which, curiously arranged like a fan, separate the valleys of the Gaves. From the Pic de Corlette issue two secondary chains, the Corbières, of which the southern is high, pointed, and granitic, and the northern flat and calcareous.

This chain is continued by the Cévennes, which begin at the neck of Naurouze, and extend over a length of 475 kilomètres (295 miles). They are divided into the southern Cévennes, which are rocky and granitic chains whose principal peak is L'Aigoual (1568 mètres); the central Cévennes, which comprise the mountains of Gévaudan and Vivarais, and whose most remarkable peaks are the Gerbier de Jonc (1562 mètres), the Mézenc (1766 mètres), and the Lozère (1702 mètres); and finally the northern Cévennes, which again are subdivided into the mountains of Lyonnais, Beaujolais, and Charolais, which fall to an average height of 550 mètres.

To the N. the Cévennes are continued by the Côte d'Or, which produces the finest wine in France, the plateau of Langres, and the Faucilles Mountains, which communicate with the Vosges. N. of the Faucilles Mountains extend the plateaus of Lorraine, L'Argonne, with its famous defiles, and the Ardennes, covered with forests and deeply cut by the streams which traverse them. Between the Ardennes and the sea stretch the plains of Flanders and the fertile and well-cultivated plains of Artois and Picardy, which are continued westward to the sea by the plains of Caux.

To the W. of Côte d'Or, whose average height is 500 mètres, is found a small granitic group, elevated from 800 to

900 mètres, which is called Morvan; on account of its strategical position it is considered the citadel of France. Still more westerly, and N. of the Loire, stretches the immense plain of the Beauce, the vast granary of France. Between the Beauce and Finistère are the heights of Perche and Maine, from which a double granitic range traverses Bretagne from E. to W. N. of Maine are the graceful and fertile hills of Lower Normandy, and finally the peninsula of Cotentin, terminating in Cape de la Hague and the high hills which enclose the naval port of Cherbourg.

Between the Loire and the Garonne are the remarkable summits of the central group which in remote ages separated the gulf of the Seine from that of the Garonne. This group comprises very different chains: the granitic mass of the Margeride, from 1500 to 1600 mètres high; the mountains of Auvergne, whose highest peak is the Plomb du Cantal (1858 mètres), an old volcano, and in the centre the groups of Cézallier and Mont Dore, which contain the Puy de Sancy (1886 mètres), the highest peak in Central and Northern France, and which project towards the N. W. a granitic spur, the mountains of Lower Auvergne, and towards the N. the chain of the Puys, a curious line of old, extinct volcanoes, now covered with verdure, but whose craters are still distinguishable, as are also the immense streams of lava, which in the country itself are called *cheires*. Puy de Dôme (1465 mètres) and Puy de Pariou are the most remarkable of these volcanoes—the one on account of its height, the other on account of its form. With the mountains of Lower Auvergne connect the granitic mountains of Limousin, which attain their greatest height in Mont de Meymac (978 mètres) and Mont Odouze (954 mètres), and which from that point slope down through the sterile plateau of Millevache to Mont Jargean (950 mètres). The central group contains several secondary ridges: to the N., a chain whose elevation seldom surpasses 1000 mètres, though in a few points it reaches 1600 mètres. It is divided into the mountains of Velay (basaltic), Forez (granitic), and Madeleine (porphyritic), and runs off from the mountains of Vivarais, forming a high barrier between the Loire and the Allier. To the N. W. the granitic mountains of La Marche communicate with Mont Odouze. To the S., and detaching itself from the chain at Mont Lozère, stretches the vast region of the Causses, high calcareous plateaus deeply cut by the valleys of the Tarn, Lot, and Aveyron. These plateaus, Causse de Sauveterre, Causse Méjean, the Black Causse, Causse de Sévérac, de Concourès, the plateau of Larzac, and Causse de Quercy, comprise nearly the whole of the old province of Rouergue. To the S., finally, are the mountains of Aubrac, a granitic group slightly connected with the mountains of Margeride.

Corsica is traversed from N. to S. by a chain of high mountains whose most elevated summit is Monte Rotondo (2764 mètres).

2. *Hydrography.*—The flowing waters form in France seven principal basins—namely, those of the Seine, Loire, Garonne, Rhine, Maas, Scheldt, and Rhône. In the first three basins, those situated in the interior of the great arc of a circle formed by the Pyrenees, Cévennes, and Ardennes, the water runs towards the N. W. to the English Channel and the Bay of Biscay; in the next three, situated to the N. of the Faucilles and the Ardennes, it runs northward to the North Sea, and in the basin of the Rhône it runs southward.

France possesses more than 200 streams which are fit for navigation or flotation of craft. Their length, as far as utilised, is 11,000 kilomètres (6200 E. m.), of which 8800 kilomètres (5500 E. m.) are used for navigation. The principal rivers in the *basin of the Seine* are the Seine, which waters Paris, Rouen, and Hâvre, where it forms a vast estuary, and its affluents—to the right, the Aube, Marne, and Oise, with its feeder the Aisne; and to the left, the Yonne and the Eure. Among the secondary basins belonging to that of the Seine are those of the Somme and the Orne. *In the basin of the Loire*, flow the Loire, which passes by Nevers, Orléans, Blois, Tours, Nantes, and St.-Nazaire, and its affluents—from the right, the Maine; and from the left, the Allier, Cher, Indre, and Vienne. The Vilaine forms a secondary basin, and becomes navigable at Rennes. *In the basin of the Garonne*, we find the Garonne, which, after its junction with its principal affluent, the Dordogne, forms the beautiful river Gironde, on whose borders stands Bordeaux. Its principal tributaries, the Tarn, Lot, and Dordogne, join it on the right side. To this basin belong those of the Charente and the Adour, which latter passes by Tarbes and Bayonne. *In the basin of the Scheldt*, the Scheldt and its affluent, the Scarpe. *In the basin of the Maas*, the Maas, which in France is called the Meuse, and which receives at Namur, from the left, the Sambre. *In the basin of the Rhine*, the Rhine, which is navigable from Bâle to the sea, and runs through Strasburg, Mainz, Coblentz, and Cologne. In the Netherlands it divides into several branches, of which the two principal ones, the Leck and the Waal, mix their waters with those of the Maas. Its principal affluent, the Moselle, waters Metz, and receives the Meurthe, which passes through Nancy. *In the basin of the Rhône*, the Rhône, which traverses Lake Leman and waters Geneva and Lyon; it receives from the right the Saône, which is greatly increased by the waters of the Doubs. It then proceeds towards the Mediterranean, where it forms its vast marshy delta. S. of Lyon its principal affluents are the Isère, Drôme, and Durance, which carry to it nearly all the water flowing into France from the Alps. To the same system belong the basins of the Var and the Aude.

Besides these great streams, several regions must be noticed which are naturally covered with ponds. They are the Sologne and the Brenne, S. of the Loire; the Dombes, E. of Lyon; and the great marsh of Lower Poitou.

The coast of the North Sea is low, partly marshy, and, down to the mouth of the Somme, bordered with a line of dunes, broken only by Cape Gris-Nez, which forms the nearest approach to England. Along the English Channel the coast of Normandy is bordered by cliffs which, cut and beaten in every direction by the sea, rise to the height of 250 metres, and run along to Cape de la Hève, W. of which the coast opens to the estuary and bay of the Seine. Then comes a line of low and very dangerous rocks, after which comes the sandy and marshy estuary of Carentan, which touches the peninsula of Cotentin. This peninsula, flat in its southern part, rises to the N. between the points of Barfleur and La Hague, where its coast attains a height of 150 mètres. In the angle formed by the peninsula of Cotentin and the northern coast of Finistère lies the bay of Mt. St. Michel, remarkable for the exceptional height of its tides (15 mètres), and defended to the N. by the English islands of Jersey, Guernsey, Alderney, and Sark. The passage between these islands and the coast is very dangerous to navigate. The whole northern coast of Finistère is strewn with dangerous reefs extending to Pt. St. Mathieu, which forms the extremity of Bretagne. At this point the coast suddenly retreats, and forms the vast roadstead at the head of which stands the naval port of Brest. From Brest to L'Orient, which also is a naval port, the coast is lower, but still hilly. Remarkable is the small gulf of Morbihan, studded with low islands, and the peninsula of Quiberon. Then comes the mouth of the Loire, and between the Loire and the Charente a succession of dunes and extensive marshes. Along the coast from Finistère to the Charente are situated the islands of Ouessant (Ushant), Groix, Belle Ile, Noirmoutiers, Yeu, Rhé, and Oleron. Farther S. the ocean receives the Gironde, which is deep and broad, like an arm of the sea. From the Gironde to Spain the coast is traced as a straight line bordered by vast dunes, which are broken only to the right of the basin of Arcachon and at the mouth of the Adour.

Along the Mediterranean the western coast is low, and its gracefully rounded heads conceal a series of marshes, of which the most important are those of Than and Mauguio, but especially that of Berre, which separates Marseille from the mouth of the Rhône. At Marseille the coast rises, and from here to the Italian frontier it presents a picturesque and much-indented line of headlands and bays. The road beyond the Hyères Islands, around the so-called Corniche, is admired by all tourists. The tide, so strong on the shores of the ocean, is very insignificant on those of the Mediterranean.

The western coast of Corsica is steep and abrupt, the eastern low and marshy.

3. *Climate.* The mean temperature of France is 12½ degrees Centig., or 55° Fahr. To the W. the isothermal lines are raised northward by the heating influence of the south-westerly winds and the Gulf Stream; to the E. they are lowered when removed from these influences. Rain is frequent and more abundant on the western coasts and in the mountainous regions (33 inches on the Atlantic border; 23 inches in Paris; 39 inches in Morvan; 40 to 45 inches on the slopes of the Alps and Pyrenees). Although the climate is generally temperate and mild, it nevertheless presents five different types, which are called the Sequanian (from the *Seine*), Vosgian, Rhodanian, Mediterranean, and Girondin. The Sequanian climate reigns N. of the Loire; its mean temperature is 52° Fahr.—in winter 38° F., in summer 66° F. The prevailing winds are W., S. W., and S.; the first two are rain-bearing. The Vosgian climate is more extreme; its mean temperature is 49° F.; rain is less frequent. The mean temperature of the Rhodanian climate (the valley of the Rhône) is 52° F., but the hot and dry southern winds (sirocco or Fœhn), alternating with the cold northern, produce sudden changes in the temperature. Rain is abundant in the Alps. The Mediterranean climate is warmer, its mean temperature being 57° F. The summer is hot and dry; the autumn is rainy, and disagreeable on account of the cold and impetuous N. E. wind called the mistral. The

climate in general is milder in the winter and hotter in summer than the Sequanian climate. N. W. and S. W. winds alternate, and produce rapid changes in the atmosphere.

III. Agriculture.—France presents four agricultural belts, which traverse it from S. W. to N. W.—namely, that of the olive, bounded by a line which connects the foot of the Corbières with the Alps of Dauphiné; that of the maize, whose northern boundary runs from the island of Oléron to the middle of the Vosges; that of the vine, which ceases at a line drawn from the mouth of the Loire to the source of the Oise; and N. of this line the belt of the apple tree. The system of small holdings prevails in France, the average size being 10½ hectares; the largest number of great holdings is found in the central part of the country. The cultivation of cereals occupies 15,000,000 hectares, and yields 250,000,000 hectolitres. Wheat is produced, especially in the north-eastern part of the country (in an average year 7,000,000 hectares, yielding 100,000,000 hectolitres); spelt (1,300,000 hectolitres); rye (2,000,000 hectares, 25,000,000 hectolitres); barley, in the same regions as wheat, but on poorer soil (1,000,000 hectares, 20,000,000 hectolitres); oats in the N. W. (3,000,000 hectares, 75,000,000 hectolitres); maize in the south-eastern and south-western parts (600,000 hectares, 10,000,000 hectolitres); millet in the western part (40,000 hectares); buckwheat in Bretagne, Normandy, and on the central plateau (700,000 hectares, 10,000,000 hectolitres); rice in the southern part, but only in small quantities. Of garden-vegetables and root-crops there are raised the true potato (1,200,000 hectares, producing 100,000,000 hectolitres), cultivated over the whole territory; kidney beans (200,000 hectares); broad beans (150,000 hectares), and in smaller quantities peas and lentils. Vegetables are raised, especially around the large cities (there are 1300 kitchen-gardens around Paris). The beet-root, cultivated especially in the N. E., occupies 130,000 hectares, and produces 44,000,000 quintals, from which more than 200,000 tons of sugar are extracted. Of textile plants, flax and hemp occupy 200,000 hectares. Of oil-seeds, colza, rape, and poppy cover 300,000 hectares, which yield 3,500,000 hectolitres of seed. The olive of Southern France gives the best table-oil; from that part of the country come also madder, saffran, and other dye-stuffs. Tobacco is cultivated in several establishments under the superintendence of the state, which holds a monopoly of this product (about 250,000 quintals). The natural meadows (Bretagne, Normandy, the coasts, and the mountains) cover 5,000,000 hectares, and produce 15,000,000 tons of hay. There are also artificial meadows, in which clover, lucerne, and grass are sown (2,700,000 hectares), and common pasturages in the mountains (6,000,000 hectares). One of the most important resources of France is the vine (2,500,000 hectares in 78 departments, producing 60,000,000 hectolitres of wine, of which one-third is for exportation). The production falls into seven groups—Burgundy, Bordelais, Champagne, Rhône, the central part of the country, Charente, and the southern part. Charente produces by the distillation of its wines the most excellent brandies. Other products of the vine are table-grapes and the raisins of Provence.

The northern part of the country produces excellent cider and perry, the quantity amounting to one-tenth of that of the wine. The manufacture of beer is important in the northern and north-eastern parts and in Lyon, the quantity amounting to one-eighth of that of the wine. Fruits are largely exported—apples and pears from the N., oranges, lemons, and pomegranates from the S.; excellent peaches, strawberries, and currants are grown near Paris; apricots in the central part; cherries near Paris and the coasts of the Channel. Dried fruits—pears, apples, prunes, figs, almonds, and nuts—come from the central and southern regions.

Of trees important to industry, France possesses the walnut, olive, and chestnut (Corsica, Provence and the central plateau), whose wood is used for cooperage and the fruit for food; the white oak and the mulberry, so important for the silk cultivation in the basin of the Rhône. The forest trees are—of hard wood, oak, elm, ash, hornbeam, beech, chestnut, etc.; of soft wood, alder, poplar, aspen, willow, birch, etc.; of resinous wood, fir, larch, and pine. There are in France 8,500,000 hectares of forest (in the N. E., in the Alps, the Landes, and the Pyrenees).

France possesses of live-stock 3,500,000 horses, 800,000 asses and mules, 12,000,000 horned cattle, 30,000,000 sheep, 1,500,000 goats, and 5,000,000 swine. The other domestic animals are rabbits in the surroundings of Paris; turkeys, ducks, geese in Orne, Maine, and the vicinity of Toulouse; pigeons, and especially chickens. The value of the annual production of eggs and poultry amounts to 100,000,000 francs, of which production 28 per cent. is for export.

The value of the annual production of honey and wax in France amounts to 24,000,000 francs; there are about 3,000,000 hives. The silkworms furnished, before the prevalence of disease among them, 25,000 tons of cocoons. The production of game—hares, partridges, wild-ducks, rabbits, pheasants, roebucks, wild-boars, etc.—amounts to one-third of that of poultry. Martens, foxes, otters, and other beasts and birds yield furs and feathers to the value of 30,000,000 francs a year.

The fisheries are very important. The trade in sea-fish exceeds 60,000,000 francs a year. The oysters of Cancale and Marennes are much esteemed, but the beds are nearly exhausted. For pisciculture there was formerly an excellent establishment at Hüningen; it is now carried on at Concarneau, and by its aid the oyster production in the basin of Arcachon has been developed considerably.

Of the 53,000,000 hectares of French soil one-half is under tillage, of which three-fourths are in cereals, one-fifth is in artificial meadows and industrial plants, and one-fifth in fallow. More than one-fifth is in natural meadows and pasturage, one-twentieth in vineyards, one-fifth in orchards, woods, and forests, and the rest in roads, private grounds, etc. The *relative* value of the products was in 1869 nearly 5,000,000 francs for cereal grains and straw, 2,000,000 for hay and pasturage, 1,500,000 for industrial plants, 1,500,000 for beverages, and 6,000,000 for domestic animals, of which one-third of the value was in horses, one-half in horned cattle, and one-tenth in sheep.

IV. Industry.—1. *Mining Industry.*—Granite occurs especially in Cotentin, the Chausey Islands, and several points of Bretagne, in the Vendée, Limousin, the Alps, and the Vosges. Among the volcanic products are noticeable the basalt of Auvergne and the porphyry of Corsica, Var, and Epinal. Excellent slate-quarries are found in the vicinity of Angers. Bayonne gives feldspar and asphaltum from the clay-schist of Ain. France is rich in marbles for building purposes. The most remarkable quarries are at Boulogne, Maubeuge, and Givet in the N.; at Le Mans and Sablé (Sarthe) in the W.; at Chomerac (Ardèche), La Droix (Côte d'Or), Châtillon (Loiret), and several other places in the central part of the country: at Campan, St.-Béat (a beautiful white marble), Castéra-Verduzan (a beautiful yellow marble), and Caunes in the Pyrenees, at Grenoble in the Alps, at Laveline in the Vosges, and at Corte in Corsica. A fine lithographic stone is found at the Vigan (Gard). Different kinds of freestone abound. The most beautiful are those found in the vicinity of Paris, at Creil (Oise), Crouy (hard), Bourgogne (very fine), Euville in Lorraine, etc. Chalk is found at Rouen, Meudon (in the vicinity of Paris), Troyes, and in Touraine, etc. Of siliceous materials, France produces the excellent millstones from La Ferté-sous-Jouarre, a repository of 3000 hectares, yielding 3500 stones a year. These stones have a wide fame; remarkable are also those from Lesigny (Creuse), Bergerac (Dordogne), etc.; and the sandstone of Fontainebleau, with which Paris is paved, and of the Vosges Mountains. The best plaster is that from the vicinity of Paris; the best cement comes from Boulogne, Vassy (Yonne), Pouilly (Côte d'Or), and Grenoble. Besides the common potter's clay, which is found everywhere, a finer sort of clay is found at Gien and Limoges, from which a celebrated *faïence* is made. Porcelain clay is found at St.-Yrieix. France produces both rock-salt and sea-salt. The former is found especially in Lorraine, near Nancy, and in the Jura, at Salins and at Lons-le-Saulnier; the second is produced from salt-marshes on the Atlantic from the mouth of the Loire to the Gironde, and on the coast of the Mediterranean. The annual production exceeds 500,000 tons.

Of mineral and thermal springs there are four groups: 1, that of the Vosges, generally chalybeate (Plombières, Bussang, Luxeuil, and Bourbonne-les-Bains); 2, that of the Jura and the Alps, chloric and sulphurous (Salins and St.-Gervais in the Jura, Aix-les-Bains in Savoy, Allevard-Uriage in Dauphiné, Condillac and Montélimart in the valley of the Rhône, and Aix in Provence); 3, that of the centre, whose waters generally are chalybeate and carbonated, and rise from the volcanic group of Auvergne (Évaux, Néris, Pougues, Bourbon-l'Archambault, Vichy (the most important thermal spring in France, especially for bowel complaints), St.-Galmier, Vals, Royat, Mont Dore, Balaruc, Bourboule, and Chaudes-Aigues); 4, that of the Pyrenees, whose waters generally are sulphurous (Amélie-les-Bains, Ax, Bagnères-de-Luchon, Barèges (the strongest sulphur spring in France), Bagnères-de-Bigorre, St.-Sauveur, Cauterets, and Eaux-Bonnes). Besides these four groups must be mentioned the sulphur springs of Enghien in the vicinity of Paris and of Bagnoles (Orne), the chalybeate springs of Forges-les-Eaux (Seine-Inférieure), and the famous springs of St.-Amand.

France is poor in metals with the exception of iron. Argentiferous lead is found at Pontgibaud (Puy-de-Dôme), Vialas (Lozère), etc.; copper in the Alps and Corsica; zinc in small quantities in Gard and the Pyrenees; man-

ganese at Romanèche (Saône et Loire); antimony in Haute-Loire, Cantal, and Corsica; nickel in small quantities in Isère (Les Chalanches); tin in Limousin and Bretagne; gold-dust in the sand of the Rhône, but not in sufficient quantities to make the extraction remunerative; iron pyrites for sulphuric acid is largely worked in Gard, Ardèche, Rhône, and Vosges. The total value of these several products is 6,500,000 francs, of which 3,500,000 are for lead alone. The importation of gold and silver amounts to 700,000,000 or 800,000,000 francs: that of copper, lead, tin, and zinc to 100,000,000 francs.

In 1815, France produced about 900,000 tons of coal and 110,000 tons of pig iron, and consumed 1,000,000 tons of coal and 110,000 tons of pig iron. In 1866 she produced 12,000,000 tons of coal and nearly 1,500,000 tons of pig iron. In the last half century the consumption of coal has increased tenfold and that of pig iron a hundred fold. Anthracite is mined in Hautes Alpes and Fréjus in Var; lignite in Aisne, Manosque, and Aix in Provence (200,000 tons); and peat in the Pas-de-Calais, Somme, Aisne, Oise, Seine-et-Oise, Vosges, and Jura. The alluvial districts of Seine-Inférieure, the valley of Grésivaudan, in Isère and Marais de Fos (Bouches-du-Rhône), 100,000 tons. The collieries, numbering 590 and comprising an area of more than 5,500 sq. kilomètres, are located in 71 basins and distributed in four groups: 1, That of the N., which, on the northern slope of the Ardennes, comprises the beautiful basin of Valenciennes (Anzin, Denain, Aniche, Douai, etc., probably stretching as far as the Boulonnais), and which yields one-fourth of the whole production. 2, That of the E., which was very important before the war of 1870, but of which only a few collieries at Ronchamp (Haute-Saône) have remained in French possession. 3, That of the centre, which extends from the foot of the Morvan and around the granitic districts of the central plateau. Its mines are numerous and often very rich: Épinac, 160,000 tons; Blanzy and Montchanin, 700,000 tons; Dieuze, 100,000 tons; La Chapelle-sous-Dun; Ahun, Commentry, 780,000 tons; Bert, Fins, St.-Eloy, Brassac, etc. In the great basin of the Loire, yielding one-fourth of the whole production, are Rive-de-Gier, Firminy, St.-Etienne, where the heaviest seam attains a thickness of 12 mètres; the basin of Alais (Bessèges, Porte, La Grand-Combe, etc.); St.-Gervais and Graissessac (150,000 tons); Carmaux (100,000 tons); Aubin (500,000 tons). 4, That of the W., from the foot of the granite of the Vendée and of Maine. Here are found the mines of Vouvant and Chantonnay; the basins of the Lower Loire (100,000 tons), Maine (100,000 tons), Cotentin, and Littry. Besides these four groups, the collieries of La Tour-du Pin and the Drac must be mentioned (100,000).

Iron ore is not often found in France in veins (Vosges and Pyrenees), but more frequently in beds (carbonate of iron in the coal regions, oxide of iron in the Jurassic regions, cretaceous iron in Le Creusot, in Franche Comté, Isère, Ardèche, and Aveyron); and oftenest as alluvial or bog ore (Ardennes, Champagne, Bourgogne, Franche-Comté, Berri, Poitou, Périgord, and Landes, where it is found in beds of a thickness of 30 mètres). The iron mines, numbering about 240, comprise an area of 1200 sq. kilomètres, and yield annually 3,000,000 tons of raw ore. The principal deposits are those of Vassy (Haute-Marne), yielding 500,000 tons a year; Châtillonnais, which form a belt stretching through three departments; Franche-Comté, which are situated between Langres, Vesoul, Besançon, and Dijon; of the department of Cher, which are the richest in France, and yield one fifth of the whole production.

The manufacture of pig iron and steel is increasing in France. In 1870, 1,000,000 tons of pig iron and about 10,000 tons of steel were manufactured.

2. *Manufacturing Industry.*—Hydraulic motors are manufactured especially in Paris, where all kinds of industry are united, and in Chartres, Essonnes (Seine-et-Oise). Steam-engines are manufactured at Paris, Rouen, Hâvre, Lille, St.-Quentin, Lyon, Marseille, and Nantes. In 1820, France possessed only 65 steam engines; in 1840, 2600; and now about 20,000. The number of movable and fixed motors, taken together, amounts to 29,000, with a power equal to that of 675,000 horses. Agricultural machines are made in Paris, Liancourt (Oise), Nancy, Meaux, Orléans, and Bourges. Spinning and weaving machines are made—for cotton, in Paris, Rouen, and St. Quentin; for flax, in Lille; for wool, in Roubaix, Elbeuf, Louviers, and Sedan; for silk, in Lyon and St.-Chamond; for hosiery, in Nîmes. Sewing-machines are made in Paris and Lyon. Machine-tools are made in Paris, St.-Denis, Rouen, Creusot, etc.; tools for naval woodwork, in Hâvre. Metallic wares are made in Paris, Villedieu (Manche), and Guise (Aisne). Hardware is made for tools in Paris and St.-Etienne; for buildings, in Charleville (Ardennes), L'Aigle (Orne), Rugles (Eure); for the household, in Paris and Lille. Arms are manufactured at Paris, Châtellerault, St.-Etienne, Charleville, Tulle, etc.

Alcohol is made from wine (500,000 hectolitres) at Herault and Charentes, and from beet-root (1,000,000 hectolitres) in French Flandre. Chemicals are manufactured in Paris and its vicinity, at Lille, St.-Gobain, Rouen, Cherbourg, Lyon (dyestuffs), Montpellier, Marseille, Bordeaux, etc. The consumption of sulphuric acid in France is 50,000 tons. Oils are made from olives in Provence, Roussillon, and Southern Languedoc; from nuts, in Charente and Dordogne; from colza and flax-seed, in Flandre; from rapeseed, at Caen and in Franche-Comté. Candles and other chandlery products are made at Paris, Lyon, Montpellier, Marseille, and Lille; soaps, at Marseille, Nantes, Hâvre, Amiens, Rouen, Elbeuf, Rheims, and Lyon; toilet soaps, at Paris; hair-dressing articles, at Givet, Paris, Château-Renault, and Grenoble; glue, in Flandre, at Paris, and Givet.

Milling is carried on extensively at Corbeil (Seine-et-Oise), between the Beauce and the Brie, the two great wheat-fields of France; at Gray, Poitiers, Marseille, Hâvre, etc. The so-called *pâtes d'Italie* are made especially in Paris, but also in Marseille, Lyon, Clermont-Ferrand.

Of preserved food may be mentioned the sardines of Bretagne, the meat-pies of Nérac, the pastries of Toulouse, the brandy-pickles of Troyes, Lyon, Arles, and Bayonne, and the preserved viands of Nantes, Bordeaux, Marseille, and Mons. Cheese-making is much developed in France. The most famous kinds of cheese are the Maroilles, Brie, Camembert, Neuchâtel, Livarot, Pont-l'Evêque, and Isigny; those of Jura resemble the gruyère of Switzerland; the Septmoncel and Mont d'Or cheeses are made of goat's milk. The manufacture of beet-root sugar is carried on especially in the N. W. (Paris, Lille, Valenciennes, Douai, Arras, Péronne). More than 200,000 tons of sugar are produced from roots grown in France; the total production is 325,000 tons, of which 225,000 tons are consumed in the country. The raw sugar from the colonies is refined at Marseille, Bordeaux, Nantes, and Hâvre. Confectionery is principally made in the great cities; the confections of Verdun and the jellies of Bar-le-Duc may be mentioned. Liqueurs are distilled at Paris, Chartreuse, and Cette. In the Vosges excellent cherry brandy (Kirschwasser) is made. Chocolate is manufactured in Paris, Noisiel, Bayonne, and the Nord. Vinegar is made in Charente and Orléans; mustard is prepared extensively in Paris, Bordeaux, and Dijon; drugs mainly in Paris.

Cotton Stuffs.—120,000 tons of cotton are annually imported. It employs 7,000,000 spindles and 150,000 looms. The territory in which this industry is carried on may be divided into four regions: 1, that of the E., formerly comprising Alsace, is now nearly confined to the valleys of Lorraine, especially at Senones (Vosges), to which may be added Bar-le-Duc, Nancy, and Troyes; 2, that of Normandy, whose principal market is Rouen; the factories are at Rouen, Gisors, Evreux, Falaise, Flers (Orne), and in the district around Cholet; 3, that of the N., whose most important market is St.-Quentin, and whose most extensive factories are at Amiens, which annually produces 100,000 pieces of cotton velvet, Lille, Tourcoing, Roubaix, etc.; 4, that of Lyonnais, whose centre is Tarare and Roanne and Vichy. The manufacture of printed calicoes is now, since 1870, confined to Paris and Rouen.

Linens.—Of textile plants, hemp and flax are indigenous in France. The production and importation, whose value amounts to 60,000,000 francs, employ more than 650,000 looms. This industry is principally located in the northern part of the country. In Flandre (Lille and its environs, Armentières, Dunkerque (Dunkirk), for veils; Valenciennes and Cambrai for laces; Abbeville for spinning, Amiens for plain stuffs; St. Quentin for damasks, etc.). In Normandy and Maine (Le Mans for coarse stuffs; Laval, Fresnay sur Sarthe, Alençon, Lisieux, Vimoutiers for sheetings; Vire, Bernay, Angers, and Cholet for handkerchiefs; Hâvre, Angers). In Bretagne in the linen manufactures of Landerneau. Besides these there are some points in the Vosges, Béarn, and Dauphiné where this industry is prosecuted.

Woollens.—Besides the indigenous product, France imports annually wool to the amount of 200,000,000 francs. Its manufacture is carried on in seven regions: 1, That of the N.—Roubaix and Tourcoing for fancy goods; Cateau-Cambrésis, Fourmies, and Sains for merinos; St. Quentin and Guise for light stuffs; Amiens for velvet; D'Utrecht and Abbeville for heavy cloths; Mouy for furniture cloths. 2, That of Normandy (Elbeuf and Louviers for heavy cloths, Lisieux, Vire, etc.). 3, That of Ardennes (Sedan for fine cloths, Rheims). 4, That of the E. (Nancy). 5, That of Isère (Vienne). 6, That of Languedoc (Lodève for heavy cloths, Bédarieux, Carcassonne, Mazamet, Mende, etc.). 7, That of the centre (Limoges for flannels, Châ

teauroux and Romorantin for army cloths; Orléans for blankets, etc.). Shawls are made at Paris and Lyon; tapestries (besides the celebrated Gobelins at Paris) at Beauvais, Aubusson, Nîmes, Roubaix, and Tourcoing.

Silks.—It is principally in the valley of the Rhône that silks are manufactured, as it is the region of the silkworm. Besides the indigenous produce, France imports annually raw silk to the value of over 100,000,000 francs. The winding and spinning are done principally in Ardèche, Drôme, Vaucluse, Gard, and Hérault. For weaving Lyon and the department of the Rhône are the most noted places (120,000 looms); next, St.-Etienne and St.-Chamond (ribbons and brocades), Nîmes (light stuffs), Tours (furniture silks). Lace is made at Alençon, Bayeux, Caen, Chantilly, Bailleul, Lille, Arras, Mirecourt, employing 100,000 women.

Tulle is principally made in Calais, St.-Pierre-les-Calais, and Lyon; embroidery in Nancy and in the Vosges; small wares in Lyon and Paris. Hosiery is manufactured in Troyes, the whole of Champagne, Amiens (woollen, 25,000 hands), Falaise, Lyon, and Nîmes (silk). Straps are made in Rouen and Paris; buttons in Paris and Creil. In drapery, making up, and *modes* Paris is the principal centre; her products are very remarkable, and are exported to the value of hundreds of millions. Hats come especially from Paris, but also from other great cities (felt hats from Aix); kid gloves from Paris and Grenoble; boots from Paris, Bordeaux, and Marseille. In jewelry no place in France, and perhaps none in the world, can rival Paris, which also manufactures watches, though this industry has another very important centre in Besançon, where the mounting of the pieces manufactured in the Jura Mountains is done. Perfumery is made in Paris and in Provence.

V. Commerce. 1. *Means of Communication.*—The roads of France are divided into three classes—national roads, maintained at the expense of the state, and extending 35,000 kilomètres (21,740 E. m.); departmental roads, maintained at the expense of the departments, and extending 45,000 kilomètres (27,960 E. m.); and parochial roads, maintained by the communes, and subdivided into three grades, of which the first extends 75,000 kilomètres (46,604 E. m.), the second 75,000 kilomètres (46,604 E. m.), and the third 340,000 kilomètres (211,270 E. m.). Only the last grade of the last class is on the natural soil.

The water-roads, on which the interior navigation takes place, comprise the navigable courses of the rivers, extending 9400 kilomètres (5840 E. m.), and the canals, extending 4800 kilomètres (2980 E. m.). The first French railroad was constructed in 1828, from Andrezieux to St.-Étienne and Lyon; horses were used on this road until 1832, when the first locomotive was employed. The next railroad was that from St.-Germain to Paris. The real system of railways was commenced in 1847; its actual length is 16,000 kilomètres (9940 E. m.), its proposed length 20,000 kilomètres (12,430 E. m.). These railways have cost 6 milliards, of which the state paid one, and they are worked by companies which have a lease on them for 99 years, at the end of which term they become the property of the state. There are six great companies—namely, that of the West, the North, the East, the Paris Lyon and Mediterranean, the Orléans, and the South: and 23 small ones, which only work 1350 kilomètres (940 E. m.), and of which the principal are those of Charentes, Vendée, Orléans, Châlons, etc. All the great companies, with the exception of that of the South, have the heads of their lines in Paris, where they are connected by belt-lines. The traffic on the French railways amounts to 100,000,000 passengers, the larger part of whom travel less than 20 kilomètres (12½ E. m.), and 38,000,000 tons of merchandise, which generally travels more than 150 kilomètres (93 E. m.). The receipts amount to 700,000,000 francs, of which one-third is for passengers. The traffic conveying merchandise on the water-roads is about one-half of that on the railways. The steam navigation in the basin of the Seine is equal to that in all the other basins together.

The post and telegraph follow the great roads of communication. Both are regulated by the state. The first transports annually about 700,000,000 articles, letters, postal cards, etc. (350,000,000 letters). The postage of a letter is 0f. 25, of a postal card 0f. 15. But this institution does not offer to the public the same facilities for sending printed matter, etc. as it does in other countries—for instance, England. The telegraph conveys more than 3,000,000 messages of an average price, for France, of 0f. 60, over 30,000 kilomètres of lines (18,640 E. m.).

The traffic on the sea is not prosperous. The number of vessels has remained stationary for about thirty years, though their tonnage has been doubled. The effective force of the commercial fleet (with the exception of craft employed in the fisheries of the coast) is 15,600 vessels, of about 1,000,000 tons burden. The general movement amounts to more than 16,000,000 tons. The coasters make annually 76,000 voyages; the ports in which the coasting trade is most active, are Marseille, Hâvre, Bordeaux, Nantes, Rouen, Dunkerque (Dunkirk), Cette, Arles, Tournay, Charente, and Libourne. The ports for the equipment of fishing-vessels are Gravelines, Boulogne, Dieppe for herring; Douarnenez for sardines; Granville for oysters. The great sea-traffic which exists between France and England, and between France, Italy, Turkey, Spain, and Russia, starts partly from Marseille and Hâvre, ports of first rank, and partly from Bordeaux, Nantes, and Dunkerque, ports of second rank. The cod-fishery employs 500 vessels, but for several years no whaling fleet has been equipped.

2. *Money and Measures.*—The great Revolution of 1789 gave France the metrical system, so admirably founded in reason, and now adopted by the greatest part of continental Europe. The basis is the mètre—that is to say, the $\frac{1}{10000000}$th part of the quadrant of the meridian passing through Paris (according to measurements made at the end of the eighteenth century by French astronomers), and the scale is arranged in accordance with the decimal system. The French money basis is the Franc (which see). The mints of Paris and Bordeaux produce yearly from 200,000,000 to 400,000,000 francs in coin, chiefly in gold. Before 1870, France possessed 4½ milliards of money. Besides the ordinary commercial paper, which is used principally in the great financial and banking establishments of Paris, France employs bills on the Banque de France, an institution whose credit is equal to that of the state, and which, through the central bank of Paris and the 80 provincial banks, discounts about 6 milliards a year, and puts into circulation bills of its own to the amount of 2 milliards. In May, 1874, the balance of the bank showed a deposit of 3,226,000,000 francs.

3. *Interior Commerce.*—The interior commerce of France circulates annually more than 29 milliards. The increased facilities for communication have served to increase the interior commerce; thus, the number of letters has increased fivefold since 1830. Besides the great cities, in which the retail business, and the manufacturing centres, where the wholesale business is carried on, there are throughout the whole of France periodical markets much frequented by the agricultural population. The most important of these markets are the cattle-market of La Villette in Paris, the fair of Guibray near Falaise, and that of Caen, where there is a large trade in horses.

4. *Foreign Commerce.*—The general commerce of France, with the exception of that of the precious metals, comprises more than 8 milliards, of which 4 are for importation and more than 4 for exportation; half a century ago it did not exceed 1 milliard. It takes place mostly by sea. That of the precious metals exceeds generally 1 milliard, of which 700,000,000 are for importation. The special trade transit and storage comprise 5¾ milliards, of which 2¾ are for importation, and 3 for exportation; the importation of natural produce and raw materials for manufacturing amounts to 2 milliards, that of other materials and objects of consumption, 800,000,000.

France draws silk (worth 350,000,000) from China, Japan, Bengal, the Levant, Italy; cotton (from 200,000,000 to 425,000,000) from the U. S., India, Egypt, Turkey; wool (250,000,000) from Australia, the Cape of Good Hope, La Plata, Turkey, the Levant, Germany, and finer sorts from Spain and Southern Russia; flax, hemp, and jute (from 30,000,000 to 90,000,000), the first from Belgium, Russia, England, Germany; the second from Italy and Russia; the third from India; hides, skins, and peltry (100,000,000) from La Plata, Brazil, Australia, Russia, and Germany.

Commodities.—France imports sugar (100,000,000) from her colonies, and to some extent from Mauritius, the Antilles, Brazil; coffee (80,000,000) from Brazil, India, the Greater Antilles, Peru, Venezuela; tobacco (20,000,000) from the U. S., the Greater Antilles, Algeria, and Turkey; cocoa (10,000,000) from Brazil, Antilles, Peru, Venezuela; vanilla (1,500,000); spices (4,000,000); gums (8,000,000) from Senegal, Egypt, Turkey; bark (5,000,000) from tropical America and the U. S.; dyewoods (12,000,000) from Central America, Brazil, Senegal; indigo (20,000,000) from India, Java, the Antilles, and Guatemala.

France imports copper (45,000,000) from England, Peru, Chili, the U. S., Spain, Russia; lead (15,000,000) from Spain, Italy, Algeria, England; zinc (18,000,000) from the Netherlands, Belgium, Prussia; tin (10,000,000) from the Netherlands, England, India, Peru; iron (10,000,000) from England, Prussia, Belgium, Sweden; sulphur (5,500,000) from Sicily; coal (100,000,000) from Belgium, Prussia, England; petroleum (15,000,000) from the Levant and the U. S.

Building timber (130,000,000): pine is received from the N. of Europe, Switzerland, Germany; oak from the U. S., Austria, and Belgium. Among other materials for manufacturing industry, oil-seeds (50,000,000), tallow (20,000,000) from the same countries as hides; olive oil (30,000,000)

from Italy; fat oils (10,000,000), from Germany; potash (8,000,000) from America, Italy, and the Netherlands.

Animals (75,000,000) come from Germany, Belgium, Switzerland, Italy: fertilizers (20,000,000) from Peru, Chili, La Plata, Russia, Germany, Belgium; seed-corn (25,000,000) from England, Germany, and the U. S.; eggs of silkworms (10,000,000) from China and Japan; timber from Germany and the Scandinavian countries.

France imports salt fish (20,000,000), cheese (18,000,000), fruit (20,000,000), rice (10,000,000), salted and smoked meat (5,000,000), hops (4,500,000). The importation of cereals varies from 30,000,000 to 300,000,000, and takes place from Southern Russia, Egypt, Algeria, and the U. S. Horses (10,000,000) come from Germany, England, and Belgium.

The importation of manufactured articles forms only one-fourteenth of the whole, and comprises woven fabrics (wool, 40,000,000; flax and hemp, 11,000,000; cotton, 15,000,000; silk, 10,000,000; hair, 5,500,000) from England, Germany, Belgium, Switzerland, and Italy; yarn (wool, 1,000,000; cotton, 7,000,000; flax, 2,000,000) from England, Belgium, and Germany; mattings and plaitwork from the same countries and from Russia; straw hats (10,000,000) from Italy, Peru, and Brazil; feathers (5,000,000) from England, Germany, Italy, Algeria, Egypt, and La Plata; machines (12,000,000) and tools (5,500,000) from England, Belgium, and Germany; watches (3,000,000) from Switzerland, Germany, and England.

Exports.—These consist chiefly of manufactured articles, the value of which amounts to 1,600,000,000; that of the total exportations to 3 milliards. It comprises woven fabrics (silk, 420,000,000; wool, 335,000,000; cotton, 95,000,000; flax and hemp, 25,000,000) to Germany, the U. S., Spain, and Switzerland; yarn (cotton and wool, 20,000,000; linen, 21,000,000) to the same countries; articles of toilet (furnishing goods, 120,000,000; modes, 20,000,000; perfumery, 15,000,000) to America, England, Belgium, Spain, and the Levant; chemicals (60,000,000) to Belgium; madder and indigo (20,000,000) to Belgium, Spain, Switzerland, Italy, and England; drugs (10,000,000); soap (6,000,000), stearine and candles (5,000,000), sugar (100,000,000) to Turkey, the Levant, England, and Italy; toys, haberdashery, etc. (200,000,000) to England, Belgium, Germany, Italy, and Spain; skins (150,000,000) to England, Spain, and Turkey; tools (40,000,000), machines (8,000,000), and arms (8,000,000) to England, Italy, Spain, South America, and the colonies; jewelry (20,000,000) to America, Turkey, Egypt, and Spain; watches (8,000,000) to Italy, the Levant, America; paper (35,000,000) to England, Spain, America, and Turkey; pottery and glassware (32,000,000) to Italy, the Levant, Belgium, and England; musical instruments (8,000,000) to England, the U. S., Belgium, and Spain. Of other products are exported, wine (230,000,000) and brandy (50,000,000) to England, Russia, Belgium, Switzerland, Italy, Germany, Egypt, Brazil, the U. S., and La Plata; textile fibres (silk, 100,000,000; cotton, 60,000,000; wool, 30,000,000; hair, 25,000,000) to Switzerland, England, Germany, Spain, and Italy; cereals in very variable quantities; cheese and butter (65,000,000); eggs (35,000,000); dried vegetables (8,000,000); fruit (20,000,000) to England, Belgium, and Austria; oil (10,000,000) to the U. S., Switzerland, and the colonies; salt-water fish (20,000,000) to the U. S.; salted meat (8,000,000) to England; horses (20,000,000) and cattle (30,000,000) to England, Spain, Belgium, and Italy; seed corn (30,000,000) to England and Germany; hides (14,000,000) to England; oleaginous seeds (15,000,000) to England and Belgium; wood (34,000,000) to Belgium, Germany, and Spain; madder (12,000,000) to England, the U. S., and Switzerland; copper (8,000,000) to England, Italy, etc.

7. The balance of importations and exportations with respect to different countries with which France holds the most important commercial relations is shown by the following table:

	Imports in francs.		Exports.
England	700,000,000		1,000,000,000
Belgium	300,000,000		260,000,000
United States	50,000,000	(1869)	108,000,000
	191,000,000	(1871)	317,000,000
Switzerland	100,000,000		221,000,000
Italy	240,000,000		271,000,000
Germany	165,000,000		211,000,000
Spain	51,000,000		157,000,000
Turkey	136,000,000		64,000,000
Russia	100,000,000		26,000,000
Egypt	71,000,000		57,000,000
Brazil	52,000,000		7[illegible]
La Plata	75,000,000		49,000,000

8. The transit trade carries 3,500,000 of quintals, valued at 800,000,000 francs. The temporary importation amounts, when entering France, to 100,000,000, and when leaving to 200,000,000.

9. *Custom-houses.*—The most important are—

	Tons.	Duty.
Marseille	1,500,000	1,500,000 fcs.
Havre	800,000	1,[illegible]
Boulogne	175,000	600,000
Dunkerque	47[illegible]	2[illegible]
Bordeaux	9[illegible]	4[illegible]
Nantes	1[illegible]	110,000
Jeumont	1,[illegible]	11[illegible]
Lille	140,000	1[illegible]
Paris	130,000	500,000

The warehouses contain merchandise to the value of about 500,000,000 francs.

VI. The Press and Periodical Publications.—The total number of periodical publications (newspapers, magazines, etc.) is 2500, of which 775 are published in Paris and 1725 in the provinces. They represented the following specialties:

	Paris.	Provinces.		Paris.	Provinces.
Political	48	1001	Technical	60	9
Administration	15	30	Commercial	39	51
Religious	58	112	Financial	44	4
Military	16	112	Literary	77	55
Law	31	25	Art	52	5
Scientific	64	58	Modes	37	2
Medicine	40	32	Sports	10	1
Agriculture	32	120	Sundry	99	44
Industrial	32	17			

The most important political journals are published in Paris.

VII. The POPULATION of France is increasing, but not in so large a ratio as that of other countries in Europe. About 150 years ago it was estimated at 20,000,000, and at the time of the Revolution (1789) at 25,000,000. In 1831 it was 32,500,000, and in 1866, 38,000,000. On account of the loss of territory occasioned by the late war it is now only 36,100,000; an average of 69 inhabitants to each square kilomètre. At the time of Cæsar 10,000,000 Gauls lived poorly on a much larger territory, while the 36,000,000 Frenchmen of to-day live in comparative comfort. The total number of births annually is 1,000,000. A little more than one-half of the births are male, but the total number of women is a little greater than that of men (501 women to 499 men). The number of deaths annually is 850,000; of marriages 300,000, of which 250,000 are first marriages. The majority of the population (29,000,000) is settled in the country; about 19,000,000 live by agriculture. The town population (people who live in communes numbering more than 2000 souls) amounts to more than 10,000,000, of whom the larger part follow some trade or profession. There are in commercial business about 4,000,000. The manufacture of textile fabrics, clothing, toilet articles, and buildings employs each about 1,000,000 hands; next come the preparation of food, transportation, mining, and quarrying, 500,000. The ten departments in which the population is densest, and which owe their prosperity especially to manufactures or commerce, are Seine, Bouches-du-Rhône, Rhône, Loire, Nord, Loire-Inférieure, Gironde, Var, Vendée, and Corsica. We find 42 towns which have over 30,000 inhabitants; 20 number between 30,000 and 50,000 inhabitants—namely, Rochefort, Poitiers, Béziers, St. Denis, Bourges, Dunkirk, L'Orient, Cherbourg, Clermont-Ferrand, Troyes, Avignon, Boulogne, Caen, Grenoble, Tourcoing, Dijon, Tours, Le Mans, Orléans, Besançon; 13 between 50,000 and 70,000 inhabitants—namely, Nice, Rennes, Nancy, Limoges, Angers, Montpellier, Nîmes, Brest, Versailles, Toulon, Rheims, Roubaix, and Hâvre; 8 with more than 100,000 inhabitants—namely, Rouen (102,000), Paris (1,851,292), St.-Étienne (111,000), Nantes (119,000), Toulouse (125,000), Lille (158,000), Bordeaux (194,000), Marseille (313,000), and Lyon (323,000).

The length of life has increased in France in a very remarkable degree, probably on account of the development of the industry and agriculture of the country. The average lifetime, which was 28 years in 1789, is now 37 years. The race is strongest and most robust in the N. and N. E.

With respect to religions, France contains only a small number of Jews (50,000), mostly living in Lorraine and the department of the Seine. The 600,000 French Protestants, mostly Calvinists, live in Franche-Comté and in the S. (Languedoc, Dauphiné, Savoy, and Guyenne). The rest of the population is Roman Catholic.

In ethnological respects the French nation is a very mixed race. The first occupants of the soil did not form a homogeneous mass. They consisted of three nations: Kymric Celts, tall and blonde, in the N. E.; true Celts, small and short, in the centre and W.; Basques, in the S.; and besides these three races there was perhaps a fourth aboriginal race, from which the inhabitants of Central France may have inherited certain traits, and of which memorials are found in the caves and in the megalithic monuments. This original stock, composed of four partially unknown elements, received manifold influences from the successive conquering races. The Romans ascended along the Rhône and de-

scended along the Garonne: the Visigoths settled in the basin of the Garonne; the Normans at the mouths of the rivers and in Normandy: the Arabs in Roussillon, Lower Languedoc, and Provence. Later on came the English into the S. W., and the Spaniards into Flandre and Franche-Comté. And to these influences must be added that of more recent immigrations. At the census of 1866 there lived on French soil 635,000 foreigners, attracted by the beauty of the climate and the facility of living—namely, 276,000 Belgians, 107,000 Germans, 100,000 Italians, 42,000 Swiss, 33,000 Spaniards, 30,000 Englishmen, and 10,000 Poles. Thus, the French nation is not, properly speaking, a *race*, though the Gallic element is predominant. From this diversity of origin of the population it is a natural result that in certain regions of the country the national language is placed in a sort of competition with other idioms. Thus, in the department of Nord there are from 150,000 to 200,000 persons who generally use the Flemish language. Before the dispossession of Elsass and Lothringen 1,300,000 or 1,400,000 French citizens used a German jargon. In the W. 1,300,000 persons speak Breton, a Celtic idiom nearly allied to the Welsh. In the S. W. 120,000 Basques speak a language whose origin, like that of their race, is entirely unknown, unless it be aboriginal. The 260,000 inhabitants of Corsica are Italians with respect to the language which is spoken in their towns, and which is to be distinguished from the numerous dialects spoken among their mountains. The French themselves, numbering 35,000,000, make use of two great dialects—*langue d'oïl*, which is the proper French language, and *langue d'oc*, which is rather a Romance language. But this distinction is now of very little consequence, as the *langue d'oc* exists only in the form of a jargon, very variable according to the locality in which it is spoken, and steadily retreating before its conquering rival, the *langue d'oïl.*

VIII. Constitution and Administration.—1. *Administrative Divisions.*—The principal divisions of France were, before the great Revolution of 1789, for administrative purposes intendancies, and for military purposes provinces. The first were in reality the most important, but the second were the best known; they were founded in the nature of things, and they correspond at this day to old customs. There were 32 great and 8 small governments, forming what to-day is called the "old provinces" of France. For this organization the Constituent Assembly of 1790 substituted the division into departments, districts, cantons, and municipalities or communes, and, somewhat modified, this division has been finally adopted, and is that still existing, only that arrondissements, less numerous and more extensive, have been substituted for the districts. The division of the departments does not coincide exactly with that of provinces; it was the idea of the Constituent Assembly to break the provincial traditions. The names of the departments have generally been borrowed from the physical geography. Now (in 1875) France comprises 36 old provinces, forming 86 departments, 362 arrondissements, 2700 cantons, and 36,000 communes; the number of the two last divisions is subject, however, to some variation. The following table gives the relation between the provinces and the departments, and the capitals of the latter.

1. North-West.

Provinces	Departments	Capitals.
Flandre	Nord	Lille.
Artois	Pas-de-Calais	Arras.
Picardie	Somme	Amiens.
Normandie	Seine-Inférieure	Rouen.
	Eure	Evreux.
	Calvados	Caen.
	Orne	Alençon.
	Manche	St-Lô.
Bretagne	Ille-et-Vilaine	Rennes.
	Côtes-du-Nord	St-Brieuc.
	Finistère	Quimper.
	Morbihan	Vannes.
	Loire-Inférieure	Nantes.
Anjou	Maine-et-Loire	Angers.
Maine	Mayenne	Laval.
	Sarthe	Le Mans.
Ile de France	Seine-et-Oise	Versailles.
	Seine	Paris.
	Seine-et-Marne	Melun.
	Oise	Beauvais.
	Aisne	Laon.

2. North-East.

Provinces.	Departments.	Capitals.
Champagne	Ardennes	Mézières.
	Marne	Châlons.
	Aube	Troyes.
	Haute-Marne	Chaumont.
Lorraine	Meuse	Bar-le-Duc.
	Meurthe-et-Moselle	Nancy.
	Vosges	Epinal.
Alsace	Belfort	Belfort.
Franche-Comté	Haute-Saône	Vesoul.
	Doubs	Besançon.
	Jura	Lons-le-Saulnier.
Bourgogne	Ain	Bourg.
	Saône-et-Loire	Mâcon.
	Côte-d'Or	Dijon.
	Yonne	Auxerre.

3. South-East.

Provinces.	Departments.	Capitals.
Lyonnais	Loire	St.-Étienne.
	Rhône	Lyon.
Dauphiné	Isère	Grenoble.
	Drôme	Valence.
	Hautes-Alpes	Gap.
Savoie	Savoie	Chambéry.
	Haute-Savoie	Annecy.
Comtat Venaissin	Vaucluse	Avignon.
Provence	Bouches-du-Rhône	Marseille.
	Var	Draguignan.
	Basses-Alpes	Digne.
Comté de Nice	Alpes Maritimes	Nice.
Corsica	Corse	Ajaccio.
Languedoc	Haute-Loire	Le Puy.
	Ardèche	Privas.
	Lozère	Mende.
	Hérault	Montpellier.
	Aude	Carcassonne.
	Tarn	Alby.
	Haute-Garonne	Toulouse.
	Gard	Nimes.
Roussillon	Pyrénées-Orientales	Perpignan.
Comté de Foix	Ariège	Foix.

4. South-West.

Provinces.	Departments.	Capitals.
Guyenne and	Hautes-Pyrénées	Tarbes.
Gascogne	Gers	Auch.
	Tarn-et-Garonne	Montauban.
	Aveyron	Rodez.
	Lot	Cahors.
	Dordogne	Perigueux.
	Lot-et-Garonne	Agen.
	Gironde	Bordeaux.
	Landes	Mont-de-Marsan.
Béarn	Basses-Pyrénées	Pau.
Angoumois	Charente	Angoulême.
Aunis and Saintonge	Charente-Inférieure	La Rochelle.
Poitou	Vendée	La Roche-sur-Yon.
	Deux Sèvres	Niort.
	Vienne	Poitiers.

5. Centre.

Provinces.	Departments.	Capitals.
Touraine	Indre-et-Loire	Tours.
Orléanais	Loir-et-Cher	Blois.
	Eure-et-Loir	Chartres.
	Loiret	Orléans.
Berry	Cher	Bourges.
	Indre	Châteauroux.
Marche	Creuse	Guéret.
Limousin	Haute-Vienne	Limoges.
	Corrèze	Tulle.
Auvergne	Cantal	Aurillac.
	Puy-de-Dôme	Clermont-Ferrand.
Bourbonnais	Allier	Moulins.
Nivernois	Nièvre	Nevers.

2. *Communal and Departmental Administrations.*—The commune represents the elementary unit of the territorial division and of the administrative organization. It is a part of the territory comprising either a town or one or more villages, with their annexes and fields. It is governed by a *maire*, deputies, and a municipal council. The maire was formerly elected by the municipal council, but he is now, according to a recent law, appointed by the government, and chosen as far as possible from the municipal council. He is assisted by one or more deputies, who are appointed in the same manner, and who take his place in case of absence. The municipal council, of which the maire is the president, and which is composed of from 10 to 36 members elected by the inhabitants of the commune, exercise within the very narrow limits of the law a deliberative power in all communal affairs, issuing either decisions or deliberations or simple advice. It holds annually four sessions, generally of ten days each. Paris and Lyon have special administrations; their municipal councils elect their presidents and vice-presidents. The prefect of the department has a right to enter the council, and has under him the maires of the different arrondissements of these cities; the maires are appointed by the government.

The canton generally consists of 10 communes. It is not, properly speaking, an administrative division, but it serves as a basis for the election to the general council and to the council of the arrondissement. It is specially a judiciary circumscription. Recruiting for the army takes place at the principal town of the canton.

The arrondissement consists, generally, of 8 cantons. It is governed by an under-prefect, who ranks next to the prefect of the department. The arrondissement, however, in which the capital of the department is situated is governed by the prefect himself. The under-prefect is appointed by the chief of the state (the President of the republic). He is assisted by a council of the arrondissement, which consists of as many members as there are cantons, but which plays a somewhat weak part. It assembles on the call of the prefect; it deliberates on the

public works, and it assesses the direct contributions upon the communes.

The department consists, generally, of 4 arrondissements, and is the only division of any great consequence in an administrative point of view. The prefect, who governs it, is appointed by the President of the republic on the nomination of the minister of the interior, and he can be recalled. He represents the government; brings the laws and the ministerial orders into execution; superintends and maintains public order, and exercises a sort of police inspection over the towns. He introduces all affairs concerning the department, and executes the decisions of the general council and of the departmental committee, within the limits of the law. The deliberative power pertains to the general council, composed of as many members as there are cantons, though not more than 30, who are elected for nine years and renewed by thirds. It deliberates and votes on all departmental affairs; in the interval between its sessions it assigns its power to a departmental committee, which superintends the administration of the commune. Besides these two powers there is a third administrative power, exercised by the council of the prefecture, which decides on all demands for reductions in contributions, etc. Relief to the poor and the sick must be provided for by the commune; the communal hospitals are governed by a committee of five members, appointed by the prefect and presided over by the maire. The arrondissements have, generally, hygienic committees, physicians for infants, committees for inspecting the drug-shops, etc. Every department must have a lunatic asylum.

3. *Army.*—Nothing definite can as yet be said of this subject, as at this moment (June, 1874) the French army is in a state of reorganization. This, however, is an outline of its actual but provisional state, in accordance with laws recently enacted by the National Assembly: It consists of (1) volunteers or re-enlisted men, who form about one-tenth of the annual contingent, and (2) young men twenty years of age and fit for military service, whom the laws of recruiting summon annually to form what is called "the contingent." These young men serve five years in the active army, then five years in the territorial army, and at last six years in the reserve of the territorial army. The enforcement of the new laws will give, in time of peace, an army of 450,000 men, and in time of war an active army, with its reserves, of 775,000 men, a force in garrison of 610,000 men, a territorial army of 580,000 men, and reserves for the territorial army of 620,000 men; total, 2,685,000. In the same manner as in Germany and Austria young men who fill certain conditions (unmarried, scholars, etc.) can be exempted from serving more than one year of the five they owe to the state by submitting to certain examinations and by paying 1500 francs.

France is divided into 19 military regions, occupied each by an army corps. The head-quarters of these divisions are Paris, Amiens, Rouen, Le Mans, Orléans, Châlons, Besançon, Bourges, Tours, Rennes, Nantes, Limoges, Clermont-Ferrand, Lyon, Marseille, Montpellier, Toulouse, Bordeaux, and Algiers. Each of these divisions consists of 8 subdivisions. There are, besides, two military governments—those of Paris and Lyon. Each army corps consists of 2 divisions of infantry, which have each 1 battalion of chasseurs and 4 regiments, forming 2 brigades, 1 brigade of cavalry of 2 regiments, 1 brigade of artillery, 2 regiments of engineers and military equipment. Finally, there are, besides these 19 army corps, 34 regiments of cavalry, destined to eventually form divisions of cavalry.

4. *The Navy.*—The French fleet consists of 467 vessels, of which 339 have steam-power. Of this number, 38 are ships of the line (2 iron-clad), and 43 frigates (14 iron-clad). The *personnel* consists of (1), 2550 officers; (2), a body of mechanics; (3), 16,000 marines, *gendarmerie*, artillery, infantry; (4), a corps of naval engineers; (5), the naval commissariat, analogous to the intendancy and administration of the army; (6), the crews (29,000 men), recruited either by voluntary enlistments or from a portion of the army contingent, or by drafting those men from the seaboard whose names are entered on the naval registers. The maritime territory of France is divided into 5 maritime arrondissements, commanded by a maritime prefect, who has the rank of vice-admiral. The capitals of these five arrondissements are the five military ports Cherbourg, Brest, L'Orient, Rochefort, and Toulon.

5. *Finances.*—The budget of the commune is prepared by the maire, voted by the municipal council, and approved by the departmental committee of the general council. The departmental budget is prepared by the prefect, and discussed and voted by the general council. The budget of the state is prepared by the ministers, presented by the President of the republic, and discussed, article by article, by the National Assembly one year in advance. After the close of the inspection which the budget has thus undergone the accounts are examined and verified by the court of accounts. The departmental expenses exceed 350,000,000. The expenses of the state are as follows, the figures being approximative:

1. Public debt and dotations	1,200,000,000
2. General service of the ministries:	
Justice	34,000,000
Foreign affairs	11,000,000
Interior	88,000,000
General government of Algeria	27,000,000
Finances	18,000,000
War	480,000,000
Navy and colonies	154,000,000
Public education, fine arts, worship	96,000,000
Agriculture and commerce	17,000,000
Public works	[illegible]
3. Cost of collection	[illegible]
Total	2,525,000,000

The receipts of the general budget come from the following sources:

1. Ordinary budget:	
Direct taxes	433,000,000
Domains and forests	[illegible]
Indirect taxes and revenues	1,943,000,000
Universities	1,000,000
Algeria	20,000,000
Revenues from civil pensions	15,000,000
Sundry	52,000,000
2. Budget extraordinary:	
Surplus from last year, foreign indemnities, sale of rentes, etc.	5,000,000
Total	2,525,000,000

The following are some details of the different receipts: The direct taxes arose to 682,000,000, consisting of land-tax, 356,000,000; personal tax, 105,000,000; tax on doors and windows, 64,000,000; tax on patents, 157,000,000. Of indirect taxes the most important are—the custom-houses, 307,000,000; tax on beverages, 340,000,000; salt-tax, 9,000,000; duty on sugar, 94,000,000; the monopoly of the state on tobacco, 225,000,000; on matches, 16,000,000; duties levied on travellers on the railways, 68,000,000; duty on paper, 10,000.000. The indirect taxes are collected in different ways—the direct by collectors. Each arrondissement has a receiver, who sends the funds received from the agents to the general treasury of the department or disposes of them according to its orders. In Paris is a central cashier, who knows the general state of the treasury from day to day, and directs with precision the vast money movements of the ministry of finance. At the head of the financial system stands the court of accounts. Finally, may be mentioned the sinking fund for the payment of the public debt. The debt of France is, in consequence of the war with Germany, about 18 milliards.

6. *Justice.*—Justice is administered in France in the name of the chief of the state. There are three different jurisdictions: (1) The civil jurisdiction, which takes cognizance of all personal or real relations of the citizens. The civil law, the law of civil process, and the commercial law are its rules. It is exercised by justices of the peace, of whom there is one in each canton who conciliates, if possible, or decides cases of minor importance, including annually about 2,500,000 cases, of which at least three-fourths are conciliated, and 220,000 are closed by definitive judgments. Above them are the civil tribunals, or "tribunals of first instance," which pronounce annually on about 140,000 cases. There are in France 80 *conseils de prud'hommes*, of whose members one-half are elected by the employers and one-half by the employés, and who in the manufacturing towns act as justices of peace in cases between employer and employed; they treat annually 40,000 cases, of which more than two-thirds are conciliated. In the manufacturing and commercial cities there are 216 tribunals of commerce, whose members are elected, and which pronounce in first instance on about 230,000 cases annually, of which one-fourth are conciliated and two-thirds closed by definitive judgment. Above the civil tribunals and the tribunals of commerce there are 26 courts of appeal, which judge about 12,000 cases annually. (2) The criminal jurisdiction. The simple misdemeanors come before the tribunals of police. The maires and justices of peace exercise this jurisdiction in 40,000 cases annually. Offences are brought before the tribunals of correction, which form a particular branch of the civil tribunals, and which can administer from six days' to five years' imprisonment. Grave crimes, which lead to infamy and severe punishment, are brought before the courts of assize, of which there is one in each department. They are composed of three magistrate-judges and a jury. The jury is composed of twelve citizens chosen by lot from a list which the administration prepares in accordance with the law. The jury decides the point of fact, the judges apply the law. From the verdict of the court of assize there is no appeal. Besides the magistrature which judges there is a magistrature which administers—that is to say, performs the office of public

prosecution. To each court of appeal a general procurator is attached, assisted by several advocates or deputies. To each civil tribunal, and under the authority of the general procurator, is attached a procurator of the republic, assisted by one or several substitutes. At the tribunals of the police the office of public prosecutor is performed by the maire or the commissioner of police. The public prosecutor interferes only exceptionally in civil cases. In criminal cases, on the contrary, he acts a principal part. He orders the examination of the offence or crime, has the accused person arrested, superintends the trial, accuses before the judges, and proceeds with the execution of the verdict given. When an offence comes to his knowledge he brings the case before the examining judge, who decides whether it is of such a nature as to be brought before a court of assize. Above all the other tribunals is the court of cassation, which secures the exact application of the law, and any verdict given by any tribunal may be brought before it. By its decrees it confirms or reverses the verdict given, and in case of cassation the suit is recommenced before another tribunal instituted by the court of cassation. The convicts receive their punishment, according to the gravity of their offence, in the police prisons, in the departmental prisons, which also serve as jails (387 jails, with room for 25,000 inmates), in the penitentiary colonies for young convicts, in the central prisons for those sentenced to compulsory labor, in the houses of detention for local crimes, and in the penal colonies of Guiana and New Caledonia. With the administration of justice are furthermore connected the notaries, who receive acts and contracts and give them the character of authority; the attorneys, who represent the parties before the tribunal; and the sheriffs, who carry the summons, serve the judgment, and regulate its execution.

7. *Public Education.* There is in France a system of public education which is administered by the commune, the department, and the state, and a free education given by private institutions. There is a primary and a secondary instruction, which latter is divided into the classical, the industrial, and the higher instruction. Primary instruction is given in the communal schools, which are under the direction of lay teachers appointed by the prefects. Each commune of 500 souls is obliged to have a school for boys and one for girls. There are more than 4,000,000 pupils distributed in 53,000 public schools and 16,000 free schools; and besides these there are about 30,000 educational institutions of a higher grade, *cours d'adultes*, and a number of infant schools, which prepare children under seven years of age for the primary schools. The teachers are educated in 81 primary normal schools, about one for each department. The secondary, classical, or industrial instruction is given by the state in the lyceums, by the communes in the communal colleges, and by the clergy or by laymen in seminaries. There are 75 lyceums, which are generally situated in the capitals of the departments, and contain more than 20,000 pupils; 250 colleges, with 25,000 pupils; and 1000 free establishments, numbering nearly 65,000 pupils. The classical schools give diplomas as *bachelier ès lettres* and *bachelier ès sciences*. In order to educate professors, the state has established for the classical branch the high normal school, and for the industrial branch the special normal school of Cluny. The higher instruction is given by the universities (*facultés*), of which there are 15 for literature and science, 10 for law, 7 for theology, and 3 for medicine. The universities confer grades of *bachelier*, *licencié*, and *docteur*. The Collège de France and the Museum of Natural History, both in Paris, represent the independent studies; the Conservatoire des Arts and Métiers (for arts and trades), in Paris, is a sort of industrial university.

Besides the military schools above mentioned, may be named—(1) in Paris, l'École Polytechnique, for officers and state engineers; the Central School of arts and manufactures, for civil engineers; the School of fine arts, for painters, sculptors, and architects; the Conservatoire, for musicians and actors; the School for living Oriental languages. (2) Outside of Paris there are three schools of the arts and trades, several schools of fine arts (Dijon, Toulouse, etc.), 3 schools of agriculture, 1 of horticulture. 3 for veterinary surgeons, 1 for miners at St.-Etienne, and 1 for mining engineering; to which may be added several communal and private institutions, such as schools for drawing, Central School in Lyon, the school for watchmaking in Besançon, the excellent industrial school in Mulhouse (before the war), etc. (3) In foreign countries the French school in Rome for a limited number of artists, painters, sculptors, architects, and musicians, chosen by competition; and the schools of Rome and Athens for the study of ancient literature, to which the pupils are chosen from among the pupils of the high normal school. The administration of each of the sixteen academies, or territorial circumscriptions of public instruction, is confided to a rector assisted by an academical council. The rector has under his orders an inspector of the academy and several inspectors of the primary instruction. Algeria has a separate academy. The instruction is facilitated by libraries, which exist in most of the towns, and which are being founded in the communes, in the primary schools, in the regimental schools, and at the museums. There are learned societies in almost all the departments, and some of them enjoy a very high reputation. Paris contains a great number of these (Association Française pour l'Avancement des Sciences, Société de Géographie, de Géologie, d'Anthropologie, Association Polytechnique, Société d'Agriculture, etc.), besides several great public institutions, such as the Observatoire, the Bureau des Longitudes, the Medical Academy, and L'Institut de France, composed of five academies (Académie Française, des Inscriptions et Belles-Lettres, des Sciences, des Beaux-Arts, des Sciences Morales et Politiques), each of which contains 40 members (Académie des Sciences 66), chosen by the members themselves.

8. *Worship.*—There are in France three forms of *worship* recognized by the state and maintained at its expense—the Roman Catholic, the Protestant, and the Jewish.

(1) *The Roman Catholic Church.*—The parish is the elementary unit, and there is one or more parishes in each commune. Of the parishes, some are *curacies*, others *succursals*. The former number 45,000; the priest is irremovable, appointed by the bishop and approved by the state. The priests of the latter are simply appointed by the bishop, and may be removed by him. Above the priest is placed the bishop. According to the concordat of 1801, there are 84 dioceses and 67 bishoprics in France, nearly one in each department; the see of the bishop is generally in the capital of the department. The bishops are appointed by the chief of the state, and canonically instituted by the pope. Above the bishops stand the archbishops, who administer their own dioceses and exercise authority over ecclesiastical provinces or archbishoprics consisting of several dioceses or bishoprics. There are 17 archbishoprics, corresponding nearly to the old provinces from the Roman period—namely, Paris, Rouen, Tours, Cambray, Rennes, Rheims, Besançon, Lyons, Chambéry, Avignon, Aix, Toulouse, Bordeaux, Auch, Alby. Bourges, and Sens. Above the archbishops are five cardinals.

(2) *The Protestant Church.*—This comprises two denominations recognized by the state—the Calvinistic and the Lutheran. In both of them the parish has its minister and presbyterial council, which administer under the authority of the consistory. In the Calvinistic Church the ministers are chosen by the consistory, and the superior authority is exercised by the synod, consisting of five consistorial churches, and by the central council of the Reformed Church. At Montauban is a theological university. In the Lutheran Church the ministers are chosen by a directory, which acts under the authority of the consistory.

(3) *The Jewish Church.*—A communal rabbi presides at each synagogue, assisted by officials who are under the authority of a departmental consistory, which again ranks under the central consistory of Paris, presided over by the grand rabbi.

Algeria forms one archbishopric (Algiers) and two bishoprics (Oran and Constantine). It has two Protestant consistorial churches and three Jewish consistories.

9. *Central Government.*—Since the revolution of Sept. 4, 1870, France is ruled by a republican government. As yet, however, the National Assembly has not decided on the definitive form of government and constitution. The executive, administrative, and judiciary powers are vested in the President of the French republic. The legislative power is exercised by the National Assembly. The present President is Marshal de MacMahon. The duration of his power has been fixed at seven years from May, 1873. He exercises the executive power under the control of the National Assembly, which elected him. He chooses and dismisses the ministers and presides in the council of ministers. He can enter the Assembly and demand to be heard, but as yet he has communicated with it only by messages. He is assisted by a council of state, whose members are elected by the National Assembly. The ministers are nine: 1, the minister of justice, under whom is placed the national printing establishment; 2, the minister of foreign affairs; 3, the minister of the interior, under whom are the prefects and maires, consequently the whole general, departmental, and communal administrations of France; 4, the minister of finance; 5, the minister of war; 6, the minister of the navy and colonies; 7, the minister of public education, fine arts, and worship; 8, the minister of agriculture and commerce, who by a singular anomaly has not the administration of the forests and the tobacco manufactories, which belong to the minister of finance; 9, the minister of public works. The National


MAP OF
FRANCE
Drawn and Engraved on Copper-Plate
EXPRESSLY
FOR
JOHNSON'S UNIVERSAL CYCLOPÆDIA
Scale of Eng Miles
CORSICA
ENGLISH CHANNEL
NORTH SEA
BAY OF BISCAY
MEDITERRANEAN SEA
GULF OF LYONS
GULF OF GENOA
BADEN
PIEDMONT
PARIS
LONDON
Longitude East from Greenwich
Longitude East from Washington

Assembly represents the nation, by which it is elected and in whose name it exercises the sovereign power. The executive power it has conferred upon the President of the republic; the legislative power it has kept for itself. The laws are promulgated in the name of the president of the National Assembly. It was elected by universal suffrage, in accordance with the law of June, 1849.

CAPTAIN PRUDENT, *French Top. Engineer.*

France, The History of, begins in the fifth century with the conquest of the Roman province of Gallia Transalpina by the Franks, a Gotho-Germanic tribe, who settled in the country and gave it its name. Ancient Gaul (Gallia Transalpina) was originally inhabited by three different nations—the Belgians, in the N. and E.; the Celts, in the W. and centre; and the Aquitanians, in the S. Along the Mediterranean coast several Greek colonies were situated, among which was Massilia. These nations, subdivided into many different tribes, the Batavi, Helvetii, Suessiones, Ædui, etc., were subdued by Cæsar between 58 and 52 B. C., and the whole country reduced to a province of the Roman empire. Roman institutions, language, civilization, and religion soon took root among the people, and the country flourished; but in the fifth century A. D. the Roman empire had become too weak to defend this its best province against the invading barbarians. The Visigoths conquered the southern part, and connected it with Northern Spain; the Burgundians established an independent kingdom in the E.; and in 486, Khlodwig or Clovis, chief of the Salian Franks, a grandson of Meroveus and founder of the *Merovingian* dynasty, defeated the Roman governor, Syagrius, at Soissons, and took possession of the whole northern part of the country to the Loire. In 507 he also defeated the Visigoths at Vouillie, and added their possessions N. of the Pyrenees to his dominions, thus forming a kingdom which comprised nearly the same area as modern France, with the exception of the eastern districts between the Rhine, the Saône, and the Rhone, which were occupied by the Burgundians. Persuaded by his wife Clotilda, he embraced Christianity, and by this step he succeeded in reconciling the clergy, and, through them, the Gallo-Romanic population to his rule; so that at his death in 511 a Frankish empire was actually consolidated in Gaul. The further development of this new kingdom was seriously impeded, however, by civil wars between the eastern Franks (Austrasia) and the western (Neustria), brought on by the dangerous custom, common to all Gotho-Germanic nations, of dividing the kingdom at the death of the king between his sons. But fortunately, during the last kings of the Merovingian dynasty, who were men of weak characters and with no talents as rulers, a new family rose into power, capable of keeping the empire united in spite of the tendencies to separation which it contained, and capable of defending it against the most formidable enemies from without. Pepin of Héristal, *major domus* to Clovis II., established the authority of Austrasia firmly in the dominions of Neustria, and his son, Charles Martel, succeeding him in his position as *major domus*, a sort of viceroyship, routed the Saracens at Tours in 741. Charles Martel's son, Pepin the Short, confined, with the consent of the clergy and the pope, the last king of the Merovingian dynasty, Childeric III., in a monastery, and ascended the throne himself in 752, thus founding the *Carlovingian* dynasty. The Merovingian kings had established a Gotho-Germanic empire on Roman soil; during the reign of the Carlovingian dynasty this Gotho-Germanic empire became French. After the formation of a new kingdom followed the formation of a new nation. Pepin the Short ruled with great vigor, and made one very valuable addition to his dominions—namely the coast regions along the Mediterranean, which hitherto the Arabs had held. His son, Charlemagne, from 768 to 814 conquered Lombardy and the northern part of Spain; subdued the Saxons along the Elbe and converted them to Christianity; threw back the Avars in Hungary; and ruled from the Eider and the Baltic to the Ebro and the Mediterranean, and from the Atlantic to the Theiss. By establishing this vast empire he laid the foundation of modern Europe. Although at this time the different tribes of the Gotho-Germanic race had formed several empires, and in several places commenced the development of individual forms of civilization, still the settlement was not yet final. They were still on the move, wandering to and fro, partly impelled by their own unstable instincts, partly disturbed by new swarms which from Asia continued to pour into Europe. This migratory state of society Charlemagne brought to an end. He stopped the invasions from Asia, and he compelled the tribes to stay where they were. By transforming the chiefs of the tribes into feudal lords, vassals with power, but also with responsibility, and by introducing Christianity and the institutions of the Roman Catholic Church throughout his realm, he secured the first rudiments of order. Civilization began on a grand scale, and one of its very first results was the formation of the different nationalities. At the beginning of Charlemagne's reign people from the Danube, the Rhine, the Seine, and the Loire spoke the same language; thirty years after his death an interpreter was necessary. The name of "France" occurs for the first time in history in the middle of the ninth century. After the death of Louis le Débonnaire, a son of Charlemagne, the empire was divided between his three sons by the treaty of Verdun in 843. Louis the German received that part which lay E. of the Rhine, and which was called Deutschland (Germany); Charles the Bald received that part which lay W. of the Scheldt, Meuse, Saône, and Rhône, and which was called France; the long strip of land stretching between these two boundary-lines from the North Sea to the Mediterranean was given to Lothair, together with Italy and the title of emperor. As soon as the treaty was concluded wars broke out between the contracting parties, and these wars did not cease until a new dynasty, which had grown up on French soil, and which entertained no general Gotho-Germanic (but simply French) ambition, ascended the throne of France. It was, however, not so much their imperial ambition as their utter inability which cost the Carlovingian kings their crowns. There were forty hereditary (*i. e.* independent) vassals in the territory of France. One of them was the duke of Normandy, formerly the chief of the Norse pirates, to whom Charles the Simple had given in 912 the beautiful province W. of the Lower Seine, in order to stop his invasions. Another was the count of Paris, one of whose family, Count Odo, was chosen king in 887, and vindicated himself against Charles the Simple till his death, in 898. A third was the duke of Lorraine, who offered his allegiance to the king of France or to the emperor of Germany, just as he liked. To a man who had no other purpose than to govern these forty vassals the task might prove difficult enough, and it became fatal to any one who besides had Gotho-Germanic ambitions. When, at the death of Louis V. in 987, the vassals passed by the proper heir, Charles of Lorraine, because he had given his allegiance to the German emperor, and chose for king Hugh Capet, count of Paris, duke of France, and founder of the *Capetian* dynasty, there was a French nation, but there was hardly a French kingdom in existence.

The consolidation of the royal power and the establishment of the absolute monarchy are the leading ideas in the history of France under the two following dynasties—the House of *Capet*, from 987 to 1328, and its collateral branch, the House of *Valois*, from 1328 to 1589. Not that they are the sole motives in all the various events which crowd its pages during this period, but they are the common result of them all. The Crusades acted chiefly as a vent for the romantic ambition of the feudal lords, and as a means of rallying them around the person of the king. The Church was usually an ally of the Crown, and for the time from 1309 to 1377, while the pope resided at Avignon and two œcumenical councils were held here in 1326 and 1377, even a very submissive ally. The Reformation was actually used as a means of curbing and destroying the heads of the nobility, and the very moment it became a party against the absolute power of the king it was crushed. The wars with England and Austria were thoroughly dynastical, and could not help attaching a particular importance to the representative of the dynasty. The development of the cities was furthered and privileges were granted to the burghers, but only so far as to enable the third estate to form an effective opposition to the nobility, but not so far as to make it capable of checking the royal power. And even the nobility itself was made a monarchical instrument. It lost its power, but not its splendor. It was transformed from a feudal aristocracy into a court nobility. And it is this same idea, the establishment of the absolute monarchy, together with the consequences following therefrom, which gives the history of France its paramount importance in the history of Europe. How early a powerful national feeling was developed in France was shown under Louis VI. (1108–37). In the long wars which he waged against Henry I. of England about Normandy, which by the Norman conquest of England threatened to become lost to the French crown, Henry succeeded in forming a formidable alliance with the German emperor. But, although the relations between the French king and the French vassals—the counts of Flanders, Champagne, Lyon, Provence, Toulouse, etc.—were very loose, in this emergency an army of 200,000 men was immediately formed for the defence of France. Louis VI. was a sagacious ruler. He abolished serfdom in his own territories, and formed his cities with their adjacent districts into corporations. But by his example he compelled his neighbors to do the same, and thus he sowed a very fertile seed of opposition to the feudal lords among their own subjects. Philip Augustus (1180–1223) made the first steps toward centrali

zation, and made them successfully. He formed a chamber of peers, a sort of council of state, consisting of six secular and six ecclesiastical members, which tended to secure uniformity in the actions of the king and his vassals; and he established the right of appeal from the decision of the feudal lord to the royal court; which measure, in the course of time, seriously impaired the influence of the lord. Meanwhile the Crown grew richer. Philip Augustus conquered Normandy, Maine, Touraine, and Poitou from the English after the battle of Bouvines in 1214; Philip III. (1270–85) acquired Toulouse and Venaissin by negotiation; and Philip IV. (1285–1314) received Navarre, Champagne, and Brie by marriage. This latter prince could afford to treat the order of the Templars in the most arbitrary and despotic manner, and on one occasion, when the nobles pressed him too hard, he baffled all their exertions by convoking for the first time (Mar. 28, 1302) the general estates, in which assembly the burghers took seats and voted beside the nobility and the clergy. On the accession to the French throne of the House of Valois, in 1328, with Philip VI., nephew of Philip IV., the terrible wars with England began, the English king, Edward III., claiming the crown of France as a grandson of Philip IV. These wars lasted one hundred years. Vanity and treason were the fuel, bankruptcy and misery the result. But when at last the Maid of Orléans succeeded in rousing the national feeling to an unconquerable height, and carried, in 1429, Charles VII. to Rheims to be crowned, it is curious to notice how all the enthusiasm of the people was concentrated on the person of the king. In spite of all the incapacity and corruption which royalty had exhibited in France during these one hundred years, it had become very dear to the French people; and although persons like Louis XI. (1461–83) and Catharine de Medici, who actually governed France during the reign of her three sons, Francis II. (1559–60), Charles IX. (1560–74), and Henry III. (1574–89), were not fit to make royalty charming to the minds of the people, they were eminently fit to make it respected and feared. Charles IX. had all the leaders of the Protestant party murdered at the massacre of St. Bartholomew in 1572; Henry III. had all the leaders of the Roman Catholic party murdered one after the other. When (in 1589) Henry IV. ascended the throne and founded the *Bourbon* dynasty, he must have felt quite lonesome in France; at all events, the royal power stood now victorious, undisputed, and alone.

There was, indeed, something exalted and solemn about the royal power as it was exercised by Cardinal Richelieu under the reign of Louis XIII. (1610–43), but the impression was utterly changed by the magnificent but challenging arrogance of Louis XIV., who said, "L'état c'est moi." During the first years of the reign of Louis XIV. (1643–1715) France was eminently prosperous, and held the most prominent place not only in European politics, but in European civilization. Louvois and Colbert were excellent ministers; the treasury was full; commerce and industry flourished; the army and navy were in an effective state; Turenne, Condé, and Luxembourg brought home great victories, and new provinces were added to the kingdom. The king was exceedingly prodigal, but his prodigality was accompanied by an elegance and taste which spread a magnificent and even blinding radiance around him; all other kings tried to imitate him. Corneille, Racine, Molière, Boileau, Bossuet, and Fénelon had the ear of the world, and dictated the taste in all other literatures. But after some years the true character of the absolute monarchy became apparent. In 1685 the king revoked the Edict of Nantes because his mistress, Madame de Maintenon, was under the control of the Jesuits. Thereby the guaranty of religious freedom which was given to the Protestants by Henry IV. in 1598 was destroyed, and persecutions immediately began. Thousands of the most industrious and intelligent citizens of France were exiled. Some of the most prosperous branches of French industry stopped; the revenues decreased, and an uneasy feeling crept into the hearts of the people. The king's prodigality, however, did not decrease with his diminished revenues; on the contrary, his passion for stupendous buildings and gorgeous court magnificence grew stronger as he grew older. His second war (from 1689 to 1697) was not successful, and in his last (from 1700 to 1713) failure followed failure. Both were begun for reasons of mere vanity, but, although his armies were defeated time after time, his arrogance did not abate. In many districts of France food began to become scarce, but the Jupiter residing at Versailles heeded it not. When he died he left a debt of 3,500,000,000 livres, a country utterly exhausted, a court more demoralized and more expensive than any other institution which modern civilization has ever seen, and a people deeply discontented, though perhaps as yet unconscious of the reasons of its discontent. Under his successors, Louis XV. (1715–74) and Louis XVI. (1774–93), the consciousness came, and with it the crisis.

The French court was the government of France. There was no constitution, and such fragments of a constitution as existed were either out of working order on account of disuse—the general estates had not met since 1614, the assembly of the notables not since the first year of Louis XIII., the Parliament of Paris not with full authority under Louis XIV.—or if capable of working, they worked against each other, and produced only confusion. Thus, the archbishop of Paris forbade a Jansenist priest to administer the sacrament of the Lord's Supper; the Parliament of Paris gave the priest a permit; the council of state cashiered the permission; the Parliament issued a new warrant; the priest was imprisoned by a royal order. The only valid authority was the king; he could interfere even with the courts of justice by his *lettres de cachet*. He governed France by the court and an immense tail of officials; 250,000 were employed to gather the land and income tax alone. There were about 4000 offices which conferred nobility on their incumbents—that is, exemption from taxation and from military service. These offices were sold, and the sale was not a fraud on the administration, but a financial operation of the government. It cost 60,000 francs to become a member of the Parliament of Paris, 500,000 francs to become its president. Offices were sometimes sold to three or four persons, who alternately held them for one or two months. The people under this government consisted of three classes—the nobility, the clergy, and the third estate. The nobility comprised a long scale of different degrees of rank, from the forty-four peers of the realm to the swarm of parvenus who had received their nobility from an office; and this scale was expressed by an intricate system of etiquette. But all nobles—and their proportion to the whole population was as 1 to 250—were exempted from land-tax, from military service, from contributions to the maintenance of roads, etc.; they paid only an insignificant class-tax; and on such conditions the nobility held more than one-half of the soil of France, enjoying the right of hunting, exercising police superintendence, administering justice, etc. The Church owned a little over one-sixth of the soil, from which it derived an income of 160,000,000 livres a year, and on which it paid no regular taxes. Of these 160,000,000, 40,000,000 were received by the active servants of the Church, the curates, the priests; the rest was swallowed by the appanages of the prelates or spent in benefices which the king bestowed on the younger members of the noble families, and which enjoined no kind of service on the beneficiaries. The third estate had the whole burden of the defence of the country, the whole burden of the defrayment of the public expenses, the whole burden of productive labor, and in the fulfilment of these duties it was trammelled by the most absurd laws political economy ever saw.

Between the different provinces there were raised artificial bars at which a toll was levied. Different systems of taxation reigned on the two sides of these bars, and prevented a natural adjustment between supply and demand—when, for instance, there was scarcity of wheat in one province and superfluity in another. The duke of Orléans, the infamous regent during the minority of Louis XV., made an enormous fortune by corn speculations. The cost of production of 1 hundredweight of salt amounted to about $1\frac{1}{2}$ livres, but on account of the salt-tax its market value rose in Bretagne to 44 livres, in Maine and Anjou to 61 livres. A fortune could be made simply by transporting salt over the boundary of Bretagne and Anjou, and consequently about 1600 men were yearly punished for smuggling.

Between this people and this government stood a numerous class of writers—Voltaire, Rousseau, D'Alembert, Montesquieu, Diderot, and many more—whose glory has faded very much since it became evident that their positive ideas were wrong, but who conferred a great benefit not only on France, but on Europe, by their criticism of the actual state of affairs. The dignity of human nature is greater than the Encyclopædists dreamt of, but we have discovered it from the higher level to which they raised us. With matchless eloquence, with irresistible wit, they showed that faults and demoralization on the one hand were the true causes of the misery and degradation on the other, and they taught men not to take the world as it was, but to try to make it what it ought to be. This was the situation to which the absolute monarchy in France came: a corrupt government, falling short of means by which to gratify its vicious appetites, a hard-toiling people, pinched by hunger and almost driven to despair; and between them a literature which told the starving man who it was that stole his food. The result could be nothing else than the *Revolution*.

Money was wanting: the state was on the verge of bankruptcy. The king first tried different ministers of finance:

Necker, but he only revealed the state of affairs to the public, and informed the people that His Majesty had used 860,000,000 of livres for his own person; Calonne, but he only increased the debt by his economical speculations, which destroyed much private capital and the last rest of public confidence; Brienne, but he could do nothing when the nobility and the clergy absolutely refused to be taxed. The king then recalled Necker, and convoked the general estates to meet at Versailles May 5, 1789. In this assembly the votes were cast not by poll, but by class, and thus the third estate was completely overruled by the two privileged estates. The third estate protested against such an order of conducting business, and demanded a vote by poll. The two other estates refused. On June 17 the third estate constituted itself the National Assembly, and invited the two other estates to participate in its debates; on the 20th the Assembly pledged itself by oath not to separate until a constitution was made; and on the 23d it declared its membership inviolable. To this the king answered by dismissing Necker and ordering the concentration of a body of troops at Versailles. But on July 12th the first insurrection took place in Paris; on the 13th a national guard and revolutionary municipal boards were formed; on the 14th the Bastille was stormed, and on Aug. 4th the National Assembly—or, as it was generally called, the Constituent Assembly—abolished all feudal and manorial rights. The royal princes fled, the emigration began. On Oct. 5th the mob of Paris, followed by the national guard, rushed out to Versailles, and, after massacring the royal guard, they carried the king and queen back to Paris, whither also the Constituent Assembly removed. July 14, 1790, the constitution was ready, the king took his oath on it, and those of the nobility and clergy who refused to do so were thrown into prison. Still, the excitement and disorder in Paris increased every day, and on the frontier the royal princes organized corps of *émigrés*, while Austria, Prussia, Saxony, England, and Spain formed an alliance and offered the king their help against his subjects. June 20, 1791, he and the queen tried to flee, but were stopped at Varennes, brought back to Paris, and confined in the Tuileries. On Sept. 14th he had to take oath on a new constitution, and then the Constituent Assembly considered its work as done, dissolved, and gave place for the Legislative Assembly.

This Assembly met Oct. 1, 1791. Meanwhile the protests of the foreign courts against the constitution, the royalist insurrections in Calvados and Vendée, and the movements of the emigrants on the frontier caused a terrible excitement in Paris. War was declared against Austria and Prussia, and when reports came of the defeat of the French armies, and when, moreover, the king, in confidence of help from the approaching Austrians, assumed a more decided attitude towards the Legislative Assembly, the excitement grew into wild fury. Armed bands broke into the Tuileries June 20, July 5, and Aug. 10. On the last occasion the Swiss guard was horribly massacred, and the king and the royal family were compelled to seek refuge in the Legislative Assembly, from which they were brought to the Temple as prisoners. Robespierre, Marat, and Danton swayed the Parisian populace through the club of the Jacobins and through Marat's paper. On the news of the Prussian invasion of Champagne and the fall of Verdun a tribunal of national defence was formed, the constitution abolished, the Legislative Assembly dissolved, and a National Convention convoked.

The National Convention, which met Sept. 21, 1792, consisted of two parties—the Jacobins, generally called the "Mountain," and comprising the most radical democrats—men without any definite ideas, but determined to carry the passion of the hour to its last consequences; and the Girondists, the representatives of law and order under the form of a constitutional monarchy, who were men of probity and talent. The Jacobins were in the majority, and on Sept. 25th, on the motion of Collot d'Herbois, France was declared a republic. Their power was still more strengthened by the success of the war. The Prussians were driven back, Dumouriez conquered Belgium, Custine crossed the Rhine, and Montesquiou entered Savoy. They felt that they were irresistible, and they pushed forward, trampling down everything which opposed them. The king was brought to trial Dec. 11th, and executed Jan. 21, 1793. The Girondist leaders were arrested June 2, 1793, and executed Oct. 31. A committee of public safety was formed and invested with absolute power. The Convention passed a decree against all who were "suspected," and Barère declared that "terror" was the order of the day. Terror was indeed the weapon the Jacobins employed. In Bordeaux, Marseille, and Lyon counter-revolutions took place, but they were put down with a cruelty and violence which the world had not seen since the days of the Roman emperors. The government was a perfectly unlimited despotism, exercised not by one, but by many. He whom the Parisian mob lifted on their shoulders became a despot for the hour, and he could do with lives and property as he liked. No institution could withstand these surges. The Christian religion was formally abolished, and the worship of "Reason," represented on the occasion by a danseuse from the opera, was introduced.

At this moment, however, a reaction began to set in. Not that the Reign of Terror ceased and the cruelties stopped. But the revolutionary frenzy had reached its culmination. The movement could go no farther; it had to turn. In the excesses of Hébert and his party, especially in the abolition of religion, there was something which actually offended and disgusted Robespierre. He was thoroughly in earnest. He wanted a perfect democracy, with "liberty and equality," and he was willing to go through the terror of anarchy in order to break down the old social order and produce the new. But anarchy itself was not his ideal. Hébert and twenty of his party, the *Enragés*, were arraigned as vicious men and traitors to their country, and brought to the guillotine on Mar. 24, 1794. A worship of the Supreme Being was substituted for that of Reason. But the reaction, once begun, could not be stayed. Hébert was followed by Danton (Apr. 5), and Danton by Robespierre himself (July 28). The Jacobins were now without leaders, and on Nov. 11 their club was closed. During the first half of the year 1795 the Convention debated and adopted a new constitution, which placed the executive power in the hands of a Directory of five, and the insurrection against this new constitution, brought about by the intrigues of the radical democrats and the royalists, was successfully put down by the young general Bonaparte; the mob of Paris was disarmed Oct. 5.

The situation of the Directory was, nevertheless, by no means an easy one. From without it was attacked by England, Austria, and Russia. But this part of its duty it discharged with great success. By regular conscription it brought 200,000 men into the field. The war was everywhere carried on in the enemy's territory, and the armies of the young republic seemed to be unconquerable. Foreign countries were subdued, and French ideas were impressed on Europe, not by mere eloquence, but by the aid of arms. In the interior, however, the government of the Directory was much less successful. La Vendée was still in uproar, and when more peaceful and conciliatory measures were adopted, the royalists returned and began their intrigues. At the election of 1797 they gained the majority in the representation, and the government had to use very harsh, not to say terroristic, means in order to save itself. The Tuileries was surrounded with troops and cannons, and the royalist members were arrested. Their election was declared illegal, and they were banished from the country. Also the financial difficulties proved too great for the government. In spite of the enormous sums which it drew from Belgium, Germany, and Italy, the Directory was unable to pay the public debt. It had to declare the state bankrupt and reduce its obligations to one-third their amount. Under these circumstances there arose a general feeling of the necessity of concentrating the government in one single individual, and when (Nov. 9, 1799) General Bonaparte overthrew the government of the Directory by military force and grasped the reins himself, most people in France approved of the measure.

(For the rest of the history of France see the articles NAPOLEON, LOUIS XVIII., CHARLES X., LOUIS PHILIPPE, NAPOLEON III., and the FRANCO-GERMAN WAR. The chief works narrating the entire history of France are, MARTIN, *Histoire de France* (16 vols., 18[illegible]–60), and MICHELET, *Histoire de France* (17 vols., 1833–66).) CLEMENS PETERSEN.

Fran'cestown, tp. and post-v. of Hillsborough co., N. H., 2[illegible] miles S. W. of Concord. It has 1 national and 1 savings bank, an academy, and manufactures of soapstone goods, cooperage, etc. Pop. 9[illegible].

Franche-Comte was the name of one of the old provinces of Eastern France, which now is divided into the three departments of Doubs, Haute-Saône, and Jura.

Fran'chise, in law, a particular privilege conferred by government on individuals or corporations which does not belong to the citizens of a country generally by common right. Franchises are created either by express legislative grant or by prescription, which presupposes a grant. In England the varieties of franchises are very numerous, and include such rights as those [illegible] wrecks, estrays, treasure trove, or forfeitures; to hold fairs or markets; to establish and maintain ferries; to have a forest, chase, park, warren, or fishery, etc.

In the U. S. the classes of these special privileges are greatly reduced in number, and they are, almost without exception, vested in corporations. The most usual and important are the privileges of maintaining ferries, bridges, turnpikes, and railroads, and the right to be a corpora[illegible]

tion for any purpose. The bestowal of these constitutes a contract between the State and the possessor of the franchise, and the latter thereby assumes certain obligations as a consideration for the rights conferred upon him. If the privilege be to construct and maintain a common highway or provide any means of public transportation, there is annexed to the grant a power of taking tolls from those who enjoy the superior facilities afforded, as a means of remuneration; and the owner of the franchise must in return provide proper accommodations for the public, take all reasonable measures to promote the safety and comfort of travellers, and be ready at all proper times to give them passage. For any violation or neglect of these duties he may be made to respond in damages, or he may even be deprived entirely of the power with which he had been entrusted. On the other hand, while he enjoys his privilege it is a right of property which cannot be destroyed by the government for the creation of other franchises or public works, in the exercise of the power of eminent domain, without adequate compensation being made. (See EMINENT DOMAIN.) An interesting question has frequently arisen in the courts as to whether the government is, in like manner, restricted from creating other franchises which would not directly destroy or divest any previously existing right of the same kind, but would seriously interfere with its exercise and diminish its value, as by establishing a new ferry or bridge in the immediate neighborhood of another. It has been asserted by some jurists that at common law any such infringement upon franchises was a nuisance, which might be prevented by injunction or be made the subject of an action for damages. But the U. S. courts have decided that there is, in such cases, no violation of proprietary rights, and that the State is under no obligation to make recompense. Public grants are to be construed strictly, and no implications of the kind under consideration are to be annexed to them. In some instances express terms are inserted excluding all interference within a specified distance, and a protecting stipulation is thus made expressly a part of the contract, which the State cannot violate without making compensation.

A franchise is generally included in law among incorporeal hereditaments. But as it is usually conferred upon a corporation, which is regarded as having a perpetual existence, it can scarcely ever be said to pass as an inheritance. But it has this quality when vested in an individual, and it clearly indicates the nature of a franchise as a right of property, an incorporeal hereditament being regarded as real estate. (See FERRY, RAILWAYS, TURNPIKE, CORPORATIONS, etc.)

In political law, the word "franchise" is sometimes used as an equivalent to the right to vote for candidates at a public election. The right of citizens of the U. S. to vote is now, to a certain extent, guarded by the U. S. Constitution, which provides (Amendment 15th) that it shall not be denied or abridged by the U. S., or by any State, on account of race, color, or previous condition of servitude, and that Congress shall have power to carry this provision into effect by appropriate legislation. (See VOTE and VOTING.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fran'cia (JOSÉ GASPAR RODRIGUEZ), D. D., LL.D., known as **Dr. Francia,** b. at Asuncion, Paraguay, in 1757, became a Franciscan, and was trained at the University of Córdova, now in the Argentine Republic. His father is variously stated as having been French, Portuguese, and Brazilian. The young Francia received doctorates in divinity and canon law, and was for some time a theological professor, and then gained distinction as an advocate in Asuncion. In 1811, when Paraguay became independent, he was made chief of the junta; in 1813, one of the consuls; in 1814, dictator for three years; in 1817, dictator for life. He forbade any one to enter or leave the country; compelled every one to work for a living; seized the goods of the rich and gave to the poor; enforced popular education; and compelled the people to obey the laws by means of new and frightful penalties. He lived in almost complete isolation. When sixty-nine years old he forgot his priestly vows and took a wife. One of the most unaccountable acts of his life was the imprisonment of the botanist Bonpland for ten years. He d. Sept. 20, 1840. Though a cruel man and a rigorous tyrant, Dr. Francia was generally beloved by his subjects.

Fran'cis I., king of France, was b. at Cognac Sept. 12, 1494. He was the son of Charles, count of Angoulême, and succeeded his cousin and father-in-law, Louis XII., Jan. 1, 1515. In the following July he named his mother regent, and set out at once for the conquest of the Milanese territory, which was defended mainly by Swiss mercenaries. He won the great battle of Marignano, the "battle of the giants" (Sept. 14–15), where he displayed much valor and skill, and was knighted on the field by Bayard. Thereupon followed his entry into Milan, the league with the Swiss, the founding of Hâvre de Grace, and the alliance with the emperor Maximilian against the Turks. In 1518 he won Tournay from the English, and in 1519 began his rivalry with Charles V. in the contest for the imperial crown. Francis, irritated by his defeat, was led by feelings of jealousy to acts of hostility. In June, 1520, he met Henry VIII. of England on "the field of the cloth of gold," between Guisnes and Ardres, and on the Pale of Calais, desiring to win Henry's friendship by displays of chivalric pageantry and acts of princely courtesy. Charles, more politic, won Henry's favor partly by flattery, but more by the promise of the papacy to Wolsey, whose powerful influence was thus obtained. In 1522, Francis began the war against the emperor, the pope, and England, most unwisely attacking at once Navarre and the Netherlands. Prosper Colonna, at the head of the Italian troops, rapidly dispossessed Francis of his Italian possessions, except Cremona; the French were routed in Navarre; and on the eastern frontier the only advantage was the check given to Charles at Mézières. Meanwhile, the English invaded the N.; the constable Bourbon went over to the enemy; Bonnivet was driven out of Italy; Bayard was slain, Provence overrun by the Germans, and the queen died. Francis, however, rapidly cleared Provence of his enemies, and followed them into Piedmont, but was defeated and captured at the great battle of Pavia, where he performed prodigies of valor. He was kept a close prisoner at Madrid for one year; but England, Venice, Rome, and Genoa demanding his release, the emperor liberated him, after exacting the most humiliating conditions, which were, under the protest of Francis, confirmed by an oath, from which the pope hastened to release the French king. The war was at once renewed in Italy; Rome was sacked by the constable Bourbon, the pope imprisoned, and the French army under Lautrec was destroyed before Naples by a loathsome disease, hitherto unknown in Europe. Francis thereupon challenged Charles to mortal combat, but the latter, though pretending to accept, took such care of himself that a combat of words alone followed. In May, 1529, both parties were exhausted, and the Peace of Cambray ensued, though the war broke out afresh in 1534 and 1542, each time with apparent but not permanent advantage to France. The latter part of the king's reign was marked by terrible persecutions of the Protestants, in which many thousands of his subjects were slain and banished. Francis d. at Rambouillet Mar. 31, 1547. The character of Francis is marred by jealousy, libertinism, religious bigotry, and extravagant love of military glory. His conspicuous merits were valor, frankness, generosity, good-breeding and a love for the liberal arts. When compared with that of his great rival, Charles V., the character of Francis seems almost admirable.

Francis II. of France, b. at Fontainebleau Jan. 19, 1543, was the son and successor of Henry II., and came to the throne in 1559. He is chiefly noteworthy as the first husband of Mary queen of Scots. The king was feeble of body and mind, and the Guises were the real rulers of France. The great events of this reign were Condé's Huguenot conspiracy against the Guises, and the many consequent executions. Francis d. at Orléans Dec. 5, 1560, and the crown went to his brother, Charles IX.

Francis I., emperor of Germany, b. Dec. 8, 1708, succeeded his father, Leopold, as duke of Lorraine in 1729, and in 1735 received Tuscany in exchange for Lorraine, succeeding the last Medicean as grand duke in 1737. In 1736 he married the arch-duchess Maria Theresa, and became generalissimo against the Turks. In 1741 he was declared co-regent with his wife, and in 1745 was chosen emperor. Most of his attention was given to Tuscany, and Maria Theresa was the true sovereign in Germany. D. at Innspruck Aug. 18, 1765.

Francis II. of Germany, son of Leopold II. and grandson of Francis I., was b. at Florence Feb. 12, 1768; served in youth as titular chief commander, under Laudon, against the Turks, and was present at the taking of Belgrade 1789; succeeded his father in 1792, in which year war was declared against him by France at the beginning of the Revolution. He commanded in person on the Rhine, but with no success. Napoleon's brilliant operations in Northern Italy followed, and the Treaty of Campo Formio (1797) robbed him of Belgium, the Milanese, and part of the Rhine provinces. In 1799–1800 he joined Russia and Great Britain in another war, but Moreau in Germany and Napoleon in Italy (Marengo, June 14) brought this war to a termination favorable to France in 1801. In 1804, Francis took the title of emperor of Austria, joined the third coalition of 1805, and was compelled by the calamities of Ulm and Austerlitz to renounce his title of emperor of Germany (1806), together with his claim to Venice and the Tyrol. This was the end of the Holy Roman Empire. The Peace of Tilsit

forced him to a fourth calamitous war, which ended at Wagram 1809. In 1810 his daughter, Maria Louisa, was given by him in marriage to Napoleon. He joined the allies, and took part in the battle of Leipsic and the occupation of France in 1815. Napoleon's final overthrow left Francis stronger than ever before. He became a leading figure in the Holy Alliance, and Austria's name was for years after the symbol of despotism and reaction against liberal politics. D. at Vienna Mar. 2, 1835.

Francis I., king of the Two Sicilies, b. at Naples Aug. 19, 1777; became duke of Calabria in 1799; succeeded his father, Ferdinand I., in 1825, having previously been associated with the constitutionalist and revolutionary party. Nevertheless, his reign was one of cruel tyranny and corruption. D. at Naples Dec. 8, 1830.

Francis II. of the Two Sicilies (FRANCESCO D'ASSISI MARIA LEOPOLD), b. at Naples Jan. 16, 1836, succeeded his father, Ferdinand II. ("Bomba"), in 1859, and adopted his father's reactionary policy. His realm was invaded and quickly overrun by Garibaldi's forces in 1860, and when Gaeta, his last stronghold, was surrendered (1861), Francis escaped to Rome, and has since lived in retirement.

Francis (CONVERS), D. D., b. at West Cambridge, Mass., Nov. 9, 1795; graduated at Harvard in 1815; studied divinity at Cambridge, Mass.; held a Unitarian pastorate at Watertown, Mass., 1819–42; was Parkman professor of pulpit eloquence and pastoral care in the Cambridge Divinity School 1842–63; wrote biographical, historical, and other papers, including contributions to Sparks's *Biographical Collections*, the publications of the Massachusetts Historical Society, etc. D. at Cambridge Apr. 7, 1863.

Francis (JOHN M.), b. in Prattsburg, Steuben co., N. Y., Mar. 6, 1823. After receiving a common school education, he was at the age of fourteen put as apprentice to the printing business. In 1843 he was employed as editor of the *Wayne Sentinel* at Palmyra, N. Y. After studying law for some months he became in 1845 leading editorial writer of the *Rochester Advertiser*, and in 1846 performed a similar service for the *Troy Budget*, of which he was afterwards editor and associate proprietor. After serving on the *Troy Post* and the *Troy Whig*, he established the *Troy Times* in 1851, and has since remained controlling proprietor of that journal. In 1871 he was appointed by President Grant U. S. minister to Greece, which position he resigned Nov. 17, 1873. J. B. BISHOP.

Francis (JOHN WAKEFIELD), M. D., LL.D., b. in New York Nov. 17, 1789; graduated at Columbia College in 1809; in 1811 received his medical degree at the New York College of Physicians and Surgeons; became the partner of Dr. Hosack, his preceptor, with whom he published (1810–14) the *American Medical and Philosophical Register*; in 1813 became professor of materia medica in Columbia College and lecturer in the College of Physicians and Surgeons; went to Europe and studied under Abernethy; returned to New York, and held in the last-named school successively the chairs of the institutes of medicine, of medical jurisprudence, and of obstetrics; was professor of obstetrics in the Rutgers Medical College 1826–30; was an editor of a medical journal 1822–24; engaged actively in benevolent enterprises, in literary and in reformatory work; author of various professional and biographical works and of many scientific papers; was a member of many learned societies. An able practitioner, a pleasing writer, an able and popular instructor, his social qualities, his literary tastes, and benevolence rendered him one of the most useful citizens of his time. D. in New York Feb. 8, 1861.

Francis Joseph, emperor of Austria and king of Bohemia, Hungary, etc., was b. Aug. 18, 1830, son of the archduke Francis Charles and nephew of Ferdinand I., whom he succeeded in 1848. The Hungarian war was inherited, not brought on, by him, and since its close the emperor has become personally highly popular in his dominions. The Franco-Italian war of 1859 and the Prusso-Italian war of 1866 considerably reduced the area of his dominions, but the Austrian policy has become every year more liberal, and the industrial progress of the country has been remarkable. (See AUSTRO-HUNGARIAN MONARCHY for a full sketch of the events of his reign.)

Francis (JOHN BROWN), b. in Philadelphia May 31, 1791, was a grandson of Nicholas Brown of Providence, R. I.; graduated at Brown University in 1808; received a mercantile education in the famous business house of Brown & Ives, Providence; studied law at Litchfield, Conn.; was in the Rhode Island legislature 1821–29; in the State senate 1831, 1842, and 1849–56; governor of Rhode Island 1833–38; U. S. Senator 1844–45, and held other positions of honor and trust. D. at Warwick, R. I., Aug. 9, 1864.

Francis (SAINT) **of Assisi,** founder of the orders of Franciscans in the Roman Catholic Church, was b. in 1182 at Assisi, and named GIOVANNI BERNARDONE, but called FRANCESCO by his father, a rich merchant who traded much with France, whence the child's name. He was a thoughtless, gay youth, and served as a soldier against the troops of Perugia, but was taken prisoner and confined for a year. This imprisonment, and a consequent sickness, led him to make a vow to renounce the world—a vow which he soon forgot. But warned, as he conceived, by a voice from Heaven, he took a final vow of poverty. One day, as he was praying in church, the crucifix, we are told, spoke and bade him repair the walls of God's house. Francis stole and sold a horse and some rich goods belonging to his father, and offered the money to the priest of the church, who refused it; whereupon Francis cast the money into the street, and took up his dwelling in the church, the repair of which he undertook by begging and by the labor of his own hands. The father of Francis flogged and imprisoned him for a time as a thief (1206), and Francis formally refused all inheritance in his father's property. He now begged money for the repair of the churches; washed the feet of beggars and lepers, and kissed their sores; clothed himself in a robe of serge sewed with packthread and tied about the waist with a rope; ate the meanest food, and covered it with ashes, and wept and fasted almost continually; slept on the ground, and used a stone for a pillow. In 1209, having a few personal followers, he drew up a monastic rule for them, which was in 1210 approved by Innocent III., and in the same year Francis was made a deacon, the highest clerical position he would receive. In 1212 he was joined by Saint Clara and her two sisters, the original Clarisses or Poor Clares of the Order of Saint Francis. In 1219 he joined the crusaders at Damietta; in 1221 he founded the Tertiary Order. Soon after, as we are told, he had a vision of Christ, and received upon his hands, feet, and side the *stigmata*, or marks resembling the wounds of Christ. (See STIGMATIZATION.) Among his numerous reputed miracles was the healing of the infant Bonaventura, afterwards a distinguished saint. Saint Francis d. Oct. 4, 1226, and was canonized in 1228. Through whatever of invention and myth there may be in the stories of the life of Saint Francis, we may discern in him the lover of his kind, the faithful, earnest toiler for the spiritual and physical well-being of his fellows. Even the beasts and birds experienced his kindness, and he preached to them as to his brethren. He was cruel to no one except himself. He taught his followers that it was not maceration and fasting that led to spiritual advantage, but that such advantage sprang from the love which prompted to self-renunciation. His own self-inflicted sufferings were endured for the purpose of enabling him to control his appetites. His life has been written by Thomas de Celano, Bonaventura, Luke Wadding, Voigt, Chavin, Hilyot, Chalippe, F. Morin, Böhringer, Hase, Papini, Da Magliano, and many others. CHARLES W. GREENE.

Francis (Sir PHILIP), K. B., b. at Dublin Oct. 22, 1740, was the son of Philip Francis (1700–73), an Anglican clergyman and translator of Demosthenes and Horace. Young Philip entered public life in 1756, under the patronage of Henry Fox (see HOLLAND, LORD), as a placeman in the state department, and held afterwards various places in the civil service at home and abroad until 1772. He was a member of the council for Bengal 1774–80, and the constant opponent of Hastings, by whom he was badly wounded in a duel. He entered Parliament in 1784, and finally left it in 1807. He was prominently connected with the Hastings trial, in which his revengeful spirit is supposed to have been a principal element. Throughout a large part of his public life he was an ardent and active advocate of reform measures. At present he is chiefly remembered as perhaps the author of the *Junius* letters; although the question has not yet been settled, the weight of the evidence is generally regarded as favorable to the theory of his authorship of those letters. (See JUNIUS.) D. in London Dec. 22, 1818. None of his acknowledged writings are now important.

Francis Xavier, SAINT (FRANCESCO DE XAVIER), "patron saint and protector of the East," was b. of a noble family at the castle of Xavier, in Navarre, Apr. 7, 1506, and took his name *Xavier* from an estate of his mother's. He was educated at the college Sainte Barbe, Paris, taught philosophy with applause in the College of Beauvais, and received the doctorate from the Sorbonne. In 1534 he joined the new society proposed by his fellow-student and compatriot Loyola, and in 1536 they, with a few others, the germ of the future Society of Jesus, went to Rome and received the papal benediction upon their new enterprise. He now toiled with zeal in the Roman prisons and hospitals, and in 1541 was sent by Loyola to Goa, India. On the way he cared for the sailors sick of scurvy, and preached with great power and effect. During his ten years' apostleship in India, Ceylon, Japan, and Malacca he baptized, we

are told, more than 1,000,000 persons, and planted the faith in 52 kingdoms. Much of his remarkable success was doubtless due to the exercise of the Jesuit practice of "accommodation." He d. of fever, in the island of Sancian (Hiang-Shan), near Macao, China, Dec. 2, 1552, and was canonized in 1622. Many miracles are ascribed to him by Roman Catholic writers. (The standard *Life* of this saint is that of Bartoli (1666); also written by Tursellini (1594), Bouhours (1682; in English by John Dryden, 1688), Sandoval (1619), Toscano (1658), Raybois (1838), Reithmeyer (1846); by H. Venn, Protestant (1862), and by H. J. Coleridge.)

Francis de Paul (SAINT), b. at Paola, in Calabria, in 1416, became a Franciscan in youth, but assumed the life of a hermit near his native town. He soon acquired a wide fame by the terrible austerities of his life, and his reputed miracles brought to him many followers. In 1436 he established the order of Hermits of Saint Francis, afterwards called Friars Minims, Bon Hommes, and Fathers of Victory. In 1482 he visited Louis XI. of France, who hoped in vain to be cured by him of his long and at last fatal illness. He remained in the service of Charles VIII. and Louis XII. of France, and d. at Plessis-les-Tours Apr. 2, 1507. He was canonized in 1519.

Francis de Sales (SAINT) was b. at the Château de Sales, near Annecy, Savoy, Aug. 21, 1567, of noble parentage; was educated at Paris and Padua, where he was passed a doctor of laws when twenty years old; embraced a clerical life, and as deacon and provost of the cathedral of Geneva won fame as an eloquent preacher; became a priest in 1593; went on a mission to Savoy, whence in 1598 he procured the expulsion of certain Protestant ministers. He was then sent by the pope to convert Beza, to whom he offered a cardinalate, but all in vain. In 1599 he became coadjutor, and in 1602 bishop, of Geneva. In 1610 he founded, with Madame de Chantal, the order of the Visitation, with the mother-house at Annecy. D. at Lyon Nov. 28, 1622. He was distinguished for zeal, charity, purity, eloquence, and personal excellence. His complete works have been often published. The most famous are *L'Introduction à la vie dévote* (1608), and *L'Amour de Dieu* (1616). There are many memoirs, chiefly French. Canonized 1665. He was made oecumenical doctor in 1877.

Francis'cans, Mi'norites (*Fratres Minores*), **Gray Friars** (in England and Ireland), sometimes called also **Seraphic Brethren,** one of the great mendicant orders of the Roman Catholic Church. Its founder, son of a wealthy merchant, Pietro Bernardone (and christened Francesco, "the Frenchman," because his father was absent in France at the time of his birth), was b. at Assisi, in Central Italy, in 1182. A wild youth sobered by adversity, he gave himself up in 1207 to a life of most passionate religious devotion, choosing absolute poverty as the badge of a new apostolate which should carry the gospel to the poor. The founding of the order dates from May 16, 1209, when he was joined by two companions at the church of the Virgin at Portiuncula. In that same year the order was provisionally sanctioned by Innocent III., commended to the favor of the fifth Lateran Council in 1215, and finally established by Honorius III. in 1223. The rule was given in 1210. In 1224 Saint Francis had the famous vision, when, as his followers believed, the five wounds of our Lord were miraculously impressed upon his body. He d. Oct. 4, 1226, and was canonized by Gregory IX. in 1228. The female order of CLARISSINES (St. Clara), which took its rule from him in 1224, dates from 1212. His TERTIARIES date from 1221. And so he is called the founder of *three* orders. Mediæval Europe owes much to the Franciscans. They went everywhere, and were like flames of fire wherever they went. First of all, they roused the masses. Poor men, wearing nothing but brown frocks girded about the waist by bits of rope, brought the gospel home to the poor. By and by they made themselves felt in every walk of life. Assisi became the acknowledged capital of Christian art. Thomas de Celano, author of *Dies Iræ*, and Jacopone da Todi, author of *Stabat Mater*, were both of them Franciscans; pontiffs like Nicholas IV., Alexander V., and Sixtus V. were Franciscans; but, above all, some of the greatest and best of the Schoolmen, such as Roger Bacon, Duns Scotus, Bonaventura, Alexander of Hales, and Ockham, belonged to the same order. The war between Thomists and Scotists was still more a war between Dominicans and Franciscans. Even in the lifetime of Saint Francis strife arose in regard to the strictness of the rule. The extreme asceticism which originally inspired the order has repeatedly reacted against its declining discipline. Hence, such temporary off-shoots as the Cæsarines (1236–56), the Celestines (1294–1307), and the Clarenines (1302–1506). The Capuchins (dating from 1525) are still in existence. Hence also, especially, the great schism of 1368, which established the two branches of milder Conventuals and more rigorous Observants. The numerical strength of the order was greatest about fifty years after its foundation, when it had between 7000 and 8000 convents and nearly 200,000 monks. In the fifteenth century it declined, and was again greatly weakened near the close of the eighteenth century. At present the number of monks is nearly 100,000, and they are found in almost every part of the world.

(The literature of the subject is voluminous. The *Life* of Saint Francis was first written by THOMAS DE CELANO in 1229; then by the three associates, LEO, RUFINUS, and ANGELUS, in 1246; and by BONAVENTURA in 1261. These may all be found in the *Acta Sanctorum*, 2d vol. for October. Of modern *Lives* of the saint, we have, amongst others, in English, RICHARDSON (2 vols., 1854); in French, MALAN (1855); in German, HASE (1856). For the history of the order we have the *Annales Minorum* of LUKE WADDING, who in the early part of the eighteenth century edited the first 16 vols. of a work, the 23d and 24th vols. of which appeared in 1859 and 1860.) R. D. HITCHCOCK.

Francis'co, tp. of Buckingham co., Va. Pop. 1615.

Fran'cisville, post-v. of Salem tp., Pulaski co., Ind. It has one weekly newspaper. Pop. 281.

Franck'e (AUGUST HERMANN), a great German Lutheran divine and philanthropist, b. Mar. 23, 1663, in Lübeck; commenced his studies at Erfurt 1679, continued at Kiel, and finished them at Leipsic in Hebrew, Greek, and theology. He delivered theological lectures in Leipsic 1689–90, was dean in Erfurt 1690–91; in 1691 was called to the new university of Halle as professor of the Greek and Oriental languages, and as pastor of the suburban town of Glaucha. Breithaupt and Lange were his associates in the faculty and in the spirit of practical energy in which he followed up the work of SPENER (which see). In 1715 he became pastor of the church of St. Ulrich. He was founder of the greatest orphan-house of Protestant Europe, of a free school, a free table for students, and of a seminary for teachers. In 1698 these institutions were brought together in one great edifice. The whole was sustained by private beneficence or by the judicious labor connected with the orphan-house. Among its useful appendages was a publishing establishment, from which were issued many valuable books, especially the cheap Bibles of the Canstein Institute. After his death, June 8, 1727, the work was carried on by his son and by Frelinghausen, his son-in-law. The best biographies of Francke are by Niemeyer, 1794; Guerike, 1827 (translated into English); Kramer, 1861; Eckstein, 1863.

C. P. KRAUTH.

Francoa'ceæ, a small natural order of stemless exogenous herbs, chiefly Chilian. Lindley regards them as having affinity to *Dionæa*. They have astringent qualities, but none are important. The principal genus is *Francoa*.

Franco-German War (1870–71). Under the statesmanlike leadership of Bismarck, Prussia wholly gave up, in 1866, its modest and somewhat ambiguous attitude of former days, and on the basis of the very decided impression which its victory over Austria produced, it took the hegemony in Germany. But thereby the old enmity between France and Germany was immediately rekindled. The government of Napoleon III. could not but feel a depressing influence from the astonishing success of Prussia. It was itself based on the success of its foreign policy. Its important reforms in the field of political economy had found only a cold reception, and Napoleon understood that it would be very difficult for him to maintain himself as emperor of France when he could not maintain the French empire as leader of Europe. Perpetually stirred up and irritated by the opposition, the national feeling of France began to rise against a ruler who suppressed her freedom without increasing her fame and power. The French people felt its pride offended, and the cry was heard, "Revenge for Sadowa!" Thus, after 1866 the imperial government tried its utmost to put the French army with the greatest possible rapidity on a footing which would enable it to declare war against Prussia, while at the same time it endeavored by diplomatic means to gain such concessions from Prussia as might look like compensations for the aggrandizement of that power. It failed, however, in both plans. The introduction of the Chassepot guns was carried through with great rapidity; at the end of 1869 the entire body of infantry was provided with this weapon. But the reorganization of the army met, in general, with so much opposition from the side of the representatives of the people that, especially after the death of the energetic Marshal Niel, only a few reforms of any consequence could be effected. By the army law of Feb. 1, 1868, presented and carried by Niel, the time of military service was fixed at five years in the active army and four years in the reserve, and an active national guard was formed, in which all those who bought themselves off from military service,

or who remained after the annual conscription (100,000 men) was filled, were compelled to serve. On paper the active army and the reserve amounted, according to this law, to 900,000 men, and the national guard, which was to be used for the defence of the frontier, to 550,000 men. But how small a part of this immense army was actually mobilized and fit for battle the year 1870 showed. And even this army suffered from peculiar weaknesses, arising from a policy whose aim had been to make it a support of the dynasty rather than the defence of the nation.

The attempts at inducing Prussia to yield and surrender territory were entirely frustrated by the proud but prudent stubbornness of Bismarck, who after 1866 began to show himself not as a Prussian minister, but as the chancellor of the North German Confederation and a German patriot. In Aug., 1866, he declined an offensive and defensive alliance offered through Benedetti, which stipulated that Prussia should consent to the annexation of Luxembourg and Belgium to France, and France recognize the appropriations which Prussia had made and the intimate connection with Southern Germany which she wished to accomplish. During the following years he several times refused similar propositions which were made to him under different forms, and in the spring of 1867 he took so decidedly a national position in the Luxembourg question that France, not yet ready for war, was compelled to stop short of her demands. Meanwhile, the North German Confederation became more and more consolidated every year, and in Southern Germany an inclination to the North began to show itself. Napoleon believed that a complete political union of the whole of Germany was not far off, and he understood fully that such a combination would make his adversary superior in power. He therefore determined, reluctantly, it is said, presuming that his army was fit for battle, and considering the war unavoidable, to strike now rather than later on. In the middle of May he appointed Gramont minister of foreign affairs in the cabinet of Ollivier, and from that moment the French policy assumed a decidedly warlike course, especially influenced by the empress Eugénie, who was entirely under the control of the Ultramontane party.

Soon after, the question of the Spanish crown furnished the issue. On July 3, 1870, Marshal Prim, the president of the Spanish ministry, communicated to the court in Paris that Prince Leopold of Hohenzollern had declared himself willing to accept the royal crown of Spain, and the imperial government determined to use this event for the humiliation of Prussia or as a cause of war, probably hoping that the case would be considered as merely concerning the Prussian dynasty, and that King William, moved by this consideration, would yield, whereby, to the eyes of the French people and all the world, a diplomatic victory of great political consequence would be gained. King William would be induced to forbid Prince Leopold, as a member of the House of Prussia, to accept the Spanish crown. On July 4 the French *chargé d'affaires*, Le Lourd, who represented the French government at Berlin during the absence of the ambassador, Benedetti, appeared in the office of the foreign ministry of the North German Confederation and set forth the painful impression which the candidature of Prince Leopold had made in Paris. The under-secretary of state, Von Thiele, answered that the question did not concern at all the Prussian government. The next day the duke de Gramont declared in the Corps Législatif that no foreign power would be allowed to disturb the balance of the political system of Europe, and slight the interests and the honor of France, by placing one of its princes on the throne of Charles V. This declaration—which, however, was severely attacked by the opposition, especially by Emanuel Arago, Crémieux, Picard, and others—produced great excitement in the whole nation, and attracted serious attention from all other powers. All felt that France intended war, but the public opinion generally went against the disturber of the peace. In Germany both the press and the people in general remained perfectly calm, partly because they confided fully in their own power and the wisdom of the Prussian government, partly because they did not believe that the French really desired a war. The French government, however, persevered in the course it had assumed. On July 9, Count Benedetti appeared before King William, who was at Ems using the waters, and proposed, in his peculiarly insinuating manner, that the king should command the prince to withdraw his acceptation of the Spanish crown. But King William, although unguided by his ministers, felt immediately the consequence of this seemingly unimportant question, and gave an answer which conformed to his dignity without offending France. He emphasized that he had given his consent to the prince's acceptance of the crown, not as king of Prussia, but as chief of the family, and he declined to recall the consent. On July 11 the French ambassador repeated his demand in a more impressive manner, even threatening with war, but he received the same answer from the king. Once more he returned to the same topic (July 13, in the morning), and this time still more urgently; and when the king told him that the prince had renounced the Spanish crown on the previous day of his own free will, the ambassador asked him to declare publicly that he approved of the renunciation, and would not permit any resumption in the future of the candidature of the prince. Such a declaration—given, for instance, in the form of a letter to the emperor Napoleon—would be necessary in order to still the excitement of the French people. This demand the king refused peremptorily; and when Benedetti asked for another audience later on in the same day, and designated the repetition of this demand as the purpose of the audience, the king declined to receive him.

While the renunciation of Prince Leopold was hailed in Germany and everywhere as a guaranty for the preservation of peace, the party at the court of Napoleon III. which wished the war on any account, succeeded in making its views predominate, reckoning much on aid from other powers, especially from Austria; on which point they were supported by Gramont's reports on the feeling in Vienna. The Austrian cabinet had, indeed, given assurances which looked much like a promise of alliance, and which might lead a sanguine politician to reckon on aid from that side. There were also some prospects of an alliance with Italy, and the participation of Denmark in the war was more than probable. The emperor himself never overlooked the fact that none of these alliances could be actually realized until the French army had achieved some signal success, but such a success might be hoped for by an immediate attack, by a surprise; and it was determined to declare war. A distorted representation of the previous negotiations was laid before the representative assembly (July 15), alleging a gross affront offered to the French ambassador; and, although vehemently opposed by some members, especially by Thiers, the Assembly voted, nearly unanimously, 500,000,000 francs for the war. This was the actual declaration of war; the formal followed July 19.

Meanwhile, the government of the North German Confederation had taken the possibility of war under consideration. On July 11 a council of ministers was held at Berlin, presided over by the minister of war. The question of making some preparatory steps was debated, but in full confidence of the perfect working capacity of the army organization it was decided not to give any pretext for war by preliminary arming. The council knew that even if the South German states did not participate in the war, the North German Confederation could send to the frontier within two weeks an army of 511,826 men, with a reserve of 265,082 men in garrison and 180,672 men of the second call; thus placing a force of 975,256 men, including the staff, against the French army. Count Bismarck, who was on his estate at Varzin, repaired to Berlin on July 12th, and the same day arrived Gen. von Moltke from Schweidnitz. It was Bismarck's plan to go to Ems on the 13th, but the tidings of the renunciation of the prince reached Berlin on the 12th in the evening, and the plan was given up. On the 13th several high officers of the staff received long furloughs, and Admiral Prince Adalbert of Prussia was sent with his squadron on a trip to the South. So peaceful an aspect had affairs at Berlin. But on the 15th the report of what had taken place at Paris wholly changed the situation. The king left Ems for Berlin that day, and on arriving at the Brandenburger dépôt, where he was received by the crown prince, Bismarck, Moltke, and Roon, he heard of the vote of the representative assembly in Paris. He gave immediate orders for the mobilization of the whole army of the North German Confederation. The next day the Federal Council assembled, and the Parliament was called for July 19. In Southern Germany the French challenge produced, contrary to French expectations, the same outburst of patriotic enthusiasm as in the North. Louis II. of Bavaria took the lead in this national movement, and ordered the mobilization of his army (July 16). Baden, Hesse, and Würtemberg followed the example. The question hardly came up whether or not a *casus fœderis* existed; the South German states joined the North German Confederation by the force of a natural instinct.

Even now, while the arming went on in France and Germany with the utmost energy, and before any encounter had taken place between the two armies, the superiority of Germany began to show. The rash challenge of France had made people believe that her army and navy were ready to strike a blow at the very first moment—a blow so decisive in its character as to counterbalance the disadvantageous impressions she had made by breaking the peace. But as day after day elapsed and nothing particular happened, and as it at last became evident that it cost Napoleon great exertions to mobilize his army, an unprejudiced esti-

mation of the position took place, and the result was advantageous to Germany. Austria felt as yet by no means inclined to join France, Italy remained perfectly neutral, and Denmark saw no reason why it should enter on so dangerous an undertaking as a war with Germany. Towards the establishment of this general neutrality Bismarck's diplomatic actions contributed very much. He made known to the world, through a notice in the *London Times* (July 25), and through a communication of July 28 to the German ambassador in London (Count Bernstorff), the proposition of common land-robbery which the French government had made to him from time to time, and the denials of Benedetti and Gramont he disproved (Aug. 10) by communicating a letter of Aug. 6, 1866, from the former, containing a project of re-establishing the frontiers of France as they existed in 1814.

The attitude of England was principally determined by these revelations, and France had to fight the war alone. She proceeded very slowly. It was not until July 22 that Admiral Bouet-Willaumez received the command of a so-called Baltic fleet, consisting of fourteen iron-clad frigates and a number of minor vessels suited for shallow waters; which fleet was destined to be followed by a transport fleet under Admiral de la Roncière le Noury, with 30,000 troops. And when he arrived at Cherbourg to enter on his commandership he found that not only was the number of the ships short, but even *personnel* and *matériel* were wanting. On July 24 he had to go to the Baltic with seven frigates and one corvette, in order not to lie wholly idle. He went to the Sound, returned then to the gulf of Jade, but saw nothing of the German fleet, and proceeded to the Baltic. He accomplished no results, however—especially none in Denmark, as Napoleon did not send an ambassador to the king until after the declaration of war, and the efforts of the duke of Cadoro were paralyzed by the counteraction of England and Russia and the news of the battles of Wörth and Saarbrücken. Along the coast nothing of importance was effected; the decision was to be made on the French-German boundary. But here, too, a singular contrast showed itself between the actual military operations and the haughty haste of the diplomatic preliminaries. If Napoleon had ever had a plan of operations, he was soon compelled to give it up on account of the state of his army and the attitude of Southern Germany. It cannot be doubted that even before the first battles were fought a complete lack of plan and decision reigned at the French head-quarters. On July 14 the reserve was called in, but while the greatest exertions were made to collect a strong force on the German frontier, the bad organization of the army and the defective system of its mobilization caused an indescribable confusion in all military branches and on all the railways and at the dépôts.

The chief defects of the organization proved to be the division of each army corps into small bodies of troops scattered over the communes, and the accumulation of the material of war at a few isolated points. The whole formed one mass of confusion. The chief defect of the mobilization consisted in sending the regiments to the frontier before they had received their reserve and material, so that they had to accomplish their equipment far from their quarters and in the midst of the whole mass of troops. To all this was added the fact that the actual strength of each single body of troops fell very much short of the amount which Le Bœuf had figured out on paper, and in which the emperor had trusted. The whole force which on the French side was ranged in the front line—that is, all the corps which were ready for battle at the end of July and in the beginning of August—numbered hardly more than 250,000 men. And this force, moreover, was dispersed in the following manner: 1st corps, 37,440 men and 120 guns, under MacMahon, was at Strasburg; next to it was the 5th corps, 28,080 men and 90 guns, under De Failly, at Bitsch; to the left, opposite Saarbrücken, was the 2d corps, 28,080 men and 90 guns, under Frossard; the 3d corps, forming the reserve of the 2d, 37,440 men and 120 guns, was at Metz, under Bazaine; and to the left of this, at Diedenhof (Thionville), was the 4th, 28,080 men and 90 guns, under L'Admirault. The 6th corps, 37,440 men and 120 guns, under Canrobert, was concentrated at Châlons; the guard, 17,280 men and 72 guns, under Bourbaki, at Nancy; and the 7th corps, 27,360 men and 90 guns, under Douay, at Belfort. Napoleon later on asserted that this arrangement was based on the idea of forming a strong army at Strasburg to push rapidly forward toward the Main. Be this as it may, it is certain that the corps stood too far apart when the fight began, to give each other sufficient support.

In Germany the state of affairs showed quite another aspect. Even the mobilization of the army exhibited a superiority, which later on became evident also in its strategic and tactical management. It was decided, although an early French invasion was not anticipated, that all the different army corps should be put in complete war-trim in their garrisons, while small bodies of troops should try, by clever operations on the frontier, to produce an impression of their being strong corps. The plan succeeded completely. The French were deceived with respect to the strength of the German garrisons along the frontier, and in the last week of July three powerful armies were formed, undisturbed, at Coblenz, Mentz, and Mannheim. The first army, under Gen. von Steinmetz, numbered 61,000 men and 180 guns, and consisted of the 7th army corps under Von Zastrow, the 8th under Von Göben, and the 1st and 3d divisions of cavalry. It formed the right wing, with Coblentz for its head-quarters. The second army, under Prince Frederick Charles of Prussia, numbered 206,000 men with 534 guns, and consisted of the guard, under Prince August of Würtemberg; the 3d and 4th army corps, under Von Alvensleben; the 9th, under Von Manstein; the 10th, under Von Voigts-Rhetz; the 12th, under the crown prince of Saxony; and the 5th and 6th divisions of cavalry. It formed the centre, with its head-quarters in Mentz. The third army, under the crown prince of Prussia, numbered 180,000 men, with 480 guns, and consisted of the 5th army corps, under Von Kirchbach, the 11th, under Von Bose, the 2d and 4th divisions of cavalry, the 1st and 2d Bavarian army corps, under the generals Von der Tann and Von Hartmann, and the combined corps of Würtemberg and Baden, under Von Werder. Thus, the force of the first line amounted to 447,000 men, with 1194 guns. The 6th army corps, under Von Tümpling, the 1st, under Von Manteuffel, the 2d, under Von Fransecky, the 17th division of infantry and the 17th brigade of cavalry, were in Silesia, around Berlin, and in Sleswick-Holstein, to meet any attack by Austria or Denmark; and the whole country was divided into governments, in which experienced generals were at the head of the reserve and the troops of the second call. The commander-in-chief was King William of Prussia, and his chief of staff was Gen. von Moltke. In his suite were the chancellor, Count Bismarck, the minister of war, Von Roon, and the quartermaster general, Von Podbielski. The commander-in-chief of the French army was Napoleon III.

On July 30 the strategical evolution of the German army on the Rhine was finished, and the march toward the French frontier, which as yet the French had not crossed, began. On July 28, Napoleon arrived at Metz with his son, while the empress Eugénie remained in Paris at the head of a regency. Napoleon was wavering and doubtful concerning the success of the war, and his chief of staff, Le Bœuf, showed himself as incompetent to lead an army as to organize one. Under the painful feeling of having entered on an undertaking too great for his strength, Napoleon issued, on the day of his arrival, a proclamation to the army which did not satisfy the soldiers, as it spoke of the toils of a long campaign, and they already felt uneasy on account of the general inactivity and the many contradictory dispositions. Several days passed away, with indifferent marches and counter-marches on the left wing, until at last (Aug. 2) the corps of Frossard made a real attack on the Prussian position at Saarbrücken in presence of the emperor and his son. The Prussians had as yet no reserve, and their whole force consisted only of one battalion and some squadrons. After protracted firing they retreated; Frossard occupied Saarbrücken, and the emperor hastened to send a brilliant report of victory to Paris, in which he mentioned the bravery of his son. On the same day King Wilhelm arrived at Mentz, and from that moment the serious and systematic manner in which the Germans conducted the war led to decisive encounters.

The armies had now approached very near to the frontier, the left wing, the third army, nearest. On Aug. 4 the crown prince of Prussia gave orders to pass through the forests of Bien by four different roads, and to throw back the enemy wherever he should be met. This blow was directed against the corps of Marshal MacMahon, who had been compelled to occupy a position very much scattered, in order to watch and secure all important points. His 2d division, under Gen. Douay, was at Weissenburg, the 1st, under Gen. Ducrot, to the E. of Wörth, and the rest of the corps at Strasburg, while the cavalry was widely spread in order to cover the whole sweep between the Rhine and the Vosges. Gen. Douay, who was nearest to the threatened point, heard of the approach of the enemy Aug. 3, in the evening, but only in an indefinite way. He reported to Ducrot, and received orders to take up the battle if it were offered. The German attack was made earlier and more forcibly than Douay expected. The firing between the French outposts and the German vanguard began at 9½ A. M. (Aug. 4). Large masses of the artillery and infantry of the third army soon drew up, and the attack was made with such force as to make resistance impossible. Douay himself fell in the battle, and his troops retreated

with great loss and in wild disorder. (*Weissenburg.*) As soon as the news of this defeat reached Marshal MacMahon he determined to throw immediately all disposable troops against the enemy. As he could add only one division of the 7th corps to his own, he could not reckon on meeting the crown prince with more than 50,000 men. Nevertheless, he determined to make head against the superior force, and chose a very good position at Wörth. On Aug. 5 the crown prince advanced to Sulz, with the 5th and 11th army corps in the centre, on the road to Hagenau, the Bavarians to the right, the Würtemberg-Baden corps to the left. In the night his head-quarters were at Sulz; the corps stood at Lembach, Ingolsheim, Preuschdorf, Sulz, Aschbach, Schoenenburg, and Saihl. No dispositions for attack were made the next day, as it was not intended to give battle that day. On Aug. 5, MacMahon occupied the position at Wörth; the division Dumesnil of the 7th corps was coming. He expected the corps of Failly, which the emperor had placed at his disposal, to arrive the next day. At daybreak on the 6th small skirmishes arose between the outposts, which, against the wishes of the commanders, grew into a general fight at 9 A. M. The larger part of the German corps was still far off. The French fought bravely, and they were well led. They made several assaults, and up to 1 P. M. the battle was undecided. But at that time the whole German force had come up, and the decision began to appear. The fight about the village of Froschweiler formed the crisis of the bloody battle. After several furious assaults, especially by the cavalry, MacMahon had to yield to the press of the German columns, and when at 3½ P. M. he gave up Froschweiler the battle was ended. The French fled to the mountains in utter confusion and consternation. Only the division of Guyot de Lespart, which had just arrived, and which was all the support the marshal received from the 5th corps at Bitsch, met the enemy and stopped the pursuit. (*Wörth.*)

This decided victory, which left 6000 prisoners (among whom were 100 officers), 2 eagles, 6 mitrailleuses, and 35 guns in the hands of the Germans, was of great consequence, both in military and political respects. The news that the flower of the French army, the African troops, under the best general, had been completely vanquished, filled all Germany with proud confidence, and destroyed every hope of alliance which Napoleon still might entertain. And the French were defeated on the same day not only on the right, but also on the left wing, at Saarbrück. The corps of Frossard, which on the 2d had made the rather theatrical assault on Saarbrück, retired, on hearing of the defeat at Weissenburg, into a firm position between Forbach and Saarbrück, on the heights of Speichern. Napoleon had returned to Metz. The corps situated between Metz and the frontier were distributed without plan, and pushed to and fro to no purpose. On the day of the battle at Wörth the flanks of the first and second army approached the frontier. The 7th army corps was to advance to the Saar; the vanguard of the second army stood near Saargemünd. An attack on the corps of Frossard was not yet intended. But when the cavalry division (Rheinbaben) of the first army reported that, contrary to expectation, the enemy had retreated to the heights of Speichern, Gen. von Zastrow ordered this position to be reconnoitred; and when the 14th division advanced beyond Saarbrück (Aug. 6), a skirmish began with some advanced bodies of French troops. The fight grew hot, and could not be broken off. The French were driven from the ground in front of their position, and although neither Gen. von Steinmetz nor Zastrow had ordered it, both the brigades advanced from two sides against the front of the immensely strong position. The battle was fought on the German side with great boldness, but it caused a heavy loss, and on account of the weakness of the assailants it lasted several hours without bringing any decisive result. The 14th division received so much reinforcement from the 8th and 3d army corps, parts of which hurried to the place on hearing the cannonade, that it could hold the ground which it had gained in the beginning. But the battle was not decided until the 13th division, advancing from Volklingen on Forbach, threatened the French on their left wing and rear. About 9 P. M. they retreated to Blittersdorf. (*Saarbrück.*) On both sides the battle was fought with the greatest exasperation, and the losses were enormous; each army reckoned about 4000 dead and wounded. But the result had a very bad influence on the French army. While on the German side the different divisions supported each other to the utmost, and without any previous agreement, the French felt that their generals lacked spontaneous energy. The corps of Frossard could as well have been reinforced as the German division. Marshal Bazaine was only 5 miles away from the battle-field, and the din of the battle could be heard by him distinctly. Thus, both the wings of the French army were completely defeated, the 2d as well as the 1st corps; the original position could not be held any longer; the whole force fell back.

The defeat in the field caused an immense reaction politically. Paris dreamt of nothing but victory. On the very day when both battles were lost, a false rumor had spread that the Prussians were totally defeated, Prince Frederick Charles taken prisoner, and Landau occupied. Paris was greatly excited. But soon the news was contradicted, the excitement suddenly changed, and on the 7th the regency was compelled to employ extraordinary measures of mobilization. The empress issued a proclamation in which the defeat was acknowledged, and firmness and order were urgently entreated. The acting minister of war presented a decree which asked for the enrolment of all active citizens between 30 and 40 years of age in the stationary national guard, the employment of the national guard of Paris in the defence of the capital, and the enlistment of all citizens under 30 years of age into the active national guard. Besides the department of Seine, the military districts of Lille, Châlons, Strasburg, and Lyon were on Aug. 8 declared in a state of siege, and the representative assembly was called to meet on the next day. The official journal of the 8th gave a picture of the reigning despair; it besought all the peoples of Europe to stand by France. On the 9th the representative assembly commenced its sittings, and in the Corps Législatif a real storm arose against the ministry of Ollivier. The ministry was compelled to give in its resignation, and Gen. Cousin de Montauban, Count de Palikao, was requested by the empress to form a new cabinet, in which he himself held the ministry of war, Admiral Rigault de Genouilly that of the navy, and Prince la Tour d'Auvergne that of foreign affairs. All unmarried men between 25 and 35 years of age, who before had been legally free of military service, and widowers without children, were now called in, unless already enrolled in the national guard. Companies of volunteers were also to be formed. The regency considered necessary even the barbarous measure of expelling all Germans living in France.

Meanwhile, the military position of the two armies formed itself in the following manner. The effect of the defeats of Aug. 4 and 6 was that, without any definite plan for the continuation of the defensive war, all the French corps, conglomerated into two large masses, retreated along the line of the Moselle. Two different armies were thus formed—the army of Metz, generally called the Rhine army, and the army of Châlons. The former consisted of the 2d, 3d, 4th, and 6th corps and the imperial guard; the latter of the 1st, 5th, and 7th corps, to which was added the 12th corps, formed later on. The commander-in-chief of the Rhine army was Marshal Bazaine from Aug. 12; under the moral pressure of his own incompetency and the general contempt, the emperor himself drew back. MacMahon commanded the army of Châlons.

Meanwhile, the German armies streamed over the frontier into France, pursuing the advantages already gained. Wheeling around to the right, the first army proceeded very slowly, the third very rapidly. Advancing two days' march in front of the main body, the cavalry divisions formed a line of observation. The crown prince marched his army in five separate columns through the Vosges, in spite of the fortresses of Bitsch, Lichtenberg, Lützelstein, and Pfalzburg, which should have stopped the passage; the division of Baden he sent to besiege Strasburg. The three armies then crossed the plateau of Lorraine without resistance, the first taking the direction towards Metz, the second towards Pont-à-Mousson, and the third towards Nancy. On Aug. 13 the royal head-quarters were in the castle of Herny, 15 miles from Metz. The first army, to which the 1st corps and the 1st cavalry division had been added, stood on the 11th, at noon, on the line of St. Barbe-Frontigny, with its outposts 5 miles from Metz, and in immediate contact with the enemy; the second army began at the same time to cross the Moselle at Pont-à-Mousson; the third approached Nancy with its main body. It was believed that the Rhine army would give battle at Metz on the 15th (the Napoleon day), but it looked singular that the French did not occupy the Moselle line in its whole length, but allowed themselves to be flanked by the second army at Pont-à-Mousson. Under these circumstances the king ordered that the first and second armies should remain in close connection, in order to receive battle on the right bank of the Moselle, but that one part of the second army should try, at the same time, to get into the rear of the army at Metz and cut off its retreat to Paris. The third army was employed to secure this movement from any attack by MacMahon.

On the French side the greatest confusion prevailed. When Bazaine became commander-in-chief instead of the emperor, Jarras took the place of Le Bœuf as chief of staff, but he was perhaps even more incompetent than his predecessor. A council of war was held on the 13th, and deter-

mined that the army, which was encamped entirely on the right bank of the Moselle, and under the protection of the guns of Metz, should retreat on the next day to Verdun. Early on the 14th the retreat began. It took place through the fortress and on the left bank, but was effected very slowly. As soon as the commander of the German outposts, Maj.-Gen. von Goltz, observed the enemy's movements in the afternoon, he advanced his brigade immediately and attacked. His purpose of keeping the French back and effecting a postponement of the retreat succeeded completely. By the French larger and larger bodies were opposed to the attack of the Germans, whose mass also increased with every hour, and a real battle developed—the battle at Courcelles—in which on the German side the 1st and 7th corps, and on the French the 3d and a part of the 4th, participated. It was very bloody; the French lost about 4000 men, the Germans about 5000; but the latter were victorious, and pursued the enemy to the glacis of the fortress. The whole next day (Aug. 15) was entirely lost to the French; they remained in Metz and on the left bank of the Moselle, repairing the losses of the last battle.

To the Germans, on the contrary, the day was immensely valuable; it gave the second army time to approach the enemy's line of retreat. Only the 1st army corps remained to watch Metz from the E.; the 7th and 8th were pushed near to the Moselle, S. of Metz, and the whole second army was to try to reach, as rapidly as possible, the road from Metz to Verdun. This operation was very difficult to effect. The whole course of the Moselle from Metz to Frouard is very winding, and is hemmed in by abrupt and forest-clad hills, which present formidable obstacles to the moving columns of a large army. Only two stationary bridges, at Pont-à-Mousson and at Novéant, lead across the river, which rushes through a narrow valley. The mountains of the Moselle are narrow, on the right bank rising to the height of 1000 feet, and with only a few difficult side-valleys at Corny, Arry, and Chambley; to the S. of Pont-à-Mousson they become broader and higher, and are cut by valleys which lead to Dieulouard and Marbache. On the left bank the mountains are more abrupt, several hundred feet higher, and have an average breadth of 5 miles. They slope gently down to the W., while they break off precipitously toward the river. Only a few narrow defiles lead to the N. W. from the Moselle to the road between Metz and Verdun. N. of Pont-à-Mousson are only the two valleys in which Gorze and Orville are situated. Thus, in order to approach the French line of retreat without incurring too many stoppages and too much confusion, the army had to take a circuitous course—first to the S. and S. W., and then, wheeling round, to the N. between the mountains of the Moselle and the Meuse. This operation was effected by Prince Frederick Charles during the 15th and 16th of August. Only one corps, however, the 3d, under Lieut.-Gen. von Alvensleben, and the 5th and 6th cavalry divisions, had reached far enough on the morning of the 16th to surprise the retreating army of the enemy. Thus, this small force had a task of the greatest importance and difficulty. Bazaine had ordered that the retreat should begin on the morning of the 16th, and take place along both the roads leading to Verdun; but the slowness with which the park and train columns were developed, and the delay caused by the participation of the 3d and 4th corps in the battle of Courcelles, prevented the army from effecting the march with due celerity and order. Napoleon had already left it under a strong escort. Bazaine expected an attack, but he had no idea of its direction or of its purpose. At 9½ A. M. the French outposts on the plateau of Vionville noticed the approach of the enemy, and almost immediately after the German regiments of cavalry fell on the bivouacs of the French cavalry, which were situated to the S. of the great road. The attack caused in the first moment a great confusion, but in the next the French corps took energetic measures of defence. In tactical respects the French army had many advantages over the German, but its strategical position was desperate. Even if it succeeded in defeating completely the present attack, it would still continue to be exposed during its whole march to new attacks by the rest of the German army, which pushed forward in larger and larger curves. It did not succeed, however, in defeating its first enemy. The 3d corps was sufficient to stop the retreat. Marshal Bazaine showed himself in this difficult position an incompetent commander. He knew not whether to proceed or retreat; he did not understand how to deploy his army; he did not see whether he was most threatened on the left or on the right wing. Thus, his army remained crowded together in a small space, and, singularly enough, it held two lines of retreat—one to Metz, and one to Verdun. Nevertheless, at several points the French troops gained advantages. They succeeded in checking, and partially repelling, the 3d corps and the reinforcement which first arrived, the 10th corps. Between 2 and 3 P. M. the French front had turned toward the S. and threatened to flank the German left. The fight was continued till night came, and the darkness ended it without any decisive result. Both armies bivouacked during the night in their positions.

This battle (*Vionville*) was comparatively the most bloody in the whole war. On the French side 120,000 men, on the German 60,000, were under fire. The loss on each side comprised about 16,000 men, dead and wounded. But it frustrated the intended retreat to Verdun, and compelled Bazaine to remain at Metz. On the 17th he went back to the heights which extend from St.-Privat to Rozerieulles, and took up a defensive position. On the German side it was determined to wait for the arrival of the corps still on the march, and then to push forward in a northern direction, in order to prevent any attempt at retreat. The king arrived at Gorze on Aug. 17, at 6 A. M., and inspected the battle-field. After ascertaining that the French had left their positions, he made through Von Moltke a new disposition, according to which the second army should advance on the 18th at 5 A. M. to Echelons, between Ville-sur-Iron and Rezonville, while the 7th and 8th corps should meet any attack on the right wing of this army from Metz. These operations were effected on Aug. 18 with accuracy, and at 10 A. M. it was ascertained with certainty that the enemy did not retreat, but occupied a position W. of Metz, with his front facing W. The German attack was planned accordingly: the right wing was to first engage the enemy, then the centre should attack, and at last the left wing was to strike a decisive blow by its pressure on the right flank of the French army. And thus the battle was carried out. (*Gravelotte.*) The right wing, consisting of the 7th and 8th corps, and the centre, consisting of the 9th and 3d corps, fought in front, and held the enemy engaged, without pressing him too hard, until the left wing, consisting of the Prussian guards and the Saxons, could surround the right wing of the enemy. The decisive point of the battle was St.-Privat. Here the circuit of the Saxons forced the French to yield at 7 P. M. On the French left wing the battle lasted still longer; the victory was gained here by the arrival of the 2d German army corps. The losses were very heavy. The French, numbering about 140,000 men, lost 609 officers and 11,605 men; the Germans, numbering 211,000 men, lost 904 officers and 19,658 men. The result of the battle was that the French army was shut up in the fortress of Metz under such circumstances that army and fortress paralyzed each other. As the army was much too large for a garrison of the fortress, it would soon use up the provisions, and then the fortress would have to capitulate with the army. Calculating thus, the German commander-in-chief ordered the investment of Metz, and disposed of the first and second army, under the command of Prince Frederick Charles, for this purpose. From this force, however, the 4th and 12th corps, the guards, and the 5th and 6th cavalry divisions were separated and formed into a fourth army, under the command of the crown prince of Saxony, who was now to push forward towards Paris, together with the crown prince of Prussia and the third army. Where the army of Châlons was, nobody knew, but it was expected to be found somewhere on the way to Paris. On the French side the first plan was that the army of Châlons should retreat to Paris, but the regency feared that the return of Napoleon, who accompanied this army, would occasion a revolution in Paris; and it also hoped that MacMahon would be able to relieve Bazaine at Metz. For these reasons Count Palikao ordered Marshal MacMahon to break up from Châlons with his army, now numbering 140,000 men, and move northward in a circuit around the German army towards Metz. After much opposition the marshal, as well as the emperor, yielded. MacMahon had first led the army to Rheims (Aug. 21), but when the regency persevered in its determination he broke up from Rheims on the 23d, was at Rethel on the 24th, and at Chêne Populeux on the 27th. But on that day the outposts fell in with the vanguard of the German army, and a cavalry encounter ensued at Buzancy. On the 25th the movements of MacMahon were noticed by the Germans, and the third and fourth armies, which were pushing forward to Paris, and then in the neighborhood of Châlons and Vitry-le-Français, were immediately ordered to march to the right. On the 26th both armies wheeled around to the N., and followed MacMahon in forced marches in order to place themselves between him and Metz. On the 28th the French head-quarters were at Stonne, and MacMahon intended to return, as he saw that the Germans approached him. But he received from Paris the imperative order to push forward, and he obeyed. He first thought of going to Stenay, and from that place to Montmédy, but the Germans already occupied the first town. They marched very rapidly, while the French army had made only 60 miles in 6 days. On the 29th, MacMahon removed his head quarters

to Raucourt, and the army began to cross the Meuse at Mouzon.

Meanwhile, the two German armies, which were drawn nearer together, and already had adopted the plan of pressing MacMahon towards Belgium, came in contact with the right flank and front of the French, and by the encounters at Nouart and Beaumont on the 30th they threw parts of the French vanguard back in confusion on the main body. On the 31st they advanced so near to the army encamping around Sedan that in the evening the guards stood at Carignan, the 12th corps at Mairy, the 4th at Mouzon, the 1st Bavarian at Remilly, the 2d Bavarian at Raucourt, the 5th at Chéhéry, the 11th at Donchéry, the Würtemberg at Boutancourt, and the 6th at Attigny and Semuy. The plan was to contract this curve still closer to the French army on the 1st of September, and to attack on the 2d. It was observed, however, that the French were in a wavering and uncertain condition, so that their crossing the Belgian frontier seemed by no means improbable; and for this reason the king ordered the attack on the army of MacMahon, which was very densely concentrated around Sedan, on the next morning. During the night the Würtemberg and the 11th corps crossed the Meuse at Donchéry, in order to cut the French off from the road to Mézières. The French were in a very bad situation. MacMahon had ordered the concentration of his army around Sédan in despair, for the insignificant fortress could give no shelter to the army. He formed his army in a half circle around Sédan, with the two wings resting on the Meuse, as he might expect an attack from any side; but in this position the army had no line of retreat. The 13th corps, under Vinoy, had arrived at Mézières, but no communication could be effected with it. At the dawn of Sept. 1 the German army commenced its attack (*Sédan*), and soon it grappled the French army, which was concentrated on a narrow space, in shape like a pair of tongs. The battle began at Bazeilles, and drew E. of Sedan farther and farther to the N.: on the other side of the fortress it developed somewhat later, but in the same manner, until at last the wings of the German armies united on the plateau of Illy, thus forming a circle which completely surrounded the French. Already, in the beginning of the battle, the French army had lost its commander-in-chief. MacMahon, severely wounded by a splint from a shell, gave up the command to Gen. Ducrot, from whom Wimpffen reclaimed it as the senior officer. Thus, the command and the plan changed several times. It was the idea to break through the German lines somewhere, in order to afford an escape for the emperor, and he himself sought for a long time on the battle-field for such an opportunity; but the undertaking was evidently hopeless, and the army, as its leader, had to submit to its frightful fate. A powerful artillery dashed its missiles from all sides into the orderless and rambling bodies of troops; the shells fell in great number, both in the city and on the battle-field, and, on account of the compactness of the French position, every ball found its man. As, at last, shortly after 3 P. M., one more large battery in the German centre, at Fresnois, opened fire on the city and caused a conflagration, offers to conclude a capitulation were made from the French side. At the same time, however, and before he knew that a French officer with a flag of truce was approaching, the king ordered the fire to be suspended, and sent Col. von Bronsart to Sédan with a summons to surrender the fortress and the army. When Bronsart asked for the commander-in-chief, he was, to his great surprise, introduced to the emperor, who, concerning the negotiations of capitulation, referred him to Gen. Wimpffen. Napoleon then sent the following letter to the king: "As I have not fallen at the head of my soldiers, I surrender my sword to Your Majesty." When this letter was brought to the king by Gen. Reille, adjutant general to the emperor, the king demanded the capitulation of the French army as the first condition, and declared that he then would accept the imperial sword, and charged the chancellor and his chief of staff with the necessary diplomatic and military negotiations.

The war had arrived at a point where the re-establishment of peace seemed to be possible. The situation was so decisive that it seemed necessary for France to accept even very hard conditions. Yet there appeared to be a difference between the interests of the French sovereign and those of the French nation. Napoleon would not conclude a peace which might make his dynasty impossible; and as soon as he ascertained that Germany would demand the surrender of some frontier districts, he preferred to withdraw from the direction of the negotiations. On the other hand, Germany could not conclude a peace which would be nothing but an armistice, and disappoint the just demands of her people. Count Bismarck felt it his duty to establish a safer frontier by the annexation of the French districts in which the fortresses of Strasburg and Metz are situated, and to compensate the German people for its immense sacrifices by recovering those ancient German countries. The preliminary, purely military negotiations between the generals Wimpffen and Moltke were broken off in the evening of Sept. 1, because the former would not consent to the captivity of his army, and Napoleon was determined to treat personally with the chancellor. Early on Sept. 2 a conference, which lasted several hours, took place at Douchéry, in the hut of a weaver, between the emperor and Count Bismarck; Moltke also participated now and then. But no agreement was arrived at. Napoleon thought that he could not consent to the conditions of peace which were offered, and he preferred to be treated as a prisoner of war, leaving the negotiations of peace to the regency. Thus, the purely military negotiations recommenced, and in the forenoon Gen. Wimpffen concluded the capitulation of Sédan, by which 84,433 men, 39 generals, 230 officers of the staff, and 2095 subaltern officers were surrendered into German captivity. After the conclusion of the capitulation the king and the captive emperor had a conversation of a quarter of an hour at the palace of Bellevue. Napoleon went through Belgium to the palace of Wilhelmshöhe at Cassel, which was designated as a residence for him, and the French army was sent to Coblenz, Mentz, and other German fortresses.

The news of the catastrophe, which arrived at Paris on Sept. 4, caused an immense commotion. Jules Favre and his friends assailed the regency in the Corps Législatif, and demanded the deposition of the emperor. The turbulent elements of Paris filled the streets with tumult and thronged into the hall of the Corps Législatif, which assembly they dispersed. The members of the opposition then assembled at the Hôtel de Ville and formed a provisional government of national defence. Gen. Trochu, who had been governor of Paris since Aug. 17, was elected president; Jules Favre, vice-president; Ferry, secretary; the other members were Arago, Crémieux, Gambetta, Garnier-Pagès, Glais-Bizoin, Pelletan, Picard, Rochefort, and Jules Simon. This government determined immediately on the abolition of the senate and the Corps Législatif. At 1 o'clock P. M. the empress left the Tuileries and fled to England.

The military situation of France was very bad. Not only the army of Châlons was lost, but the Rhine army had also suffered considerably. It had tried to make sallies from Metz Aug. 31 and Sept. 1 (*Noisseville*), but the result was that it became completely shut up in the fortress. The French government counted on the perseverance of Bazaine, and it reckoned that a considerable force would be detained before Metz, which the Germans would miss in their further progress. But it had absolutely no troops at its disposal to place against the German army in the field, and it could not prevent the enemy from laying siege to Paris. The only hope was that the new and numerous levies would soon be able to act as real troops, and the greatest energy was displayed in their training, equipment, and organization. The task was much facilitated by the importation of arms and munitions from England and America. Paris—thus reckoned the French government—would hold out long enough to be relieved by the new army. From the beginning of its functions the government declared that it would carry on the war to the very last, and not surrender one stone of its fortresses or one inch of its soil.

To take Paris was considered by the Germans as the most important task of the war, and immediately after the capitulation of Sédan the victorious armies began to move towards the capital. They pursued two parallel roads, and, arriving before Paris, the third army wheeled round to the S., so that on Sept. 19 the investment of the city was complete. The idea was to compel it to surrender by starving it. On account of its extent and the number of its inhabitants, this plan seemed the best. To attack it was very difficult. It had sixteen strong forts, and numerous well-built fortifications between and behind the forts. The works were mounted with very heavy ordnance served by marines, and the large army which was garrisoned in the city, although not disciplined or organized, could be very dangerous in a fight on the walls and in the streets. This army consisted of 100,000 real soldiers [illegible] marching regiments, marines, gendarmes, and fugitives from the previous battles; and in addition 100,000 men of the active national guard of the provinces and 200,000 men of the national guard of Paris. The strength of the besieging army was only 122,000 infantry and 24,000 cavalry, with 622 cannon. The complete investment of Paris, extending over a line of 50 miles, was carried out on Sept. 19, after some fighting at Châtillon, Meudon, Plessis-Piquet, and Moulins-de-la-Tour. The fourth army took position to the N. and E., the third to the S. and W.; and the positions were everywhere fortified to withstand the sallies from Paris. In order to organize a resistance against the invasion of the provinces, two members of the provisional gov-

ernment, Crémieux and Glais Bizoin, were sent to Tours, and on Oct. 6 they were joined by Gambetta, who left Paris in a balloon. Thiers commenced a tour to the different European courts to ask for their intervention, though without any result.

Meanwhile, after taking the fortress of Toul on Sept. 23, and that of Strasburg on Sept. 27, the Germans opened a safe and rapid communication with Germany, which enabled them to draw reserve troops, ordnance, and other requisites of war to the army around Paris. On Oct. 21 this army numbered 202,000 infantry, 33,794 cavalry, and 898 guns. Heavy cannons were still wanting, however, to commence the bombardment. At the end of September, Jules Favre had commenced negotiations with Count Bismarck concerning an armistice, but they led to nothing, and the war was continued with energy. On Oct. 5, the 4th cavalry division, which was posted S. of Paris in observation, noticed a French force drawing northward. It was the 15th corps, under Gen. Motterouge, the first rudiment of the army of the Loire, now forming. An army was immediately formed, under the Bavarian general von der Tann, consisting of the 1st Bavarian army corps, the 22d division, and the 2d, 4th, and 6th cavalry divisions, and on Oct. 26 this army advanced from Paris against the French. On Oct. 10, Gen. von der Tann met them before Orléans, took 3000 prisoners and 3 guns, threw them back on the other side of the Loire, and occupied Orléans on the 11th. Gambetta, the head of the delegation at Tours, recalled De la Motterouge, and appointed D'Aurelle de Paladines in his place. This general began to organize a larger army at Blois and Salbris, while Tann remained in Orléans, and only sent out detachments to Châteaudun and Chartres to disperse swarms of tirailleurs. On the other sides of Paris small encounters with newly-formed bands took place at this time, and the German army had to enlarge its line of occupation, S. to the Loire, W. to the Eure, N. to the lines of Vernon, Gournay, Breteuil, Montdidier, and Soissons. The Parisian garrison made several sallies—on Sept. 23 against Villejuif in the S. and Le Bourget in the N.; on the 30th against Villejuif, Chevilly, Thiais, and Choisy-le-Roi; on Oct. 13 against Châtillon and Bagneux; on the 21st against Malmaison and Buzenval; and on Oct. 28 the Parisians took Le Bourget, from which they were expelled, however, two days afterward. They appeared in large masses and fought well, but could not compare with the experienced and well-conducted Germans, and were always thrown back with heavy losses.

In September an obstinate war arose in the Vosges, and soon expanded over the departments of Vosges, Haut-Rhin, Haut-Saône, Doubs, Haute-Marne, Aube, and Côte d'Or. After taking the fortress of Strasburg, which was commanded by Gen. Uhrich, Gen. Werder moved towards Troyes and Châtillon with the 14th corps, consisting of 23 battalions, 20 squadrons, and 72 guns, and fought at Raon l'Étape, the Oignon, Etuz, and Cussey against Garibaldi's corps and other companies of volunteers. At the end of October he had confined the enemy to Besançon, and took up a position of observation at Gray. On Oct. 27 an important event took place; Metz capitulated. After the unsuccessful sallies on Aug. 31 and Sept. 1, Bazaine kept quiet, and the several sallies made after Sept. 22, and made with partial success, had no other purpose than the acquisition of provisions. Famine and sickness beset his army, and made it, from the middle of October, incapable of further operations. The German army, too, suffered very much from its long inaction in the wet weather; it had 15 per cent. sick.

At last, Bazaine determined to capitulate; first he tried, however, to enter into political negotiations. He sent Gen. Boyer to the head-quarters of the king of Prussia at Versailles, asking for conditions which would give him political influence. It was in vain. He had to conclude a purely military capitulation with Prince Frederick Charles, by which the fortress of Metz, with all its stores of arms and ammunition and an army of 180,000 men, was surrendered to the Germans. All France was filled with terror and fury, and Gambetta indulged in the most vehement accusations against the "traitor" Bazaine. For the Germans it now became possible to employ the first and second army on the Loire and in the N.

Operations on the Loire.—The French army of the Loire, numbering about 70,000 men, with Gen. d'Aurelle de Paladines for commander-in-chief, and consisting of the 15th corps, under Gen. Martin des Paillères, and the 16th corps, under Gen. Chanzy, started Nov. 8, from Mer, Suevres, and Marchenoir, where it had been stationed since Nov. 3, and moved towards Orléans, which Gen. Tann occupied with the 1st Bavarian corps and the 2d cavalry division. It was D'Aurelle's plan to reach the road from Châteaudun to Orléans on the 9th, and place himself between that part of the enemy which was at Orléans and that which was at Chartres, thus cutting off Tann. Tann, however, noticed the manœuvre, and in the night before the 9th he concentrated his corps at Coulmiers and called in the troops at Chartres. On the 9th the battle of Coulmiers took place, in which Tann was compelled to retreat. He went to Toury and joined (on the 10th) the 22d infantry and the 4th cavalry divisions, after which he waited for another attack. But D'Aurelle was not able to follow. He marched to Orléans, took up a fortified position, and waited for reinforcement. Meanwhile, the 17th infantry and the 6th cavalry divisions were sent to Gen. Tann, and the grand duke of Mecklenburg-Schwerin was appointed commander-in-chief of the combined force at Toury. Prince Frederick Charles, who since Nov. 2 had been on the march from Metz through Troyes, was ordered to push forward his army, consisting of the 3d, 9th, and 10th corps and the 1st cavalry division, to the middle course of the Loire, and seek the enemy. But until the prince arrived the grand duke had to watch alone the whole extensive region between Paris on the one side and Orléans and Le Mans on the other. The 15th and 16th French corps remained quiet at Orléans, but at Mer and Blois the 17th corps had been organized under Gen. Durrien, and numbered 40,000 men, and it was pushed forward to Châteaudun. Gambetta, who, in fact, was the strategical leader on the Loire, intended a concentric advance on Paris of all three corps. This plan was not executed, as D'Aurelle considered the army too weak, but the movement of the 17th corps occasioned the grand duke to turn to the W. He left the 2d cavalry division at Toury, and marched the main body towards Chartres on the 13th of November, in order to meet any attack on the army around Paris. But when he arrived at Allonnes, on the evening of the 13th, he learnt that a considerable force, advanced parts of D'Aurelle's corps, had been noticed at Artenay, and for this reason he sent only the 22d infantry division towards Chartres, while he remained himself with the main body at Allonnes. On the 14th French squadrons were observed marching through Dreux towards Houdan, and only two days' march distant from Versailles, the German head-quarters. Versailles was consequently strongly garrisoned, and the 5th cavalry division and some infantry were sent against the new enemy. But in order to secure all threatened points the grand duke marched (Nov. 15) the 17th division to Rambouillet, the 1st Bavarian corps to Auneau, and left the 22d division and the 6th cavalry division in Chartres, the 4th cavalry division at Voves, and the 2d at Toury. At the same time, however, the front of the second army appeared at Fontainebleau, and the grand duke was ordered to confine himself to the region W. of Paris, while Prince Frederick Charles was to look after that S. of the city. The prince was reinforced by the 2d, the grand duke by the 5th cavalry division. In accordance with these dispositions, the grand duke pushed the 17th division forward to Maintenon on the 16th, and drew the other troops nearer to Chartres. The 22d division, the 1st Bavarian corps, and the 6th cavalry division were sent to Châteauneuf on the 17th. All these divisions came into contact with the enemy, troops newly organized by Gen. Fièreck. The 17th division fought at Dreux on the 17th, the other divisions on the 18th at Châteauneuf, Digny, and Courville. The grand duke followed the retreating enemy, under continual small engagements, to Nogent le Rotrou, and was on Nov. 22 on the line of Bellême, Le Theil, La Ferté-Bernard, and Authon. Here he received orders from Versailles to march to Beaugency, as the main body of the enemy still rested on the Loire.

The French army had increased considerably. Its right wing had been strengthened by the 18th corps, formed at Nevers under Gen. Abdelal, but destined to operate under the immediate leadership of Gambetta; and the 20th corps, consisting of fragments of Cambriel's corps, which were brought from Besançon to Gien and placed under Gen. Crouzat. It was Gambetta's idea that these corps, in connection with the 15th corps, should make a sally towards Paris over Pithiviers. He calculated that this sally would strike the advancing army of Prince Frederick Charles on the flank. The prince marched with a broad front in a south-western direction. He had his head-quarters in Pithiviers on Nov. 20, and on the same day he concentrated his 3d corps on this place; the 10th reached Montargis; and the 9th rested on the road from Orléans to Paris, in the neighborhood of Angerville. On Nov. 21 the army numbered 49,607 infantry, 10,166 cavalry, and 276 guns. On the 24th all the corps made reconnoissances towards the French front, and an encounter took place between the 10th German and the 20th French corps at Bois Commun. The prince observed that the French occupied a very extensive line along the forest of Orléans, and determined to wait till the grand duke could join him in order to attack the whole line. The intended French sally on the right wing was delayed several days, as Gambetta and the deputy Freycinet, his right

hand in military affairs, met with opposition from D'Aurelle. At last it was executed on Nov. 28 by the 18th and 20th corps under telegraphic advice from Tours, but it failed, as it was met at Beaune la Rolande by the 10th German corps. A bloody fight ensued, but the French had to yield in spite of their great bravery. On Nov. 30 the grand duke united with the right wing of the second army, and the force under the supreme command of the prince now amounted to 85,000 infantry, 18,000 cavalry, and 484 guns, while the French army of the Loire numbered about 200,000 men. Another moment of great consequence had come, and it called forth great exertions and important battles in and before Paris.

Paris from the end of October to the beginning of December.—The loss of Le Bourget and the capitulation of Metz depressed the Parisians very much, and when Thiers, on his return from his diplomatic tour, opened negotiations for an armistice, hopes of peace awoke. The general relaxation of spirit even induced the Socialists to make an attempt (Oct. 31) to seize the reins of the government, but the attempt failed. Then the news of the victory of the army of the Loire, brought to Paris by a carrier pigeon, changed the situation suddenly and completely. Paris determined to try its utmost. Gen. Trochu had now completed the organization of the Parisian army. In November there existed three armies: the first, under Gen. Thomas, consisting of 300,000 national guards, was employed in the defence of the city line and the maintenance of public order; the second, under Gen. Ducrot, formed of troops of the line and active national guards from the provinces, and numbering 120,000 men, with 80 batteries, was to make sallies; the third, under the special command of Gen. Trochu himself, formed of regular troops and marines, and numbering 80,000 men, defended the outworks. The idea was to break through the German lines with the second army, and establish communication with the army of the Loire. Gen. Trochu believed that the end of November would be the right moment for the execution of this plan. The German army around Paris was reinforced (Nov. 10) by the 2d army corps, which, on its arrival from Metz, united with the right wing of the third army on the left bank of the Seine.

On Nov. 24 and 25 the Parisians began to make preparations for the great sally. They built bridges at St.-Denis and Bezons. On the 26th and 27th they built works on the peninsula of Gennevilliers. These measures, however, were mere feints, as the sally was not intended to take place here, but in the S. E. In the night before Nov. 27 a preliminary attack was made on the 6th corps at Choisy le Roi; a bridge was built a little below this place, and on Nov. 28 all the armed masses were gathered on the eastern front of Paris. During the night before Nov. 29 a heavy fire was directed from the forts against the German positions, especially against the Saxons and Würtembergers on the eastern front, and it was kept up during the next day and night. On the morning of the 30th, after a demonstrative sally against the 6th corps, an attack with considerable force took place in the S. E. It was effectively supported by a cannonade from all the adjacent forts, especially from Mont Avron, which had been mounted and garrisoned two days previously. At the same time Vice Admiral de la Roncière le Noury concentrated, as a demonstration, a force of troops at St.-Denis, and two divisions were pushed forward, for the same purpose, on the peninsula of Nanterre. The main body of the attacking army, numbering about 50,000 men, turned against the Saxons and Würtembergers at Champigny, Brie, and Villiers; one division, numbering about 20,000 men, pushed forward towards Mesly and Montmédy. Brie and Champigny fell into the French hands, but Villiers was stubbornly defended. At Mesly and Montmédy the Parisians were thrown back by the Würtembergers and the 7th Prussian brigade. The attempt at breaking through had failed, and the coldness of the night made the Parisians, who encamped in the open air without any covering, completely incapable of fighting on the next day. The 1st of December passed quietly, but the Germans reinforced all the threatened points with divisions of the 2d and 6th corps. On Dec. 2, in the dusk of the morning, the Germans resumed the offensive. Brie and Champigny were partly retaken, but the fight was fierce, and as the French too received reinforcement, it lasted till night. On the morning of Dec. 3 the Parisians left the left bank of the Marne and retreated to the city, with a loss of about 10,000 men. The German army had also lost heavily during these three days—163 officers and 3311 men. The failure of this violent and obstinate attack was a hard blow for the defence of Paris, as from this moment any prospect of breaking through the German lines from within the city was completely closed.

Operations of the Army of the Loire in December. The army of the Loire, on which, to a great extent, the hope of a successful resistance to the invasion rested, suffered at the same time great defeats. In connection with the sally from Paris the deputies at Tours determined to make a powerful sally from Orléans, in spite of the defeat at Beaune-la Rolande. It was Gambetta's plan that the left wing should wheel round to the right and push forward towards Pithiviers, and the centre occupy Orléans and support the left wing, while the right wing should engage according to circumstances, yet with a general tendency towards Pithiviers. In accordance with these dispositions, Chanzy pushed forward on Dec. 1 with the 16th corps, and in the neighborhood of Loigny he met the vanguard of the grand duke. He threw it back, and determined to pursue his advantages on Dec. 2. But in the evening news arrived of a great victory achieved by the Parisians, which filled the troops and the generals with enthusiasm. The 17th corps marched during the night in the direction of Patay and St.-Peravy, in order to support the 16th corps. D'Aurelle also pushed one part of the 15th corps forward. Meanwhile, the grand duke made his dispositions to assume the offensive on the 2d, and both armies met at Loigny. The Bavarians were first thrown back, but the 17th division retook the position. The 16th, 17th, and parts of the 15th corps, the left wing and the centre of the French army, were defeated by the German right wing (*Loigny*): Loigny and Poupry were stormed by the Germans; and in the evening the French were driven back to Artenay and Patay. On the same day Prince Frederick Charles received orders to attack Orléans, and he immediately made his dispositions for a concentrated attack of all the corps. The French army stood in a very bad position, with its wings widely separated and the centre very weak. Gen. d'Aurelle considered it best to make a general retreat to the left bank of the Loire. With fighting at Chevilly, Chilleurs, Neuville-aux-Bois, Artenay, and Patay on Dec. 3, and at Cercottes, Gidy, St.-Peravy, Ormes, and Orléans on Dec. 4, the army of the Loire was completely driven back and compelled to give up Orléans, although the deputies at Tours insisted to the very last moment on its being held. At midnight the grand duke occupied Orléans. The French army, which in the fight of the last days had lost 12,000 prisoners, 60 guns, and about 6000 dead and wounded, separated under the pressure of the pursuit into two parts. The 18th and 20th corps retreated to Gien and Sully, the 15th to Salbris, and the 16th and 17th to Beaugency and Blois. Gen. d'Aurelle resigned his command on Dec. 6, and the 16th and 17th corps, forming the second army of the Loire, were placed under Gen. Chanzy, and the other three corps, forming the first army of the Loire, under Gen. Bourbaki.

Prince Frederick Charles made immediate preparations to pursue the enemy in all directions. The 2d corps was to follow the right bank of the Loire to Gien; the grand duke to move to Tours; the 6th cavalry division and four battalions to Vierzon; and the 9th and 10th corps were to remain at Orléans as a reserve. All these divisions came in contact with the enemy, especially the grand duke, who met Gen. Chanzy. On Dec. 7 the 17th division first encountered the enemy at Meung, and threw him back. Advancing farther on the following day, a battle was developed between Beaugency and the forest of Marchenoir. As Chanzy had been reinforced by the 21st corps, organized at Le Mans, and by parts of the 19th corps, he ceased retreating, and took up the offensive. He had 120,000 men, and with this force he made every effort to cut off the grand duke from the road to Tours. He had to yield, however, and on Dec. 8, Beaugency was occupied by the Germans. But the resistance of the French was so obstinate that Prince Frederick Charles sent the 10th corps to the grand duke. On the 9th the battle was renewed. Chanzy attempted to surround the German wing from the forest of Marchenoir; he did not succeed, but the battle was undecided on this day. On the 10th the French attacked and took several villages, but ultimately they were thrown back. On the 11th the 10th corps arrived, and, thus reinforced, the grand duke began to pursue the slowly retreating enemy. During the three battle-days the grand duke lost about 4000 men; Chanzy still more, besides 5000 prisoners. Chanzy now altered the direction of the retreat. After Dec. 11 he moved westward, probably determined by the advance of the 9th German corps, which pushed forward along the left bank of the Loire and occupied Vienne, the suburb of Blois, on Dec. 10. The deputies at Tours fled the same day to Bordeaux. But the pursuit of Chanzy's army was continued only for a few days, as Prince Frederick Charles was afraid Bourbaki's army would advance towards Paris in the mean time. For this reason he ordered, on Dec. 16, when it became apparent that Chanzy had retreated on Le Mans, that the 9th corps should occupy Orléans, the 3d, Beaugency, the 10th and the 1st cavalry division, Tours, and the grand duke a central position around Chartres.

Operations of the Army of the North until the end of

1870.—After the capitulation of Metz, Gen. von Manteuffel, with the 8th and the largest part of the 1st corps and the 3d cavalry division, numbering 38,244 infantry, 4433 cavalry, and 180 guns, moved westward to meet the French force newly organized in the northern departments. On Nov. 20 he occupied a line from Compiègne to Noyon, and pushed forward towards Amiens. The organization of the army of the north was originally entrusted to Gen. Farre, but on Oct. 22, on his removal from Metz, Bourbaki had received the command, and, on his being called to the Loire, Gen. Faidherbe was appointed commander-in-chief. He did not enter on his office, however, until Dec. 3, and meanwhile Gen. Farre had the command. He held, with 25,000 men, an extensive intrenched position at Amiens, and Gen. Manteuffel encountered him, after some small skirmishes, at Quesnel and Mézières on Nov. 27. A battle ensued. The French were defeated, but not pursued. Amiens was occupied the following day, and on Dec. 1, Manteuffel continued his march to Rouen, in order to attack a division of the enemy which was posted there under Gen. Briand. The fortress of La Fère, besieged since Nov. 16 by the brigade Zglinitzki, capitulated on Nov. 27. The first army marched, with the 8th corps on its right wing, through Foix and Forges, and with the 1st corps on its left wing, through Breteuil; and on Dec. 4 it surprised Gen. Briand between Forges and Buchy, defeated him, and occupied Rouen the following day. From here Manteuffel sent out detached columns to Dieppe and in the direction of Hâvre.

Meanwhile, Gen. Faidherbe had organized another army with great energy, and marched it from Lille towards Paris. The interruption of the telegraphic communication between Amiens and Rouen, and the appearance of French troops at Bapaume and Roye, called forth from the German side rapid counteraction. Manteuffel received orders to concentrate his army at Beauvais, while Gen. von Kameke, who had taken Thionville on Nov. 24 and Montmédy on Dec. 17, should occupy Mézières, and the detachment encamping there march to St.-Quentin. On Dec. 20, Faidherbe rested with three divisions, under Lecointe, Paulze d'Ivoy, and Moulac, numbering 40,000 men, with 78 guns, between Péronne and Corbie, behind the Somme. He had at one time proceeded still farther southward, attempting to relieve Paris, but on the advance of Manteuffel he had returned and chosen a good position behind the Somme, in order to draw reinforcements to him and act on the defensive. On Dec. 20 a short fight took place between his outposts and a reconnoitring detachment from Amiens. On the 23d, Manteuffel had drawn together so much of his scattered force as to take the offensive. Faidherbe now held an extensive intrenched position at the small river Hallue. He made an obstinate and well-conducted resistance to the enemy, who numbered about 20,000 men, and he kept the greater part of his position. On the 24th both armies were again ready for battle, but in the evening the French made preparations for a retreat, which was carried on the following day in the direction of Douay. The Germans followed through Albert to Bapaume, Achiet, and Bucquoi, but here they stopped, surrounding Péronne. Manteuffel sent out detached columns in different directions, and ordered the 8th army corps to take up its position at Bapaume. Meanwhile, about 20,000 Frenchmen appeared in the vicinity of Rouen, advancing on both sides of the Seine. Gen. von Bentheim, who was at Rouen, hastened to meet them: on Dec. 31 he threw them back and stormed the fortified castle Robert le Diable. The first army now took up a position with the 1st corps at Rouen, and the 8th at Somme. Faidherbe reorganized his army in the northern fortresses. Mézières capitulated in the night between Dec. 31, 1870, and Jan. 1, 1871.

The War in the South-East to the end of 1870.—At the end of October, Gen. von Werder received orders to secure the march of the second army from Metz to Orléans from any French attack on its left flank, and to pursue the investment of the fortresses of Schlettstadt, Neu-Breisach, and Belfort. Accordingly, Werder took up a position at Vesoul, and sent Gen. von Beyer with the main body of the troops of Baden to occupy Dijon. Beyer met with an obstinate resistance at Dijon on Oct. 30, and could not take the town until next day after severe fighting. Belfort was surrounded by Gen. von Frischow on Nov. 3; Schlettstadt surrendered on Oct. 25 to Gen. von Schmeling, and on Oct. 27 he began to besiege Neu-Breisach, which surrendered Nov. 10. The siege-train was then carried to Belfort. Having secured the march of the second army, Werder undertook in the middle of November a march in the direction of Dôle, and destroyed the railway from Besançon to Lyon. On reconnoitring Auxonne he saw that the fortress could not be taken by one stroke, and he then took up a central position at Dijon. The troops under Garibaldi and Cremer remained around Châlons and Chagny, but on Nov. 20, Werder learned that the corps of Michel, which hitherto had been stationed in this neighborhood, had marched westward. On Nov. 26, Garibaldi ventured an attack on Dijon with 18,000 men and 12 guns, but was thrown back to Autun in utter confusion. Werder remained quiet at Dijon, and the 7th corps, arriving from Metz on Dec. 9, established communication between him and Prince Frederick Charles, occupying a position on the line between Chaumont and Joinville. After the defeat of the French army of the Loire at Orléans, Werder, commanding the 14th, and Gen. von Zastrow, commanding the 7th corps, received orders to secure the communication between the second and third armies, and to watch the movements of the French forces combined under Bourbaki. The German forces were divided and employed in different undertakings. Several encounters ensued. Gen. von Glümer met Cremer at Nuits on Dec. 18. Cremer held a good position, and had 1[illegible],000 men, but was defeated. Gen. von der Goltz beat several battalions of active national guards and troops of the line in the neighborhood of Langres. On Dec. 26 it became evident to Werder that a French army was approaching from the W., and he accordingly drew together his whole force at Vesoul. Von Zastrow marched from Auxerre back to Châtillon. The expected attack did not take place, however; Bourbaki's army was not yet ready for the offensive.

Before Paris the situation had continued essentially the same since the unsuccessful sally on Nov. 30. In the middle of December it was observed by the Germans that the French were preparing a sally to the E., and on Dec. 20 stronger forces were concentrated on the threatened points, French columns having assembled at Noisy-le-Sec and Merlan. On Dec. 21, in the morning, the Parisians made a heavy attack both on Le Bourget and on Stains. At noon an attack was directed against Maison Blanche, occupied by the Saxons, and Ville Evrart. Although they had gained several advantages, the Parisians were thrown back towards evening, but they remained during the night outside of the walls of Paris, at Noisy-le-Sec, Bobigny, Bondy, and Mont Avron, and on the following day they tried to push forward in the valley of the Marne with two brigades. They remained outside on the 23d too, but returned to Paris on the 24th. On the German side preparations had been made since Dec. 4 for an artillery attack on the city, especially for a bombardment of Mont Avron. On Dec. 27 the bombardment began, and a few days after Mont Avron was taken. Against the south-western front too 275 guns were brought into position at the end of the year, in spite of the difficulties arising from the distance between the terminating point of the railway, Nanteuil, and the point designated for the park of artillery, Villacoublay. The command of the engineers was entrusted to Maj.-Gen. von Kameke, that of the artillery to Maj.-Gen. Prince Hohenlohe, and the Germans only waited for a clear day in order to begin the bombardment.

The beginning of the year 1871 brought the last great battles and the decision of the war. On the French side the government of national defence having brought hundreds of thousands under arms since Nov. 2, 1870, by enormous conscriptions, determined to try, at every point of the war-theatre, to make one last great effort to conquer the invaders. On the German side it was determined to meet the attempt by giving up the passive attitude of the last weeks and assuming the offensive, keeping the defensive only in the S. E., where Bourbaki might make an attack. Before Paris the bombardment was to begin in order to exercise the last moral pressure on the defence, already slackening. From Orléans, Prince Frederick Charles was to take the offensive against Chanzy at Le Mans, and in the N. the first army should advance against Faidherbe.

Operations around Le Mans.—On Jan. 1, 1871, Prince Frederick Charles received orders to attack Gen. Chanzy, and the 13th corps, under the grand duke of Mecklenburg, and the 2d and 4th cavalry divisions were once more placed under his command. While he advanced the 5th cavalry division was to secure his right flank. The prince left the Hessian division at Orléans, one detachment at Blois, another at Gien, and on Jan. 5 he began the operations against Le Mans with 57,737 infantry, 15,426 cavalry, and 318 guns. On Jan. 6 the first encounter took place between the prince and the French army, which also was advancing on the offensive, and now followed daily battles on ground much cut up and in extremely rough weather, snow alternating with mist, until on the 12th the French army was completely defeated. On the 10th, 11th, and 12th the battle raged in the immediate neighborhood of Le Mans. Chanzy's army was compelled to retreat to Alençon and Laval, leaving 18,000 prisoners, 20 guns, and 2 colors in the hands of the Germans, and having lost 10,000 dead and wounded. The German army lost 180 officers and 3470 men. The pursuit was effected by detached columns, while the main body of the second army remained at Le Mans, and the 13th corps marched to Alençon.

In the S. E. the war lasted longer. In the beginning of January, Bourbaki began to operate here with an army of about 140,000 men and 500 cannon, formed of the 15th, 18th, 20th, and 24th corps. In the last days of December and in the beginning of January he had concentrated this army at Besançon, using the railways which from Nevers and Lyon centre at this fortress, and he now began to advance in the direction of Belfort. The 24th corps formed his right wing, moving along the Jura. Garibaldi and Cremer were to operate at Dijon, in order to secure his left flank. Bourbaki was at Dijon on Jan. 2, and on the 5th and 6th skirmishes with the German outposts took place at Vesoul. On the 6th and 7th the Germans ascertained the concentration of the enemy at Besançon, and dispositions were made accordingly. Zastrow was ordered to gather his army corps at Châtillon-sur-Seine; Fransecky to advance with the 2d corps from Montigny over Jugny and Tonnerre to Nuits; and Werder to cover the besieging army at Belfort, and to operate so as to prevent the enemy from throwing himself upon the 2d and 7th corps. Moreover, in order to impair Bourbaki's communications from behind, the railways from Langres to Chaumont, from Epinal to St. Loup, and from Mülhausen to Bâle were destroyed, and the ministry of war in Baden was applied to for the formation of a reserve force in Southern Baden to prevent the French from crossing the Rhine. In order to procure a perfect co-operation of all the different corps in the S. E., Gen. von Manteuffel was called from the army of the north and appointed commander-in-chief of the 2d, 7th, and 14th corps. He was, in general, instructed to threaten Bourbaki's army in the flank and rear with the 2d and 7th corps, while Werder met him in the front. It was Gambetta's plan that Bourbaki should cut off the German communication between the Rhine and Paris, thereby making a continuation of the siege of Paris impossible, relieve Belfort, and fall into Baden with one part of his army. Bourbaki's army was capable of doing this, so far as regards its numerical strength; with the troops of Garibaldi and Cremer it numbered about 180,000 men. But the troops were newly levied and newly organized, and equipments and provisions were deficient. The rough season also offered a great obstacle.

Gen. von Werder retreated slowly before the French army from Vesoul to Belfort, always in close contact with the enemy, and trying to detain him by detaching the brigade Goltz and the 4th reserve division in a demonstration against his left flank. The attempt succeeded completely. In the actions at Marat and Villersexel, Bourbaki wasted time and strength, employing a large force against a weak enemy. Thus, the French did not attack the German position on the Lisaine before Belfort until Jan. 15, and in the mean time Werder had made extensive preparations for a tenacious defence. For three days Bourbaki tried with his dense columns to defeat the enemy, but in vain; on the 18th he had to retreat, leaving behind him 8000 dead and wounded. But now Werder began to pursue him, and at the same time Manteuffel appeared from the N., cutting off his retreat to Lyon and pressing him towards Switzerland. Garibaldi, who was at Dijon to cover the rear of the great French army, did not accomplish this object. On Jan. 12, Manteuffel entered on his command of the 2d and 7th corps, and pushed forward immediately in a south-eastern direction to Selongey, Prauthoy, and Longeau, sending Gen. Kettler with a detachment against Dijon, to keep Garibaldi engaged. The 7th corps reached the eastern points of Côte d'Or on Jan. 16, and Selongey on the following day. As the situation at Belfort became perfectly clear on this day, and as the victory over Bourbaki followed on the 18th, an attempt could now be made to prevent the French army at Besançon from any further retreat. The army under Manteuffel changed its march, and proceeded still more directly to the S. On Jan. 20 the 7th corps crossed the Saône at Savoyeux, and the 2d took Pesmes; on the following day the former reached Dampierre, and the latter Dôle. Dijon was passed by, and Garibaldi, at the head of more than 20,000 men, was kept completely in check by a single detachment. On the 22d the German outposts extended beyond the Doubs; on the 23d the road from Besançon to Lons-le-Saulnier was occupied, and thus the French were cut off from the direct line of retreat to Lyon. The 14th division had on the same day an engagement at Dannemarie, and ascertained the presence of the 20th, later on that of the 15th and 18th French corps. On Jan. 25 the 7th corps stood at St. Vit and Quingey, and the 2d corps behind it on a line from Salins to Dôle. The 14th corps also advanced from the N. W. against the French army at Besançon. On Jan. 26 the division of Schmeling occupied Baume-les-Dames on the Doubs, to the N. E. of Besançon. From Blamont, nearer to the Swiss frontier, Gen. von Debschütz advanced in order to co-operate with Gen. von Schmeling against the road from Besançon to Pontarlier. At the same time Gen. von Werder had reached the vicinity of Rioz, just N. of Besançon, with three brigades of his corps, and occupied the passages across the Oignon, at Voray, Etuz, and Pin. Thus, Bourbaki at Besançon was surrounded by a circle which was open only towards Switzerland in the direction of Pontarlier. The unfortunate general fell into melancholy on account of his defeats, which destroyed the last hope of France, and as he now saw that he would have either to capitulate or to retreat on Swiss soil, he gave up the command to Gen. Clinchant and shot himself through the head, causing, however, only a severe wound.

On Jan. 27, in the morning, Gen. Clinchant commenced the general retreat to Pontarlier of the whole corps concentrated around the fortress of Besançon; only the cavalry division and about 8000 infantry had escaped to Lyon by Lons-le-Saulnier before the Germans cut off their retreat. On Jan. 28 the French army was in the vicinity of Pontarlier, on the Swiss frontier, facing N. W., with the 18th corps to the right, the 15th in the centre, at Sombacourt and Chaffois, and the 20th to the left, at Frasne; the 24th corps, which had arrived in great confusion, was behind the centre and formed the reserve. Manteuffel made the following dispositions for the attack on the French army, which had been brought into a position so very unfavorable: the 7th corps was to push forward against Pontarlier, the 2d to cut off all the roads to Lyon as yet free; and the division of Schmeling was to attack from the N. On Jan. 29 the 2d corps reached Les Planches after a short fight, and the 14th division threw the 15th French corps back to Pontarlier, beyond Sombacourt and Chaffois.

In the mean time the events of Paris had come to a decision, and in the negotiations concerning an armistice between Count Bismarck and Minister Favre particular notice was taken of the peculiar situation in the S. E. As Bismarck demanded, and Favre peremptorily refused, the surrender of the fortress of Belfort, Favre proposed as an expedient to let weapons decide with regard to Belfort and the whole south-eastern theatre of war; and thus the armistice of Jan. 28, 1871, did not comprise these fields. Favre telegraphed the conclusion of the armistice to Gambetta, but forgot to mention that an exception was made with respect to the departments of Côte d'Or, Jura, and Doubs. As now Gambetta simply showed to the generals of the republic a conclusion of an armistice, while Count Bismarck communicated to the German generals the article of exception also, misunderstandings arose. On Jan. 30 the German army continued its attack on Pontarlier, and when the 2d corps occupied Frasne and made over 3000 prisoners, Gen. Clinchant referred to the armistice and proposed to enter into negotiations. Gen. von Manteuffel refused; he advanced, occupied on the 31st the pass St.-Marie in the mountains S. of Pontarlier, and rested on Feb. 1, at noon, with his columns before Pontarlier, ready for battle. On the same morning, however, Gen. Clinchant had concluded a convention with the Swiss commander-in-chief, Gen. Herzog, according to which the French army should retreat into Switzerland and be disarmed there. The retreat began on the very day the convention was concluded, Feb. 1, and only a rear-guard remained still on French soil to cover the retreat. In the afternoon the German brigade Du Trossel attacked this rear-guard, occupied Pontarlier, made 4000 prisoners, and took a great number of carts loaded with provision and arms. In the afternoon Manteuffel had his head-quarters at Pontarlier, while the French army withdrew into Switzerland by several mountain-roads, the main body by way of Verrières. The small republic of Switzerland was completely inundated with French fugitives. Some 85,000 men, with 10,000 horses, both men and animals in a miserable condition from cold and fatigue, were received and provided for. The rest of the army was scattered; 15,000 men were taken prisoners in the last days, and 20,000 escaped to the S. Garibaldi, heavily pressed by Gen. Weyhern, appealed first to the armistice, but, as this was not recognized by the Germans, he retreated to the S., and escaped by rail. Belfort capitulated on Feb. 16, and thus in this region too the war was ended.

In the N. Gen. von Göben took the command in Manteuffel's place on Jan. 8. Not very long after the battle at the Hallue, Faidherbe had taken the offensive once more, and he now tried to relieve Péronne. The 15th division and the detachments of Göben and Prince Albrecht of Prussia were in the vicinity of Bapaume to cover the siege of Péronne. Their vanguard was defeated by the French on Jan. 2, but Gen. von Kummer concentrated the 15th division at Bapaume, Gen. von Göben sent reinforcement, and on Jan. 3 a successful resistance was made to Faidherbe. In the night before Jan. 4 the French retreated, and Péronne capitulated in the night between Jan. 9 and 10. After repeated reconnoitrings and demonstrations on both sides, the French army of the N. was concentrated around

St.-Quentin on Jan. 16, and Gen. von Göben took up a position accordingly 10 miles W. and S. of St. Quentin, in order to prevent the march of the enemy to Paris. On Jan. 19 the Germans attacked the enemy, who were in a half circle around the city, and defeated him after a fight of seven hours. The French were compelled to flee in confusion, and were pursued the following days to Cambrai and Landrecies. From Jan. 25 to 27, Göben returned to his position behind the Somme, and with the armistice of Jan. 28 the war operations ceased.

Besides several minor sallies Paris ventured upon a large engagement on Jan. 19, probably in concert with the last movements of Gen. Faidherbe. In the beginning of 1871 the lack of provisions in the great city became serious, and the military commanders were without hope. From the German side the bombardment began on Jan. 5, first of the outworks of the southern front, then of the city, and finally also of the northern front, but it did not produce the intended impression; instead of exercising a moral pressure, it stimulated the population, suffering under the monotony of a passive resistance, to new energy. Gen. Trochu was urged more than ever to make a sally *en masse*. Trochu, who considered the defence of Paris a completely aimless undertaking, and who during the whole siege followed the wishes of the population rather than military plans, yielded also now to public opinion and arranged a sally. On Jan. 19, and under his own command, more than 100,000 men pressed forward towards Versailles in three columns. But there was little consistency in the attack. Gen. Ducrot, who commanded the right wing, was delayed three hours, and thereby the centre was placed in a bad position. The French columns soon fell into a devastating infantry-fire, and were also terribly cut up by the artillery, especially by four batteries placed at St.-Michel and by flank-fire from the 4th corps. After losing about 7000 men, dead and wounded, they were compelled to retreat without having gained any advantages. The 5th corps, which from the German side participated in the battle, lost 38 officers and 599 men. This catastrophe at last brought the wish for peace into the ascendency. On Jan. 23, Jules Favre appeared at Versailles to negotiate concerning an armistice. After three days' negotiation between him and Count Bismarck, an agreement was arrived at that hostilities should cease at 12 o'clock in the night before Jan. 27, and the provisioning of Paris immediately begin. Indeed, there was great danger that a part of the population might be starved to death. On the 28th a convention was concluded containing an armistice of twenty-one days and the capitulation of Paris. The armistice was considered as preliminary to peace; its purpose was the convocation of a French national assembly. A line of demarcation was to separate the two armies from each other; the outworks of Paris were to be surrendered to the German army, which, however, should not enter into the city; the garrison of Paris was to be disarmed and considered as prisoners of war, yet remain in the city; only the national guard were to keep their arms to maintain order. The German officials were to help the French in the provisioning of Paris; and Paris was to pay 200,000,000 francs for the expenses of war. The armistice comprised also the naval forces, which, however, had not been of much consequence in this war.

On July 26, 1870, Admiral Bouet-Willaumez had gone from the North Sea into the Baltic, as he lacked coal, and intended to take in provisions in the Bay of Kjöge. On Aug. 7 he arrived at Marstall, and sailed by Wismar, Rostock, Swinemünde, and Kolberg, where land-batteries were erected. The French fleet had no landing-troops, and its vessels drew too much water to approach the coasts. After the battle at Wörth the admiral received orders to remain in the Baltic and confine himself to the blockade of the harbors. On Aug. 12, Admiral Faurichon appeared at Heligoland with 8 iron-clads and blockaded the northern harbors. The German fleet could not compare with this squadron, and remained quietly in the fortified harbors. In the middle of September, Faurichon returned to Cherbourg and took charge of the ministry of the navy. Bouet-Willaumez also returned to Cherbourg at the end of September, and another squadron, under Admiral de Gueydon, was sent into the North Sea. The French ships, however, confined their activity to the seizing of German merchant-vessels.

The National Assembly met at Bordeaux Feb. 12, 1871. It had to decide whether peace should be concluded or whether the war should be continued. Further resistance, however, seemed a complete impossibility. France was utterly exhausted and completely defeated; her long and desperate resistance, possible only on account of the heroism of the population, had increased her loss; 400,000 French soldiers, among whom were 11,860 officers, were in German captivity; about 100,000 men were disarmed in Switzerland, and the army of Paris, numbering more than 150,000 men, would, according to the convention, also have to go to Germany as prisoners of war if hostilities were recommenced. Furthermore, the active troops were in a miserable state. Not only all the officers, but also all the trained soldiers, had either become prisoners by the great capitulations of Sedan and Metz, or they were wounded or dead. The active troops consisted of recruits led by a few generals. Not only in quality, but also in number, they were inferior to their adversaries. On Mar. 1, 1871, the Germans had on French soil 569,875 infantry and 63,465 cavalry, with 1742 guns, and in Germany was an army of 250,000 men under arms. The eight French corps numbered not more than 250,000 men. An immense quantity of war-material had fallen into German hands—1835 field-pieces, 5373 heavy guns, and over 600,000 small-arms. Furthermore, all important strategical points were in the possession of the German army, and it held Paris in its hands. Under such circumstances all parties in the National Assembly, with very few exceptions, agreed that peace was necessary. On Feb. 13 the provisional government of national defence transferred its power to the Assembly; and on Feb. 17 the chief of the executive power of the French republic, the former minister of Louis Philippe, Adolphe Thiers, was sent to the German head-quarters at Versailles, where King Wilhelm of Prussia, emperor of Germany, had resided since Jan. 18, to negotiate for peace. On Feb. 21, Thiers arrived, accompanied by a diplomatic committee. The armistice was prolonged to Feb. 26. The demands of the German government were very heavy; the cession of Alsace and Lorraine, with Metz, Strasburg, and Belfort, and the payment of six milliards, were demanded. By their stubborn perseverance and by the support of the English government the French negotiators succeeded in securing Belfort as a French possession and in getting the war expenses decreased by one milliard. On Feb. 26 the preliminary peace of Versailles was signed; Alsace and the largest part of Lorraine were ceded; five milliards were to be paid as war expenses; and German garrisons were to remain on French soil until full payment was made. Concerning the payment and the occupation, it was specially stipulated that one milliard should be paid in the course of the year 1871, and the rest in three years. The German troops should evacuate the city of Paris and the forts on the left bank of the Seine immediately after the ratification of the preliminary peace, and as soon as possible the departments Calvados, Orne, Sarthe, Eure-et-Loir, Loiret, Loir-et-Cher, Indre-et-Loire, and Yonne completely, and the departments Seine-Inférieure, Eure, Seine-et-Oise, Seine-et-Marne, Aube, and Côte d'Or to the left bank of the Seine. After the ratification of the definitive peace and the payment of one half milliard the departments between the right bank of the Seine and the eastern frontier should be evacuated, and after the payment of two milliards only the departments Marne, Ardennes, Haute-Marne, Meuse, Vosges, Meurthe, and the fortress of Belfort, with its surroundings, should be occupied. An interest of 5 per cent. should be paid on the three milliards whose definitive payment was postponed. The preliminary peace also contained stipulations concerning the delivery of the prisoners of war and the government of the occupied French districts. This agreement was laid before the National Assembly by Thiers on Feb. 28, 1871, and accepted by 546 votes against 107 on Mar. 1. On the same day a part of Paris was occupied by 30,000 German troops. On Mar. 3 the ratifications of the preliminary peace were exchanged at Versailles, Paris was evacuated, and the removal of the German army to the right bank of the Seine was ordered. Mar. 13 the German emperor left Versailles for Berlin. May 10, 1871, the definitive treaty of peace was concluded at Frankfort-on-the-Main, and on account of the rapid payment of the war expenses the last German soldier left French soil in July, 1873. (See MOLTKE'S *Military Hist. of the War*.)

AUGUST NIEMANN.

François, town of Martinique, in the West Indies, on the eastern side of the island, has a good harbor. Pop. 7997.

Fran'colin, a name applied to gallinaceous birds of a group allied to both pheasants and partridges, more closely perhaps to the latter. They are found in the Old World, chiefly in Africa. The *Francolinus vulgaris* of Europe, Asia, and Africa is a finely variegated bird which frequents sunny plains in warm countries. Its size is that of the partridge. Its flesh is prized as food. The sanguine francolin (*Ithaginis cruentus*) is a splendid bird of the Himalayas—not very good as food, but remarkable for having the legs provided with several spurs. There are numerous other species.

Franco'nia [Ger. *Franken*] was the name of an old independent territory situated along the Rhine, the Neckar, and the Main, among whose dukes the German empire more than once elected its ruler. It underwent many changes and modifications until, at the dissolution of the

German empire in 1806, it was divided between Bavaria, Saxony, Hesse, and Baden.

Franconia, post tp. of Chisago co., Minn. Pop. 650.

Franconia, tp. and post-v. of Grafton co., N. H., in the Western White Mountain region, is a place of summer resort. It has valuable iron mines, and manufactures of iron, lumber, starch, wooden-ware, etc. It is 80 miles N. by W. of Concord. Pop. 549.

Franconia, tp. of Montgomery co., Pa. Pop. 1959.

Franconia Mountains, the western cluster of the White Mountain group, are in Grafton co., N. H., and are separated from the main group by the Notch. As a whole, the Franconia Mountains are not as high as the others, but the presence of little lakes adds a charm of their own. Mt. La Fayette, or the Great Haystack, is 5290 feet high. Echo Lake, Eagle Cliff, the Profile Rock, Profile Lake, Bald Mountain, Walker's Falls, the Basin, the Flume, the Pool, and Georgiana Falls are attractive points. The mountains have deposits of iron ore.

Fran'eker, town of the Netherlands, in the province of Friesland. Its university, which in 1811 was abolished by Napoleon, and in 1816 transformed into an athenæum, was a very celebrated institution in the days of Vitringa, Hemsterhuis, and Valckenaer. Pop. 5867.

Francs Tireurs ("free marksmen"), a name applied during the late Franco-German war to the members of the French guerilla-parties who carried on an annoying partisan warfare against the Germans.

Frangipa'ni, a once illustrious family of Rome, having also allied lines of the same name in Naples and Croatia. The family is traced as far back as the seventh century, and even claims to date from pagan Rome. During the eleventh, twelfth, and thirteenth centuries the name, already illustrious, became one of the most splendid in Italian annals, but rapidly declined thereafter. The name, it is claimed, signifies the "bread-breakers," from the charities of its founders.—Among its prominent members were CENCIO, a Ghibelline of the twelfth century; GIOVANNI, in the thirteenth century, a soldier and founder of the Neapolitan line; CORNELIO (d. 1581), a great Friulian advocate, living at Venice; CLAUDIO CORNELIO, his son (1533–1630); NICCOLÒ, a Venetian painter of the sixteenth century; FRANZ CHRISTOPH, a Croatian conspirator (1630–71).

Fran'gulin, $C_{20}H_{20}O_{10}$, the yellow coloring-matter of the berry-bearing buckthorn (*Rhamnus Frangula*). It is a glucoside, being resolved by acids into sugar (glucose) and frangulic acid, $C_{20}H_{20}O_{10} + H_2O = C_6H_{12}O_6 + C_{14}H_{10}O_5$.

Frank (JACOB JOSEPH), a Jewish fanatic, founder of a sect, b. in Poland in 1712, travelled in different parts of Russia and Turkey. In 1750, having acquired celebrity as an expounder of the Cabbala, he declared the Talmud unfit for religious guidance, and substituted for it the *Zohar*, one of the Cabbalistic works. He accepted the doctrine of the Trinity. His followers, who soon became numerous, were called *Frankists*, or, as they preferred to call themselves, *Zoharites*. Their confession of faith was in substance as follows: No religion can exist without the knowledge of God; all other religion is an outward service of works; piety and the love of God are the effects of a profound acquaintance with His nature, and this must be sought in the study of His law, from which it must be deduced by tradition; the doctrine of Moses and the prophets has an inward meaning far deeper than that of the letter, and without which it is the source of errors and mistakes; there is one only God, the Creator and Preserver of all things, but revealed in three persons; God has appeared upon earth in human form, but after the entrance of sin He laid aside this form, and has since taken it again for the expiation of sin; He will once again appear in human nature, finally to deliver man from sin. Jerusalem will never be rebuilt, and a terrestrial Messiah is not to be expected. His Jewish brethren, offended at the doctrine, demanded the interference of the authorities, and Frank thought it wise to embrace Roman Catholicism. He was baptized at Warsaw Dec. 25, 1759, the king himself being represented by proxy as his godfather. But Frank was soon accused of heresy, and was finally imprisoned. During the invasion of Poland by the Russians he was released by them in 1773. He now retired to Austrian territory, and in 1776, under special protection from the empress Maria Theresa, settled at Vienna, until, hunted down by the police, he felt it safer to remove to Brünn, the capital of Moravia. His followers had largely increased, and he now lived supported by them in princely splendor. He left his mansion daily to attend the service which he celebrated for his adherents, always riding in a richly-adorned carriage, surrounded by a retinue of persons mounted on splendid horses and attired in glittering raiment. In 1786, Frank established his residence at Offenbach, where he made even greater display. He declared himself the true Messiah, and was by his followers believed immortal until his death from apoplexy Dec. 10, 1791. The Frankists continue to this day in parts of Poland, dispersed among all (even the highest) classes of society. Their profession of faith, published at Lemberg, indicates a greater leaning towards Judaism than Christianity. (See JOST, *Geschichte des Judenthums und seiner Sekten*, iii. 184; DA COSTA, *Israel and the Gentiles*, p. 512–518; GRATZ, *Frank und die Frankisten*, Breslau, 1868.) JAS. H. WORMAN.

Frankalmoign' [Norman Fr., "free alms"], in English law, the tenure, chiefly of lands, by spiritual service, as where a sole or aggregate corporation holds an estate of some private person, who gives it to God as free and perpetual alms. Tenures by frankalmoign were forbidden to be created after the eighteenth year of Edward I., but there are in England many examples dating from before that time, now chiefly ecclesiastical foundations or parish glebes. Frankalmoign implied no fealty or service, as did some other similar tenures.

Frank'enberg, town of Saxony, on the Zschopau. It has very large cotton and linen manufactures. Pop. 9710.

Frankenberg, von (JOHANN HEINRICH), count and cardinal, b. at Glogau Sept. 18, 1726; studied at Breslau and Rome; became coadjutor to the archbishop of Göritz 1749; archbishop of Mechlin 1759; cardinal in 1778; became involved in a contest with the civil power, in which he defended the claims of the Church; was deposed by the emperor Joseph II., and d. at Breda June 11, 1804.

Frank'enhausen, town of Germany, in the principality of Schwarzburg-Rudolstadt, has salt-works, saltpetre-refineries, and manufactures of articles of mother of pearl. Pop. 5078.

Frankenia'ceæ, a natural order of herbs and undershrubs, none of which are North American. They are few and unimportant. Their nearest allies are the violets and Caryophyllaceæ.

Frank'enstein, town of Prussia, in the province of Silesia. It has considerable manufactures of broadcloth and linen. Pop. 7328.

Frank'enthal, town of Bavaria, in the Palatinate. A canal 60 feet broad connects it with the Rhine. It has manufactures of cloth, cotton, linen, gold and silver wire, etc. Pop. 7021.

Frank'ford, post-v. of Sidney tp., Hastings co., Ontario, Canada, on Trout River, 14 miles N. W. of Belleville, has good water-power and considerable trade and manufactures. Pop. about 900.

Frankford, post-v. in Dagsborough hundred, Sussex co., Del. Pop. 149.

Frankford, tp. of Mower co., Minn. Pop. 674.

Frankford, tp. of Sussex co., N. J. Pop. 1776.

Frankford, tp. of Cumberland co., Pa. Pop. 1369.

Frankford, formerly a borough, now a part of Philadelphia, Pa., in the N. E. part of the city, has important manufactures. Tacony Creek flows between Frankford and the main part of the city. It contains a celebrated insane asylum. (See PHILADELPHIA.)

Frank'fort, tp. and post-v. of Franklin co., Ala. Pop. of v. 162; of tp. 1517.

Frankfort, tp. and post-v. of Will co., Ill., on the Joliet and Northern Indiana R. R., 13 miles E. of Joliet. Pop. of tp. 1924.

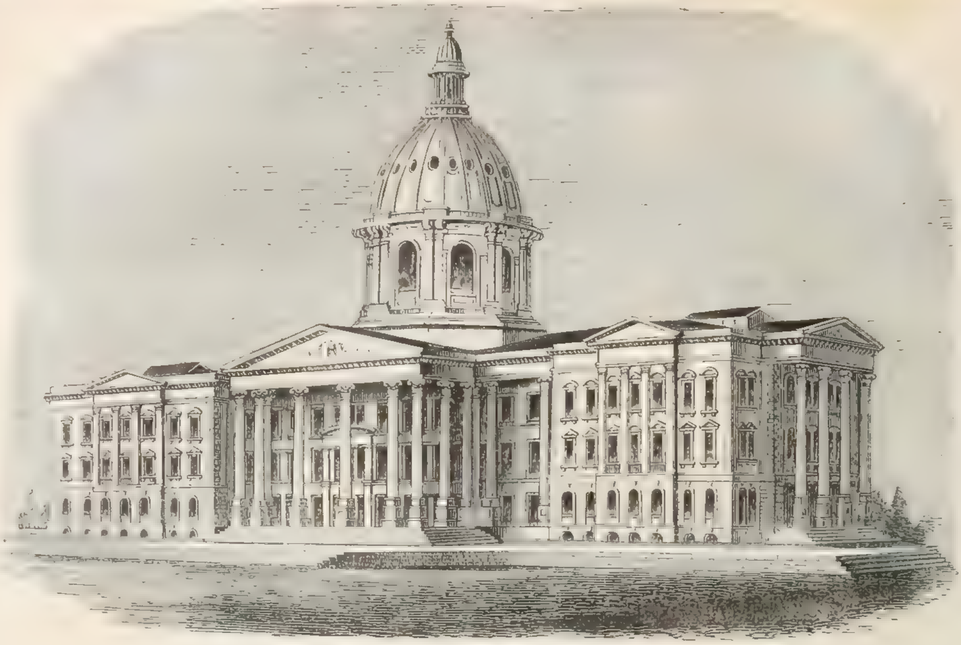
Frankfort, post-v., county-seat of Clinton co., Ind., is in a fertile region, and is 46 miles N. W. of Indianapolis. It is on the Logansport Crawfordsville and South-western, the Lafayette Muncie and Bloomington, and the Frankfort and Kokoma R. Rs. It has 2 banks, 2 weekly newspapers, an opera-house, 3 churches, a fine graded school building, hotels, stores, etc. Farming is the principal business. Pop. 1300. E. H. STALEY, ED. "CRESCENT."

Frankfort, tp. of Montgomery co., Ia. Pop. 437.

Frankfort, post-v. of Marshall co., Kan., on the Vermilion River and on the central branch of the Union Pacific R. R., 78 m. W. of Atchison. Has good water-power.

Frankfort, capital of Kentucky, also of Franklin co., situated in a rotunda of hills upon either side of the Kentucky River, on the Louisville and Lexington R. R. It is noted for the picturesqueness of its scenery and the fine drives in the vicinity. It contains 9 churches, 3 banks, a fine public school building, a high school, a seminary for young ladies, an institution for the training of feeble-minded children, 1 tri-weekly newspaper (which is published daily during the session of the legislature), gas and water works, a steam fire engine, a cotton mill, a barrel manufactory, a pottery, 3 saw-mills, 2 flouring mills, 3

distilleries, and the State prison. It has a fine hall which has a capacity for seating 1000 persons. The Capital Hotel, of stone, was erected by the city at a cost of $120,000, but is now owned by private parties. The Frankfort cemetery is very beautiful, and in it repose the remains of many of Kentucky's great and gallant men. Nearly all the various benevolent orders have lodges in the city, and the Odd Fellows own a handsome temple. Five turnpikes terminate here. Pop. 5396. H. A. M. HENDERSON,
ED. "KENTUCKY FREEMASON," and *Supt. Public Instruction.*



State Capitol, Frankfort, Ky.

Frankfort, post v. and tp. of Waldo co., Me., on the W. side of the Penobscot, 15 miles S. of Bangor. It has granite-quarries and manufactures of lumber, shipping, and cooperage. Pop. 1152.

Frankfort, post-v., capital of Benzie co., Mich., on the E. shore of Lake Michigan, 140 miles N. of Grand Haven. It has a bank, a newspaper printed by steam, a public library, a silver cornet band, a church, 3 hotels, a blast-furnace, 5 saw-mills, 2 shingle-mills, a park, a fire company, and a number of stores. Principal business, lumbering, iron manufacturing, farming, and fruit-raising. It has a good harbor. Pop. about 1500.
CORNELL & HOSNER, EDS, "EXPRESS."

Frankfort, tp. of Wright co., Minn. Pop. 564.

Frankfort, post-tp. of Knox co., Neb. Pop. 63.

Frankfort, post-v. and tp. of Herkimer co., N. Y., 10 miles E. by S. of Utica, on the Central R. R. and on the Mohawk, has manufactures of cheese, lime, matches, woollens, etc., and one bank. Pop. 1083; of tp. 3065.

Frankfort, a v. of Concord tp., Ross co., O., near the Marietta and Cincinnati R. R. Pop. 519.

Frankfort, post-tp. in Mineral co., W. Va. Pop. 957.

Frankfort, post-tp. of Pepin co., Wis. Pop. 340.

Frankfort, Council of, a synod noted in church history for its decided action against the worship of images, was called by Charlemagne A. D. 794, and, according to Dupin (*Eccles. Hist.*, cent. viii.), was attended by 300 bishops, who came from Germany, Gaul, Spain, Italy, and England, besides two delegates from the pope. This council condemned also the Adoptianists. (See HEFELE, *Conciliengeschichte*, iii. 635 *seq.*; LANDON, *Manual of Councils*, s. v.)
J. H. WORMAN.

Frankfort-on-the-Main [Ger. *Frankfurt am-Main*] was in commercial respects the most important, and on account of its historical relations the most famous, of the four free cities of Germany. It is now in the limits of the province of Hesse-Nassau, Prussia, to which it was annexed in 1866. It is situated on the right bank of the Main, over which an old stone bridge of fourteen arches, built in 1340, crosses to its suburb, Sachsenhausen. The city proper, whose population amounts to 91,040, is as beautiful as interesting. It is entered by seven large gates, two of which, the Gallus Thor and the Eschenheimer Thor, have been preserved in their old form; the other five are buildings of modern style. But the walls and ditches which formerly stretched between these gates have been transformed into charming promenades, where splendid villas and resorts of amusement alternate with almost rural surroundings. Among its public squares are the Rossmarkt, with the monument of Gutenberg, designed by Launitz, and the Götheplatz, with the statue of Goethe by Schwanthaler. Among its public buildings the most remarkable are—the Römer, an old building, in whose Wahlzimmer the electors met, and in whose Kaisersaal the elected emperor gave his first banquet; and the cathedral of St. Bartholemew, a Gothic structure begun in 1238 and finished in the sixteenth century, in which the coronation of the German emperors took place. On account of its geographical position, easily communicating with all the chief points of Europe, it early attracted attention. It was a favorite residence of Charlemagne. In 1257 it was made a free city. After the days of Frederic Barbarossa it became the place for the election of the German emperors, and by the "Golden Bull" (in 1356) Charles IV. transformed this custom into a right. Napoleon made it the capital of a great principality. In 1848 and 1849 the German Parliament sat here. After 1816 the meetings of the German Diet, in which Frankfort enjoyed an independent vote in the full council, and a vote in conjunction with the three other free cities in the limited council, were held here; but the city sided with Austria in the war of 1866, and consequently lost her autonomy in that year. Of late some branches of its trade have decreased. Leipsic has superseded it in the book-trade, but as a moneyed centre it still occupies the principal place. Frankfort is the banking-house of Germany. Its exchange rules the money-market of Germany, and exercises considerable influence throughout the world.

Frankfort-on-the-Oder, city of Prussia, in the province of Brandenburg, on both sides of the Oder. It has considerable manufactures of linen, cloth, hosiery, gloves, leather, and earthenware, and a very extensive trade. Its three annual fairs have more than 10,000 visitors, especially dealers from Poland. Its university, which was founded in 1506 by the elector Joachim I., was moved to Breslau in 1811. Pop. 43,211.

Frankfort' Springs, post-v. of Hanover tp., Beaver co., Pa., 26 miles S. W. of Pittsburg. It has two medicinal springs, Leiper's and Cave Springs, which have saline chalybeate waters. The last-mentioned spring arises in a large and very remarkable cave, and is much visited by tourists and invalids. Pop. 155.

Frank'furter (MOSES BEN SIMEON), a Jewish scholar and printer, flourished at Amsterdam between 1700 and 1762. He edited the *Great Rabbinic Bible* (Amsterdam, 1724–27, 4 vols. fol.), which is one of the most valuable contributions to the critical study of the Old Testament

Scriptures. The Hebrew Bibles are printed from this text. (See FÜRST, *Bibliotheca Judaica*, i. 295; ETHERIDGE, *Introduction to Hebrew Literature*, p. 101.) J. H. WORMAN.

Frank'incense [Lat. *thus*], a name applied to various fragrant gums and resins. It anciently designated the substance now known in commerce as OLIBANUM (which see), the product of *Boswellia serrata*, an East Indian tree, and of *Plösslea floribunda*, an African tree, both of the order Terebintaceæ. The frankincense of Sierra Leone is from the *Daniellia thurifera*, a large mountain-tree of that region. In England the frankincense of the shops is nothing but common turpentine, such as is exported from the Southern U. S.

Frank'ing Priv'ilege, the right of sending letters or packages free by mail. The post-office having been originally established solely for governmental purposes, the carriage of official correspondence remained for a long time its only business. The grant to the University of Paris and the well-known concessions of the German princes to the counts of Thurn and Taxis having placed the post in the position of a carrier for hire, free correspondence between officers of the government and other favored persons came gradually to be regarded in the modern light of a privilege. In England the right was claimed by the House of Commons in 1660, and privately allowed to members by the Crown, which had hitherto enjoyed it in connection with the entire control and revenues of the post-office. In 1660 a clause was inserted in the bill granting the post-office revenues to the king which exempted from postage the correspondence of members of the House of Commons. The Speaker, in putting the question on the clause, said "he was ashamed of it." The bill passed the Lower House, but the clause was dropped in the House of Lords. The privilege, however, continued under special agreement with the Crown until it was expressly confirmed by the act 4 Geo. III. c. 24, by which each member was allowed to send free not more than ten letters a day, and to receive fifteen, each letter to weigh not more than one ounce. Up to 1837 only the name of the member was required to be written by himself on the back of the letter; by a statute of that year he was required to write the entire address, the town, and the day of the month, and to post the letter on the same day. Owing to the high rates of postage the privilege in England was greatly abused. Investigations instituted by the House of Commons in 1735 and 1764 showed a regular trade in authentic franks, and extensive forgeries. One man was proved to have forged and sold over 14,000 in five months. In 1838, during the agitation of Rowland Hill's postal reform, the quantity of free matter was estimated at from 10 to 30 per cent. of the entire business of the post-office. In 1839 the privilege was abolished by the passage of Rowland Hill's act. In France in 1841 the number of free letters was over 12,000,000, and in 1850 38,000,000.

In the U. S. the first appearance of the franking privilege after the assumption of the post-office by the Continental Congress was in Jan., 1776, when it was granted to all private soldiers actually in service for letters written by and to themselves. The ordinance of 1782, repealing previous legislation with regard to the post-office, made free all letters, packets, and despatches to and from the members and secretary of Congress while actually attending, the commander-in-chief and the separate army commanders, the heads of the departments of finance, war, and foreign affairs of these U. S. on *public service;* also, single letters directed to any officers of the line in actual service. In 1791 an act of Congress extended the privilege to official letters of the treasurer, comptroller, auditor, and assistant secretary of the treasury. The act of the next year, establishing the post-office, exempted from postage all letters to and from the President and Vice-President; all letters, not exceeding two ounces in weight, to and from Senators and members of the House of Representatives, the secretary of the Senate, and the clerk of the House, during actual attendance in session and twenty days thereafter; to and from the secretaries of state, war, and the treasury, and the postmaster general, their assistants and bureau officers, and the commissioners for settling accounts with the States: "provided, that no person shall frank or enclose any letter or packet but his own." "Each before-named person shall deliver any letter enclosed to him, addressed to another, to the post office, noting the place whence it came, and postage shall be charged thereon." The franking officers were required to furnish specimens of their signatures to postmasters. Subsequent legislation extended the privilege, with various modifications, to newly-created cabinet and bureau officers; to Presidents and to their widows during life; to delegates from the Territories (commencing with Wm. Henry Harrison, delegate from the Territory north west of the Ohio) on the same terms as members of Congress; to deputy postmasters on letters not over half an ounce in weight; to newspapers for purposes of exchange; and to the adjutant-generals of States for certain correspondence relating to the militia. Deputy postmasters were allowed two cents for each free letter delivered other than their own. The time within which members of Congress could frank was extended to thirty, and subsequently to sixty, days before and after each session. Provision was made for the payment of postage on the excess in weight of their letters over two ounces. Executive officers were allowed to receive newspapers free, as also members and officers of Congress during the time above limited. A fine of $50 was imposed for the forgery of a frank, and of $10 for its use on letters not written by the respective franking officers, except in the case of cabinet officers, who were allowed to frank for each other. In 1808 the privilege was first extended to cover public documents, members and delegates in Congress being authorized to transmit free the President's message and accompanying papers of that year. Similar acts were passed, being generally the first of their respective sessions, in 1810, 1811, 1812, and following years, and the authority extended to the secretary of the Senate and clerk of the House. In 1813 the report of the foreign relations committee on said message and documents was added to the list, and at the same session all "executive documents." In 1820 all documents printed by order of either House were included, and the time of franking not limited. The governors of States were also allowed to exchange State documents free of postage. The act of March 3, 1845, by which inland postage was reduced to five cents, reserved to members and delegates in Congress and to the Vice-President the right to frank and receive free letters not exceeding two ounces in weight (any excess to be paid from contingent funds) and documents printed by order of either House; to the third assistant postmaster-general and to postmasters the right to frank letters on post-office business by endorsing them as official, a false endorsement to be punished by $300 fine. The franking privilege, as it regarded all other persons, was abolished, officers of the government previously enjoying it being directed to keep quarterly accounts of postage, and pay it from their respective contingent funds. This partial reform did not last long. The privilege of members and delegates was extended to the session following the term for which they were elected; certain postmasters were allowed to frank their private letters not over one half ounce in weight; letters to the army in Mexico or on the frontier were allowed to go free, and the widows of ex Presidents Adams, Polk, and Taylor were, by special acts, granted the franking privilege. The provision of the act of 1845, requiring accounts to be kept of official postage, was repealed, and $200,000 per annum appropriated therefor. This was subsequently increased to $500,000. In 1851 the free exchange of newspapers was re-established. From this time to 1863 a few minor extensions of the privilege were granted, including the carriage of books and documents for the Congressional Library. By the act of Mar. 3, 1863, the privilege was conferred upon and limited to the following persons and articles: the President and his private secretary; the Vice-President; chiefs of executive departments; such heads of bureaus and chief clerks as might be designated by the postmaster-general, for official letters only; Senators and Representatives in Congress for all correspondence, documents printed by authority of Congress, speeches and proceedings therein, and printed matter addressed to them, said privilege to commence with their term of office and to continue until the first Monday in December after its close; to all government officers for letters endorsed official and addressed to the heads of their respective departments; to postmasters for endorsed official correspondence with each other, a penalty of $300 being provided for false endorsement; to publishers of newspapers for their exchanges; and to senders of petitions to either branch of Congress. The weight of the above-named articles, excepting petitions and public documents, was limited to four ounces. Members of Congress were also authorized to frank "seeds, roots, cuttings, and scions," the weight to be fixed by the postmaster-general. With very slight modification, such as the extension of the privilege to cover "Smithsonian exchanges," medals or other testimonials voted by State legislatures to soldiers, etc., and a provision requiring franking officers to write their signatures, instead of using *fac-simile* stamps, as had become quite customary, this law remained in force until Jan. 31, 1873, when the following act was passed: "That the franking privilege be, and the same hereby is, abolished from and after the first day of July, A. D. 1873, and that thenceforth all official correspondence, of whatever nature, and other mailable matter sent from or to any officer of the government or person now authorized to frank such matter, shall be chargeable

with the same rates of postage as may be lawfully imposed upon like matter sent by, or addressed to, other persons: provided, that no compensation or allowance shall now or hereafter be made to Senators, members or delegates of the House of Representatives on account of postage." A subsequent act of the same session repealed all laws for the transmission of free matter. At the same session $1,865,900 was appropriated for the purchase of stamps at their face-value for the use of the executive and departments, the secretary of the Senate, the clerk and sergeant-at-arms of the House. This was supplemented at the next session by a deficiency appropriation of $180,000, while for the fiscal year ending June 30, 1875, only $577,000 was appropriated.

The varying course of legislation on this subject serves to show the attempts which have been made from time to time to reform the abuses of the franking privilege. Its abolition had been steadily recommended by the postmasters-general, and their recommendations supported by statistics and estimates showing the vast burden it imposed upon the post-office department. As far back as 1854 the Washington post-office sent out in one month 815,021 pounds of free matter. Mr. Creswell, late postmaster-general, to whose determined efforts the final abolition was in great measure due, estimated in his report for 1872 that the free matter would, if paid for, represent a revenue of $3,500,000. Sufficient time has not yet elapsed since the abolition of the franking privilege to determine the direct saving to the revenue occasioned thereby. Should the privilege not be re-established, a great incidental saving will undoubtedly be made in the printing of public documents, heretofore sent out gratuitously by members of Congress. ROBERT B. LINES.

Frank'inmuth, tp. of Saginaw co., Mich. Pop. 1488.

Frankists. See FRANK (JACOB JOSEPH).

Frankl (LUDWIG AUGUST), b. of Jewish stock at Chrast, Bohemia, Feb. 3, 1810; studied medicine, and became secretary to the Jews of Vienna and professor of æsthetics 1851; established a Jewish school at Jerusalem 1856; author of numerous popular poems in German; also of a history of the Jews in Vienna (1847–53), and some volumes of Eastern sketches.

Frank'land (Sir CHARLES HENRY), BART., b. in India May 10, 1716, was the son of the governor of the East India Company's factory in Bengal. In 1741 he became collector of the port of Boston, Mass. He is chiefly known by the romantic story of his love for Agnes Surriage, a beautiful young woman, a servant at an inn in Marblehead. Frankland made her his mistress, and afterwards his wife. According to the popular belief, he married her in consequence of her rescuing him from the ruins of Lisbon at the great earthquake, Nov. 1, 1755. In 1757 he became British consul-general at Lisbon. Lady Agnes resided after his death (which occurred at Bath, England, Jan. 11, 1768) at the Frankland mansion, Hopkinton, Mass., but at the outbreak of the Revolution went to England, and d. there Apr. 23, 1783. (See his *Life* (1865), by ELIAS NASON.)

Frankland (EDWARD), PH. D., D. C. L., F. R. S., b. at Churchtown, Lancashire, England, Jan. 18, 1825; was educated at London, Marburg, and Giessen; has held successively professorships of chemistry in Owens College, Manchester, Bartholomew's Hospital, the Royal Institution, and the Royal School of Mines; became president of the London Chemical Society 1871; author of published researches upon questions of organic chemistry; on the methods and materials for artificial illumination; on drinking-water and its impurities; the sewage question, etc.

Frank'lin, county of the N. W. of Alabama. Area, 590 square miles. It is bounded on the W. by Mississippi. The soil is fertile, and produces corn, cotton, and tobacco. Bituminous coal is found. Cap. Russellville. Pop. 8006.

Franklin, county of Arkansas, lying on both sides of the Arkansas River. Area, 770 square miles. The surface is broken, and abounds in timber, coal, and iron ore. The bottom-lands are very fertile. Cattle, hay, grain, and cotton are produced. The county is traversed by the Little Rock and Fort Smith R. R. Cap. Ozark. Pop. 9627.

Franklin, county in the W. of Florida. Area, 600 square miles. It is nearly level, and not extensively cultivated, but contains much excellent soil. It is bounded on the S. by the Gulf of Mexico. Excellent timber abounds, and the fisheries are important. Cap. Appalachicola. Pop. 1256.

Franklin, county in the N. of Georgia, bounded on the N. E. by South Carolina. The county is well watered, fertile, and produces grain. The surface is uneven. Iron ore is abundant. There is a good supply of water-power. Cap. Carnesville. Pop. 7893.

Franklin, county in the S. of Illinois. Area, 424 square miles. It is traversed by the Big Muddy River, and has a fertile soil. Cattle, wool, grain, and tobacco are produced. Timber is abundant. Cap. Benton. Pop. 12,652.

Franklin, county of Indiana, bordering on Ohio. Area, 395 square miles. The surface is in part hilly, the soil calcareous and productive. Cattle, wool, and grain are the staples. The manufactures include lumber, cooperage, harnesses, cotton goods, paper, and flour. It is traversed by the Whitewater Valley R. R. and by the Whitewater River and its forks. Cap. Brookville. Pop. 20,223.

Franklin, county in N. Central Iowa. Area, 576 square miles. It is well watered and productive. Grain is the principal product. It is traversed by the Central R. R. of Iowa. Cap. Hampton. Pop. 4738.

Franklin, county in the E. of Kansas. Area, 576 square miles. It is chiefly undulating, fertile prairie. Live-stock, grain, and wool are produced. It is intersected by the Marais des Cygnes and by the Lawrence Leavenworth and Galveston and other railroads. Coal is mined here. Cap. Ottawa. Pop. 10,385.

Franklin, county of N. Central Kentucky, intersected by the navigable Kentucky River. Area, 200 square miles. It has a productive calcareous soil. Live-stock, tobacco, grain, and wool are staples. The county is traversed by the Louisville and Lexington R. R. Cap. Frankfort. Pop. 15,300.

Franklin, parish in the N. E. of Louisiana. Area, 740 square miles. Its surface is uneven, but productive. Corn and cotton are staple crops. It is partly bounded on the W. by the navigable Bayou Bœuf. Cap. Winnsborough. Pop. 5078.

Franklin, county of Maine, bordering on Canada. Area, 1600 square miles. Its northern part is unsettled, and is chiefly forest-land, broken by mountain-ranges. Much of the southern portion is very fertile. Cattle, grain, wool, and dairy products are the staples. Carriages, lumber, and wooden wares are extensively manufactured. The Androscoggin R. R. terminates in this county. Cap. Farmington. Pop. 18,807.

Franklin, county of Massachusetts, bordering on New Hampshire and Vermont, and intersected by the Connecticut River. Part of its surface is broken by hills and mountains, but the alluvial lands and much of the elevated portions are very fertile, producing grain, tobacco, fruit, wool, and hay. Cattle, horses, and sheep are bred extensively. The manufactures include lumber, furniture, wooden wares, cotton goods, cutlery, etc. The county is traversed by the Vt. and Mass., the New London Northern, and the Connecticut River R. Rs. Cap. Greenfield. Pop. 32,635.

Franklin, county in the S. W. of Mississippi. Area, 590 square miles. The surface is broken, the soil along the rivers fertile, producing cotton, corn, and rice. Pine timber is abundant. Cap. Meadville. Pop. 7498.

Franklin, county of Missouri, bounded on the N. by the Missouri River. Area, 874 square miles. The county is uneven and bluffy, but very fertile, producing cattle, grain, tobacco, fruit, and wool. Lead, iron, and copper ores are abundant and good. Wine, carriages, brick, flour, lumber, charcoal, cooperage, iron, and clothing are among the articles manufactured. It is intersected by the Atlantic and Pacific R. R. Cap. Union. Pop. 30,098.

Franklin, county of Nebraska, bordering on Kansas. Area, 576 square miles. It is intersected by the Republican River. It is in a good grazing and farming region. Cap. Bloomington. Pop. 26.

Franklin, county of New York, bordering upon Canada. Area, 1718 square miles. The northern portion is generally fertile, producing grain, potatoes, cattle, wool, hay, butter, and cheese. The southern portion is in part occupied by the Ausable Mountains, a part of the Adirondack group. This region is productive of timber and iron, but is sparsely inhabited. Lumber, starch, iron, brick, flour, leather, etc. are manufactured. The county is intersected by the Ogdensburg R. R. Cap. Malone. Pop. 30,271.

Franklin, county in the N. N. E. of North Carolina. Area, 450 square miles. It is traversed by Tar River. Its surface is undulating. Cotton, corn, and tobacco are produced. Gold is found. Cap. Louisburg. Pop. 14,134.

Franklin, county of Central Ohio. Area, 530 square miles. It is traversed by the Scioto and other streams. Its surface is quite level and very fertile, producing grain, hay, tobacco, wool, and live-stock. The manufactures include carriages, railroad cars, iron, boots and shoes, metallic wares, tobacco, cigars, confectionery, and harnesses. The county is traversed by several railroads which centre at Columbus, the county-seat and capital of the State. Pop. 63,019.

Franklin, county of Pennsylvania, bounded on the S. by Maryland. Area, 740 square miles. It consists mainly of a broad and exceedingly fertile valley between two

ridges of mountains Cove Mountain on the N. W. and South Mountain on the S. E. Grain, live-stock, wool, dairy products, and hay are the agricultural staples. Carriages, flour, cooperage, harnesses, metallic wares, furniture, leather, lumber, paper, and woollen and cotton goods are manufactured. Iron ore, slate, and limestone are obtained. The county is traversed by the Franklin, the Cumberland Valley, and other railroads. Cap. Chambersburg. Pop. 45,365.

Franklin, county of Tennessee, bordering upon Alabama. Area, 615 square miles. The E. part is broken by spurs of the Cumberland Mountains, and contains important beds of coal and iron. The soil is fertile. Cattle, grain, and wool are staple productions. The county is traversed by the Nashville and Chattanooga R. R. and its branches. Cap. Winchester. Pop. 14,970.

Franklin, county of Vermont, bounded on the N. by Canada and on the W. by Lake Champlain. Area, 630 square miles. The surface is uneven, but very fertile. Grain, live-stock, wool, hay, and dairy products are the staples. Flour, cooperage, leather, lumber, carriages, furniture, harnesses, woollen goods, and metallic wares are among the manufactures, for which the Missisquoi and Lamoille rivers furnish water-power. It is intersected by the Vermont and Canada and other railroads. Cap. St. Albans. Pop. 30,291.

Franklin, county of Virginia, in the S. part of the "Piedmont region," S. E. of the Blue Ridge. It is drained by affluents of the Staunton River, and, though hilly, is very fertile. Grain and tobacco are staple products; iron ore is found. Cap. Rocky Mount. Pop. 18,264.

Franklin, post-tp. of Henry co., Ala., on the Western R. R., 34 miles from Montgomery. Pop. 1040.

Franklin, tp. of Macon co., Ala. Pop. 1294.

Franklin, tp. of Calhoun co., Ark. Pop. 438.

Franklin, tp. of Chicot co., Ark. Pop. 344.

Franklin, tp. of Drew co., Ark. Pop. 567.

Franklin, post-tp. of Fulton co., Ark. Pop. 580.

Franklin, tp. of Grant co., Ark. Pop. 298.

Franklin, tp. of Independence co., Ark. Pop. 559.

Franklin, tp. of Izard co., Ark. Pop. 660.

Franklin, tp. of Little River co., Ark. Pop. 388.

Franklin, tp. of Union co., Ark. Pop. 799.

Franklin, post-tp. of Sacramento co., Cal. Pop. 1272.

Franklin, tp. and post-v. of New London co., Conn., on the New London Northern R. R., 20 miles N. of New London. Pop. 731.

Franklin, post-v., cap. of Heard co., Ga., on the E. bank of the Chattahoochee River, 60 miles S. W. of Atlanta. It has a good water-power, 1 steam saw and grist mill, 15 or 20 stores and shops, a court-house, 2 churches, and 1 weekly newspaper. M. M. Barron, Pub. "News."

Franklin, post-v. of Oneida co., Id., on the Utah Northern R. R., 61 miles from Brigham.

Franklin, tp. of De Kalb co., Ill. Pop. 1004.

Franklin, tp. and post-v. of Morgan co., Ill., on the Jacksonville North-western and South-eastern R. R., 13 miles from Jacksonville. Pop. 2057.

Franklin, tp. of De Kalb co., Ind. Pop. 1243.

Franklin, tp. of Floyd co., Ind. Pop. 793.

Franklin, tp. of Grant co., Ind. Pop. 1471.

Franklin, tp. of Harrison co., Ind. Pop. 1402.

Franklin, tp. of Hendricks co., Ind. Pop. 1316.

Franklin, tp. of Henry co., Ind. Pop. 1579.

Franklin, post-v. and tp., cap. of Johnson co., Ind., on the Cincinnati and Martinsville and the Jefferson Madison and Indianapolis R. Rs., 27 miles E. of Martinsville. It has a college, a high school with a $55,000 school building, 5 churches, a gas works, Masonic, Odd Fellows, Knights of Pythias, Sons of Temperance, and Foresters orders, 2 weekly newspapers, 2 national banks, 2 planing-mills, 3 flouring-mills, 3 saw-mills, and a fair retail trade. Pop. of v. 2707; of tp. 2903. H. C. Allison, Ed. "Jeffersonian."

Franklin, tp. of Kosciusko co., Ind. Pop. 1280.

Franklin, tp. of Marion co., Ind. Pop. 2376.

Franklin, tp. of Montgomery co., Ind. Pop. 1683.

Franklin, tp. of Owen co., Ind. Pop. 1512.

Franklin, tp. of Pulaski co., Ind. Pop. 226.

Franklin, tp. of Putnam co., Ind. Pop. 1266.

Franklin, tp. of Randolph co., Ind. Pop. 1537.

Franklin, tp. of Ripley co., Ind. Pop. 1961.

Franklin, tp. of Washington co., Ind. Pop. 1366.

Franklin, tp. and v. of Wayne co., Ind. Pop. of v. 80; of tp. 1385.

Franklin, tp. of Allamakee co., Ia. Pop. 850.

Franklin, tp. of Appanoose co., Ia. Pop. 888.

Franklin, tp. of Bremer co., Ia. Pop. 643.

Franklin, tp. of Clarke co., Ia. Pop. 677.

Franklin, post-tp. of Decatur co., Ia. Pop. 466.

Franklin, tp. of Des Moines co., Ia. Pop. 1549.

Franklin, tp. of Fremont co., Ia. Pop. 2232.

Franklin, tp. and v. of Lee co., Ia., on the Burlington and South-western R. R. Pop. of v. 628; of tp. 1872.

Franklin, tp. of Linn co., Ia. Pop. 2738.

Franklin, tp. of Marion co., Ia. Pop. 768.

Franklin, tp. of Monona co., Ia. Pop. 856.

Franklin, tp. of Monroe co., Ia. Pop. 613.

Franklin, tp. of Polk co., Ia. Pop. 654.

Franklin, tp. of Story co., Ia. Pop. 924.

Franklin, tp. of Washington co., Ia. Pop. 816.

Franklin, tp. of Bourbon co., Kan. Pop. 1207.

Franklin, tp. of Franklin co., Kan. Pop. 1021.

Franklin, tp. of Jackson co., Kan. Pop. 2325.

Franklin, post-v., cap. of Simpson co., Ky., on the Louisville and Great Southern R. R., 134 miles S. of Louisville, Ky., and 51 N. of Nashville, Tenn. It has 4 churches, 2 colleges (male and female), 1 weekly newspaper, 1 woollen-factory, 2 flour-mills, and about 40 stores. Pop. 1808. John Brevard, Ed. "Franklin Patriot."

Franklin, post-v., cap. of St. Mary parish, La., on Bayou Têche, 30 miles W. of Brashear City. It has 1 hotel, 1 weekly newspaper, and several churches and stores. Pop. 1265. W. B. Merchant, Ed. "The Brashear News."

Franklin, tp. and post-v. of Hancock co., Me., 11 miles E. of Ellsworth, has a harbor at the head of Frenchman's Bay, good water-power, shipbuilding, and manufactures of lumber. Pop. 1012.

Franklin, tp. of Carroll co., Md. Pop. 2037.

Franklin, post-v. and tp. of Norfolk co., Mass., on the Boston Hartford and Erie R. R., 28 miles from Boston. It has 1 national and 1 savings bank, 6 churches, a library, 1 weekly newspaper, and several manufactures of woollen and straw goods. Dean Academy is situated here. Pop. 2512. James M. Stewart, Ed. "Register."

Franklin, tp. of Houghton co., Mich. Pop. 2163.

Franklin, tp. of Lenawee co., Mich. Pop. 1459.

Franklin, post-v. of Oakland co., Mich.

Franklin, tp. of Wright co., Minn. Pop. 797.

Franklin, tp. of Dent co., Mo. Pop. 848.

Franklin, tp. of Grundy co., Mo. Pop. 1029.

Franklin, post-tp. of Howard co., Mo., on the Missouri River, opposite Booneville. Pop. 2474.

Franklin, tp. of Miller co., Mo. Pop. 622.

Franklin, tp. of Newton co., Mo. Pop. 1238.

Franklin, post-tp. of Richardson co., Neb. Pop. 225.

Franklin, post-v. of Merrimack co., N. H., at the junction of the Pemmigewasset and Winnipiseogee rivers, which form the Merrimack, and on the Northern R. R., 18 miles N. of Concord, at the junction of the Bristol branch. It has a savings bank, a weekly newspaper, a large paper-mill, machine-shops, wood-working shops, several woollen-mills, 5 churches, 3 hotels, etc. The New Hampshire Orphans' Home is in this town, 3 miles S. of the village, on the farm once owned by Daniel Webster. Pop. of tp. 2301. O. A. Towne, Ed. "Merrimack Journal."

Franklin, tp. of Bergen co., N. J. Pop. 2899.

Franklin, post-v. of Essex co., N. J., on the Erie R. R., Newark branch.

Franklin, tp. of Gloucester co., N. J. Pop. 2188.

Franklin, tp. of Hunterdon co., N. J. Pop. 1342.

Franklin, tp. of Somerset co., N. J. Pop. 3912.

Franklin, tp. of Warren co., N. J. Pop. 1655.

Franklin, post-v. and tp. of Delaware co., N. Y., 4 miles E. of Otego on the Albany and Susquehanna R. R., and 5 miles N. of Merrickville on the New York and Oswego Midland R. R. It has 1 national bank, 1 weekly newspaper, an excellent school, 5 churches, 1 hotel, and a number of stores. It lies in a very pleasant and fertile valley. Principal business, farming and dairying. Pop. of v. 681; of tp. 3283. Theo. Smith, Ed. "Register."

Franklin, tp. of Franklin co., N. Y., on the Saranac, has iron-mines. Chief pursuit, lumbering. Pop. 1195.

Franklin (P. O. Franklin Iron Works), a v. of Kirkland tp., Oneida co., N. Y., on the New York and Oswego Midland R. R., 11 miles from Utica, has a furnace which usually turns out 8000 tons of iron a year. Pop. 379.

Franklin, post-v., cap. of Macon co., N. C., situated in a deep valley on the Little Tennessee River, 14 miles N. W. of Walhalla, S. C. Pop. of tp. 1310.

Franklin, tp. of New Hanover co., N. C. Pop. 1309.

Franklin, tp. of Rowan co., N. C. Pop. 1184.

Franklin, tp. of Surry co., N. C. Pop. 629.

Franklin, tp. of Adams co., O. Pop. 2172.

Franklin, tp. of Brown co., O. Pop. 1225.

Franklin, tp. of Clermont co., O. Pop. 3298.

Franklin, tp. of Columbiana co., O. Pop. 866.

Franklin, tp. of Coshocton co., O. Pop. 972.

Franklin, tp. of Darke co., O. Pop. 1366.

Franklin, tp. of Franklin co., O. Pop. 2629.

Franklin, tp. of Fulton co., O. Pop. 999.

Franklin, tp. of Harrison co., O. Pop. 1153.

Franklin, tp. of Jackson co., O. Pop. 1665.

Franklin, tp. of Licking co., O. Pop. 847.

Franklin, tp. of Mercer co., O. Pop. 831.

Franklin, tp. of Monroe co., O. Pop. 1418.

Franklin, tp. of Morrow co., O. Pop. 1011.

Franklin, tp. of Portage co., O. Pop. 3037.

Franklin, tp. of Richland co., O. Pop. 943.

Franklin, tp. of Ross co., O. Pop. 1082.

Franklin, tp. of Shelby co., O. Pop. 839.

Franklin, tp. of Summit co., O. Pop. 1887.

Franklin, tp. of Tuscarawas co., O. Pop. 998.

Franklin, tp. and post-v. of Warren co., O. It has 1 national bank and 1 weekly newspaper. Pop. of v. 1832; of tp. 3012.

Franklin, tp. of Wayne co., O. Pop. 1302.

Franklin, tp. of Adams co., Pa. Pop. 2176.

Franklin, tp. of Allegheny co., Pa. Pop. 716.

Franklin, tp. of Beaver co., Pa. Pop. 676.

Franklin, tp. of Bradford co., Pa. Pop. 705.

Franklin, tp. of Butler co., Pa. Pop. 1047.

Franklin, borough of Cambria co., Pa. Pop. 426.

Franklin, tp. of Carbon co., Pa. Pop. 1912.

Franklin, tp. of Chester co., Pa. Pop. 922.

Franklin, tp. of Columbia co., Pa. Pop. 506.

Franklin, tp. of Erie co., Pa. Pop. 994.

Franklin, tp. of Fayette co., Pa. Pop. 1299.

Franklin, tp. of Greene co., Pa. Pop. 1500.

Franklin, tp. of Huntingdon co., Pa. It contains iron-mines and furnaces. Pop. 1355.

Franklin, tp. of Luzerne co., Pa. Pop. 644.

Franklin, tp. of Lycoming co., Pa. Pop. 739.

Franklin, tp. of Snyder co., Pa. Pop. 934.

Franklin, tp. of Susquehanna co., Pa. Pop. 849.

Franklin, city, cap. of Venango co., Pa., on the Allegheny River at the mouth of French Creek. It is on the lines of the Allegheny Valley, the Atlantic and Great Western R. Rs., and the Jamestown and Franklin R. R., a branch of the Lake Shore and Michigan Southern R. R. It contains 8 churches, 5 banks, 3 stone-quarries, 1 union school building and several private schools, 2 flouring-mills, 3 machine-shops, 2 planing-mills, 2 carriage factories, 10 hotels, 2 weekly newspapers, 2 lubricating-oil refineries, 2 illuminating-oil refineries, 2 building and loan associations, and about 50 stores. Incorporated 1868. Pop. 3908.

JOHN H. WHITAKER, ED. "VENANGO SPECTATOR."

Franklin, tp. of Washington co., Pa. Pop. 1074.

Franklin, tp. of Westmoreland co., Pa. Pop. 1796.

Franklin, tp. of York co., Pa. Pop. 910.

Franklin, post-v., county-seat of Williamson co., Tenn., is on Harpeth River and on the Louisville Nashville and Great Southern R. R., 18 miles S. of Nashville. It has a national bank, 10 churches, a Masonic temple, a weekly newspaper, 2 flouring-mills, a furniture-factory and planing-mill, 2 steam cotton-gins, 2 carriage-manufactories, and other business enterprises. It is the seat of Tennessee Female College, a prosperous institution, of Harpeth Male Academy, and of other schools, some of them free. It is in a rich and well-peopled district. Here Gen. Van Dorn was repulsed by Gen. Granger Apr. 10, 1863, and here, Nov. 30, 1864, a bloody battle was fought between the forces of Gen. Hood and those of Gen. Schofield. (See FRANKLIN, BATTLE OF.) Pop. 1552.

THOS. E. HAYNES, ED. "REVIEW AND JOURNAL."

Franklin, tp. and post-v. of Franklin co., Vt., on the Canada line. Pop. 1612.

Franklin, tp. of Rockingham co., Va. Pop. 3200.

Franklin, tp. of Southampton co., Va. Pop. 1564.

Franklin, tp. of Braxton co., West Va. Pop. 1279.

Franklin, tp. of Marshall co., West Va. Pop. 1610.

Franklin, post-v. and tp., cap. of Pendleton co., W. Va., on S. branch of the Potomac, has churches, schools, a newspaper, factories, and stores. Pop. 1209.

S. D. GORDON, ED. "EXAMINER."

Franklin, tp. of Kewaunee co., Wis. Pop. 1280.

Franklin, tp. of Manitowoc co., Wis. Pop. 1597.

Franklin, tp. of Milwaukee co., Wis. Pop. 2090.

Franklin, tp. of Sauk co., Wis. Pop. 786.

Franklin, tp. of Vernon co., Wis. Pop. 1231.

Franklin, Battle of. After the fall of Atlanta (Sept. 2, 1864), Gen. Sherman encamped his army in its vicinity. His line of communications now extended to Nashville, or, properly speaking, to Louisville, a distance of 500 miles, every foot of which had to be protected. The Confederate authorities, aware of the necessity of drawing or forcing Sherman from Georgia, determined upon an invasion of Tennessee, and on Oct. 1, Hood, who had succeeded (July 17) Johnston in command of the Confederate army, crossed the Chattahoochee with 40,000 men to destroy Sherman's communications, invade Tennessee, and thus force him to retreat. Sherman, becoming aware of this intention, had sent (Sept. 28) Gen. Thomas to Nashville, and, perceiving the impossibility of maintaining his long lines of communication, the plan of abandoning them and striking for the Atlantic coast was proposed and finally determined upon. Sending back the 4th corps (Stanley) and 23d corps (Schofield) to report to Thomas at Nashville, Sherman (Nov. 12) severed his communications and proceeded on his famous "march to the sea." After Sherman's departure Gen. Hood, under orders of his government, continued his sortie towards Nashville, frequently engaging the Union troops, under Schofield, who continued to fall back before Hood's advance, until, arriving at Franklin, Tenn. (Nov. 30), Hood followed in such close pursuit that Schofield was compelled to give battle here. Of Hood's movement Grant says: "Hood, instead of following Sherman, continued his march northward, which seemed to me to be leading to his certain doom. At all events, had I had the power to command both armies, I should not have changed the orders under which he seemed to be acting." Franklin is situated on the S. bank of Harpeth River, 18 miles S. of Nashville. The river here so bends as to surround more than half the town, leaving only the S. and W. exposed. Gen. Schofield's object was to get his trains across the river and away to Nashville; Hood's object was to attack before he could do so. Schofield disposed his cavalry along the N. bank above and below the town to guard the fords, on the heights of which bank a part of his artillery was also placed. His army numbered about 17,000 men, all told, but of these only about 10,000 were available to maintain his perilous position on the S. side of the river. The 23d corps, covering the Columbia and Lewisburg roads, formed the centre of his line; Kimball's division, 4th corps, the right, both flanks resting on the river; two brigades of Wagner's division were posted in front. Hastily-constructed breastworks were thrown up along the main line, reaching from river to river, behind which artillery was thickly strewn. At 4 P. M. Hood attacked Wagner in his advanced position, who, maintaining the defence too long, was finally driven back in confusion, with a loss of 1000 men, into and through the centre of the main lines. Reforming his lines, Hood threw his men within the broken Union lines, capturing 8 guns. At this critical moment Col. E. Opdycke (125th Ohio), commanding the brigade of Wagner's division which had been left within the main lines, without waiting for instructions, led his brigade into the gap, forcing back the Confederates and recapturing the guns. Of this exploit Gen. Thomas reported that "it saved the army from destructive defeat." Four different assaults were made by the Confederates, the battle lasting till a late hour, but each time they were repulsed with great loss. At midnight Schofield withdrew his troops and train to Nashville, meeting little molestation. Confederate loss, nearly 6000 in killed, wounded, and prisoners; Union loss, 189 killed, 1033 wounded, 1104 missing.

Franklin (BENJAMIN), LL.D., F. R. S., was b. at Boston, Mass., Jan. 17, 1706. His father was an intelligent and devout chandler of English birth; his mother, the daughter of Peter Folger of Nantucket, a prominent citizen. Benjamin was the fifteenth of a family of seventeen children. To keep him from going to sea, he was apprenticed to his brother James, a printer, and by much reading, careful and assiduous writing (as much as possible after the style of the *Spectator*), together with the unassisted study of mathematics, he acquired such knowledge

and facility in writing that he ventured to print his thoughts upon public affairs in his brother's newspaper, the *New England Courant*. His papers were well received by the public, but the discovery of their authorship led to a quarrel between the brothers. The newspaper was for a time published in Benjamin's name during an imprisonment of James to which he was subjected for political reasons. In 1723 the young apprentice, wearying of the tyranny he experienced, broke his indentures and ran away, first to New York, and thence to Philadelphia, where he found employment as a journeyman printer. He was in England 1724–26, having been sent by Sir William Keith, the governor, who promised to set him up in business as the public printer of Philadelphia, but failed to keep his promise. After his return to Philadelphia he married 1730, established the *Pennsylvania Gazette*, and soon found himself a person of the first consideration, not only in Philadelphia, but throughout the provinces, for his talents as a writer and his sound judgment in public and business affairs. He established the Philadelphia Library in 1742, and the American Philosophical Society and the University of Pennsylvania in 1744; carried on his famous investigations into the nature of lightning 1746–52, and still later resumed them; and for his papers on the subject he was elected F. R. S. in 1775 and received the Copley gold medal. In 1753 he was made postmaster-general for the colonies, and several times served efficiently as commissioner to the mother-country and to the various colonies. From St. Andrew's, Oxford, and Edinburgh in 1764 he received the degree of LL.D. He did his best to prevent the Revolutionary war by trying to avert the injustice which caused it; procured the repeal of the Stamp Act 1766; and ever warmly sustained the colonial rights, though by a considerable party his patriotism was somewhat later sharply questioned. In 1775 he was chosen to the Congress, and in 1776 he was one of the signers of the Declaration of Independence, having been also one of the committee to draft that instrument. He was (1776–85) employed in the diplomatic service of the U. S., chiefly at Paris, where his influence in behalf of his country was powerful and serviceable in the highest degree, and where his simplicity, dignity, and wisdom made him highly popular. He was president of the Pennsylvania supreme council (in effect governor of the State) 1785–88. In 1787 he was one of the delegates to the convention which drew up the U. S. Constitution. D. at Philadelphia Apr. 17, 1790.

Of the writings of Franklin, the *Busybody*, a series of admirable papers somewhat after the manner of the *Spectator*, but far more readable, and the incomplete *Autobiography*, are the best known, but his political, anti-slavery, financial, economic, and scientific papers are all noteworthy. He published the famous *Poor Richard's Almanac* (1732–57), which was extensively reprinted in Great Britain. In youth he was an avowed skeptic in religious matters and of somewhat loose morals, but his practical good sense enabled him to correct his way of living, and he in later life treated the Christian religion with reverence, though never avowing his faith in any religious system.—His only son, William (1729–1813), was illegitimate; was royal governor of New Jersey 1762–76; but became a royalist, went to England, and d. there.—His grandson, William Temple Franklin (1760–1823), was his grandfather's secretary in Paris and the editor of his writings. (See Lord Jeffrey's articles, *Edinburgh Review*, July, 1806; Aug., 1817; Bancroft's *History of the U. S.*, vol. ix. ch. xxix.; A. Norton's article in the *North American Review*, vol. vii.; Condorcet, *Éloge de Franklin*, 1790; Mignet, *Vie de Franklin;* Bauer, *Washington und Franklin*, Berlin, 1803–06; C. Schmaltz, *Leben Benj. Franklins*, 1840. In 1868 a corrected edition of Franklin's *Autobiography* was published by John Bigelow, from MSS. found in Paris. See also Brougham's *Statesmen of the Time of George III.*, vol. ii.; Parton's *Life and Times of B. Franklin*, 1864; and Theodore Parker's *Historic Americans*, 1870.) H. H. McFarland.

Franklin (Jesse), b. in Surry co., N. C., in 1758; attained the rank of major in the Revolutionary war; was in the house of delegates 1794 and 1799–1805; was in Congress 1795–97; a State senator 1805–06; U. S. Senator 1807–13; commissioner to the Chickasaws 1816; governor of N. C. 1820–21. D. in Surry co., N. C., Sept., 1823.

Franklin (Sir John), D. C. L., F. R. S., rear admiral, b. at Spilsby, Lincolnshire, England, Apr. 16, 1786, went to sea in childhood; entered the navy; served at Copenhagen, Trafalgar, and New Orleans (1815), and was wounded in the gunboat fight on the latter occasion; led Arctic expeditions 1818, 1819, and 1825; became post-captain and F. R. S. 1825; knight and D. C. L. 1827; was governor of Tasmania 1836–43, where he was greatly beloved. In 1845 he set out on his last polar expedition in command of the Erebus and Terror. Many expeditions were sent out in search of the Franklin expedition, and from time to time various relics of it were found; and in 1859 Capt. F. L. McClintock found at Point Victory in the Arctic region conclusive documentary evidence that Franklin d. near Lancaster Sound June 11, 1847, and there is no doubt that all his men also perished, though some long survived.—Franklin's first wife, Eleanor Ann Porden (1795–1825), was a poet; his second wife, Lady Jane, *née* Griffin, was famed for her philanthropy and her labors for the recovery of her lost husband. D. in London July 18, 1875.

Franklin (Thomas L.), D. D., b. at Philadelphia Apr. 10, 1820, graduated at the Philadelphia Classical Institute 1837; at Trinity College, Hartford, Conn., 1841; and at the Theological Seminary of Virginia 1844; entered the ministry of the Protestant Episcopal Church; was missionary committee of the diocese of New York 1853; of Western New York 1869–70; founded the Jane Grey School, Mt. Morris, N. Y., 1866; was its rector 1866–70; has been active in the work of building churches and rectories, and has occupied various important pastoral charges in his Church.

Franklin (William Buel), b. in York, Pa., Feb. 27, 1823; entered the Military Academy at West Point June, 1839; graduated June, 1843, and was assigned to the corps of topographical engineers; served in the war with Mexico on the staff of Gen. Wool, in what was called the Chihuahua column; was on Gen. Taylor's staff in the battle of Buena Vista, and was brevetted first lieutenant for "gallant and meritorious services" in that battle; served at the West Point Military Academy as acting assistant professor of natural and experimental philosophy from Sept., 1848, to Jan., 1852; professor of engineering and natural and experimental philosophy at the New York Free Academy (now College of New York) from Jan. to Apr., 1852; on lighthouse duty as inspector and engineer from 1853 to 1857; engineer-secretary of lighthouse board from Mar., 1857, to Nov., 1859; engineer in charge of Capitol at Washington from Nov., 1859, to Mar., 1861; in charge of bureau of construction and repair and superintendent treasury extension from Mar. to May, 1861; appointed colonel of the 12th U. S. Infantry May 14, 1861, and brigadier-general U. S. volunteers May 17, 1861; commanded a brigade in Heintzelman's division at the battle of Bull Run, July 21, 1861; commanded a division in front of Washington until Mar., 1862, when he was assigned to Gen. McDowell's corps; detached and joined Gen. McClellan in front of Yorktown in Apr., 1862; organized and commanded 6th corps May, 1862; commanded at the battle of West Point May 6, 1862; commanded at the affair of Golding's Farm June 27, 1862, and at the battle of White Oak Swamp June 30, 1862; appointed major-general July 4, 1862; commanded the left at the battle of South Mountain, Md., Sept. 14, 1862, capturing Crampton's Gap; present at the battle of Antietam Sept. 17, 1862, in command of the 6th corps, relieving Gen. Sumner's command after 12 o'clock; assigned to the command of the left grand division Army of the Potomac Nov., 1862, consisting of the 1st and 6th corps; commanded left wing at the battle of Fredericksburg Dec. 12 and 13, 1862; relieved from duty in the Army of the Potomac Jan. 25, 1863; assigned to duty in the department of the Gulf July, 1863; in command of expedition against Sabine Pass Sept., 1863, which was repulsed; in command of troops occupying Northern Louisiana 1863–64; in command of the 19th corps and troops of the department of the Gulf, forming the Red River expedition, in Mar. and Apr., 1864, until joined by Gen. Banks on the evening of Apr. 6; in the battle of Sabine Cross-roads, as second in command, on Apr. 7, and in the battle of Pleasant Hill on Apr. 8; wounded and lost two horses shot under him Apr. 7; conducted retreat to Alexandria, and directed Col. Bailey to make arrangements for the relief of Admiral Porter's fleet by the Red River dam; on sick leave on account of wound from June to Nov., 1864; captured on a train from Baltimore to Philadelphia July, 1864, escaping during the next night; president of a board for retiring disabled officers from Nov., 1864, to Nov., 1865; resigned as major-general of volunteers Nov. 9, 1865, and as colonel of the 12th Infantry Mar. 15, 1866. He now resides at Hartford as vice-president and general agent of Colt's Firearms Manufacturing Co.; president of commission for laying out Long Island City 1871–72; president of the board of commissioners for building new State-house 1872–73; consulting engineer of same 1874. Joseph Henry.

Franklin Grove, post-v. of China tp., Lee co., Ill., 88 miles W. of Chicago, on the Chicago and North-western R. R. It has 3 churches, a union school, 1 hotel, 12 stores, 4 grain-elevators, 1 hay-press, and other business enterprises, and 1 weekly newspaper. Pop. 757.

D. H. Spencer, Ed. "Franklin Reporter."

Franklin Island, off the coast of Knox co., Me., on

the W. side of the entrance to the river St. George, has a brick lighthouse with a flashing light, standing at the N. point of the island; lat. 43° 53′ 31″ N., lon. 69° 22′ 10″ W.

Frank'linite [in honor of *Dr. Franklin*], a mineral found associated with red oxide of zinc, found both amorphous and crystalline, chiefly at the Mine Hill and Stirling zinc-mines in Sussex co., N. J., and also found at Altenburg, near Aix-la-Chapelle, Germany. It contains from 66 to 69 parts of peroxide of iron, with from 10 to 22 parts of oxide of zinc, and about the same proportion of oxide of manganese. Franklinite is worked for making zinc paint, and the residue, itself called franklinite, is used as an iron ore, and is considered especially useful in making Bessemer steel. It makes a white cast iron like *Spiegeleisen*.

Franklin Lake, in Elko co., Nev., lies E. of the lofty East Humboldt Mountains. It is nearly fresh, very shallow, and is fed by springs doubtless derived from the mountain snows. The *tule* (*Scirpus validus*) grows abundantly in the lake, which has no outlet.

Franklin Plantation, tp. of Oxford co., Me. P. 178.

Frank'linsville, tp. of Randolph co., N. C. P. 1528.

Frank'linton, cap. of Washington parish, La., 68 miles N. of New Orleans, on Bogue Chitto. Pop. 121.

Franklinton, tp. and post-v. of Franklin co., N. C., on the Raleigh and Gaston R. R., 27 miles N. E. of Raleigh. Pop. of v. 305; of tp. 1956.

Franklinton, a former post-v. of Franklin tp., Franklin co., O., was in 1872 made a part of the city of Columbus. Pop. (1870) 690.

Frank'lintown, post-b. of York co., Pa. Pop. 181.

Frank'linville, post-v. and tp. of Cattaraugus co., N. Y., has a free academy and several mills. Pop. 1559.

Frank Marriage, a peculiar species of entailed estate formerly in use under the English law, consisting in a gift of land by a father or kinsman to a daughter or cousin and her husband at the time of her marriage, upon the implied condition that the land was to descend to the issue of the marriage. On birth of issue the condition was regarded as performed, and the estate became alienable. But the passage of the statute *De donis conditionalibus* caused such estates, like others held in tail, to be controlled by the terms of the gift, and to be reserved exclusively for the issue for whom they were originally intended; so that the power of alienation was thus taken away. Such estates were afterwards subjected to the same changes as all entailed estates. (See ENTAIL.) GEORGE CHASE. REV. BY T. W. DWIGHT.

Frank Pledge. In the early period of English history the counties of the realm were divided into hundreds, and the hundreds were still further subdivided into tithings, which received their name (Sax. *teothung*, "a company of ten") because each was composed of *ten* freeholders. These, with their families, all dwelt together, and were free pledges—*i. e.* sureties—for the good behavior and obedience to the law of one another. Upon the commission of an offence by any one of them, the others were obliged to have him forthcoming to answer the requisition of the law, or, in case of his escape, to bear the burden of any penalty that might be imposed.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Franks, The. 1. *The Name and Peoples Embraced thereunder.*—The name [Ger. *frank*; Fr. *franc*; It. *franco*; Eng. *free*] is of later origin than the first historical appearance of the different peoples designated thereby, and shadows forth that new element of individual freedom which the Teutonic peoples were destined to contribute to European civilization. The tribes embraced two and a half centuries later under this name had already, during the reign of Augustus (27 B. C.–14 A. D.), appeared upon the Rhine, and in their contact with the Roman civilization been drawn into historic notice. The Bructeri, Chamavi, Amsivarii, Catti, Chassuarii, and especially the Sygambri, mentioned by the Latin historians of this period, were the tribes which formed the nucleus of the later confederation of the "Franci." They had already at that time, in small pioneer groups, pushed across to the *left* bank of the Lower Rhine, while they occupied the territory on the right from the mouth of the Ems to the Sieg and Werra. After the middle of the fourth century appear the two groups of this Frankish confederation under the names Salian and Ripuarian—the former inhabiting the districts of the Lower Rhine, Meuse, and Scheldt, and deriving its name probably from the river Sala (present Yssel): the latter inhabiting the territory of the Middle Rhine in and about the present city of Cologne, and named from its riparian situation.

2. *Their Place in Teutonic History.*—Their problem in the civilization of Europe was the mediation of the Roman-Christian civilization with the Germanic; or, better, it was theirs to receive the inheritance of the Roman-Christian culture—to form, reform, develop, and supplement it by and with the freshness and vigor of the Germanic nature, and at the same time *be* formed, reformed, developed, and modified by it. The sinking Roman world delivered to the Franks the world-historic inheritance which it had itself received, increased and stamped with the forms and characteristics of its own nature; theirs it now became to take up this world-civilization, and by the developments and modifications to which they subjected it, and it them, to present it as their form of the world-civilization, and be presented by *it* as *its* first expression through the Germanic man, and so furnish the connecting link between the antique classic world, with its speculative and ritualistic religiosity, and the scientific political world of the new time, with its ethically religious view.

3. *The Characteristics and Conditions which made the Franks the first World-historic People of Germanic Nationality.*—*a. Their Geographical Position and Agricultural Nature.*—We find them as early as the middle of the fourth century separated into the two branches of Salian and Ripuarian, and occupying the fertile plains on the lower course of the Scheldt, Meuse, and Rhine. While thus the other German tribes, during the great "wandering of the peoples," separated themselves entirely from their original homes, and, spreading themselves like a thin lamina over other nationalities, were soon absorbed by and disappeared in the same, the Franks, on the other hand, maintained their geographical connection with the old Germanic home, from which they continued to draw new freshness and vigor by which to oppose the deteriorating and disorganizing influences of the decaying Roman world. Sustained thus from behind, they pushed gradually and peacefully (as compared with the warlike convulsions which the great immigration was elsewhere producing) forward, never forgetting in their new acquisitions the worth and importance of the old; *settling* their lands as they gained them, and reducing them to cultivation; uprooting and destroying the scanty remnants of the Celtic, and at first of the Roman-Christian, civilization; in a word, thoroughly "Germanizing" as they pressed forward.

b. Their Attitude towards the Roman State.—While we find the other German tribes and peoples, for the most part, waging an open and unceasing warfare with the Romans for supremacy and existence, the Franks, on the other hand, after the first brushes of conflict with the Roman commander Aetius in Gaul, who in 428 A. D., and again in 431 A. D., checked their south-westward movement, acknowledged the political supremacy of the Roman state, occupied peacefully the land as far as the Somme by consent of the Roman commander, and tolerated the Roman rites and religion, while their king Clovis received distinguished Romans at his court; in a word, they gradually and almost unconsciously, both to themselves and their national opponents, secured to themselves the *substance* of power, leaving to the Romans only the outward show. And not until the Roman governor, Syagrius of Soissons, had separated himself by his own usurpatory act from the source of his authority in Ravenna or Constantinople, and thus lost in the eyes of his Roman-Gallic subjects his show of legitimacy, did the Frankish king Clovis abolish these scanty remnants of Roman supremacy, and, while extending his dominions to the Loire, joined to the *substance* of the power which he already possessed the outward *form* of sovereignty (486 A. D.). Under such circumstances neither the Roman emperor at Constantinople nor the Roman-Gallic subjects took any offence at this procedure. On the contrary, after Clovis's victory over the Visigoths (507 A. D.) the emperor Anastasius bestowed upon him the dignity and title of a Roman patrician, and appointed him Roman proconsul in Gaul; and though the Frank owed his supremacy, for the most part, to his own good sword, yet he was by no means blind to the advantage of the legitimation of his title in the eyes of his Roman-Gallic subjects by the legitimate Roman emperor. He received the dignity with reverence, caused the ceremony of coronation to be performed upon himself, and was greeted by his subjects as consul and Augustus, thus settling all dispute between Frank and Roman in regard to the right of his sovereignty.

c. Their Attitude towards the Orthodox Romish Church.—We have already remarked that the Franks in their earliest appearance on the Scheldt began to root out and destroy the scanty remnants of the Roman-Christian as well as of the Celtic culture, but that, as they proceeded towards the S. W., and occupied the lands to the Somme under the recognition of the political supremacy of the Roman governor at Soissons, this opposition to the Christian culture was changed to *tolerance*, which of itself gave to the Franks a very great advantage in their relation to the Roman-Gallic population as compared with the other German tribes

upon Gallic soil, since these, for the most part, were *Arian* Christians, and unceasing in their persecution of the orthodox branch of the Church, to which the Roman Gallic inhabitants for the most part adhered. If mere tolerance, therefore, produced such advantage, what if the Franks should become the outspoken defenders of Romish Christian orthodoxy? Yea, what if they should become orthodox Christians themselves? But here was a difficulty, or rather a great series of seemingly insurmountable difficulties. In the nature and history of the Franks every presupposition and condition for such a conversion seemed to fail. First of all, the readiness to break with the past, the despair of coming to anything upon the old lines of activity, the repentance and consciousness of imperfection necessary to a change of religion, were entirely wanting —yea, inconceivable to the young, fresh, hopeful, active Germanic nature, all glowing with the recollection of its heroes of the past, and striving to imitate them. Then, again, the Christian religion was the religion of the Romans, their national enemy. The Christian God, according to their way of thinking, gave to the Romans their victories and brought to the Germans their defeats. To become a Christian was therefore to become a Roman in sympathy—in other words, a traitor. Then, again, the (at that time) emphasized principles of Christianity found but little sympathy in the nature of the German. The lowly, patient, and humble Jesus was anything but *his* idea of a perfect manhood. A proud, vigorous, belligerent, and successful individuality was to him the only example worthy of imitation. And when we turn to the speculative and moral sides, it was no better. The preliminary philosophical study and development of language necessary to convey and receive such ideas—as, for instance, the doctrine of the Trinity—were entirely wanting, while the principle of blood-revenge for injury to one's self or family was the German-heathen correspondent in morals to that of brotherly love in Christianity. Many years of contact with the Romans had perhaps, in some features, softened the bluntness of the opposition; still, the Franks remained entirely true to their heathenism, and the only perceivable effect of this contact was an indifferent toleration for Christianity as *one of the Roman institutions*. All *natural* conditions were thus lacking, and nothing short of a course of events *miraculous* in their nature to *the minds of the Franks* could secure their conversion; and such a conversion must and did establish peculiar, and in some respects dangerous, relationships to the ecclesiastical power. About 493 A. D. the Frankish king Clovis took for his consort an orthodox Christian, Clotilda, daughter of King Chilperic of Burgundy, who shortly before the marriage of his daughter had been murdered by his own brother Gundobald, also king in Burgundy, and an *Arian* by profession. The orthodox Christians of Gaul believed that difference of creed was the cause of the murder, and it fired their souls with hatred against Gundobald. Clovis inherited by his marriage with Clotilda, according to the German law of blood-revenge, the duty of revenging the blood of his father-in-law. Here, at least, was one point of sympathy between him and the orthodox inhabitants of all Gaul. Clotilda lost no time in attempting by her persuasions to extend this sympathy on the part of her consort, but in vain. Clovis gave way only so far as to allow his first-born son to receive the Christian baptism. A few days afterward the babe sickened and died. A second was born to him, and likewise, through the persuasions of Clotilda, subjected to the Christian rite. In five days this child sickened and came near unto death. It is difficult for men of our day and way of thinking to represent to themselves the thoughts and emotions of Clovis at this critical juncture. In allowing these acts he had been a traitor to the gods of his fatherland—those gods who had rewarded with victory and success his devotion to them, and who now punished his treason. It was therefore a matter of no small moment that this child recovered, and that the Christian God thus vindicated himself (so to speak) and his power in the eyes of Clovis. Thus aroused, disturbed, and excited in spirit, the Frank neared the decisive instant. The Alemanni, a warlike German tribe occupying both sides of the Rhine from Mayence to Bâle, pressed hard against the Ripuarian Franks, whose king, Sigebert, with the aid of Clovis the Salian, prepared to meet them in battle. The conflict took place in the neighborhood of the present city of Zülpich (496 A. D.). The Franks fell by thousands; complete destruction threatened them. In this moment of despair, and doubt in the power and inclination of the gods of his own worship to save him, Clovis lifted his eyes to heaven and pledged himself by an oath to receive the Christian God, the God of his Clotilda, if that God would only prove his power and favor by securing to him the victory. Then, inspired by the sublime loftiness of this wager of his faith, he plunged once more into the heat of the battle, and *won*. The God of the Christians had by this *miracle* vindicated his right and claim to the faith, the devotion, and the sword of the Frank; and the conversion was complete. Clovis, with 3000 of his followers, received immediately the Christian baptism from the hand of the bishop Rhemigius of Rheims, and vowed their allegiance to the orthodox Church. The *manner* of this conversion was the *undoubting reception* by the Franks of the Romish Christian Church *in its totality as the infallible organ of the invincible God.* Neither the reasonableness of the orthodox doctrine nor the examples of its votaries had produced this change in the Frankish mind, but the Christian God had proved himself the *superior God* of the universe in the miracle of the victory over the Alemanni, and had also manifested therein his *favor* for the Franks. And that was enough for them. Under his favor and by his power the Frank now felt himself invincible and called upon to subdue the world to his sceptre. But the Frank knew nothing of this God *save as presented by this Church through its priesthood.* This Church was to him a *prehistoric* institution. He knew nothing of its origin or development into its then existing ecclesiastical form. The command of the *priest* was to him the command of the Christian God, and service to the *Church* was service to that God. In a word, *the manner of the conversion of the Franks to the Romish-Church Christianity forestalled all distinction between that Church and Christianity, and bound the hopes of the Frank for victory and success together with faith in the invincible divine power of that Church.*

Enabled thus, by their geographical position, to draw continually fresh vigor from the old Germanic home, legitimized politically by the Roman emperor in the eyes of the Roman-Gallic subjects, drawn into most intimate sympathy with the same through the bonds of a common religion, and inspired with the idea of being the favored people of the invincible God, the Franks rapidly overcame all opposition on the part of other tribes and peoples, and at the death of Clovis (511 A. D.) had extended their kingdom and sovereignty from the Garonne and the borders of Septimania to the mouth of the Scheldt, and from the Atlantic on the W. to Thuringia on the E.

4. *The Merovingian Government.*—Through the long years of constant warfare and motion during the immigration of the Teutonic peoples the chief command in war and in immigration had gradually become hereditary, chiefly because, in the absence of other educational means, the father would most naturally train up his own son to the *duties* of the chief command. The assumption of a state of peace at the close of the "great wandering" was gradual, and the ruler in the half-nomadic war continued the ruler in peace, the military leader became the king, the "Herzog" became the "König." The first Frankish king of whom we have any mention was Clodio, while the second, Merovius, founded the dynasty which Clovis fixed firmly in power. The government was thus, by the nature of its origin, a monarchy —not a constitutional or absolute or feudal monarchy, nor yet a military monarchy in the modern sense of that term, but the patriarchal monarchy in its most warlike type. The king's court was the central point of the government. No distinction was made between the king's private property and the state treasury. The officers of his household were *ex officio* the highest officers of the state, the major domo at their head. The government was administered through the agents of the king—viz. counts and bishops—and these officials, as well as all servants and favorites of the monarch, were paid or rewarded by grants of land, the only species of property at hand in sufficient quantity for the purpose at that stage of Teutonic civilization. The lands thus granted were already inhabited and cultivated by a Romish-Gallic peasantry; and, since no distinction had as yet arisen between public and private functions, the king's grant of land transferred the people dwelling thereon to the political jurisdiction of the grantee—that is, exempted the inhabitants of these grants from the *immediate* power of the king. Of course such an economy of the treasury must, sooner or later, result in the exemption of the entire territory of the Frankish crown from the immediate power of the king, and raise up a powerful and defiant nobility which he could not control. This cause, taken together with the conflicts engendered by the absence of any fixed law of succession within the royal family itself, and the degeneration of the Merovingian dynasty through contact with the decaying Roman world, brought the Frankish state, after an existence of more than two and a half centuries, near to its dissolution.

5. *The Carlovingian Reform.*—The Carlovingian dynasty was in its origin the ducal house of the Ripuarian Franks. This branch of the Frankish folk had remained upon the soil of the fatherland, and, though united with the Salians in the confederacy of the Franci, had preserved the Germanic freshness and vigor, while the closer contact of the

latter (the Salians) with the decaying Roman world upon Gallic soil had produced weakness and decline. As at the close of the seventh and the beginning of the eighth century the dissolution of the Frankish state became imminent, three mighty dukes of the Carlovingian House, Pepin von Landen, Pepin von Heristal, and Charles Martel, gradually and successively gathered into their own hands all political power—first in Austrasia, the more German half of the kingdom, sometimes wearing here the title of major-domo, to lend the show of legitimacy, sometimes not; and then in Neustria, the more Romanic half, where, having no ducal authority, the office of the major-domo was always assumed for the sake of legalizing their sovereignty over their West Frankish subjects. By the influx of this fresh and vigorous German element the process of dissolution was checked and the unity of the Frankish state restored. The Carlovingian dukes broke the independent power of the defiant nobility; brought the royal domain back to the ownership of the Crown; established the principle that the grant of crown-lands meant only the grant of the use of the same, and that only upon condition of service to the state; extended the boundaries of the kingdom; planted the Church in new places; lent their aid to Boniface in the conversion of the Thuringians, Frisians, and part of the Saxons; and successfully defended the European-Christian civilization against the terrible Moslem invasion. Not until they had virtually ruled the Frankish state for more than fifty years, and had grounded their power through these mighty achievements, did they move for the possession of the crown in their own name and right. It was Pepin le Bref who submitted this question first to an assembly of the magnates of the kingdom, and then, after receiving their approval of his design, took one more step in the legitimation of his title, which, at the same time that it accomplished most thoroughly its aim, laid also the foundation for ideas, conceptions, and claims which from that day to this have filled the centuries with intellectual contest, and oft with bloody warfare: we mean the appeal of Pepin to the Roman pontiff for the recognition of his authority as king of the Franks. Upon the reception of the affirmative reply of Pope Zacharias, Pepin was crowned and anointed by the presiding bishop at Soissons in May of 752 A. D. From this time forward the unity of Church and State in the Frankish kingdom became closer and closer. The bishops exercised more and more of the functions of political officers over the inhabitants of the bishoprics. The extension of the kingdom by Pepin and Charlemagne was at the same time a missionary movement for the planting of new churches, the establishment of new dioceses, and the conversion of new peoples. At length, after the mighty Charlemagne had reduced to the sway of his sceptre all the territory of Europe, from the Ebro to the Eider, and from the Frisian coast to Dalmatia and the southern shores of Italy, Pope Leo III. set the crown of the Roman emperor upon his head in the church of St. Peter's at the grave of the apostles, and the Roman people greeted him as emperor and Augustus (Christmas Day of the year 800). With this it was *said* that the Roman-Christian empire of Constantine had been restored—restored *as the feudal grant of the Roman pontiff to Charlemagne.* We do not believe that Charlemagne himself so considered it. He undoubtedly thought that it was the Romans' way of acknowledging that which already existed independent of them. This is clearly seen in the fact that Charlemagne crowned with his own hands his son Louis the Pious as his imperial successor, without any regard to the pope. Still, the manner of the origin of the imperial title gave a color and a moment to the papal assumption of the power to grant and confiscate thrones which the entire Middle Ages did not shake off. During the reign of Charlemagne (768–814) the Frankish state stood at the summit of its power and glory. But the strength and endurance of personal government always depend upon the capacity of the ruler, and when the mighty personality which created the great empire was no more, and his only surviving son, Louis the Pious—a character to wear a cowl, but not a crown—succeeded to the sovereignty, the dissolution began. The wealth of the Crown and the powers of the state were squandered upon the clergy, and the latter half of the weak monarch's reign was a constant scene of conflict between his sons in regard to the succession. At length it came, after the father's death (840 A. D.), to the compact of Verdun between them (Aug., 843 A. D.), according to which the eldest, Lothair, received Italy, the beautiful Burgundian lands, the valleys of the Meuse and Moselle, and the present Holland, and called after his name Lothairingia or Lorraine. Louis the German received the more German portion of the empire, E. of Lothair's kingdom; and Charles the Bald, the Romano-Gallic portion, W. of the same. We may therefore look upon this compact of Verdun as the birth-moment of the three great nationalities—German, French, and Italian—whose friendships and hostilities, workings and interworkings, influences and reflex influences upon each other, have formed the substantial part of European continental history for the last thousand years. The peoples out of whom these three great nationalities were to be developed had been bound together in this mighty political structure of the Frankish state. By the power of this unity, whose chief and fundamental bond was a common religion and a common Church they had succeeded to the inheritance of all that was destined to be of world-historic value in the civilization of the Roman world. Amid all the wreck and ruin of the centuries of the "great wandering," the Church alone, of all institutions, had stood firm, and now, as the established religion of the Frankish empire, it transmitted to all the peoples of this great state-unity the culture of the Roman world, which it had accumulated and preserved. In this the Frankish state had accomplished its work in the world-historic plan. The peoples brought together to participate in a common civilization by it now separate, each to go its own way—each to develop, supplement, and work up in its own way that which it had received—each to make its own valid at the expense of the rest. The elements clash against each other; sharpen, purify, and develop, thereby, themselves and each other; fall into false connections; become again dissolved, until at last the proper affinities, positions, and relations begin to be found, and the active, intelligent, and reflected harmony of the new time begins to appear. (Sources: *Monumenta Germaniæ Historica*, edited by PERTZ; WIETERSHEIM'S *Geschichte der Völkerwanderung*; WEBER'S *Geschichte des Mittelalters*; WAITZ'S *Deutsche Verfassungsgeschichte*; GIESEBRECHT'S *Geschichte der deutschen Kaiserzeit*; RÜCKERT'S *Culturgeschichte des deutschen Volks*; GREGOROVIUS'S *Geschichte der Stadt Rom im Mittelalter*; MARTIN'S *Histoire de France*; GUIZOT'S *Histoire de Civilisation en France*; HALLAM'S *History of the Middle Ages*.) J. W. BURGESS.

Franks, tp. of St. Francis co., Ark. Pop. 1906.

Franks'town, post-v. of Douglas co., Col., on the Territorial road from Denver to New Mexico, 30 miles S. of Denver. It has a brewery, hotel, several stores, and one weekly newspaper. Chief business, cattle-raising and dairying. E. H. STURDY, ED. "DOUGLAS CO. NEWS."

Frankstown, post-tp. of Blair co., Pa., 3 miles E. of Hollidaysburg. Pop. 1553.

Frank'ton, post-v. of Pipe Creek tp., Madison co., Ind. Pop. 270.

Frank'town, post-tp. of Washoe co., Nev. Pop. 271.

Franktown, post-tp. of Northampton co., Va. Pop. 2270.

Frank'ville, tp. and post-v. of Winneshiek co., Ia. Pop. 1154.

Fran'zensbad, or **E'gerbrunnen,** a v. of Bohemia, in the county of Eger. It is a celebrated bathing-place. The waters of its four cold mineral springs are mostly used for drinking, and are very efficacious in scrofulous diseases; 300,000 bottles are annually exported.

Frasca'ti, town of Central Italy, 12 miles from Rome, on the slope of the Alban Hills, and celebrated as a summer resort. It was built, after the destruction of ancient Tusculum in 1191, on the ruins of a villa overgrown with underwood (*frasche*), whence its name. The villas of Aldobrandini, Piccolomini, and Rufinella are celebrated. Pop. 5000.

Fra'ser (ALEXANDER CAMPBELL), LL.D., b. at Ardchattan, Argyleshire, Scotland, Sept., 1819; educated at the University of Edinburgh; in 1846 appointed lecturer on mental philosophy in the New College, Edinburgh. From 1850 to 1857 was editor of the *North British Review*, succeeding Sir William Hamilton in the latter year as professor of logic and metaphysics in the University of Edinburgh, which chair he at present (1875) retains. Besides many valuable contributions to the *North British Review* and other periodicals, he is the author of *Essays in Philosophy* (1856), *Rational Philosophy* (1858); in 1871 he published a collected edition of the *Works* of Bishop Berkeley, with dissertations and annotations; also the *Life and Letters of Bishop Berkeley, with an account of his Philosophy.*

G. C. SIMMONS.

Fraser (CHARLES), an American painter, b. in Charleston, S. C., Aug. 20, 1782; studied law, was admitted to the bar, and practised with such success that his art-studies were suspended. In 1818 renounced the profession of the law and devoted himself to painting. In the department of miniature he chiefly excelled, though historical subjects and landscape tempted him. His popularity in his native city was great. At an exhibition of his works held there in 1857 there were 313 miniatures and 139 paintings in oil

of other styles. Mr. Fraser was a man of letters, as well as an artist. D. in Charleston, Oct. 5, 1860.

O. B. FROTHINGHAM.

Fraser (SIMON), a gallant Scottish officer who entered the 2d Highlanders in 1757, after service in Holland; served on the Continent with honor; in 1761 became major of the 21st Foot, and received the various grades of promotion up to that of brigadier-general, to which rank he was appointed in 1776. He served with skill and valor under Burgoyne in America; gained an advantage over the Americans in the action at Hubbardton, Vt., July 7, 1777; bore a prominent part in the battles at Stillwater, N. Y., in the second of which he was mortally wounded, and d. on the following morning, Oct. 8, 1777.

Fraser (SIMON). See LOVAT, LORD.

Fraser River, in British Columbia, is, next to the Columbia and the Yukon, the largest American river falling into the Pacific. It rises by two forks, one of which flows S. E. from near 54° N. lat. and 125° W. lon. for 250 miles, while the other flows from the Rocky Mountains (in lat. 53° 25′ N., lon. 118° 40′ W.), and reaches the junction after a N. W. course of 200 miles. The union is near Fort George (about 53° 25′ N. lat., 122° 40′ W. lon.). The course of the main stream is southward for 800 miles. Large steamers ascend it 150 miles from its mouth to Fort Hope, and at high water they can go 12 miles farther up. Large sea-going vessels mostly stop at New Westminster, 75 miles from the Gulf of Georgia. The Fraser River is chiefly important for the rich gold-mines along its banks, and for its salmon fisheries, which are destined to become of the first importance. The river flows throughout a great part of its course in deep cañons, with a rapid current. Its mouth is near the U. S. line, on the Gulf of Georgia. Fraser River affords five species of salmon, and in the spring its estuary contains millions of the *oulachon*, or candle-fish, a fine smelt (*Thaleichthys Pacificus*), which is very valuable for food and oil. Along its banks there are good timber and fur regions and some fine grazing-lands. The lower Fraser Valley is densely timbered.

Fraserville, Canada. See RIVIÈRE DU LOUP.

Frater′nities [from the Lat. *fraternitas*, "brotherhood"], voluntary associations of men for mutual benefit, benevolence, or pleasure. Such are the numerous secret and benevolent societies, and in a large sense the term may include the orders of the Church and the monastic and sacerdotal congregations, and even the orders of knighthood; also guilds, trades unions, and the like. Among the laity of the Roman Catholic Church there are numerous associations called fraternities, sodalities, confraternities, arch-confraternities, etc., designed for benevolent or devotional purposes. Some of these are very extensive and have many branches, while others are quite local and confined to one parish. (See FREEMASONRY, ODD FELLOWS, DRUIDS, GUILD, etc.)

Fra′tres Arva′les [from *arvum*, a "field"], a college of twelve priests in ancient Rome, established at a very early period. According to the legend, Acca Larentia, the nurse of Romulus, lost one of her twelve sons, and Romulus took his place, and gave to himself and brothers the name Fratres Arvales. The office of these priests was for life, and was not lost even by exile and imprisonment, while their duties were connected with agriculture, one of them being to celebrate each year, in May, a festive procession in honor of the gods who preside over the fields. They chanted hymns also, one of which, contained in an inscription of A. D. 218, is regarded as one of the earliest specimens of the Latin language. The tablet containing the inscription is preserved in the sacristy of St. Peter's. (See KLAUSEN, *De carm. fratr. arval.*, Bonn, 1836; CORSSEN, *Origines*, Berlin, 1846; DONALDSON'S *Varronianus*, London, 1860, p. 252; WORDSWORTH, *Early Latin*, pp. 180-188.) H. DRISLER.

Fraticel′li [the equivalent of *Fratres Minores*, the "Lesser Brethren," an official title of the Franciscans], a name given to certain zealots of the twelfth, thirteenth, fourteenth, and fifteenth centuries, who were originally Franciscans, but, adopting extravagantly ascetic habits and heretical doctrines, they were condemned in 1302 by Boniface VIII. The Celestines and the Benedictines of Flore seem to have led the movement at first. The Fraticelli suffered much persecution, and thousands were put to death. They paid almost divine honors to Saint Francis, and are accused of calling the works of Joachim of Flore their everlasting gospel. They believed in a new dispensation to take the place of that of the New Testament, and were distinguished for austerities and blind ascetic zeal.

Frat′ta Maggio′re, town of Southern Italy, in the province of Naples. Its rope works and silk are celebrated. Pop. 10,687.

Fraud [Lat. *fraus*]. Fraud of which the law takes cognizance has the effect to render voidable every transaction into which it enters as a constituent material element. But, as the essential qualification contained in this statement implies, it is not every perpetration of fraud that warrants legal interposition. In the sphere of morals all deceptive artifices for the purpose of misleading, every form of crafty imposition with the design of taking advantage of a person's confidence or credulity, are reprehensible as violations of the law of moral duty. But the enforcement of ethical obligations, simply on account of their rightful binding force upon the conscience, is, and must necessarily be for obvious reasons, altogether impracticable in courts of justice. Those forms of fraudulent practices, therefore, which legal methods are competent to examine and punish must be considered as included within the category of acts fraudulent in a moral sense, but not coextensive with it. And yet the precise line of demarcation cannot be definitely drawn, though certain general principles may be stated upon which the distinction essentially depends. The first of these, and the most important, is, that no dependence is to be placed upon the inherent quality of actions without regard to their natural or necessary consequences. The law considers the *results*, either actual or to be reasonably presumed, of every act concerning which question may arise as to its fraudulent character, and exerts its remedial agency only when injury to individuals or to the public welfare has, in fact, been occasioned or is to be naturally expected, and then only in behalf of the party whose interests may be prejudiced. Moreover, the injury must consist in an interference with some legal right or violation of some legal duty resulting in actual or probable pecuniary loss on the part of the person against whom the deception is practised, or serious public detriment. It follows, therefore, as a deduction from this rule, that the same act, though done with intent to deceive, may sometimes be deemed fraudulent in law, and at other times not fraudulent, while in a moral aspect it would be fraudulent in all such cases. The distinction drawn in ordinary language between *deceive* and *defraud* serves to illustrate, in some degree, the difference between moral and legal fraud. Any adequate definition of fraud in law which will distinguish the character of actions considered simply in themselves is an impossibility. This fact has been so generally recognized by the courts that the attempt to frame such a definition has been pronounced contrary to the policy of the law. It is none the less true, however, that there are numerous classes of actions whose tendency to impair legal rights is so uniform and natural that they may be generally pronounced fraudulent when considered simply in themselves. But these can be more advantageously enumerated than defined. Another characteristic of acts deemed fraudulent in law is an intent, either actual or presumed, to occasion harm or damage to another. The principle is the same as in morals—that a wrongful purpose is necessary to render a deceptive act culpable. In a large class of cases, however, a fraudulent intent is presumed from the nature of the transaction. Hence arises the doctrine of constructive fraud, to be hereafter noticed. Actual fraud, on the contrary, consists in intentional deception, artifice, or concealment, with the view or expectation that a person will be misled, and the actual misleading him to his injury. Both actual fraud and constructive fraud are, with but few exceptions, within the cognizance of courts either of law or courts of equity under the division of jurisdiction which exists in the English and American systems of jurisprudence. (See COMMON LAW, EQUITY.) The chief exception to equity jurisdiction in questions of fraud is in relation to wills. Wills of personal estate are considered in probate or surrogate courts—those of real property in the common law tribunals. But the general jurisdiction of equity over the subject of fraud is very comprehensive, and cases of constructive fraud particularly are much more commonly considered in equity than at law. The legal remedy consists merely of an award of damages to the injured party, while the modes of equitable relief, which admit the setting aside of a fraudulent transaction or the enforcement of the specific performance of an agreement, are oftentimes much more beneficial and desirable. It has been said that equity would presume the existence of fraud upon slighter evidence than would be required in courts of law, but this assertion is hardly sustainable. The more extensive jurisdiction of equity in cases of fraud is to be attributed especially to the superiority of its remedial processes. It will therefore be most expedient, in the further consideration of this subject, to state only the body of principles which have been established in equity, since they not only include those maintained at law, but are still more extensive in scope.

I. *Actual Fraud.*—Cases of this kind may be divided into two principal classes. The first class includes those forms of fraud which occur between parties who are under no legal incapacity, and who are in no mutual confidential

or fiduciary relations with each other. The second class of frauds embraces those whose origin is chiefly attributable to the mental infirmity or legal disability of the persons injured, by reason of which imposition and deception may be more readily practised than is usually possible.

1. In the first class of cases it is only necessary to have regard to the conduct of those committing the fraud and the nature of the transaction in which it occurs, without reference to the peculiar condition of those injured. The fraud perpetrated may be either, as it is termed in Latin phrase, *suggestio falsi*, the statement of an untruth, an open misrepresentation, or *suppressio veri*, concealment or suppression of the truth.

(*a*) *Suggestio Falsi.*—There are various elements necessary in an actual misrepresentation in order that it may furnish a ground of action. (1) The falsity of the statement must be known to the party making it, or else he must be justly chargeable with the possession of such knowledge. If he is perfectly honest in his belief of the truth of his representation, and is guilty of no imprudence or negligence in making the statement, he is not answerable for any injurious consequences that may result on the theory of fraud, though the transaction may perhaps be set aside on the ground of mistake. (See MISTAKE.) If his conviction was formed upon evidence sufficient to satisfy a reasonable mind, he would be justified in asserting as a fact what he properly deemed to be such. But if, while aware that his opinion is founded upon mere rumor, conjecture, or trivial testimony, he states it as matter of positive knowledge on his part, in order to induce others to act upon the faith of it, or with good reason to suppose that they will so act, he is deemed as culpable in law as if he actually knew that he was giving erroneous information. The statement, under such circumstances, of what one does not know to be true is said to be as unjustifiable as the statement of what one actually knows to be false. In like manner, if the means of information are peculiarly accessible to the person making the representation, and he is aware that his assertion will be acted upon, his failure to acquire the necessary information may constitute a fraud. (2) The statement must be made with intent to influence some person's action, or upon the understanding or reasonable belief that such a result is likely to ensue. In cases of this latter kind the nature of the concomitant circumstances would be sufficient evidence of fraudulent intent. If erroneous assertions be simply made in casual conversation as matter of gossip or common interest, or if they be stated merely as opinions, or if no transactions are contemplated or known which could be affected by confidence in the statements, any resulting deception and loss constitutes no legal injury. (3) The misrepresentation must be as to some *material* fact constituting an inducement to the act or omission of the other party. The test of materiality is whether, if the party had known the truth, he would have engaged in the transaction by which loss was sustained. (4) The person to whom the misrepresentation was made must rely upon it as a motive to his action, and must be justified in such reliance upon grounds of ordinary prudence and caution. If, notwithstanding the false statements, the person to whom they are made relies entirely upon his own judgment and sagacity, he will not be permitted to maintain an action on the ground that he was deceived, and sustained injury in consequence. When persons deal at "arms' length," as it is termed, there is no room for one to allege deceit against the other. Moreover, if reliance upon the false representations were an act of folly, such as no sensible man would have been guilty of, the courts will afford no relief. If the fact which is misstated is plainly within observation, and one acts upon faith in the falsehood, rejecting the evidence of his own senses, his injury is the result of his own wrong, and not of another's. But if some examination be necessary to detect the error, and the party to whom the representation is made acts with ordinary prudence, confidence in the representation will not be unreasonable, and the deceiver will be responsible. Moreover, if mere belief be stated as belief, opinion as opinion, or supposition as supposition, no person is justified in acting upon it as if it were an expression of actual truth, and if he does must suffer the consequences. So, if a person knows a representation made to him to be false, such knowledge will prevent any allegation on his part of fraudulent deception. (5) The party deceived must have sustained an injury. Wrong without loss no more gives a cause of action than loss without wrong. Fraud and damage must coexist as cause and effect. This rule is, however, more formal than substantial, as injury may be presumed so far at least as to entitle one to nominal damages.

(*b*) *Suppressio Veri.*—A concealment of the truth, by reason of which injury is occasioned, is not to be deemed fraudulent under all circumstances, but only where a person is bound in conscience and duty to make disclosure in order to prevent undue advantage being taken of another. If a vendor knows that there are latent defects in his goods of which the buyer is not aware, and that the consummation of the intended purchase would not be effected were it not for such a misunderstanding, and the buyer cannot discover the defects by ordinary observation, a failure to remove the delusion is equivalent to an express misrepresentation; but if no confidence is reposed in the person making the concealment, the other party preferring to trust to his own judgment, no wrong is done by a failure to reveal a secret source of mistake. And if a defect be patent and readily discoverable upon examination, the maxim of *caveat emptor* will apply, and a seller will be under no obligation to protect a purchaser who by his own imprudence fails to profit by opportunities of discovery within his reach. There are, moreover, cases in which a delicate sense of moral duty would prompt to disclosure, while no similar obligation would be imposed in law. If, for instance, a man knowing of the existence of a valuable mine upon another's land, of which the latter was ignorant, should buy the property without mentioning this important fact, his action would be deemed justifiable. The same view would be taken in many forms of speculation where persons enjoying peculiar facilities for acquiring information about the value of property buy or sell without communicating knowledge which would materially modify the terms of the negotiation. In contracts of certain kinds, however, the fullest information and good faith is requisite, or the contract will be invalid. This is true in cases of suretyship and insurance. Dealings between parties between whom fiduciary relations subsist must also be marked by the most complete confidence and frankness. (For fraudulent warranties, see WARRANTY.)

2. The second class of cases of actual fraud includes deceptions rendered possible by mental infirmity or want of ordinary discretion on the part of those injured. Persons under such disability are incapable of giving that free and rational consent which is necessary to render their acts valid. The mental aberration may be so complete as entirely to prevent a legal transaction, as in cases of lunacy, idiocy, or dementia, or there may be only such a degree of weakness of intellect that undue influence may be more or less readily exercised by designing persons. In instances of this latter kind dealings which can be proved to have been conducted with entire fairness will be sustained, but they will be subjected to a careful scrutiny, and the burden of proof may be cast upon the person profiting by the transaction to show its fairness. For similar reasons, if there be such a degree of drunkenness as to utterly deprive a person of his reason and understanding, dealings with him to his disadvantage will be deemed fraudulent unless there is clear evidence to the contrary. Acts of infants and their contracts, except for necessaries, are judged voidable on account of their lack of reasonable discernment and discretion. Similar protection is afforded to persons under duress or in such extreme necessity that undue advantage is taken of them.

II. *Constructive Fraud.*—The peculiarity of this is that no intent to defraud necessarily exists, but is presumed as an inference of law. Cases under this head may be divided into three classes. The first includes contracts which are deemed fraudulent as contrary to public policy; the second, injurious acts which arise from some peculiar confidential or fiduciary relation between the parties; while the third embraces transactions which operate substantially as frauds upon the rights of third persons.

1. The principal varieties of contracts invalid, as in contravention of public policy, are—(1) Marriage-brokage contracts, by which a person agrees to give another a reward if he will negotiate a marriage for him. Money paid on such a contract may be recovered back. (2) Rewards promised for influencing another person to make a will in a particular manner. (3) Contracts in general restraint of marriage, because they are detrimental to the general welfare of society, which is promoted by suitable marriages. The restraint is "general" when a person is bound not to marry at all, or to marry nobody except a particular person who is under no corresponding obligation. (4) Contracts in general restraint of trade, as tending to promote monopolies and discourage business industry and enterprise. (5) Various other contracts founded upon violations of public trust and confidence, as, *e. g.*, agreements to procure the passage of legislative acts by unjustifiable means, contracts for the buying and selling of public offices, agreements for the composition of a felony, wager contracts, usurious contracts, etc. In like manner, contracts founded upon corrupt considerations or moral turpitude are void. Of this sort are all agreements given to procure the commission of a public crime, or the omission of a public duty, or an offence against chastity.

2. In cases of constructive fraud arising from some con-

fidential or fiduciary relation between the parties the peculiar nature of the wrong lies in its being an abuse of confidence lawfully reposed. Oftentimes there is some actual deceit or imposition practised, but this is not necessary in order that the transaction may be invalidated. A wrongful intent may be presumed from the want of that perfect openness and fairness which the relation demands. The relations of the parties may be of various kinds: (1) *Parent and Child.*—Conveyances by children to parents are subjected to careful scrutiny on account of the danger that they may have been procured by an undue exercise of parental authority. Even after a child has attained his majority, the presumption is that parental influence continues for at least some short period, and mutual dealings to the child's detriment must be proved to have been attended with the utmost good faith or they will not be sustained. (2) *Guardian and Ward.*—A guardian will not be permitted to reap any advantage from dealings with his ward until the influence which his position of authority gives him has entirely ceased. A settlement or contract favorable to the guardian immediately after the ward reaches his majority is looked upon with great distrust. (See GUARDIAN.) (3) *Attorney and Client.*—In any transactions to which this relation gives rise it is a general rule that the attorney shall not gain any advantage to himself at the expense of his client beyond the amount of his just and fair professional compensation. (4) *Physician and Patient.*—Similar principles prevail in reference to this special relation. (5) *Trustee and Cestui que trust.*—A trustee is bound not to place himself in any position antagonistic to the fulfilment of the duties of his trust, and can derive no personal benefit to himself in the discharge of such duties. A purchase by a trustee from his *cestui que trust*, even though it cannot be proved to be unfair, may be set aside at the latter's desire. It is thought wise to *disable* him from dealing with the beneficiary in order that he may be under no temptation to profit by a breach of trust. (6) Other fiduciary relations, as between principal and agent, partners, creditor and surety, etc., are governed by similar principles.

3. Transactions deemed fraudulent because they unwarrantably compromit the rights and interests of third parties afford ground for equitable relief on account of their pernicious tendency, although the persons immediately concerned may have acted freely and willingly. But the third persons who are injured must stand in some peculiar relation with one of the immediate parties to the transaction, and the injury must be dependent upon this relation. There are several classes of cases to which this doctrine is applicable. (1) Relief will be granted in what are called catching bargains with heirs or expectants during the life of their parents or other ancestors. By bargains of this kind are meant agreements to purchase the expected interest for a present sum, and by such transactions, of which the ancestor is ignorant, he is deceived into leaving his property to other persons than those to whom he believed it would pass. Sales of expectancies are, in general, only made by those who are improvident and necessitous, and will never be sustained unless the purchaser can establish that there was no fraud, but that a fair and adequate consideration was given. Upon the same principle, *post obit* bonds given by heirs and expectants are set aside. These are securities promising, for a present loan, to pay a larger sum, exceeding the legal rate of interest, upon the death of the person from whom the expectancy is to be received. (2) Conveyances to defraud a party to a marriage are constructive frauds, as if either party to a marriage contract should enter into an agreement with a third person by which the other party would be defrauded of reasonable expectations. (3) Conveyances to defraud creditors and purchasers are of the same character. (These are considered under the head of FRAUDULENT CONVEYANCES.)

Only an enumeration of the more important classes of fraudulent devices can be attempted. Frauds, as has been said, are infinitely various. But this general *résumé* of the leading principles appertaining to the subject shows that the jurisdiction of the courts in cases of this nature is very comprehensive and very salutary. The advanced and enlightened doctrines of equity are in furtherance of the highest practicable standard of morality which human tribunals can be deemed capable of adequately enforcing.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Frauds, Statute of, a celebrated statute, originally enacted in England in the reign of Charles II. (1677), for the prevention of frauds and perjuries, requiring the use of written instruments in many classes of contracts and in the various modes of transfer of different interests in property. The imperfection and danger of oral testimony as an adequate means of proof of the nature of past transactions, especially when valuable interests are at stake, renders this statute one of the most salutary measures of legislation in English jurisprudence, and its importance has been so fully recognized in this country that it has been substantially re-enacted in nearly every State, and in some of them its provisions have been made still more comprehensive and stringent. The difficulty of ascertaining the exact nature of certain agreements into which parties have entered, if dependence were to be placed chiefly or entirely upon the vague and unsatisfactory remembrance of witnesses, would prove a very serious interference with the proper administration of justice, and would afford an opportunity and a powerful temptation to unprincipled men to fabricate evidence in the furtherance of fraudulent designs. The chances of detection would be too meagre to be of any practical value. Where discrepancies in testimony can be attributed to a natural forgetfulness, rather than to any wrongful intent, discrimination between honest and dishonest claims becomes wellnigh impossible. Moreover, a very slight change in the terms of a stipulation has oftentimes a serious influence upon the interests of those whose rights are in controversy, and witnesses with every intention to be accurate would unavoidably differ in their accounts of the same occurrence. Writing exhibits the precise nature of an agreement, unaffected by the contrariety of testimony, or by the mental reservations of the parties concerned. Written documents, moreover, remain as a perpetual memorial of the events which they record, while the removal of witnesses by death would not unfrequently render it impossible to secure the requisite oral testimony if this alone were necessary to be introduced. The adequate protection of private rights, therefore, and the furtherance of the remedial operations of the courts, render the requirement of written evidence, in many cases, a necessity.

The scope of the statute is very comprehensive. It includes within its provisions the subject-matter of a variety of contracts, and also transfers of land by way of devise. Certain sections require writing in the creation, assignment, or surrender of leases; others apply to devises; others to declarations and assignments of trusts (but these will be considered more conveniently under the specific topics LEASE, WILL, TRUSTS, to which reference may be made). The sections which it will be most desirable to examine in this connection are those which most particularly affect the law of ordinary contracts. These are the fourth and the seventeenth of the original English statute. By the fourth section it is provided that "no action shall be brought (1) whereby to charge any executor or administrator upon any special promise to answer damages out of his own estate; (2) or whereby to charge the defendant upon any special promise to answer for the debt, default, or miscarriage of another person; (3) or to charge any person upon any agreement made upon consideration of marriage; (4) or upon any contract for the sale of lands, tenements, or hereditaments, or any interest in or concerning them: (5) or upon any agreement that is not to be performed within the space of one year from the making thereof; unless the agreement upon which such action shall be brought, or some memorandum or note thereof, shall be in writing and signed by the party to be charged therewith, or some other person thereunto by him lawfully authorized." The requirement of signing which the statute imposes is sufficiently complied with if the name be written in any part of the instrument for the purpose of authenticating it. In some of the American States, however, the language of the statute is not "signed," but "subscribed;" and this renders it necessary that the signature be at the end of the writing. The form of the instrument is immaterial. The object is to secure correct and adequate documentary evidence of the intent and agreement of the parties; and it is therefore sufficient if the stipulations which are concurred in are embodied in separate letters or in distinct instruments, provided the contents of each have so intimate a connection with, and so evident a reference to, the matter contained in the others that the entire contract is manifestly ascertainable only from a comparison of all the writings. But the whole agreement must be deducible from the connected instruments, without its being necessary to supplement them by parol declarations.

The statement of the consideration of the contract is required in England and some of the States, but in others the consideration may be proved by extraneous evidence. The statute, it will be noticed, provides that the signature of a properly authorized agent will be equally valid with that of the party actually interested. Such authority may be given either orally or by writing, provided the act to be done does not require the execution of a deed or other conveyance. Where the conveyance must be under seal, so must the authority be. A single person may act as agent for both parties to the contract, as, for instance, an auctioneer or broker, whose signature will be binding upon either vendor or purchaser. The signature to the instrument

may be written either in ink or in pencil, or will be sufficient if printed, if this mode of authentication is usually adopted by the person to be charged or is sufficiently authorized by him.

Under the first clause of the section it has been decided that if an executor or administrator give bonds for the faithful discharge of his duty, a subsequent promise to pay a debt of the testator will be construed as charging the assets derived from the testator's estate, and not the representative's own property, so that no writing will be necessary. A promise made by an administrator before letters of administration are issued to him from which he derives his authority is also not within the requirement of the statute. The second clause, applying to promises "to answer for the debt, default, or miscarriage of another," necessitates the use of writing in all contracts of guaranty. (The rules upon this subject will be considered under the special title GUARANTY.) The third clause, referring to "promises made in consideration of marriage," is held to apply to promises of settlement, advancement, or other provision in anticipation of marriage, but not to promises to marry, which may therefore be made orally, unless they fall within the fifth clause referred to below. The written promise, to be enforceable, must be effectually operative in inducing the claimant under it to enter into the marriage contract. Hence, when a father made a written promise of advancement to his daughter in case she was married to a particular person, but the intended husband did not know of the promise, nor act upon the faith of it in marrying her, he was not allowed to enforce the promise. The fourth clause, concerning contracts for the sale of real estate or any interest therein, does not require writing in the sale of crops or annual industrial products. If, however, the sale is of standing trees or products not the result of annual cultivation, the better opinion is that the case falls within the statute. When both land and its products are sold to the same individual, the entire contract must be in writing. A mere license to use land does not create any legal interest in the property, and need not be written to be valid, though in such case it is in general revocable at will. The fifth clause relates to "agreements that are not to be performed within the space of one year from the making thereof." Under this provision it is not necessary that an oral agreement be actually fulfilled within the limits of a year from the time when it was made in order to be sustainable, but only that it be capable of fulfilment within that period in the contemplation of the parties when they enter into the stipulations. The actual result may show that the anticipations were unrealized, but the validity of the engagement, though it be unwritten, is in nowise impaired.

The other section of the statute which especially relates to ordinary contracts—viz. the seventeenth—provides that "no contract for the sale of any goods, wares, or merchandise for the price of £10 sterling or upwards, shall be allowed to be good except the buyer shall accept part of the goods so sold, and actually receive the same, or give something in earnest to bind the bargain or in part payment, or that some note or memorandum in writing of the said bargain be made and signed by the parties to be charged by such contract, or their agents thereunto lawfully authorized." In the statutes of the American States the principal alteration made in these terms is by the specification of a different sum of money. The sum generally established is fifty dollars, but in some of the States it is thirty dollars or forty dollars. This section is distinguished from any others contained in the statute by authorizing various modes of giving validity to contracts besides the single method of writing. This diversity is established on account of the comparatively greater frequency with which contracts for the sale of goods are made, and on account of the great inconvenience that would ensue if formal and precise agreements were always necessary to be prepared to effectuate such ordinary transfers. There is, however, this disadvantage—that by dispensing with the requirement of writing in every case the difficulty of proving the terms of many contracts is much increased; but the greater facility with which business operations may be conducted is deemed amply compensatory for this defect. The first mode mentioned by which the sale may be rendered valid is by delivery and acceptance of the goods. Both these prerequisites are absolutely essential in the absence of writing or part payment. A mere expression of final agreement to the terms of the sale of specific chattels is not, as in ordinary transactions of the kind, sufficient to impose a liability upon the purchaser. The delivery may be either actual or constructive. Constructive delivery occurs when means of readily taking possession of the goods are given to the purchaser, which he may exercise in exclusion of the vendor's claim. Thus, the delivery of a key giving access to a warehouse in which the merchandise is deposited is equivalent to a complete transfer of possession. The same purpose is accomplished by giving an order upon a bailee of the goods, which the bailee accepts. The delivery of an integral part of the articles sold is virtually a delivery of the whole. Acceptance on the part of the buyer must be manifested by a suitable act. It is thought by some that there are two acceptances—one, to satisfy the statute of frauds; the other, to preclude the purchaser from objecting that the goods did not correspond with the statute. Accordingly, the former acceptance might have been made, while the purchaser might be still able to return the goods, on the special ground that they did not comply with the contract. As a second method of binding the bargain, earnest may be given. Earnest is a token or pledge passing between the parties by way of evidence or ratification of the sale. The article given must have some appreciable value, even though this be quite insignificant. A chip or pebble would be inadequate, while a cent or a ring would suffice. The effect of earnest is to impose upon the seller an obligation to retain the goods subject to the demand of the purchaser; but the latter must pay the purchase-money upon obtaining delivery. The giving of earnest was a common practice in the early history of English law, but it has now fallen into general desuetude. Thirdly, part payment may be made. This has the same effect as the giving of earnest. There must be an actual transfer of a portion of the price agreed upon, since the liquidation of a former debt as a part of the consideration for the sale will not be sufficient. Fourthly, the agreement or some note or memorandum thereof must be in writing. The principles applying when this mode of authenticating the contract is adopted have been already considered.

It has been much questioned whether executory contracts for the sale of goods which were not in existence in the form contemplated by the parties at the time when the agreement was made are within the statute of frauds. It is now, however, generally settled, contrary to the rule formerly prevailing, that such contracts, if they have reference substantially to a sale of chattels, even though these must necessarily be fabricated out of certain materials before delivery can be made, are within the statute, and must consequently be in writing. But if the contract is essentially for the performance of work and labor about certain chattels, the requirements of the statute have no application.

Courts of equity, as well as courts of law, are bound to comply with and enforce the provisions of the statute of frauds. But where strict compliance would produce hardship and injustice, as sometimes proves to be the case, courts of equity have power to grant special relief, even though the precise letter of the law be violated. Thus, if a contract which ought to have been in writing is fully set forth in the bill of the plaintiff in equity, and is confessed by the answer of the defendant, it will be enforced, since there can be no danger of the commission of fraud, and the defendant may be deemed to have waived his right of defence under the statute by failing to urge it. If, however, he adduces and maintains such a defence, it will be effectual to protect him against the plaintiff's claim. In like manner, specific performance of an oral contract will be decreed if it has been partly carried into execution. This principle is established because a different rule would enable fraudulent designs to be consummated, which it was the design of the statute to prohibit. But the part performance must be something more than the part payment of the price. Moreover, the act must be done solely with a view to the performance of the agreement. An illustration of such a part performance would be the act of making improvements upon land by a purchaser in pursuance of an oral contract for its purchase. A still further exception to the statute is where an agreement is intended by the parties to be reduced to writing in the appropriate manner, but this is prevented by the fraud or cunning shrewdness of one of the parties. Equity follows the spirit of the statute by preventing the commission of fraud wherever it is possible. (See SPECIFIC PERFORMANCE.) GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fraud'ulent Convey'ance, a conveyance the object, tendency, or effect of which is to defraud another not a party to such conveyance, or the intent of which is to avoid some debt or duty due by or incumbent on the party making it. Such conveyances are declared invalid by two famous English statutes, which have been re-enacted throughout the U. S. with substantially the same provisions. By one of these, passed in the thirteenth year of the reign of Queen Elizabeth (1571), and commonly referred to as the statute 13 Eliz. ch. 5, all fraudulent conveyances, gifts, or alienations of lands or goods whereby *creditors* might be in any wise disturbed, hindered, delayed, or defrauded of their just rights, are rendered utterly void; but the act does not extend to any estate or

interest in lands *on good consideration*, and *bona fide* conveyed to any person not having notice of such fraud.

The points deserving particular attention in the provisions of this act are—that it applies to chattels as well as to lands; that it protects only the interests of defrauded *creditors;* and that the exception refers only to *lands* conveyed upon "good consideration" *and* to a "*bona fide*" grantee. Both these latter characteristics are necessary to the conveyance to render it not fraudulent, and if there were only a "good consideration" *or* a "bona fide" transfer, the privilege of the exception would not be available, and creditors might impeach and overthrow the conveyance. By a good consideration, as the phrase is here used, is intended every kind of consideration known to the law, whether it belong to the class more specifically termed "good" or meritorious considerations, by which is meant motives of natural affection founded on relationship, or to the class known as valuable considerations, which include every mode of pecuniary return for a promise or grant. If, therefore, there be an actual fraudulent intent in making a conveyance, and this be known to the grantee, so that he becomes a participant in the wrong committed, it is immaterial, as regards the validity of the conveyance, that there was an adequate consideration, even of a pecuniary nature. The fraud would be fatal. But if the purchaser for a valuable consideration acted innocently, under the influence of an honest belief that the conveyance was unobjectionable, his right to the property would be superior to the claims of creditors. But questions of most importance and difficulty have arisen under the statute in regard to the effect of voluntary conveyances, by which is meant, in a legal sense, those which are intended as mere gifts or are made merely upon meritorious considerations of natural love and affection. The principle is maintained in law, as well as in the sphere of morals, that "a man must be just before he is generous;" and if one under a burden of indebtedness disposes of the property, which ought to be used in satisfying the claims of his creditors, in gratuities to his relatives or friends, a fraudulent intent is imputed to him as a necessary presumption, without the need of positive proof. But if the property transferred were in no way essential to the maintenance of the debtor's full solvency, the conveyance would, according to the prevailing opinion, be sustained. A person, for instance, might possess ample means to discharge all his obligations after bestowing a portion of his property in gifts upon others, and the conveyance would then be deemed valid, as involving no reasonable implication of dishonest intention. To impose any prohibition upon those whose debts bear but a small proportion to their actual resources, preventing them from disposing of at least a part of the surplus in voluntary conveyances if they so desired, would be manifestly unjust, since the rights of creditors would receive, without such a rule, full and adequate protection, to which alone they are entitled. It has been decided in England that a voluntary conveyance is not fraudulent unless it transfer property which might be taken in execution for the payment of debts, since otherwise creditors receive no injury. This doctrine has been somewhat controverted in this country, though it has nevertheless been generally sustained. However, if the law of the State permits property which cannot be taken on an *execution* to be seized by some other process for the payment of debts, it would be a fraud upon creditors to withdraw it from their reach. When the gratuitous disposition of property is injurious to subsequent rather than antecedent creditors, the presumption of a fraudulent purpose is not so readily entertained. If it were proved that such an act formed a part of a preconceived scheme to incur indebtedness after the means of payment had been bestowed upon others, the conveyance would justly be invalidated. But in the absence of such evidence no conclusion could be fairly drawn, from the mere circumstance of a gift to a wife, child, or friend which was not at the time prejudicial to the interests of any other persons, that the transfer was made in the prosecution of a fraudulent purpose.

The second statute against fraudulent conveyances is known as the statute 27 Eliz. ch. 4, enacted in 1585. It enacts that the conveyance of any interest in lands for the intent and purpose to defraud and deceive subsequent *bona fide purchasers* of the lands for a good consideration shall be utterly void. This act differs from the previous one in applying simply to lands, and in protecting the interests of purchasers instead of creditors, but it contains similar provisions declaring the validity of any previous conveyance if it be upon valuable consideration and to a *bona fide* purchaser. It has been adjudged in England, in the interpretation of this statute, that if the previous conveyance be voluntary, it is void as to a subsequent purchaser, even though he had notice before he received his deed that such a conveyance had been made. This doctrine has been generally rejected in the courts of the U. S. as inequitable, and the principle adopted that the receipt of notice gives a person intending to purchase ample opportunity to protect his own interests, and if he is guilty of imprudence in accepting the conveyance he ought to receive no assistance from the courts. This seems the better doctrine. Under both statutes voluntary conveyances are never set aside as between the immediate parties, but only in favor of creditors or purchasers.

George Chase. Revised by T. W. Dwight.

Fraun'hofer, von (Joseph), b. at Straubing, Bavaria, Mar. 6, 1787, was brought up to his father's trade as a glass-worker, but studied optics, astronomy, and mathematics, and in 1806 became a director of the mathematical institute of Munich. In 1815 he observed, measured, and described with admirable fidelity the dark lines of the solar spectrum, called Fraunhofer's lines, first noticed by Wollaston in 1802 (see Spectroscope), and in 1817 was admitted to the Academy of Sciences, Munich. He was a partner in the manufactory of optical apparatus at Benedict-Beuren, which in 1819 was removed to Munich. He made many improvements in fine glass-making, in dioptric instruments, and in the machinery for the manufacture and finishing of lenses; made the noble refracting telescope of the Dorpat Observatory; in 1823 became professor and director of the Cabinet of Physics, Munich. D. at Munich June 7, 1826.

Frau'stadt, town of Prussia, province of Posen, has a large corn and cattle trade. Pop. 6515.

Frax'in, or **Pa'viin,** $C_{16}H_{18}O_{10}$, a fluorescent glucoside found in the bark of the ash (*Fraxinus excelsior*), in the horse-chestnut with æsculin, and in some other barks. It is sparingly soluble in cold water. Its very dilute solution exhibits by daylight a beautiful blue-green fluorescence. Dilute sulphuric acid converts it into fraxetin and glucose. C. F. Chandler.

Fray Ben'tos, town of Uruguay, South America, on the left bank of the Uruguay, is noteworthy as one of the principal places for the manufacture of meat extract, to which industry it owes its foundation a few years ago and its present prosperity. Pop. 3000.

Fraxinel'la, the *Dictamnus albus* or *Dictamnus Fraxinella*, called bastard dittany, an aromatic European herb which is sometimes raised in gardens. It abounds in volatile oil to such an extent that in warm, still weather the air becomes charged with an inflammable vapor. This phenomenon is best shown by enclosing the plant in a box or Wardian case. The plant belongs to the order Rutaceæ.

Frazee' (John), an American sculptor, b. in Rahway, N. J., July 18, 1790; commenced business as a stone cutter in New Brunswick 1814; later opened a marble-yard on Broadway, N. Y. From 1819 till 1823 his work was chiefly in mantlepieces and monuments. His first bust, a head of John Wells, was executed in 1824. He subsequently made busts of Chief Justice Marshall, Dr. Bowditch, Daniel Webster, Gen. Jackson, John Jay, Judges Story and Prescott. Crawford the sculptor took his first lessons in statuary from Frazee and his partner Launitz. D. at New Bedford, Mass., Mar. 3, 1852. O. B. Frothingham.

Fra'zer, tp. of Colleton co., S. C. Pop. 827.

Fra'zeysburg, post-v. of Jackson tp., Muskingum co., O., on the Pittsburg Cincinnati and St. Louis R. R., 49 miles N. E. of Columbus. Pop. 325.

Fra'zier's Farm, Battle of, June 30, 1862. Continuing its retreat towards the James, the Army of the Potomac had, by the morning of June 30, 1862, crossed the White Oak Swamp; the extreme advance had, indeed, reached the river, while the artillery was parked on Malvern Hill. Closely following came the Confederate army in two columns, commanded by Jackson and Longstreet; the former following direct by way of White Oak Swamp, while the latter, making a détour of the swamp, hastened forward to intercept the retreating army, the two wings to unite upon Jackson's emerging from the White Oak Swamp. To prevent this union was McClellan's first concern. Leaving Franklin with the divisions of Smith and Richardson and Naglee's brigade, the artillery under the direction of Capt. Ayres to guard the passage of the swamp, he hurried the remainder of his army, with its train, along the Quaker road to the James. By daylight, Jackson, having repaired the Grapevine bridge across the Chickahominy in his front, resumed pursuit, arriving at White Oak Creek by noon, to find the bridge across the creek and marsh also destroyed. Attempting to pass by the ordinary crossing, he was prevented by the fire of the batteries on the opposite side, and all his efforts to force a passage at this point were successfully repulsed. Longstreet meantime, by his détour, had flanked the swamp, and moved rapidly along the New Market road, bisecting at right angles the Quaker road, by which latter McClellan was passing, arriving about

noon within a mile of the junction of the two roads; which point he discovered to be occupied by the Union forces. By gaining possession of this important point he would cut the retreating army in two; and, though Jackson had not been heard from, the latter determined to attack. The Union line was formed at right angles with the New Market road, in front of the Quaker road. McCall's division of Pennsylvania Reserves held the point of intersection; Sumner in the rear and to the left of McCall; Hooker on the left and in advance of Sumner; on McCall's right was Kearney's division. Longstreet's own division formed the right of the Confederate line; that of A. P. Hill the left—all under Longstreet. At 3 P. M. Longstreet attacked the left of McCall's division, which hereupon changed front, and a vigorous fight of two hours' duration ensued, McCall holding his position. Meanwhile, desperate assaults were made upon the Union batteries on the right and centre, which were as often repulsed; but finally, by a determined charge, the 55th and 60th Virginia regiments succeeded in capturing Randall's battery after a desperate hand-to-hand fight with the supporting regiment. A renewed effort upon McCall's left meanwhile had succeeded in turning that flank, but the Confederates, following up their success, were taken in turn by a flank fire from Hooker, driving them across Sumner's front and on McCall's centre, which, with the right, remained unshaken; and Hooker and Kearney, now advancing, recovered part of the ground lost and repelled further attempts, which were continued till a late hour of the night. Jackson had during all this time been within sound of the battle, but all his efforts to cross the marsh and creek were repelled; and the battle was fought on the Confederate side by the divisions of Longstreet and A. P. Hill. Immediately after the close of the fight the Union troops resumed their retreat, together with Franklin's force, and by morning of the next day the whole army had arrived and were in position at Malvern Hill, and communication with the James ensured. The Union loss in this action, which is also known as Glendale and New Market Cross-roads, was about 1800 in killed and wounded; the Confederate loss about 2000.

Fre'co, tp. of Ouachita co., Ark. Pop. 868.

Frederi'ca, post-v. in South Murderkill hundred, Kent co., Del., 13 miles S. of Dover. Pop. 588.

Frederi'cia, town of Denmark, in Jutland, at the entrance of the Little Belt. It is fortified, and has considerable manufactures of tobacco. Pop. 7186.

Fred'erick, county of Maryland, extending from Pennsylvania to the Potomac River. Area, 642 square miles. On the W. is the South Mountain, and the Catoctin range breaks the surface of the county, the soil of which is very fertile. Limestone, copper, marble, and iron are abundant. Live-stock, grain, tobacco, wool, and hay are staple products. Flour, cooperage, leather, carriages, saddlery, cigars, metallic wares, clothing, furniture, etc. are among the manufactures. It is traversed by the Baltimore and Ohio and other railroads. Cap. Frederick. Pop. 47,572.

Frederick, the most northern county of Virginia, bounded on the N. E. and N. W. by West Virginia. Area, 378 square miles. It is a part of the fertile Valley of Virginia, and is broken by mountains. Grain is extensively produced. Flour is the principal article of manufacture. It is traversed by the Winchester and Strasburg R. R. Cap. Winchester. Pop. 16,596.

Frederick, tp. and post-v. of Schuyler co., Ill., on the Illinois River and the Rockford Rock Island and St. Louis R. R., 4 miles N. of Beardstown. Coal is found in the vicinity. Pop. of v. 669; of tp. 956.

Frederick, post-tp. of Montgomery co., Pa., on a branch of the Philadelphia and Reading R. R. Pop. 1818.

Frederick I., emperor of Germany. After Henry IV., emperor of the Holy Roman Empire, had been thoroughly humiliated by Pope Gregory VII. in the celebrated snow-covered courtyard of Canossa, he determined upon surrounding himself with a new and reliable set of followers. In pursuance of this policy he created Count Frederick von Büren duke of Suabia, and at the same time bestowed upon him the hand of his daughter Agnes. Von Büren shortly after removed his castle to the summit of a mountain named Hohen Stauffen, and was thenceforth always called by that name, though his family was also known by the name of Weiblingen, from the castle Weibling—a name which was changed subsequently by the Italians into Ghibelline. When Henry IV. died, Frederick served Henry V. with the same fidelity. Upon the death of the latter emperor the Salic line of German emperors became extinct, and a new election was ordered. Frederick was an applicant for the crown, but his haughty manner set the electors against him, and Lothair of Saxony was elected. Upon Lothair's death, which followed soon after his election, Conrad von Hohenstauffen, duke of Franconia and brother of Frederick, was elected king of Germany, but he was never crowned emperor by the pope. In 1147, when Bernard of Clairvaux started the second great crusade, Conrad was, after a long resistance, induced to join it, and took with him his nephew Frederick (b. 1121), son of Frederick of Suabia, whose merits made themselves so apparent to Conrad that after his return from the crusade, and when he felt his end approaching, he recommended his nephew to the German electors as his successor. Frederick Barbarossa (so named on account of his red beard) was thirty-one years old when the German princes elected him their king. He at once restored the Guelphic duke, Henry the Lion, to his dukedom of Bavaria, of which Conrad had dispossessed him, and having brought order into all the political affairs of Germany, went to his Lombardian possessions, where the larger cities had raised various disturbances. Frederick speedily restored order, and having proceeded to Rome, was there crowned emperor of the Holy Roman Empire in 1155 by Pope Adrian IV. He was in the zenith of his glory when he returned to Germany from this first expedition. Literature, art, and sciences now began to flourish in Germany, under Frederick's fostering care, as they had never flourished before. The cities of Lombardy, however, did not leave him long rest, and even the destruction of Milan by Frederick on his second expedition did not succeed in suppressing the spirit of revolt. Supported by the pope, Alexander III., three more insurrections took place, and when Frederick for the fifth time entered Italy to subdue his refractory subjects, he was terribly beaten at the battle of Legnano (1176). He then made peace with the pope, whose influence was supreme with the people of Lombardy, and hastened back to Germany to punish Henry the Lion, who had, forgetful of all Frederick's past generosity, refused to accompany him on that fifth expedition, and had thus virtually brought about its disastrous end. This was the beginning of the endless conflicts between the Ghibellines (Frederick's party) and the Guelphs (the party of Duke Henry). Henry was dispossessed of all his lands, and retired to the court of his father-in-law, Henry II. of England. His two dukedoms, Bavaria and Saxony, were divided into smaller parcels among the emperor's friends, and thus Frederick put an end to the overbearing rule of the great German dukes and made the imperial rule supreme in Germany. He now went once more to Italy, but this time in peace, and was everywhere received in triumph. His son Henry was crowned king of Lombardy (1186), and married to Constance, the heiress of the crown of the Two Sicilies. Upon his return Frederick organized the great crusade, in which Richard Cœur de Lion also took such prominent part. The unhappy conclusion of that crusade he was fortunately spared witnessing. While advancing in triumph at the head of his troops, after having stormed and taken the capital of the sultan of Credi, he was drowned in attempting to cross the Calycadnus, June 10, 1190, or, as some say, d. of a fever.

A. E. Kroeger.

Frederick II. of Germany, b. at Jesi, in the March of Ancona, Dec. 26, 1194. He was the son of Henry VI., and, though elected king of the Romans in 1196 and king of Naples and Sicily in 1209, and though duke of Suabia by inheritance, he did not succeed to the imperial crown until 1215, when, by the aid of the Ghibellines and Innocent III., his guardian, he successfully asserted his claim against Otho IV., promising the pope to go at once upon a crusade; but his long delay caused him much trouble with the popes, and the failure of his first two expeditions caused him to be twice excommunicated; and though at last he spent fifteen years in the Holy Land in successful warfare, taking Jerusalem (1229) and crowning himself king, he was never forgiven, and after his return was twice more excommunicated, and was involved in lifelong wars incited by the popes. D. at Fiorenzuola Dec. 13, 1250.

Frederick III. of Germany. This title is sometimes given to the duke of Austria, elected emperor in 1314, who reigned as joint emperor with Louis IV. from 1325 to his death, Jan. 13, 1330. By others he is reckoned as a king of Germany, but not an emperor. The Frederick III. of history was a son of Ernst, duke of Styria and Carinthia, b. at Innspruck Dec. 23, 1415; in 1440 was elected emperor. He reigned fifty-three years, the longest German reign, but this period was one of almost continual civil wars. The emperor was a man of virtue, fond of learning and quiet, and in spite of the confusions of his reign managed to strengthen greatly his own family, which for almost 400 years retained the imperial dignity, and which still bears sway in Austria. D. at Linz Aug. 19, 1443.

Frederick I., the first king of Prussia, was b. at Königsberg July 22, 1657; succeeded his father, Frederick William the Great, as elector of Prussia, with the title of

Frederick III., in 1688. Deformed and feeble from infancy, his training was slighted, but on coming to power he declared null the will of his father, by which his half-brothers received a part of his inheritance, and thereafter by skilful diplomacy greatly strengthened his influence in foreign parts, at the same time enriching his treasury with foreign gold, obtained by the lending of troops, and from time to time enlarging his boundaries at the expense of small neighboring states. In 1701, with the purchased consent of the emperor, he took the title of king. He maintained a splendid court, and was personally popular, though his excessive taxation was a grievous burden to the people. D. at Berlin Feb. 25, 1713.

Frederick II., called THE GREAT, king of Prussia from 1740 to 1786, was b. Jan. 24, 1712. His father, Frederick William I., was a rough, narrow-minded despot, subject to fits of senseless frenzy, and spending his time on the parade-ground, where he displayed no other talents than those of a drill-sergeant, or in the smoking-room, where he more than once was taken in by diplomatists who condescended to flatter his coarseness. The queen, Sophie Dorothea, a Hanoverian princess and sister to George II. of England, was a lady of refinement and education, rather than of talent and character; she suffered immensely from the violence of her husband, but, although she was without power, she was not without dignity. By her and by his earliest surroundings a taste for poetry and music was awakened in Frederick, and in after years this taste, strengthened by a natural talent, grew into a passion; he played the flute with great skill and delicacy, and his verses, although without poetic merit, were not without spirit. But this passion brought him into dangerous collisions with the father, who despised poetry and music as much as the son abhorred drilling and smoking. He was repeatedly exposed to the harshest treatment, and at last he determined to flee to his uncle, George II., but the plan was discovered; one of his helpers, Keith, escaped, but the other, Katt, was beheaded, and he was dragged to the window himself to look at the execution. It was indeed the king's idea to have the prince sentenced to death, and only the interference of the kings of Sweden and Poland saved his life. He was pardoned at last, but he was placed in a somewhat subordinate position in the civil administration, and was shortly after married against his will to Elizabeth Christine, princess of Brunswick-Bevern. Ruppin and Rheimsberg were then given him for support and residence. During his residence at Rheimsberg, however (from 1734 to 1740), he succeeded in somewhat mitigating his father's wrath by the administrative talent, the sense of order and economy, and the spirit of enterprise he evinced; and his intimate correspondence with Voltaire, his curious book against Macchiavelli, and his talents for entertaining and charming people who visited him drew the eyes of Europe on him.

On May 31, 1740, Frederick William I. died, leaving to his son a well-furnished treasury and an army of 70,000 men ready for battle. Shortly after, the emperor, Charles VI., also died, and, according to the Pragmatic Sanction, his daughter, Maria Theresa, succeeded to all his possessions. But in Dec., 1740, Frederick marched his army into Silesia, and without any declaration of war seized this whole province of the Austrian empire. At Mollwitz, his first battle, he fled, believing all to be lost, but his generals gained a brilliant victory, and the ridicule which by this curious opening of his military career he threw over his own name he very soon silenced by giving proofs of a most decided military talent. The rapidity of his movements, the decisiveness of his actions, amazed his adversaries, and after the victory at Chotusitz he kept Silesia by the Peace of Breslau (1742). Two years after, however, he had to fight again for his conquest, but his victories at Hohenfriedberg, Sorr, Hennersdorf, and Kesselsdorf compelled Austria once more to leave Silesia a Prussian possession by the Peace of Dresden (1745). This seemingly so unprovoked attack on Austria has often been denounced as a mere robbery, but the House of Hohenzollern had old claims on certain parts of Silesia, and the negotiations which the late emperor had carried on concerning a renunciation of these claims and a compensation in some other place looked very much like mere shifts. But the king of Prussia could by no means suffer himself to be slighted in that way. The kingdom of Prussia was only forty years old, and comprised only 2,000,000 inhabitants; it was recognized by the other European powers with a smile rather than with respect, and the king had to vindicate his position with audacity or to give it up entirely. There was hardly anything to blame in Frederick's proceedings with respect to Silesia, and, on the whole, he was as far from being a moral monster as from being a moral ideal. It is true he scoffed at religion, and the liberality with which he received and treated the Austrian Protestant immigrants was the result of religious indifference, worldly prudence, and perhaps some humane sympathy. It is also true he laughed at morality, and no falsehood, no trick, was too low for him when it was useful; his hirelings stole by help of false keys documents for him from the royal archives in Dresden. But he had, nevertheless, in certain relations a strong sense of duty, and as far as this sense went he discharged his duties with an energy and honesty which command respect. His relations to his own subjects show quite another man than his relations to foreign courts exhibit. From the documents stolen in Dresden, Frederick learned that there existed an alliance between Austria, Saxony, and Russia, apparently for the purpose of humiliating Prussia. He immediately threw his army into Saxony (Aug., 1756), and thus began the famous Seven Years' war, in which France and Sweden joined the allies, and England was the only power which sided with Frederick. Austrian, Saxon, and French armies entered his country from the S. The Swedes took his cities and closed his ports to the N., and from the E. the Russian hordes penetrated into the heart of his kingdom, plundered his capital, devastated and burnt his cities, murdered and massacred everywhere. He won great victories at Prague, Rossbach, Zorndorf, Torgau, and Freiberg, but he also suffered great reverses of fortune at Hochkirch and Kunersdorf, and the circle of his enemies was drawn closer and closer upon him. Still, to the very last his energy was unwearied, his perseverance unbroken, his resources unexhausted, and by the Peace of Hubertsburg (1763) he yielded not an inch of his land to his enemies; on the contrary, he secured to Prussia the final possession of Silesia and a respectable place in the political system of Europe. Indeed, all Europe was filled with his praise. He conquered his adversaries as much by the admiration he compelled them to feel for him as by his real talents; and his friends represented him as a prey for his neighbors' rapacity, as the champion of the Protestant religion, as a martyr for freedom, as a hero. But there was nothing heroic in this disciple of Voltaire, who always carried poison in his waistcoat pocket, except perhaps that heroism of despair which even egotism is capable of. In a hero there must be a positive idea, but there was no other idea in Frederick the Great than his own *I*; and that which alone can reconcile us to his enormous egotism is that he never separated himself from his people. He would probably never have bought the happiness of his subjects by sacrificing himself, but as little would he ever have secured his own interests by sacrificing the welfare of his subjects.

The whole character of Frederick's government shows, however, that he understood the relation between himself and his people only as a relation between king and subjects. That these subjects were a people, a nation, he had no idea of. He wished the Prussians to be better educated and become more enlightened, but only because he believed that thereby they would become better subjects. He wished science and art to flourish in his kingdom, but only because it would spread new splendor around the king. The wonderful progress which German civilization made in his time through Kant and Goethe he despised; he imported his philosophers and poets from France, and what was German he did not and would not understand. All his own writings are in French. This entire ignorance of certain ideas which in our days play the most prominent parts in politics explains many actions of Frederick the Great which otherwise would be without any excuse at all; as, for instance, his participation in the first division of Poland in 1772. He did not understand that in history the dismemberment of a nation corresponds to a murder in individual life. He no doubt considered the division as the easiest, most sensible, and most businesslike solution of a difficult and dangerous problem, and of course this view was to some extent promoted by the circumstance that the solution was advantageous to himself. He incurred, however, great odium, even among his contemporaries, for his action in this case, and traits of his private life and of his diplomatic negotiations utterly disparaging of his character were circulated with great malignity. He had fallen behind his time; he soon fell even behind himself. His quick and refined sensibility of former days became capricious, his energy restless, his wit coarse, his contempt and suspicion more cynical; at last a kind of stupor seemed to petrify him. He d. Aug. 17, 1786, sitting full dressed in his field chair at no in the room. CLEMENS PETERSEN.

Frederick Charles Nicholas, FIELD-MARSHAL PRINCE, b. at Berlin Mar. 20, 1828, a nephew of the emperor William of Germany, was educated at Bonn; entered the army in youth; served with distinction in Sleswick (1864); had an important share in the victory of Sadowa (1866), where he displayed great energy and skill; commanded the second German army (consisting of six army corps, with some 250,000 men and 800 guns) in the Franco-German war; had command in the siege operations against Metz, after the surrender was made a field-marshal.

and afterwards dispersed the army of the Loire in a six weeks' campaign.

Frederick William (THE GREAT), eleventh elector of Brandenburg, b. Feb. 6, 1620, succeeded his father, George William, in 1640, and found his dominions in a deplorable state of ruin, caused by the ravages of the Thirty Years' war and by the misrule of his predecessors; made an advantageous peace with Sweden (1648); reorganized the army; joined Sweden against the Poles in 1655, and freed Brandenburg from the Polish sovereignty, and was himself recognized as sovereign of Prussia (1663); took a leading part (1672–73) in the war with Louis XIV., and Louis having induced the Swedes to invade Prussia, the elector routed them at Fehrbellin (June 18, 1675), and by 1679 had expelled them from Prussia and Pomerania, but by the treaty of St.-Germain gave up a large part of his conquest in exchange for French gold. In 1685 he greatly enriched his provinces by offering an asylum to the French Protestants. The last years of his reign were devoted to the development of the material prosperity of his territories. D. at Potsdam Apr. 29, 1688.

Frederick William I., king of Prussia, b. at Berlin Aug. 15, 1688, succeeded his father, Frederick I., in 1713. He maintained a great standing army and a full treasury; forced the surrender of a large part of Swedish Pomerania to his sway, but paid for it from his treasury (1720); abolished feudal tenures (1717); was often cruel and unjust, as in the treatment of his son, the future Frederick the Great; had a whimsical passion for forming a guard of giant soldiers, for whom he found giant wives. His character was unamiable and full of apparent contradictions, and the ruling purpose of his life, to all appearance, was the assurance of the future greatness of his own family through the military and material greatness of Prussia. D. at Potsdam May 31, 1740.

Frederick William II., king of Prussia, b. Sept. 25, 1744, succeeded his uncle, Frederick the Great, in 1786, and by a natural reaction from the enforced severity of his previous life entered upon a course of immoderate luxury. The trans-Rhenish provinces were lost to the French republic in 1795, but his share in the second and third partitions of Poland (1793–95) largely extended his sway. His extravagance and tyranny were offset by legal reforms and the encouragement of Prussian industries. D. Nov. 16, 1797.

Frederick William III. of Prussia, b. Aug. 3, 1770, succeeded his father, Frederick William II., in 1797; undertook at once the reform of the abuses of his father's reign, and by treaties increased his dominions. He kept the peace with Napoleon, but having exchanged Franconia for Hanover, which was ceded to him by the French (1805), he was involved with England, and felt compelled to demand neutrality of Napoleon. The latter fell upon him, and the battles of Jena, Auerstadt, Eylau, and Friedland, followed by the Peace of Tilsit (1807), made Prussia virtually a French province, and reduced it to half its former extent; but thorough political reforms, the abolition of serfdom, the sale of royal domains and of church property, and the reorganization of the army, went far toward making the calamity of Prussia a great blessing. In the Russian invasion of 1812 the Prussian contingent was very wisely allowed to escape unharmed by Diebitsch; and in 1813 the War of Liberation from the French was inaugurated; the battles of Lützen, Bautzen, Leipsic, and Brienne, and the occupation of Paris by the allies followed, and Prussia became more powerful than ever before, chiefly at the expense of Saxony. At Waterloo the Prussian army too performed a most important part. In the closing years of his reign a conservative policy was adopted. D. June 7, 1840.

Frederick William IV. of Prussia, b. Oct. 15, 1795, was carefully educated; served in the wars against Napoleon, and was exceedingly popular in early life. In 1840 he succeeded his father, Frederick William III., and by his reactionary policy disappointed the high hopes which had been indulged regarding him. The affairs of the Zollverein (established 1819) were so managed as to increase Prussian influence, and internal improvements were pushed forward, but in 1841 the king refused the request of the estates for a constitution, and repeatedly declared that the estates should be convened only at his own will, and then only as an advisory body, with no legislative power. The revolution of 1848 followed, but the victories of the army gave the king confidence, and in place of the constitutions proposed by the revolutionists, he promulgated one of his own and dissolved the popular assembly. In 1849 he declined the imperial crown tendered him by the Frankfort Diet. In 1858 he became insane, and d. Jan. 21, 1861.

Frederick William, crown prince of Germany and Prussia, b. near Potsdam Oct. 18, 1831, son of the present emperor, William I., was educated at Königsberg; married in 1858 the eldest daughter of Queen Victoria; entered the military service in early life; bore an important part in the Austro-Prussian war of 1866, in which he commanded the second army, numbering some 125,000. During the Franco-Prussian war he led the third army, which consisted of about 200,000 men and 500 guns; won the victories of Weissenburg and Wörth, and bore a distinguished part in the succeeding events of that war. He has the rank of general field-marshal and general inspector in the German army.

Frederick City, cap. of Frederick co., Md., is situated in a rich and fertile valley on the Baltimore and Ohio R. R., which connects it with the cities of Washington and Baltimore, also with Pennsylvania and the West. It lies within 3 miles of the Monocacy battle-field, and 12 miles from the battle-field of South Mountain. The Confederate army, under Gen. Robert E. Lee, occupied Frederick City for six days from Sept. 6, 1862, and on the 12th of the same month the Union army, under Gen. McClellan, entered and occupied the city. On July 9, 1864, it was again occupied by the Confederate army, under Gen. Jubal Early, who demanded and received as a ransom from her citizens $200,000. The remains of Francis S. Key, a native of Frederick county, and the author of *The Star-Spangled Banner*, are buried in the cemetery adjoining the city, and the body of Roger B. Taney, late chief-justice of the Supreme Court of the U. S., is interred in the old graveyard belonging to the Catholic church of Frederick City. Barbara Frietchie, the good old dame who has been immortalized in verse by the poet Whittier, is buried in the same cemetery with Francis S. Key, and not far from the spot where his remains repose. Frederick City is noted for its good health, its pure mountain-air, and the excellent quality of its water. It has 4 national and 2 State banks, the deaf and dumb institute of Maryland, 2 colleges, 2 female seminaries, public schools, 12 churches, 3 foundries, one fruit and vegetable canning establishment, which in the busy season affords employment for 500 hands; 3 planing mills, 4 large tanneries, 6 hotels, 3 newspapers, 2 fire insurance companies, 3 brick manufactories, fine dry-goods, grocery, and drug stores, gas and water works, 3 fire companies, temperance and Christian associations, Masonic, Odd Fellows, Improved Order of Red Men, Harrigari, and Knights of Pythias lodges; 10 turnpikes into the city, 2 coach-factories, 2 flour-mills, 1 nunnery, 1 novitiate, and a new, very large, and magnificent city hall. Pop. of city, 8526; of tp., exclusive of city, 3378.

CHARLES COLE, ED. "THE MARYLAND UNION."

Fred'ericksburg, post-v. of Posey tp., Washington co., Ind. Pop. 160.

Fredericksburg, post-tp. of Chickasaw co., Ia. P. 611.

Fredericksburg, a v. of Salem tp., Warren co., O. Pop. 64.

Fredericksburg, post-v. of Salt Creek tp., Wayne co., O., on the Cleveland Mount Vernon and Delaware R. R. Pop. 539.

Fredericksburg, post-v. of Bethel tp., Lebanon co., Pa. Pop. 480.

Fredericksburg, post-v., cap. of Gillespie co., Tex., 85 miles W. of Austin, has 5 churches, a convent school, 3 other schools, 3 flouring and 3 saw mills, 2 weekly newspapers (1 English and 1 German), and a lively trade in wheat, corn, and merchandise. The situation is elevated and healthful. It was settled in 1846 by a German colony. Pop. 1164, much increased since the census.

T. W. SWILLING, ED. "SENTINEL."

Fredericksburg, city of Spottsylvania co., Va., on the S. bank of the Rappahannock River, at the head of tide-water, 92 miles from its mouth. The river is navigable for steamers and sailing vessels. It is on the Richmond Fredericksburg and Potomac R. R., 60 miles S. of Washington, 13 miles S. of the Potomac, and 61 miles N. of Richmond, and on the (incomplete) Fredericksburg Orange and Charlottesville R. R. It has a very great water-power, for a dam has been constructed across the Rappahannock just above the city, rendering available the whole water-power of the river. This dam, built under the supervision of Mr. John Chase of Holyoke, Mass., is 900 feet long and 18 feet high, giving a fall of 48 feet 2 inches, and affording some 4000 horse-power, of which only one-tenth is now utilized. There are several large flouring-mills, which produce the wheat flour for which Fredericksburg is so famous; also 2 large iron-foundries, an extensive woollen-mill, and a paper manufactory. Fredericksburg was the scene of several bloody contests during the late civil war. It has a national bank, 8 churches, and 4 semi-weekly newspapers. Pop. 4046. J. H. KELLY, ED. "HERALD."

Fredericksburg, Battle of. The Union Army of the Potomac, resting on its arms after the battle of Antietam, had been reorganized and equipped when (Oct. 26–

Nov. 2, 1862) it crossed the Potomac River at Berlin, 5 miles below Harper's Ferry. The Confederate army of Northern Virginia lay, meanwhile, in the vicinity of Winchester. Directing his course southward towards Warrenton, McClellan, by guarding the passes of the Blue Ridge, through which he threatened to issue, succeeded in screening his intention so far that on the arrival of the army at Warrenton (Nov. 9), while one half of Lee's army, which had moved parallel with McClellan's, was at Culpeper, the other half, under Jackson, was scattered through the Shenandoah Valley, the two wings separated from each other by fully two days' march. McClellan's intention appears to have been, by moving obliquely westward from Warrenton, to interpose his army between the dismembered Confederate forces; but on the night of Nov. 7 he was relieved from his command and succeeded by Gen. A. E. Burnside. Gen. Burnside assumed command unwillingly, and publicly expressed his sense of inability to command so large an army. Accepting the direction thus reluctantly, he abandoned McClellan's plan of operations, and halted his army at Warrenton for the purpose of consolidating the six corps of which it was composed into three grand divisions of two corps each. The right grand division was placed under Gen. Sumner; the centre grand division under Gen. Hooker; and the left grand division under Gen. Franklin. Richmond being Burnside's objective point, he submitted a plan to the general-in-chief, in which he declared his intention of moving his army to Fredericksburg, from which he proposed to advance upon Richmond by the line of the railroad. This project was at first disapproved at Washington, but finally assented to, and on Nov. 15 the army was put in motion for Falmouth, on the N. bank of the Rappahannock, to cross thence to Fredericksburg opposite, and secure possession of the heights in rear of that city. In pursuance of this plan, Sumner's grand division, in advance, reached Falmouth on the 17th. At this time Fredericksburg was occupied by but one regiment of cavalry, four companies of infantry, and a light battery, which latter opened fire on Sumner's advance, but was soon silenced by the fire of a Union battery; the river was besides, at this time, fordable at points, and Sumner on the night of the 17th asked for orders to cross and take possession of the city, which Burnside declined to give "until his communications were established." During the 19th and 20th the remainder of the army arrived and took position along the Rappahannock. In the mean time, Lee, discovering Burnside's intention, directed Longstreet from Culpeper to Fredericksburg, where his advance arrived on the 19th, to which point Jackson was also ordered, arriving in the vicinity a few days later. The task of obtaining possession of the heights had even now become formidable, but a further delay was occasioned by the non-arrival of the ponton trains which had been ordered from Washington, and it was not until Dec. 10 that the preparations for crossing were completed, by which time the entire Confederate army had arrived, and the ridge in rear of Fredericksburg been fortified. The river at this point takes a nearly southerly direction, on each side of which are commanding heights; those on the S. (or W.) rise at a distance of from one-third of a mile to 2 miles beyond the river-bank, extending from above and to the rear of the city some 6 miles down to Massaponax Valley, gradually diminishing in height and sinking away towards this point, leaving a broken intermediate plain, which, in rear of Fredericksburg, is traversed by a canal, at right angles with which, and leading up to the heights, run the telegraph and plank roads. Back of this first ridge is an elevated plateau, and then a second terrace of hills, also fortified. The plain of a third of a mile deep between Fredericksburg and the first ridge was the theatre of Sumner's operations. The heights on the N. (or E.) bank fall rapidly down to the river, commanding those on the opposite bank, which latter, however, command the intermediate plain, across which they can only be assailed. This position in rear of the town formed the left of the Confederate line, held by Longstreet's corps, extending to the river above, the right of which was held by Jackson's corps, 2 miles below the town; Stuart, with two brigades of cavalry and his horse artillery, forming the extreme right, extending to Massaponax Creek. The preliminary preparations being completed, it was determined to force the passage of the river the next morning (Dec. 11). Burnside's plan was to cross by five ponton bridges—three opposite the city, and two below some 2 miles; on the former of which Sumner's and Hooker's divisions were to cross; Franklin's and part of Hooker's on the latter; the rest of Hooker's to be held in reserve. The spanning of the river at the latter point, where the plain attains its greatest width and was swept by the Union artillery, was accomplished by noon; but the attempt above was met by a severe fire from the sharpshooters posted behind the walls and houses along the river front, compelling the cessation of work, notwithstanding the severe bombardment to which the city was subjected by the Union batteries, firing it in several places, but which was without effect upon the low ground held by the sharpshooters, until, by the happy suggestion of Gen. Hunt, chief of artillery, several ponton boats were filled with troops and rowed to the opposite bank, from which they drove the Confederates, and the bridges were soon after established. No attempt had been made by Lee from the heights to oppose the crossing. The entire division of Sumner was crossed over that night and the next day, and the city occupied, Franklin crossing at the same time below. The 12th was consumed in completing the crossing of the river and disposing the forces.

Thus, two days had elapsed since the commencement of the crossing, by which time the Confederate army had assembled in its naturally strong positions, now strengthened by fortifications, whereas the only hope of a favorable result to Burnside's plan lay in the crossing being made a surprise. For prudential reasons alone the plan should now have been abandoned, or at least new dispositions adopted for its execution. To add to the critical situation, a misunderstanding occurred between Gen. Burnside and his division commanders as to the part to be taken by them the coming day. The plan of attack, as determined upon the night of the 12th, was for Franklin, with his division and a part of Hooker's, to make the attack in force on the left, while Gen. Sumner's attack on the heights in rear of the town was to be made contingent on Franklin's success. The terms of Burnside's instructions to Franklin on the morning of the 13th, however, led him to conclude that Burnside had altered his determination of the night previous, and now contemplated only an armed reconnaissance with a single division. In this interpretation Franklin was supported by his corps commanders, Reynolds and W. F. Smith. Sumner's instructions were to "form a column of a division for the purpose of pushing in the direction of the telegraph and plank roads, and seizing the heights in rear of the town, holding another division ready to advance in support." The morning of the 13th opened with a heavy fog, which filled the valley and delayed operations for some time. About 10 A. M. the fog lifted, disclosing Franklin advancing, who, construing Burnside's orders liberally, advanced Meade's division, with Gibbon's in support on the right, and Doubleday's in reserve. Advancing along the plain, Meade's left soon encountered a fire from Stuart's batteries, placed on the Port Royal road, which being soon silenced, he moved forward, shelling the wooded heights in his front, and causing considerable damage to Jackson's advanced line, but without drawing its fire till he arrived at short range, when the Confederate batteries opened with shell and canister, doing much damage, through which Meade continued, driving three Confederate batteries back from in advance of the railroad, and attacking vigorously Hill's division, pierced its lines, sweeping it back to the right and left, capturing 200 prisoners. Crossing the railroad and pushing up the ridge, he met Gregg's brigade holding a line along a new military road constructed for affording direct communication between the wings of Lee's army, behind which was Jackson's second line. For a moment Gregg mistook the advancing column for a body of Confederate troops, and withheld his fire, but soon discovering his error, the brigade now poured in its fire at close range, and Early's division advancing, Meade was assailed in front and on both flanks, and driven back with much loss. Gibbon, who had not advanced as far as Meade, now met the retreating columns, somewhat checking the pursuit, but Jackson being reinforced from Longstreet's right, the two divisions were driven still farther back. In the mean time, Birney's division from Hooker's grand division had been sent forward, and now opened such a fire upon the Confederates that they abandoned further pursuit, and retired to their old position on the crest.

On the right affairs were still more serious. In obedience to his instructions, Sumner had ordered forward French's division (2d corps) from Fredericksburg about noon, to be followed and supported by Hancock's. Moving out on the telegraph and plank roads and crossing the canal, French, under cover of a knoll, deployed his columns with brigade front. Even while emerging from the town the Confederate batteries on the heights opened a destructive fire, to which the Union batteries on the opposite bank could not reply without endangering their own men. As his advance line, Longstreet held the stone wall and rifle-pits along the telegraph road at the foot of Marye's Hill. Of this position Gen. Kershaw (Confederate) says: "Marye's Hill, covered with batteries, falls off abruptly toward Fredericksburg to a stone wall which forms a terrace on the side of the hill and the outer margin of a road which winds along the foot of the hill. This road is about 25 feet wide, and is faced by a stone wall about 4 feet high on the city side.

The road, having been cut in the side of the hill in many places, is not visible above the surface of the ground." This position was of such strength, the defenders being under complete protection, that but 1700 men were found necessary to occupy it. Moreover, the whole plain, a quarter of a mile in width, over which the attacking army must pass, was swept by a direct and enfilade fire from the batteries crowning the semicircular crest above on the plateau, behind which lay the main body of the Confederates. By his orders nothing remained but for French to assail the position. Advancing his columns upon the narrow plain, they were at once met by a fire from the batteries above, which ploughed through their ranks; but, closing up, they pressed forward and had crossed about half the interval when they were met by volley upon volley of musketry from the sunken road, before which their shattered columns fell back with a loss numbering nearly half their force. Following close behind came Hancock, who now advanced, joined by such of French's command as retained their organization, up to and beyond the point reached by French, but were compelled to retire by the same deadly fire with a loss of more than 2000 men. Howard's division now at hand, with Sturgis' and Getty's divisions (9th corps), advanced to the support of the 2d corps, with the only result of holding an advanced line on the plain under a constant artillery fire. Burnside, who had witnessed from the opposite shore the failure of the repeated assaults, still determined to carry the crest that night, and ordered Hooker in to renew the assault. Hooker crossed with three divisions, and after communicating with those who had gone before, returned to Burnside and endeavored to dissuade him from further attack. Burnside, however, was immovable. Already two batteries had been thrown forward to within 150 yards of the enemy's line, and an attempt made to open a breach, but no fire could touch the sunken road, and the effect was imperceptible. About sunset Humphrey's division was ordered to renew the assault with unloaded muskets, there being no time to load and fire. Advancing nearly up to the stone wall, they too were met by the same resistless shower of bullets, and, like those who had gone before, driven back with a loss of 1700 out of 4000 in the short space of 15 minutes. The attack was not renewed by Hooker. "Finding," says he, "that I had lost as many as my orders required me to lose, I suspended the attack, and directed that the men should hold for an advanced line a ditch which would afford shelter." The Confederates rested on their arms that night, anticipating a renewal of the attack next day, for they were unaware of the loss they had inflicted. Gen. Burnside indeed determined to renew the assault, and had given orders to that effect, when he was finally dissuaded by the earnest entreaties of Gen. Sumner, who agreed with every other corps commander upon the hopelessness of such an assault. Both armies remained in position till the night of the 15th, when, during a violent storm, Gen. Burnside withdrew his forces to the N. bank of the river. The Union loss at Fredericksburg is officially reported at 1138 killed, 9105 wounded, and 2078 missing; total, 12,321. The Confederate loss was 595 in killed, 4061 wounded, 563 missing; total, 5309. Eight days later Gen. Burnside was removed from the command of the army.

Fred'ericktown, post-v., cap. of Madison co., Mo., on the St. Louis and Iron Mountain R. R., 105 miles S. of St. Louis and 4 miles from the celebrated Mine la Motte lead-mines. It has a number of stores and shops, 4 school-houses, 5 churches, and 1 weekly newspaper. Pop. 601.
E. P. CARUTHERS, ED. AND PUB. "THE BEE."

Fredericktown, post-v. of Knox co., O., on the Lake Erie division of the Baltimore and Ohio R. R., 45 miles N. E. of Columbus; has 4 dry-goods, 2 drug, and 2 hardware stores, 1 bank, 2 hotels, 1 plough and farm-bell foundry, 2 carriage manufactories, 1 weekly newspaper, and 3 churches. Pop. 690. C. W. TOWNSEND, ED. "INDEPENDENT."

Fred'ericton, a beautiful city, the cap. of New Brunswick and of York co., is situated on a plain on the right bank of the river St. John, 84 miles from its mouth. It is finely laid out, and has many handsome buildings. Among the public buildings of importance may be named the government-house, the province building, court-house, city hall, barracks, the exhibition building, the dépôt of the Fredericton Railway (which extends 22 miles to Fredericton Junction (Blissville) on the European and North American Railway), the University of New Brunswick, a flourishing institution, 8 churches, Christ church cathedral (Anglican), the custom-house, jail, etc. Fredericton is the seat of an Anglican bishop. The river is navigable to this point by large steamers; above, small steamers ply during high water, proceeding as far as the Grand Falls. A steam-ferry connects it with St. Mary's, on the opposite bank of the river. The city is lighted with gas. Besides the institutions already mentioned there are several libraries, a reading room, a bank, a Baptist seminary, 4 weekly newspapers, circuit, divorce, vice-admiralty, jurisdiction, probate, piracy, and county courts, a collegiate school, provincial training and model schools, and a steam fire department. The city is divided into five wards—Wellington, St. Ann's, Carleton, Queen's, and King's. Pop. in 1871, 6006.

Fredericton Junction. See BLISSVILLE.

Frederi'ka, post-tp. of Bremer co., Ia. Pop. 389.

Fred'erikshall, town of Norway, in the stift of Aggershuus. It is a strong fortress. Here Charles XII. of Sweden was killed in 1718. It has a fine harbor. Pop. 7408.

Fred'erikshamn [Finnish, *Hamina*], town of Russia, in the grand duchy of Finland, on the Gulf of Finland, in lat. 60° 27′ N. The treaty by which Finland was ceded to Russia was signed here in 1809. Pop. 3278.

Fred'erikstad, a fortified seaport of Norway, 50 miles S. E. of Christiania, at the mouth of the Glommen, has a spacious harbor, a good trade, and thriving manufactures. Pop. with surroundings, 6833.

Fredo'nia, post-tp. of Chambers co., Ala. Pop. 1186.

Fredonia, post-v. of Ohio tp., Crawford co., Ind. Pop. 72.

Fredonia, post-v. of Concord tp., Louisa co., Ia., on the Cedar River and the Chicago Rock Island and Pacific R. R. Pop. 150.

Fredonia, post-v., cap. of Wilson co., Kan., near Fall River, and on the M. and N. R. R., in a fine farming region. It has 3 churches, 2 banks, 2 schools, a weekly newspaper, 3 hotels, a mill, etc. W. A. PEFFER, ED. "JOURNAL."

Fredonia, post-v. of Caldwell co., Ky. Pop. 155.

Fredonia, tp. of Calhoun co., Mich. Pop. 1031.

Fredonia, post-v. of Chautauqua co., N. Y., in Pomfret tp., and on the Dunkirk Warren and Pittsburg R. R., 40 miles S. W. of Buffalo and 3 miles from Lake Erie. It has a State normal school (built by the village at a cost of $100,000), 2 weekly newspapers, 5 churches, and a street-railroad running to Dunkirk, 3 miles distant. The village has for more than forty years been lighted with natural gas, obtained by boring into the bituminous shale; one of the gas-wells is over 1000 feet deep. The raising of garden-seeds and of grapes, and the manufacture of carriages, are extensively carried on. There are 2 fire companies, 1 national and 2 private banks, and various public and private halls. The first grange of the Patrons of Husbandry was organized here. The first academy in Western New York was established here in 1824; its library of some 2000 volumes has been transferred to the normal school building. Pop. 2546. W. MCKINSTRY, ED. "CENSOR."

Fredonia, post-v. of McKean tp., Licking co., O. Pop. 99.

Fredonia, post-tp. of Ozaukee co., Wis., on the Wisconsin Central R. R., 33 miles N. of Milwaukee. P. 1688.

Free'born, county of Minnesota, bordering on Iowa. Area, 720 square miles. It is fertile, and diversified by timber, prairie, lakes, and streams. Grain, hay, and dairy products are the staples. It is traversed by the Southern Minnesota R. R. Game is abundant. Cap. Albert Lea. Pop. 10,578.

Freeborn, post-tp. of Freeborn co., Minn. Pop. 362.

Freeborn, tp. of Dunklin co., Mo. Pop. 1104.

Free'burg, post-v. of St. Clair co., Ill., on the St. Louis Alton and Terre Haute R. R., 22 miles S. E. of St. Louis. Pop. 920.

Freeburg, post-v. of Snyder co., Pa. It has 2 churches, an academy, 1 musical college, a town-hall, 5 dry-goods stores, a drug-store, 3 hotels, 1 grist-mill, 2 weekly newspapers, a marble-yard, etc. Principal business, farming and ore mining. D. B. AND C. F. MOYER, EDS. "COURIER."

Free Chap'el, tp. of St. Clair co., Ala. Pop. 873.

Free Church of Scotland. The movement in the Church of Scotland which terminated in the formation of the Free Church is closely connected with controversies which have lasted for more than 300 years. (For the earlier history of these controversies we refer the reader to the article SCOTLAND, REFORMED CHURCH OF.) In 1647 an act of the Assembly of the Scottish Kirk was passed, adopting the Westminster Confession with two modifications—the one in favor of the system of Presbytery, which is omitted from the Confession, and the other affirming the right of the Church to meet in synods and assemblies without the consent of the magistrate.* On Mar. 9, 1649, the Scottish Parliament passed an act abolishing patronage in the Kirk, as being unlawful and unwarrantable by the word of God

* Innes, 65.

and contrary to the doctrines and liberties of the Church. The General Assembly in June of the same year passed an act entitled "The Directory for the Election of Ministers," in which it was declared that the kirk session, or board of elders elected by the congregation, should elect the minister, and intimate their election to the congregation for their approbation; if the majority dissented, another election was to take place. No minister was to be settled but "upon the suit and calling of the congregation." The session elected, but the congregation must mark their consent by an orderly call before the settlement could take place. This Assembly completed what is usually spoken of as the Second Reformation of the Kirk, in which the great principles of her Presbyterian constitution and her inherent right of spiritual jurisdiction were vindicated.*

After the restoration of Charles II. patronage was restored in connection with the introduction of the episcopal form of church government.

We pass on to the union of the two kingdoms of England and Scotland and the merging of the two legislatures in one Parliament. This was preceded by a succession of legislative acts which were intended to secure to the Scottish nation, by the most solemn guaranties, the maintenance of the doctrines, principles, and government of the Kirk. In 1705, the act for securing the Protestant religion and Presbyterian church government was passed by the Scottish Parliament, and was afterwards incorporated into both the Scottish and English acts for ratifying and approving the union. This act received the royal sanction in 1707, when the union was consummated, and has been regarded by Scotchmen not as a simple legislative statute, but as a fundamental and essential condition of the treaty of union.† This important act not only confirms the act of 1690, ratifying the Confession of Faith and settling the Presbyterian church government, but also the other acts which followed that, abolishing the royal supremacy, and substituting the election of the session and the call of the congregation for the presentation by lay patrons. But in 1711 the famous act of Queen Anne for the restoration of patronage was passed, and on this act the present practice of patronage in the Church of Scotland rests. All parties in the Kirk united in resisting the restoration of patronage; the General Assembly, while yielding to it, continued for many years to protest against it. Lord Macaulay thus speaks of the serious consequences of this alleged breach of the constitution of the Church of Scotland: "The British legislature violated the articles of union and made a change in the constitution of the Church of Scotland. From that change has flowed almost all the dissent now existing in Scotland. Year after year the General Assembly protested against the violation, but in vain, and from the act of 1711 undoubtedly flowed every secession and schism that has taken place in the Church of Scotland."‡

The question here arises as to whether the terms of the Revolution settlement, subsequently ratified by the treaty of union between England and Scotland, are legally so stringent that they could not be altered by subsequent legislation without a breach of the covenant. It must be noticed that it has proved to be impossible for one generation to bind all those who succeed it in any department of human interest, and least of all in the sphere of religion. The acts that were embodied in the treaty of union required all university professors to sign the Confession of Faith and submit to the government and discipline of the Kirk. This was, equally with the abolition of patronage, a fundamental condition of the union; but in 1853 a Universities (Scotland) Act was passed by the Parliament which limited this subscription to theological professors. In the present condition of parties in Scotland the right of the legislature to make this change will scarcely be questioned. The subject in its purely legal aspect is not without difficulties, but it cannot be maintained that the legislature of to-day is bound to perpetuate what it regards as inexpedient or even wrong, because it was a condition of the treaty of union 200 years ago.

It must, however, be borne in mind that the act of Queen Anne which abolished patronage was in direct opposition to the declared principles of the Church of Scotland and to various solemn acts both of the General Assembly and of Parliament. No change in the opinions of the Scottish Church or nation had taken place to warrant such a breach upon the constitution of the Kirk, and the measure was passed in spite of the earnest remonstrance and protest of the Church and nation. Apart, therefore, from the grave question in reference to the irrevocableness of any statute, the act itself was unwarranted, and its consequences were as serious as Lord Macaulay has represented them to be.

The history of the Church of Scotland from 1711 to 1834 is marked by many instances of the intrusion of ministers into parishes against the will of the people. In 17[illegible] the Assembly passed an act against the intrusion of ministers into vacant parishes, and up to 1784 the Assembly continued from year to year to remonstrate against the law of patronage, and instructed each succeeding commission § to make application to the king and Parliament for redress of the grievance. A case of disputed settlement under the patronage act led to the first Secession, in 1733, and another case of the same kind led to the formation of the Relief Church in 1752.

A full statement of the facts of these Secessions belongs properly to the history of the United Presbyterian Church in Scotland. From the time of the second Secession the dominant party in the Church continued to enforce the law of patronage for many years, but a minority within the Church continued to protest against the intrusion of ministers and to contend for the doctrine of spiritual independence. About the beginning of this century the party opposed to patronage, now known as the "Evangelical party," was greatly increased. The settlement of Dr. Andrew Thomson as minister of St. George's church, Edinburgh, in 1810, and the subsequent publication of the *Christian Instructor* under his management as editor, gave a great impulse to the Evangelicals.‖ In his work of rousing the energies of the Scottish people to seek ecclesiastical reform he was joined by Dr. Thomas McCrie, the historian, and shortly afterwards, in 1815, Dr. Thomas Chalmers was removed from the country parish of Kilmany to the Tron church of Glasgow, and threw all his talents and energies into the same great work. These three ministers were of those men who stamp the impress of their own characters upon the age in which they live, and were influenced by the same strong, lofty views of the independence of the Church, and by the same ardent love for the principles which they regarded as fundamental to the constitution of the Reformed Church of Scotland. In 1825 an anti-patronage society was formed, the most active member of which was Dr. Andrew Thomson, but the majority of the Evangelical party declined to unite with it, and continued to seek the regulation and control of the law without contemplating its total abolition. In 1832 overtures from three synods and eight presbyteries were laid on the table of the General Assembly, representing that the call had been reduced to a mere formality, and praying that measures be adopted to restore it to its constitutional and salutary efficiency. A motion declaring it to be inexpedient to take any action was carried by a majority of 42. At the Assembly in 1833 no less than 45 overtures asking for the restoration of the call to its proper place in the constitution of the Church were presented. Dr. Chalmers moved that the dissent of a majority of the parishioners be conclusive against the settlement of a minister, provided the objections were not founded on malice or caprice. A motion, in effect continuing the practice then in use, was carried by a majority of 12. The agitation of the subject was continued, and at the General Assembly of the following year (1834) a great number of overtures brought up the discussion of the call, and a motion made by Lord Moncrieff to the same purport as that made by Dr. Chalmers in the preceding year was carried by a majority of 46. The act on calls, generally known as the "veto act," was only a half measure; instead of giving any direct efficacy to the call of the people, which was what the constitutional principles of the Church warranted, it simply rendered the dissent of the people conclusive against the presentee; but the passage of this act marks the beginning of the "ten years' conflict" between the ecclesiastical and the civil power in Scotland. The first case that arose under this new act will serve as an illustration of the conflict which was carried on between the co-ordinate courts. The church and parish of Auchterarder having become vacant in Aug., 1834, on Sept. 16 thereafter the earl of Kinnoul, as patron, issued a presentation in favor of Mr. Robert Young, a licentiate of the Church. The call was laid before the presbytery on Oct. 14, and in terms of the veto act and its relative regulations the matter was brought before the parishioners. The call was signed by the earl of Kinnoul's factor, not a resident in the parish, and by two heads of families. On the other hand, 287 heads of families, being communicants, subscribed a dissent from the call; in consequence of this the presbytery rejected Mr. Young as presentee to the parish. Mr. Young appealed first to the synod, and afterwards to the Assembly, but both of these courts reaffirmed the decision of the presbytery by large majorities. Thereupon the

* Baillie, Hetherington, and Innes. † Act of Security, Innes, 117. ‡ Macaulay, *Speeches*, ii. 180.

§ The commission of Assembly is a kind of committee of the whole, which has power to meet at any time of the year in reference to any matters which may affect the interests of the Church.

‖ We use the terms *Evangelicals* and *Moderates* to save circumlocution.

earl of Kinnoul and Mr. Young instituted a process in the court of session,* contending that the rejection of Mr. Young as presentee was *ultra vires* of the presbytery, in violation of the statutes, and to the serious injury of their patrimonial rights as patron and presentee. The presbytery of Auchterarder asked advice of the commission of Assembly which met Nov., 1835, and the commission instructed their procurator, or legal agent, to conduct the defence at the expense of the Church. On Mar. 8, 1838, the court gave its decision by a majority of three—the numbers being eight and five—to the effect that the presbytery had acted to the hurt and prejudice of the patron and presentee, illegally and in violation of their duty, and contrary to the provisions of the statute of Queen Anne for the restoration of the rights of patrons. At the next meeting of the presbytery of Auchterarder the whole matter was referred to the synod, and from thence sent up to the General Assembly, which met in May, 1838. The Assembly authorized the procurator of the Church to appeal the case to the House of Lords, and on May 3, 1839, the judgment of the House of Lords was given to the effect that the appeal be dismissed and the decision of the court of session affirmed. Thus, the highest legal judicatory in the kingdom declared the veto act to be illegal, and that the law recognizes neither the call nor the objections of the people in the appointment and ordination of a minister to a parish, and that if they interfere with the patron in the exercise of his right, they must be put down. A crisis had now arrived, and the General Assembly of 1839 met prepared to deliberate on the course to be taken. Dr. Cook, as leader of what was called the Moderate party, moved, in effect, that as the veto act had been pronounced illegal by the supreme civil tribunals of the country, the General Assembly should instruct all presbyteries to proceed in the settlement of parishes according to the practice which prevailed previously to the passing of that act. Dr. Chalmers, as leader of the Non-intrusion party, moved a resolution affirming the readiness of the Church to give obedience to the civil courts so far as the civil rights and emoluments of the Church were concerned, but at the same time declaring the principle of non-intrusion to be an integral part of the constitution of the Reformed Kirk of Scotland, and that the principle could not be abandoned; therefore no presentee should be forced upon any parish contrary to the will of the congregation. This resolution further provided for the appointment of a committee with instructions to confer with the government of the country with a view to the restoration of harmony between Church and State. This motion was carried in the Assembly by a majority of 49; it declared in effect that the civil courts might do what they chose with the emoluments of the parish of Auchterarder, but that the Church courts could not proceed at the dictation of these courts to the ordination and settlement of Mr. Young. Thus terminated for a time the Auchterarder case, but the collision between the Kirk and the civil courts continued.

The position of the Church was becoming more and more difficult and complicated. The Non-intrusionists were willing to abandon the temporalities of the benefices, and claimed for the Church only spiritual and pastoral rights; but this was met, on the part of the civil courts, by the principle that ministers of the National Church were statutory functionaries, bound to perform their duties as fixed by the supreme courts, and that they could not evade these duties by merely abandoning the emoluments. Meanwhile, some attempts were made to afford relief from this conflict of jurisdiction by means of legislation. In May, 1846, the earl of Aberdeen brought forward a bill on the Church question, but it failed to meet the difficulties, inasmuch as it acknowledged the validity neither of the veto nor of the direct call, and left the proceedings of the Church courts subject to the review of the court of session. After a second reading it was withdrawn. The General Assembly of 1842 transmitted to the Crown "the Claim, Declaration, and Protest anent the encroachments of the court of session." "The Claim of Rights," as it was called, is a most valuable historical document, gathering up the principles of the majority in the Assembly, and giving a comprehensive statement of the scriptural, constitutional, and legal grounds on which these principles rested, of the wrongs which the Church had sustained from the civil courts, and of the claim for protection which she put forth. It closed with a solemn declaration that at all hazards the Church was prepared to defend and maintain her inalienable rights. Towards the close of the same year (1842) a convocation was called to take into consideration the position of the Church in relation to the civil courts. This meeting was opened on Nov. 17, and about 450 ministers were present. A memorial to government was subscribed by nearly all the ministers present, by which they committed themselves to the relinquishment of the Church temporalities if they could no longer hold them in consistency with the free and full exercise of their spiritual functions. Mr. Maule introduced a motion into the House of Commons, Mar. 7, 1843, to the effect that the House should resolve itself into a committee to take into consideration the grievances of which the Church of Scotland complained; 76 voted for this motion, and 241 against it, but the Scottish members voted in the proportion of 2 to 1 in its favor. It was felt in Scotland as a grievance that in a purely Scottish question the voice of Scotland, as expressed by her representatives, was overborne by the votes of English and Irish members. With this decision the negotiations for relief from the conflict of opposing jurisdictions by means of legislation came to an end.

The Assembly met on May 18, 1843. That day witnessed a transaction which profoundly agitated the Scottish nation; a thrill of enthusiasm passed from heart to heart such as had not been felt for centuries. After the usual preliminary services the Rev. Dr. Welsh, as moderator, impressively declared that it was impossible to constitute a free Assembly under the conditions of establishment as now fixed by the civil authorities, and then read the protest. The protest having been laid on the table, he rose and left the chair, and proceeded up the aisle to the door; he was speedily joined by Dr. Thomas Chalmers, and they were followed by over 400 ministers and a still larger number of elders. They were received by the people outside the church with an irrepressible cheer, and as the crowd fell back on either side to allow them to pass out, they spontaneously, though without any previous arrangement, fell into a line three abreast, and thus made their way to the large hall at Cannonmills which had been prepared for their reception. Dr. Chalmers was elected the first moderator of the Free Assembly, and the Secession was completed by the subscription of the act of separation and disruption. Four hundred and seventy ministers thus abandoned the Church of Scotland as by law established, renouncing all rights and emoluments in that Church. A yearly revenue of more than £100,000 sterling was voluntarily relinquished. We can quite understand how the fire of a holy enthusiasm would glitter in many an eye as they witnessed this example of the supremacy of conscience amid many temptations to compromise with the civil authorities. One great service which the disruption rendered to the common cause of Christianity was the testimony that it bore to the existence and power of a self-sacrificing attachment to the cause of Christian truth. Here was a company of nearly 500 ministers who, rather than do what they believed would be hurtful to religion, resigned their secure emoluments and threw themselves and their families upon the providence of God. The deed took many by surprise, and closed many a lip that had sneeringly proclaimed that the ministers would cling to their manses and stipends. It filled every generous mind, every lover of the noble and heroic in every land, with a glow of admiration. Whatever opinion men held of the merits of the previous controversy, the disruption itself made a deep and broad impression that the sacrifice it involved was made at the shrine of conscience. Nor was it done in the heat of a momentary impulse. It was reached by slow and well-measured steps calmly and deliberately taken, and the truest honor is due to the men who thus rose at the call of duty above all personal, all earthly considerations.

It is necessary to notice that the Free Church thus constituted held strongly to the principle of a religious establishment. The testimony of the Church of Scotland has always been that Christ is not only Head over the Church, but also Head over nations and states as such; and it was held by the leaders of the Free Church movement, and especially by Dr. Chalmers and Hugh Miller (who as editor of the *Edinburgh Witness* did much to prepare the people for the disruption), that this doctrine of Christ's headship involved the duty of the civil magistrate to support the Church of Christ in the land over which he rules.

The distinctive principles of the Free Church may be summed up under two heads: (1) The right of those who are members of the Church, and in full communion with her, to have the uncontrolled power of choosing their own pastors. At the beginning of the conflict it was simply asked that no pastor should be intruded by a patron or by a Church court upon an unwilling people, but as the battle went steadily on this claim was intensified, and the abolition of patronage was demanded as a right. The right of a call in some form or other has always been claimed by the Church of Scotland for the people. It is not necessary to review the facts on this subject; the only question is as to whether an Established Church, having no power but what the state has conferred on it, is not bound to acquiesce in the legis-

* The court of session is the supreme civil court in Scotland, having jurisdiction in all civil cases of whatever nature. It was instituted in 1532. The number of judges is thirteen—the lord president, the lord justice's clerk, and eleven ordinary lords.

lation of the state and the decisions of the civil courts. The Claim of Rights maintains that the restoration of patronage by the act of Queen Anne was a breach of contract as ratified in the treaty of union: but it was held, on the other hand, that the Establishment is not founded on contract at all, inasmuch as the legislature of one period cannot be bound by the acts of their predecessors. That the constitution of the Church of Scotland involves the right of congregations to elect their ministers cannot be doubted, and we find that after the dust of the conflict had cleared away the Church of Scotland once more, under the leadership of such men as the late Dr. McLeod and Dr. Caird, continued to claim for the people this right of electing their ministers. (2) The second great principle asserted by the Free Church was the right of the Church through its courts and under Christ, and in accordance with the word of God, to regulate all purely spiritual and ecclesiastical affairs. The Evangelical party in the Church of Scotland maintained that in matters so purely spiritual as the exercise of discipline over their own members and office-bearers they could not be interfered with by the civil courts. They were quite willing that the civil courts should assume the direction of the civil or pecuniary interests of their members, but when the court of session reviewed and reversed, declared null and void, the ordinations, suspensions, and depositions which the Church courts had pronounced and ratified — when it prohibited ministers whom the Church courts had appointed to preach in certain districts from exercising within these districts any function of their ministry—it was felt that the Church was stripped of her independence, and the doctrine of Christ's headship over the Church thrust aside. The appeal to the British Parliament to sustain the Church's claim to a separate and exclusive jurisdiction in things spiritual and ecclesiastical was rejected; and now it was left for those who contended for the Church's freedom and independence either to surrender the liberties and privileges which they regarded as in harmony with all the principles and statutes upon which the Kirk of Scotland was established; or to disobey the law as now declared and to submit to whatever penalties might be inflicted; or to quit the Establishment, and so relieve themselves from legal obligations which they could not conscientiously discharge. At once they chose the latter as the only open and honorable course for them to take, and rather than sacrifice the spiritual independence of the Church, they paid the forfeit of their livings.

When the Free Church was thus constituted a great work was before it. Churches had to be created, provision made for the support of the ministry, a college to be organized and sustained, and missionary operations to be carried on. So much energy and zeal were put forth that within three years and a half after the disruption over $2,000,000 had been expended on churches and manses, and $350,000 had been obtained for educational purposes. In its subsequent history the Free Church has afforded the noblest demonstration of the power of a Christian Church to maintain an educated ministry, and at the same time to prosecute missionary and other benevolent enterprises with increasing liberality. The Free Church annually raises over $100,000 for the sustentation fund, and through its agency the ministers in the poorest parishes receive adequate support. Nearly all the foreign missionaries connected with the Established Church took part with the Free Church, and on this Church, even amid its own early struggles, the support of these missions devolved. It has missions in India, in Eastern Europe, in Asia Minor, and in Africa; it has contributed largely to the evangelization of the colonies, especially Canada and Australia; and it makes grants from year to year to evangelical societies on the continent of Europe. Free Church schools have been established through Scotland, and there are three theological colleges sustained with efficiency. Whatever may be said of the principles maintained by the Free Church, there can be only one estimate of the character and worth of the outgoing ministers, and of the zeal and liberality and success with which that Church has so far prosecuted its work.

DAVID INGLIS.

Free Cities, or, as they generally were called during the Middle Ages, **Imperial Cities,** were those German towns which governed themselves by elected magistrates, and formed independent communities, subject only to the emperor. They were a natural creation of the unsettled state in which society found itself early in the Middle Ages, and which made it necessary for the most peaceful industry and commerce to wear helmet and sword and protect themselves by walls and towers against the robberies of the knights. And they obtained their privileges from the emperor on account of the support they were capable of giving him in his quarrels with the nobility and clergy. Under the altered circumstances which modern society presents these free cities became first a curiosity and then a nuisance, and most of them were incorporated into neighboring states. In 1866, Frankfort-on-the-Main was annexed to Prussia, and Hamburg, Lübeck, and Bremen, which in the same year became members of the North German Confederation, are now the only free cities left. (See HANSE TOWNS.)

Free Congregations [Ger. *Freie Gemeinden*], an association of German Rationalists who were originally called "Protestant Friends." At first many of them professed to be Christians, but now they reject the doctrine of a miraculous revelation, and generally that of a personal Deity. They have been subjected in Germany to very oppressive laws; nevertheless, they had in 1868 in Germany 121 congregations, with 25,000 members, besides at least five German congregations in the U. S.

Freed'man [Lat. *libertus, libertinus*], in ancient Rome a free man who had been a slave. Slaves liberated by certain forms, or owned with certain conditions before liberation, or over thirty years old at the time of acquiring freedom, became not only freedmen, but Roman citizens; others belonged to the class Latini; still others (*dediticii*) had no recognized political existence. The descendants of freedmen were free, but even when citizens they did not have the rights of the gens.

Freedmen's Bureau. *Introductory.*—Preliminary to the establishment of the bureau officially known as the "Bureau of Refugees, Freedmen, and Abandoned Lands," new problems were pressed upon the attention of the American people by results flowing directly from the great war of 1861–65. Between four and five millions of people were suddenly set free from chattel slavery; a large class also of the poor white population of the Southern States were disturbed, and sought refuge and supplies for their necessities in the cities and villages. The pauper class had become so much increased from the late slaves and the whites in 1865 that at one time the army alone was feeding upwards of 140,000 of such dependants. Society in the South at the close of the war was completely broken up. The questions at that time discussed in Congress were such as these: "What shall be done with the South? what shall be done with the negro? what shall be done in the work of reconstruction as a stepping-stone to political existence, to political equality?"

After lengthy discussion the object was effected by the passage of what is popularly known as the "Freedmen's Bureau Act," establishing a bureau in the war department; the act was approved Mar. 3, 1865. To this bureau were committed the supervision and management of abandoned lands, and the control of all subjects relating to refugees and freedmen from any district of country within the territory embraced in the operations of the army, under rules and regulations prescribed by the head of the bureau and approved by the President. The bureau was to be under the "management and control of a *commissioner* to be appointed by the President, by and with the advice and consent of the Senate." Yet a clause of the act permitted the detail of all officials from the army, provided there should be no increase of pay or allowances to those so detailed. The original act of Congress would seem to confer powers sufficiently broad, yet subsequently the work of the bureau was enlarged to embrace "the supervision and care of all loyal refugees and freedmen, so far as the same shall be necessary to enable them as speedily as practicable to become self-supporting citizens of the U. S., and to aid them in making the freedom conferred by proclamation of the commander-in-chief, by emancipation under the laws of States, and by constitutional amendment available and beneficial to the public."

In fact, until the subsequent acts of reconstruction had been passed and put into active operation this bureau had in its hands pretty much the entire machinery of government and responsibility so far as the classes named in the act were concerned. How the powers conferred were used will appear to some extent in the following brief sketch of the operations of the bureau.

The Commissioner.—In speaking of the commissioner selected to perform the administrative duties a congressional investigating committee in 1870 introduce what they have to say by showing something of the anticipated scope and purpose of the bureau. They quote from the solicitor of the war department substantially as follows: "The work laid out for the bureau of emancipation is of immense magnitude. Two and a half millions of wards driven from their accustomed shelter by the sharp catastrophes of war, landless, houseless, homeless, appeal to the government to guard and save them. From their earliest years deprived of the light of knowledge, they are children able as yet to see only the star of freedom. They feel with hope and confidence that the flag which brings to them liberty will spread over them the mantle of its protection. In the heart

of this great people every pulsation throbs for freedom. The instincts of national honor will allow no faltering and no failure in our duty to the oppressed freedmen, who stand shoulder to shoulder in this struggle for our country's safety and renown. The plan proposed in this bill is for the organization of a bureau in the war department. Perhaps this is the best means of commencing the great work, but I think the time will soon come, if it has not already arrived, when the duties of this bureau will require the powers and merit the dignity of a separate executive department. There are several subjects which might be advantageously grouped together, and ought to be placed under the management of one controlling mind. Among them are the following: 1, taking possession, on behalf of the U. S., of all real estate abandoned by its owners; 2, taking possession of all real estate forfeited to the U. S. to be sold for taxes, whether bought in by order of the President of the U. S. or sold to settlers and others; 3, taking possession of all lands confiscated to the U. S.; 4, taking possession of all personal property of the enemy derelict, abandoned, or captured, except prizes at sea; 5, taking care of, and making provision for, all persons now freed or hereafter to be freed under any laws of the U. S. or proclamations of the President or acts of manumission; 6, taking care of all colored men in the rebellious districts who were free before the war, and of all fugitives thereto from loyal States; 7, all legal proceedings for the confiscation of property in the courts, the U. S. attorneys or special attorney to act under orders of the new department so far as respects these proceedings; 8, the administration of all laws, rules, and regulations relating to the migration of colored people; 9, and of laws relating to the compensation, if any, which the government may hereafter give to aid loyal States in emancipating slaves; 10, all other matters relating to the emancipation and its processes, its rules and regulations, etc., and the protection of the interests of the colored men on one hand and the U. S. on the other.

"These subjects are intimately connected together. They would require genius and active energy of the most powerful executive talent. The secretary of war and of the treasury are already so overwhelmed with labor and responsibility that it is ungenerous to demand of either of them to assume this herculean task. The labors of this emancipation department will be unsurpassed by those of any other executive minister. Its importance to the ultimate issue of the war, to the reputation of our country abroad, to the moral character of our people in the Southern States, to the treasury, to the soldier, and to the industrial interests of this great nation, can hardly be overestimated. Whoever is competent to fill the office of secretary of emancipation should have a seat in the cabinet."

Commissioner. — Gen. Howard was appointed commissioner May 12, 1865, and immediately commenced the organization of his bureau.

Assistant Commissioners.—The assistant commissioners soon appointed or detailed from the army were—Col. O. Brown for Va., head-quarters, Richmond, Va.; Col. E. Whittlesey, for N. C., head-quarters, Raleigh, N. C.; Gen. R. Saxton for S. C., Ga., and Fla., head-quarters, Beaufort, S. C.; Col. T. W. Osborn for Ala., head-quarters, Mobile, Ala.; Chaplain T. W. Conway for La., head-quarters, New Orleans, La.: Col. Samuel Thomas for Miss., head-quarters, Vicksburg, Miss.; Gen. C. B. Fisk for Ky. and Tenn., head-quarters, Nashville, Tenn.; Gen. J. W. Sprague for Mo. and Ark., head-quarters, St. Louis, Mo.; Col. Jno. Eaton, Jr., for a district near Washington, head-quarters, District of Columbia. The ensuing September a few changes were made: Gen. Saxton's district was reduced to South Carolina and Georgia, head-quarters at Charleston, S. C.; Gen. Davis Tillson took Georgia as sub-assistant for a time: he was soon made a full assistant, reporting directly to Washington; Gen. Wager Swayne was assigned to Alabama, and Col. T. W. Osborn to Florida; Texas meanwhile had been opened to us, and Gen. E. M. Gregory assigned, with head-quarters at Galveston, Tex. These assistants were, many of them, replaced by others for various causes. For example, Gen. J. M. Schofield and Gen. A. H. Terry had Virginia in succession; Gen. N. A. Miles and Col. J. V. Bomford, North Carolina; Gen. R. K. Scott, South Carolina; Gen. C. C. Sibley and Col. J. R. Lewis, Georgia; Gen. Wm. P. Carlin, Tennessee; Gen. J. C. Davis and Gen. S. Burbank, succeeding each other in Kentucky; Gen. C. H. Howard, District of Columbia, including in his district parts of Virginia, West Virginia, Maryland, and Delaware; Gens. A. Baird, J. H. Mower, Col. W. H. Wood, and Gen. R. C. Buchanan, Louisiana; Gen. C. H. Smith, Arkansas; Gens. Chas. Griffin, J. B. Kiddoo, and J. J. Reynold, Texas; Gen. E. M. Gregory was transferred to Maryland, and Gen. E. Whittlesey to Washington.

Sub-Assistants.—Each assistant commissioner's district was divided into a number of sub-districts, and a sub-assistant assigned to each. For the most part an army officer, or a volunteer officer "retained in service" by special act of Congress, occupied this position. In addition to these officials there was in each State, besides the ordinary staff of an officer commanding a district, a *superintendent of education.*

Where Located.—Perhaps the briefest possible method of giving any sort of view of the organization and magnitude of the work of the Freedmen's Bureau is to take up in succession each branch of the commissioner's *home office* and explain its operations. This office was first located in Washington in a large dwelling-house at the corner of I and 19th streets, Washington, D. C. After a time a building nearly opposite was added for the assistant commissioner of the district and contiguous territory. Subsequently, after the erection of the Howard University, the bureau was moved into the main building of that institution, renting such portions of it as could be spared from the use of students.

Adjutant's Division.—The organization grew up rapidly from the different kinds of work presented in the operations immediately rendered necessary. First, an immense bundle of reports and communications was put into the hands of the commissioner by Mr. Stanton, then secretary of war. It was plain that the necessary correspondence would increase. Naturally assimilating all matters to the rules of the war department, an *adjutant's division* was instituted, with all the necessary clerks, books, and papers. To this division was assigned first Lt.-Col. Saml. L. Taggart, then Col. J. S. Fullerton. He was succeeded by Gen. Max Woodhull; the latter by Cols. Samuel Thomas and A. P. Ketchum, followed by Gen. E. Whittlesey.

Quartermaster's Division.—Official and private letters began to multiply from all quarters. Disorganization of society was having its necessary fruits in destitution, crowding of people into the cities, and sickness. To meet the destitution in food and clothing that the army had been temporarily supplying to some 140,000 dependants, the *quartermaster's division* was established, the officer in charge doing really the ordinary duty of both commissary and quartermaster. Lt.-Col. Geo. W. Balloch of the commissary department first conducted this branch, but after his services were needed elsewhere, Gen. H. M. Whittlesey was detailed. The latter, after some four years' service, was succeeded by Maj. J. M. Brown. This branch took the charge of all clothing received and sent, of all school-buildings to be rented, constructed, or finally disposed of, and generally of the issuance of supplies of all kinds to the destitute.

Special Commissary Division.—When a severe famine took place, ranging along the Southern coast in Mar., 1867, and a special appropriation was made by Congress for all classes of starving people, a separate division was made under Gen. E. Whittlesey. It met the temporary necessity, and was then closed.

Medical Branch.—The sickness was so extensive, and the number of orphan children and aged infirm people so great, that a medical branch was early organized, and these several classes put under its supervision. Dr. Caleb W. Horner started the division, and was followed successively by Dr. L. A. Edwards, U. S. A., and Dr. Robert Reyburn.

Land and Claim Division.—Maj. Wm. Fowler (succeeded by Gen. A. P. Howe and Mr. Wm. P. Drew) took charge of the "abandoned land" division. The abandoned property that came under the supervision of the bureau was upwards of 800,000 acres of lands, besides 3373 town-lots. The work in this division conformed to the changing policy of the government in the South, where the property was situated. A portion served the purpose of revenue for a time. A careful record was taken, plans were entered upon for the settlement of freedmen, and afterward modified or abandoned. Finally, all or nearly all was restored to the former owners. Gen. Howard's report of Dec., 1865, recommends as conditions of pardon extended to certain of these—"1st, That the land-owner agree to set apart and grant title, in fee-simple, to each head of family of his former slaves a homestead varying in extent from five to ten acres, to be secured against alienation during the lifetime of the grantee. 2d, That others be like conditioned according to their circumstances, to be determined by a committee appointed by the President." This method was not adopted by President Johnson, who had already become reconciled and friendly to those he was ostensibly pardoning. The commissioner, speaking of this plan of restoration, says: "The uncertainty of the tenure of the bureau over property, which is the result of the policy of restoration adopted, has rendered the division and assignment of land to refugees and freedmen impracticable." The bureau aided quite extensively in attempting the settlement of freedmen on the public lands under the Homestead law, but was never very successful in isolating independent

families of refugees or freedmen, as occurs with many of our Northern emigrants. For a time the freed people were quite gregarious, choosing villages and cities, where there were churches and soon schools springing up, or seeking temporary labor on plantations for wages.

Transportation.—Speaking of the subject of transportation, which belonged to the quartermaster's division, the report to Congress in 1866 says: "At the beginning of this year assistant commissioners and planters asked that the freedmen be transported back to their old homes, where they could be employed at good wages. As this change would in a great measure relieve the government of their support, it was thought best to grant transportation to those either dependent or likely to become so immediately, and by this means place them in the way of permanently caring for themselves. During this year (1866) 387 refugees and 6352 freedmen (men, women, and children) were transported to places where there was employment for them and assured support. In 1867 this relief was much increased, the number of refugees sent being 778, and freed people 16,931.

Claim Division.—To the land division was assigned, after a time, what was called, after the lands had been all restored, "the claim division." This was organized to take up the work undertaken and left by the Sanitary Commission, of aiding soldiers in the collection of bounties, prize-money, and other dues, without charge to them. This division applied in the bureau to the *colored* (soldiers, sailors, and marines) alone. The number of such claims in process of settlement in Dec., 1867, was over 4000, in 1868 upwards of 17,000. The commissioner's report for 1869 uses these significant words: "It is not possible by any machinery to furnish absolute security to both claimants and the government against fraud. The inventions of cupidity are almost infinite, and when no other scheme is successful the last resort of baffled dishonesty is to turn upon the bureau agents with false charges in the public prints for the purpose of getting them disgraced and removed."

School Division.—The school division was organized very soon after the bureau went into operation, under the charge of Mr. J. W. Alvord. Mr. Alvord had his representative school superintendent in each State or district, who aided the assistant commissioner of the State or district in all educational efforts, and made frequent and full reports to Washington. The first circular touching upon this subject is dated May 19, 1865, and certifies to all interested that the educational and moral condition of these people (freedmen and refugees) will not be forgotten. The commissioner adds at the close of his instructions, "that in all this work it is not my purpose to supersede the benevolent agencies already engaged in it, but to systematize and facilitate them." His theory of this proper and permanent relief to the multitudes suddenly come to the responsibility of caring for themselves and families was in the channel of public instruction, especially in the schools. The results—viz. the rapid decrease of the dependants, and the intelligent apprehension of the new rights and privileges conferred upon the freed people—were everywhere proportioned to the light and knowledge that came through the schools established.

The Teachers.—An extract from the bureau report for 1869, p. 12, gives a slight insight into the difficulties met and the changes accomplished: "Too much praise cannot be bestowed upon the noble band of Christian teachers who have carried on successfully this work of education. Many of them have come from the very best circles of refined and cultivated society, and have been exposed to privations, hardships, and perils which would have discouraged any who were not moved by the spirit of the Divine Teacher. To them belongs the credit, in great measure, for all that has been accomplished. *They* have done the hard work; *they* have been the rank and file in the long fight with prejudice and ignorance. When they first entered the field as teachers, so general and bitter was the opposition to the education of the blacks that scarcely one white family dared to welcome them with hospitality. When they were insulted and assailed very few had the courage to defend them, but their good conduct finally overcame prejudice, and better sentiments have gradually grown up in many parts of the South. Hostility to teachers and schools has in a great measure ceased."

Benevolent Societies.—The bureau co-operated with the benevolent societies and church commissions throughout the country, and extended its school-work till it ceased by law—leaving, besides the nuclei for common schools, six universities quite firmly established, and upwards of twenty institutions that rank as colleges and normal schools. In the argument of Edgar Ketchum, Esq., before the House committee on education and labor he says: "In the first year there were 96,778 pupils reported, and there were 975 schools. The schools are now (in 1870) 2118, and the pupils 250,000." Thus, the bureau afforded a beginning, a nucleus, for the present extensive system of education in all the Southern States.

Bounty Division.—The "bounty division" was added by act of Congress Mar. 29, 1867. Mr. Ketchum says of this: "The soldiers were everywhere defrauded by agents. Since Apr. 17, 1867, the total amount of the bounties paid to soldiers through the agency of the bureau has been $5,831,117.89. . . . A part of the system is a full, complete, and minute record of each case, so that its history can be easily traced." The amount of this bounty fund expended finally reached upwards of $8,000,000 before it passed into the hands of the army officers now disbursing it.

Financial Division.—The general partition of the office which embraced the payment of bounties as an item was called the "financial division." Geo. W. Balloch, detailed from the commissary department of the army with the rank of lieutenant-colonel (afterwards brevet brigadier-general by promotion), was assigned to this important division in June, 1865. The receipts and expenditures in this division during its entire existence amounted to a little more than $13,000,000 for bureau purposes proper, and upwards of $8,000,000 for payment of bounty and prize-money to colored soldiers and sailors, making the grand total upwards of $21,000,000. Gen. Balloch was discharged in 1871. For a time Gen. Howard made the disbursements himself, and then was succeeded by Maj. J. M. Brown, who continued the work till it closed. Upon the question of carefulness and honesty on the part of officers of this bureau many public and bitter accusations were made and many examinations took place. A special court of inquiry was finally ordered by Congress, which reported, exonerating the officers of the bureau from all charges, and highly commending the commissioner.

General Work.—The commissioner kept many things that had to be done by the bureau under the immediate control of his inspectors and aides. The chief clerks contemplated by the first bureau law were—first, F. W. Owen, succeeded by J. A. Bemis, then in succession J. B. Littlewood, H. D. Beam, and J. H. Cook. These often had, in addition to the charge of records, inspection duty to perform during their respective terms of service. The inspectors proper were Gen. W. E. Strong, Gen. F. D. Sewall, and J. M. Langston, Esq. These, with the aides, Lt.-Cols. H. M. Stinson, Fred. W. Gilbreth, Capts. Joseph A. Sladen and M. C. Wilkinson, and Lieut. J. H. McBlair, went frequently from place to place, inspecting books and accounts and reporting upon the condition of the people and the conduct of officers and agents. Matters especially looked into through this channel of activity were, in addition to those already mentioned, "labor questions" (written contracts and joint companies were the stepping-stones to the independency of the late slaves). Of course the free system gave rise to many complaints and much friction; an inspector started at once for the scene of a serious trouble or riot, settled the matter, if possible, and reported. Out of the "labor questions" naturally came the questions for courts—next "bureau courts and magistrates." These were kept up till the testimony of black men was received in the State and local courts. It was first accepted in Alabama by the strenuous efforts of Gen. Wager Swayne, and then quickly extended to other States.

The Freedmen's Banks for a considerable time enjoyed the bureau countenance and aid. "The attempted system of apprenticing blacks and other substitutes for slavery were looked into by the inspectors, and hindered. For a while, too, the subject of the marriage relation gave rise to much perplexity. There were so very many who had been married several times, or there had been so little recognition of marriage at all before freedom, that the difficulties were great. Agents saw to it that the marriage ceremony was performed and a careful record kept. In fact, scarcely any subject that has to be legislated upon in civil society failed at one time or other to demand the action of this singular bureau. In time bureau courts gave place to others—bureau contracts and bureau marriages to local and clerical. The pauper class was gradually transferred; the asylums and hospitals one after another assumed by societies or towns; questions of land-titles closed; in brief, all operations were purposely reduced and transmuted into the common system of government in this country. The last things of importance given up were the schools, one asylum at Washington, and the payment of bounty.

The bureau has been called a political machine. This is somewhat true: it fitted, or helped vastly to do so, the half citizen looking to full rights and responsibilities. Mr. J. M. Langston, identified by birth with the black man, spoke earnestly and constantly as the commissioner sent him out, urging schools and churches, promoting education, morality, economy, endurance, and independence; and though

there may not have been any direct instruction to him and to the other inspectors and aides to make *political* converts to the party of freedom and progress, yet doubtless the positive effect was just this: so that to the bureau, its schools, teachers, agents, and inspectors was due in some measure the strong bias of the colored voters in favor of the Republican party. The bureau was abnormal—a machine to relieve the shock when passing over the rough transition roadway. Its work, in its mistakes and in its successes, is now a subject of history. O. O. HOWARD.

Free'dom, tp. of Polk co., Ark. Pop. 257.

Freedom, tp. of Carroll co., Ill. Pop. 811.

Freedom, post-tp. of La Salle co., Ill. Pop. 1262.

Freedom, tp. of Palo Alto co., Ia. Pop. 161.

Freedom, post-tp. of Bourbon co., Kan. Pop. 815.

Freedom, post-tp. of Waldo co., Me. Pop. 716.

Freedom, post-tp. of Carroll co., Md. Pop. 3008.

Freedom, tp. of Washtenaw co., Mich. Pop. 1261.

Freedom, tp. of Waseca co., Minn. Pop. 832.

Freedom, post-tp. of La Fayette co., Mo. Pop. 2559.

Freedom, tp. and post-v. of Carroll co., N. H., 70 miles N. E. of Concord. It has a savings bank, and manufactures of leather, lumber, and bricks. Pop. of tp. 737.

Freedom, tp. of Cattaraugus co., N. Y., has quarries of good building-stone. Pop. 1371.

Freedom, tp. of Henry co., O. Pop. 812.

Freedom, post-tp. of Portage co., O., on the Atlantic and Great Western R. R. Pop. 781.

Freedom, tp. of Wood co., O. Pop. 1089.

Freedom, tp. of Adams co., Pa. Pop. 449.

Freedom, post-v. of Beaver co., Pa., on the Ohio River and the Pittsburg Fort Wayne and Chicago R. R., 3 miles E. of Beaver.

Freedom, tp. of Blair co., Pa. Pop. 1020.

Freedom, post-tp. of Outagamie co., Wis. Pop. 1330.

Freedom, tp. of Sauk co., Wis. Pop. 778.

Free'hold, an estate of inheritance or for life in real property. It was in ancient times termed a frank-tenement (a word having the same meaning as "freehold"), and denoted an estate held by a freeman independently of the mere will of the feudal lord. It includes those estates to which the mode of conveyance by feoffment with livery of seizin was, in the early common law, exclusively appropriate, and this characteristic was once used as a means of defining its extent of application; but since the abolition of feoffment such a mode of description is no longer possible. (See FEOFFMENT.) But though the ceremony of livery of seizin no longer exists, the term "seizin" has still been retained as applicable to freehold interests alone, while all inferior estates are said to exist only in "possession." An estate of freehold may be either corporeal, as in land, or incorporeal, as in rents or franchises. Freeholds of inheritance are fees simple (see FEE) and fees tail. (See ENTAIL.) Freeholds not of inheritance are life estates, which are either *conventional* or *legal*. Those which are conventional may be either (1) for one's own life, (2) for the life of another, or (3) for some indefinite period, which may possibly last during the period of one's life. Legal life estates are (1) curtesy, (2) dower, and (3) jointure. (See ESTATE FOR LIFE, DOWER, JOINTURE.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Freehold, a post-v. and tp., cap. of Monmouth co., N. J., is 24 miles E. of Trenton and 16 miles W. of Long Branch, and is the E. terminus of the Freehold and Jamesburg R. R., which here joins the line of railroad to Long Branch and Squam Village on the sea-shore. It has 6 churches, 2 large boarding-schools, 3 public schools, 2 weekly newspapers, 2 national banks, 1 iron-foundry, 1 machine-shop and planing-mill, 4 hotels, a number of large stores, the usual number of mechanics' shops, and is lighted with gas. In 1778 it was the head-quarters of the British army during the battle of Monmouth, which was fought in the immediate vicinity. It is in the centre of a rich agricultural district. Pop. of tp. 4231.

JAMES S. YARD, ED. "MONMOUTH JOURNAL."

Freehold, post-tp. of Warren co., Pa., on the Atlantic and Great Western R. R. Pop. 1316.

Free'man, a man who is not a slave, or, in a narrower sense, a citizen or burgess who has certain specified rights. In ancient Rome freemen (*liberi*) were of two classes—*ingenui*, or free-born, and *liberti* or *libertini*, freedmen who had been slaves. The two classes had a distinct legal status, but the sons of freedmen were *ingenui*, though without tribal privileges.

Freeman, post-tp. of Franklin co., Me. Pop. 608.

Freeman, tp. of Freeborn co., Minn. Pop. 694.

Freeman, post-tp. of Crawford co., Wis. Pop. 1279.

Freeman (EDWARD AUGUSTUS), D. C. L., b. at Harborne, Staffordshire, England, 1823; was chosen a scholar of Trinity College, Oxford, 1841; a fellow in 1845; examiner in law and modern history at Oxford 1857–58, 1863–64; author of *Church Restoration*, 1846; a *History of Architecture*, 1849; *Architectural Antiquities of Gower*, 1850; *Window Tracery in England*, 1850; *Llandaff Cathedral*, 1860; *Poems* (with G. W. Cox), 1850; *History of the Saracens*, 1856; *History of Federal Government*, 1863 (incomplete); *History of the Norman Conquest*, 4 vols., 1867–72 (unfinished); *Old English History*, 1869; *History of Wells Cathedral*, 1869; *Historical Essays*, 1871–73; *Growth of the English Constitution*, 1873; *Comparative Politics*, 1873, etc.

Freeman (JAMES), D. D., a Unitarian clergyman, the first in the U. S. to call himself so. By his means the "King's chapel" in Boston, the oldest Episcopal church in New England, became the first Unitarian church in New England, and consequently in America. He was b. in Charlestown, Mass., Apr. 22, 1759; was graduated from Harvard College in 1777; was chosen reader of King's chapel in 1782; became Unitarian; carried his people with him; induced them to alter the Prayer-Book in accordance with the new theology; and in 1787 was ordained pastor of the church by the wardens and people. The connection remained unbroken till his death, Nov. 14, 1835. Dr. Freeman was an accomplished scholar, a pure writer, a social, philanthropic man. He was one of the founders of the Massachusetts Historical Society. To the last Dr. Freeman continued a member of the Boston Ministerial Association, though differing so much in opinion from the rest that there was no professional exchange of pulpits. O. B. FROTHINGHAM.

Freeman (JAMES EDWARD), a painter of historical and *genre* subjects and of portraits, was b. in Nova Scotia. While he was still very young his parents removed to Otsego, Otsego co., N. Y. His early life was one of hardship, and it was with difficulty that, impelled by his desire to become an artist, he made his way to New York and entered the National Academy of Design as a student; made an associate in 1831, and an academician in 1833; married in 1834 a lady of Italian and English parentage, by name Latilla (see LATILLA), with some talent as an artist. Since 1840 Freeman has lived in Rome. CLARENCE COOK.

Free'man's, tp. of Franklin co., N. C. Pop. 1318.

Free'mansburg, post-b. of Bethlehem tp., Northampton co., Pa., on the Lehigh and Susquehanna R. R. Pop. 643.

Free'masonry is undoubtedly an ancient and respectable institution, embracing among its members men of every rank and condition of life, of every nation and clime, and of every religion which acknowledges a Supreme Being and has faith in the immortality of the soul; it stands pre-eminent among the institutions established for the improvement of mankind—as far above other secret associations in usefulness as it is beyond them in age. But its origin may be said to have been lost in remote antiquity. Neither tradition nor history can point with certainty to the precise time, place, or manner of its commencement. The popular faith of many of its disciples ascribes its foundation to circumstances connected with the erection of the first Jewish temple by King Solomon; others trace it to the Eleusinian mysteries, in which we find that the doctrine of immortality, as well as other great truths of natural religion, was taught; others, again, find its origin among the warrior-monks of the Crusades; and yet again there are scholars who have endeavored to raise the veil from the Druidical mysteries, with the view of showing an origin for Masonry among their wise men. It is difficult, if not impossible, amid all these views, to arrive at what may be regarded as correct history. That the name, *Free and Accepted Mason*, and the present ceremonials and government of the craft, are of modern origin, not having existed farther back than the beginning of the eighteenth century, is certainly true. But at the same time the idea of the association was in existence then, and had been from remote time. Societies of masons were then also extant. The author of these lines is a member of a Scottish lodge whose written records extend back to 1599, and, if tradition can be relied on, English master-builders met at York A. D. 926, during the reign of Athelstane. We shall endeavor to show that the society may lay claim to a very early origin, and to have existed from remotest ages to the present time under different forms and different appellations. We claim for the commencement of secret moral associations an origin as ancient as that of the Pyramids of Egypt, and find in the mysteries carried on by the priests

of Osiris and Isis the same method of instruction and of initiation and similar legendary history which the imaginations of 4000 years have altered to suit new views and the political and other necessities of their time.

Every human institution is subject to great and numerous variations: the different aspects under which they appear, and the principles by which they are governed, depend on the advance of civilization, the nature of the protecting government, and the peculiar habits and opinions of the members themselves. Before letters were advanced, and when the art of printing was unknown, the discoveries in the arts and sciences must, of necessity, have been known to but few individuals. The pursuit of science was a secondary matter, and questions of philosophy were solely the prerogative of priestcraft. Agriculture was the grand pursuit of life. But architecture soon, in the natural order of things, arose as a science, and human skill was called into play. The triumph of mind over matter was the great feat of the first architects, who were also the first natural philosophers. There is no speculation in the statement that these formed themselves into an association for mutual improvement at an early date; their architectural monuments, preceding the authentic records of history, are with us to this day; and traditions inform us that this union of scientific men differed from the Freemasons of to-day in little more than in name. The arts and sciences were cultivated in Egypt and the adjacent countries in Asia while all the other nations were involved in ignorance. Of these sciences, astronomy, geometry, and architecture took the first rank. Here alone should we look for the origin of the Masonic society. Doubtless, at first it was a mutual improvement association simply, and those only would be admitted whose occupation was subsidiary to the great art. But the priesthood, ambitious of erecting great temples to their deities, and anxious to acquire all knowledge which could give them a further hold on a superstitious people, sought to participate in the learning of the architects. They were admitted, and added science to their already mystic lore. Once admitted to the fraternity, they connected the mythology of their country and their metaphysical speculations concerning the nature of God with the exclusively scientific teachings of the builders, thereby producing that combination of science and theology which forms such a conspicuous part of the principles of Freemasonry. Hence, we derive what may be regarded as a simple sun-worship, overlaid with mystic speculation and scientific inquiry. The fraternity and priestcraft soon became one, imparted their knowledge in symbolic and hieroglyphic instruction, accompanied by particular rites and ceremonies. We know nothing of the nature of these mysteries, but as the Eleusinian and other mysteries took their rise in Egypt, we may judge of the source of the fountain by the nature of the stream.

Egypt was now the centre of civilization, and her immense population necessitated emigration. The first colony of the Egyptians was that conducted by Inachus about 1950 B. C.; Cecrops arrived in Attica in 1657 B. C.; Cadmus came from Phœnicia to Bœotia in 1594 B. C.; and Danaus to Argolis in 1586 B. C. The savage inhabitants of Greece regarded with awe the magic feats of the immigrants, and as they gradually obtained an insight into the arts and sciences came to regard them as gods. In the reign of Erichthonius, 1500 years before our era, the mysteries of Eleusis were established in Greece in honor of Ceres, who, in search of her daughter, had visited Triptolemus at Eleusis, and taught him the arts of agriculture and the doctrine of the immortality of the soul. Soon after, the Panathenæa were established in honor of Minerva, and the Dionysia in honor of Bacchus, who had instructed the Greeks in many useful arts, especially in the culture of the vine. These mysteries were all closely connected with the development of the arts and sciences; and if our theory concerning the origin of knowledge in Egypt be correct, it follows that the Eleusinia and Dionysia were scientific bodies whose art was tinctured with the fables of Egyptian mythology. It is not alone from conjecture that we argue. We have information from Meursius and other writers concerning the Eleusinian mysteries, which shows that they bore a striking resemblance to modern Masonry. (See article "Eleusinia" in the *Encyclopædia Britannica;* also ROBERTSON'S *Greece*, bk. i. p. 127.) That Socrates, Diogenes, Agesilaus, and Epaminondas never partook of those mysteries, and even condemned them for admitting men of low worth, is no valid objection to the nature and morals of the society. Many hold these objections to modern societies, even to the Church, forgetting that the saint and sinner often kneel at the same altar. The mysteries of Ceres were introduced into Athens about 1356 B. C., and with slight variations were observed in Phrygia, Cyprus, Crete, and Sicily. They even reached the capital of France, the name of which West derives from *Par Isis*, because built beside a temple of the goddess Isis; and it is highly probable they were carried into Britain and other northern regions. In the reign of the emperor Hadrian they were introduced into Rome (117 A.D.), and were conducted there in a similar manner to those in the village of Eleusis. In the beginning of the fifth century Theodosius the Great prohibited the pagan theology in his empire, and thus the Eleusinians came under the ban of justice.

The Dionysia, or mysteries of Bacchus, were closely connected with those of Ceres, and perhaps more so with those of the Masons. The connection between the Eleusinians and Dionysians appears from the accepted belief that Ceres was the mother of Bacchus: and Plutarch assures us that the Egyptian Isis was the same as Ceres, that Osiris was the same as Bacchus, and that the Dionysia of Greece was but another name for the Pamylia of Egypt. As Bacchus was the reputed inventor of theatres and dramatic representations, that particular class of persons who possessed the exclusive right of erecting temples, theatres, and other public buildings in Asia Minor were styled the *Dionysian artificers.* They were initiated into the mysteries of their founder, and consequently into those of Eleusis. But in the degenerate days of Greece they also degenerated, and brought disgrace upon an association founded for the promotion of virtue and the improvement of art. About 1000 B. C. the people of Attica resident in Asia invented the Doric and Ionian orders of architecture, and returned them to the mother-country, making the name of the Dionysian artificers the synonym of talent and scientific skill. We find them established in a kind of college at Teos, and making themselves known to each other in travelling by words and signs. They were also divided into bodies or lodges, governed by a master and an assistant, and holding a solemn entertainment once a year, at which they sacrificed to the gods and contributed to the wants of widows and distressed. Their monuments in the Turkish cemetery of Erakli continue to this day. (*Chandler's Travels.*) Attalus, king of Pergamos, was a member of the order. The opinion, therefore, that the Freemasons flourished at the building of King Solomon's temple may not be so absurd as is often supposed. We have seen that the mysteries of Ceres and Bacchus existed 400 years before King Solomon, and there are strong reasons for believing that the Dionysian architects existed prior to the founding of the first temple. Since Josephus informs us (bk. viii. ch. v.) that the Grecian orders were employed at the building of the temple, we are authorized not only to infer that the Dionysian artificers existed prior to the reign of Solomon, but also that they aided him in erecting his magnificent edifice to the God of Israel. Nor is this all. The Holy Scriptures inform us that Hiram, king of Tyre, assisted King Solomon in his work with materials and operatives, and that he sent to superintend the latter a cunning artificer in brass and iron—Hiram, the son of a widow of Tyre. The commerce with Tyre, the vicinity of Jerusalem to Egypt, the connection of King Solomon with the royal family of that country, the progress of the Egyptians in architecture, and their attachment to symbolic teaching, may all go to relieve the Freemasons from the charge of credulity. It has been objected that the establishment of such an organization of builders in Judæa by King Solomon would have been heard of in future times, and have attracted the notice of sacred and profane writers, and that this is not the case. On the contrary, we find the body of Essenes, whose origin, doctrines, and principles have caused so much discussion among theological writers. In them we find strong distinctive points showing a similarity with modern Masonry. It is true that we do not find the Essenes particularly devoted to architecture, but we find them general students of the arts and sciences. Pliny refers them to an origin so remote that they must have been contemporary with King Solomon, and Basnage, who regards them as more recent, still assigns them a date under Antigonus (300 B. C.). Scaliger holds that they descended from the Chasidim so honorably mentioned in the history of the Maccabees. These Chasidim were of the choice sons of Israel, illustrious for charity and piety, and were sworn to keep the temple from injury and decay and to adorn its porches. The Essenes adopted many of the Egyptian mysteries, and received all ranks into their body. They spread beyond Judea, and existed in all parts of the world, uniting the studies of ethics and natural philosophy. They endured much persecution from the Romans, and were abolished about the middle of the fifth century A. D. It has been supposed by some philosophers that Pythagoras derived his mysteries, instituted at Crotona, chiefly from the Essenes, who were highly respected, during his travels in Egypt and Syria. The Pythagoreans were undoubtedly connected with the Essenes, and the Essenes with the Chasidim.

The chief difference between the ancient and modern mysteries lies in the points which concern religion. This arises from the introduction of Christianity and the great changes which have been effected in religious knowledge.

Although Freemasonry claims to be of all religions, yet there is no doubt that since its modern establishment as a society in England it has received a stamp of Christianity which marks that origin. Many of the prayers and other portions of the ritual in America, the constant use of the Lord's Prayer and versicles in England, the exclusion of Jews in Prussia, prove this to be the case. During the Dark Ages the political and intellectual condition of society was opposed to the progress of Freemasonry; indeed, after the suppression of heathen rites in the fifth century but few of the devotees kept up secret organizations. But we have the authority of Gibbon and others that they were never completely abolished; which fact leads us to connect the heathen mysteries with that trading association of builders which appeared under the special sanction of the Church of Rome. There was an insatiable taste for finery and display in church architecture, and to encourage the building profession the pope and other potentates of Europe conferred upon their "guilds" the most important privileges, and even allowed them to be governed by their own laws, customs, and ceremonials. These guilds were composed of men of many nations—Italians, Greeks, French, German, Flemish, etc.; they were called *Free* Masons, and travelled from land to land, erecting those gorgeous cathedrals and abbeys which gratified the pride of the priests. They had a thorough organization.

It seems to us, in the latter half of the nineteenth century, strange and inconsistent that the Romish Church, ever afraid of secret organizations, should have sanctioned, and even protected, this institution. But it is to be borne in mind that the pontiffs and bishops, instead of approving Freemasonry by their patronage, only employed it as an instrument for the gratification of their pride and ambition, and that in after ages the Roman popes deprived the fraternity of the very privileges which had been bestowed on them unasked for, and persecuted with relentless hate the very men whom they had voluntarily taken into favor. Still, at this period, wherever the Romish religion was found, the Freemasons flourished. They penetrated even into Scotland, where the abbeys of Melrose and Jedburgh, the chapel of Holyrood, and the cathedral of Glasgow still attest their skill. In this little land the principles of the society long remained, ages after they had been extinguished in continental kingdoms. And in this manner it was from Scotland that these principles again issued to spread over not only the Continent, but all portions of the civilized world. Why the Freemasons existed longer in Scotland and England than in other countries is not exactly known, but we must impute it to favorable circumstances of political government, or to a superior policy pursued by the craft in avoiding the machinations of their enemies. Hence we can explain the large number—nearly 100—of Masonic degrees of European nations which had the name of Scottish. Scotland seems the very Fairyland of continental Masonry.

Freemasonry was early introduced into England, but whether from the Scotch Masons at Kilwinning, from the relics of the Knights Templar, or from other brethren on the Continent, there is no means of ascertaining. The English brotherhood claim that Saint Alban the Martyr was the first who brought the society to England about the end of the third century; that the brethren received a charter from King Athelstane, whose brother Edwin summoned all the lodges in England together at York to form the first grand lodge of England. (PRESTON'S *Illustrations of Masonry.*) But these are merely assertions, not capable of demonstration. It is, however, certain that Freemason lodges were held at York and Kilwinning, and that these lodges exercised a controlling influence over the bodies of architects in other parts of the country. But their power was gone; architects were becoming common; the sciences were studied by others; the Church of Rome regarded the association more as an enemy than as a friend, and having no longer any use for it cast it off, and thus its prestige was gone. The year 1350 is that assigned for the revision of the York Constitutions under Edward III. We know little of the craft for some time till again it makes its appearance June 24, 1502, and lays the foundation of Henry VII.'s chapel in Westminster Abbey. Thirty years after it must have reasserted its position, as the intelligence spread by it had awakened the fears of the ultramontane clergy; it was accused of bringing schisms into the Church and sedition among the people, of aiding the Reform of Luther, and of desiring to avenge the death of Jacques de Molay. This induced them to have a general convocation, at which they drew up a formal declaration of principles, since known as the "Charter of Cologne." In 1561, Queen Elizabeth became jealous of the society, and sent an armed detachment to break up the annual meeting at York. The officers sent in command made so favorable a report of the institution that the queen revoked her order, and ultimately became protectress of the fraternity. In the reign of James I. the society flourished, and the celebrated Inigo Jones became its grand-master in 1607, and inspired great spirit into the lodges. It was shortly after this that men, not architects nor masons, but eminent for learning, knowledge, or position, were admitted as honorary members of the body under the designation of *accepted* brethren; hence the origin of the present style of the society, *Free and Accepted Masons.* Elias Ashmole, the great antiquary, was so accepted, and took upon himself the task of recomposing the rituals of the order. His rituals were accepted in London, and shortly after all through England, and with slight changes are those now in use in England and America. After the beheading of Charles I., Masonry took a political bias, thus deserting its principles, and was employed by the partisans of the Stuarts. Charles II. was so pleased with the zeal displayed in his behalf that on his restoration to the throne he termed it the *royal art,* owing to his belief that it had mainly contributed to his restoration.

In 1700 the Masonic corporations, except in England, were dissolved, and even in that country were no longer busy with operative masonry. Notwithstanding the zeal of Sir Christopher Wren, the number of Masons continually diminished, the annual feasts were neglected, and the four lodges remaining in London were almost deserted. Differences of opinion as to what persons should be "accepted" kept the craft at variance. Wren died in 1716. In 1717 the four English lodges met to found a grand lodge and elect a new grand-master. George Payne was elected grand-master, and the three symbolic degrees were alone recognized. This is the date very commonly assigned by anti-Masons as that of the commencement of the society. The grand-master collected all the papers, MSS., rituals, etc., intending to frame a code for the fraternity, but unfortunately in 1720 many of them were committed to the flames by over-scrupulous members of the body itself. The succeeding year the order recommenced its sway on the Continent. Under the authority of England a lodge was established at Dunkirk, and another at Mons. Mr. Payne soon secured all the remains of the collected documents, from which he drew up a historical sketch of the order, afterwards referred to Mr. Anderson, who revised, and in 1722 was authorized to publish it. Hence come the "Anderson Constitutions" of 1722–25, by which the craft is at present governed. In 1725 we find Masonic lodges established in France, and two years later a grand lodge was established in Ireland. In 1732 the "grand lodge of York," or that of the so-called "Ancient Masons," recognized the necessity of union, and incorporated itself with the grand lodge of England. In 1733 the first provincial grand lodge was established at Boston, U. S. In 1735 we find the first modern systematic prosecution of the order commenced by the States General in Holland, who interdicted the meetings of the craft.

During all this period the Scottish Masons had been carrying on their labors with the peculiar system of an hereditary grand-master, created by James I. (Scotland) for the Rosslyn family in 1430. The prosperous state of the English lodges excited their Scottish brethren, and at a meeting held in 1736 the baron Sinclair resigned his hereditary position. This led to the formation of the present grand lodge, of which the baron was the first *elected* grand-master. Since that date several scions of the Rosslyn family have filled the chair by election, among them Earl Rosslyn, the present commissioner of the Kirk of Scotland. In 1738, Pope Clement XII. issued the first bull of excommunication against the Freemasons, immediately followed by an order of Charles VI. prohibiting the meetings in Austria. In 1738, Frederic II., king of Prussia, was initiated. His association with the Scottish rite of Thirty-three Degrees (*Ancien-Rite-Accepté*) is now a part of Masonic history everywhere. The lodge of Three Globes at Berlin, founded by Baron Bielefeld in 1740, was raised to the dignity of a grand lodge by Frederick the Great, who was elected grand-master and continued in office till 1747. In 1751, Freemasonry had found its way into all civilized countries. Its dogma of liberty, equality, and fraternity, however, alarmed the kings and clergy; Russia, France, Hamburg, Florence, and Geneva fulminated edicts against the order; Portugal, Naples, and Spain followed their example, and the terrors of the Inquisition were brought into use. The story of John Coustos has few parallels in the history of persecution. But, notwithstanding, the society flourished. The grand lodge Royal York was founded in Berlin in 1765. In 1772 the grand orient of France was chartered, and the order found its way into many of the American colonies. "High degrees" now appeared more frequently, and at the opening of the present century there were in existence at least ten "systems," which have since become extinct or have been greatly modified. In 1813 the two rival grand lodges of England were united. In the next year Pope

Pius VII. denounced the order; so did the emperor of Russia in 1822, the king of Portugal in 1824, and the king of Spain in 1828. From 1827 to about 1835 a terrible excitement, fostered for political ends, called the "Morgan Excitement," raged through the U. S., and for a time almost crushed Masonry. The order was charged with the murder of a man of that name—a charge probably false—and with being the enemy of a free republic. The good sense of the people prevailed, and the phœnix rose again. There are now in the U. S. no fewer than 44 grand lodges, which comprise over 600,000 active members. The fear is that Masonry is becoming too popular for its own good. Each grand lodge has exclusive jurisdiction *in its own territory* over what are called the first three, *Blue* or *Ancient* degrees. Nearly every State has a grand chapter, the ruling power of the degrees up to the seventh, or the Royal Arch. Next follow the grand councils of Royal and Select Masters, which exist in most of the States, and also govern these degrees. The "American Rite" is closed by the commanderies, which are the representatives of the ancient Knights Templar. Here, then, are three more degrees, making thirteen in all. Each grand lodge is independent, but most of the State grand chapters acknowledge one head, styled the General Grand Chapter of the U. S. So also the grand commanderies of States owe common allegiance to the Grand Encampment of the U. S., which holds triennial sessions, is regarded as the most distinguished branch of the society, composed as it is mainly of the present or past grand commanders of States, and representing over 70,000 men of high standing. There are also in the U. S. two bodies of the "Ancient and Accepted Scottish Rite"—one for the North and one for the South. They have control of a series of thirty-three degrees, an elaboration of other Masonic legends, and their history would occupy many volumes. (See PIKE'S *Morals and Dogma of Freemasonry;* FOLGER'S *History of the Ancient and Accepted Rite*, etc.)

There are at present seventy-nine ruling powers in Masonry in the world, whose Masonic population may be estimated at 3,000,000. In the jurisdictions where grand lodges exist there are generally also grand chapters and councils, grand commanderies and consistories; but on these there is no need to dilate. GEORGE S. BLACKIE.

Free Methodists, a small sect found chiefly in Western New York, Illinois, and Michigan. They reported in 1868, 85 preachers and 4839 members, and in 1873, 90 preachers and 6000 members.

Free'port, post-v., cap. of Stephenson co., Ill., 121 miles W. of Chicago, on the Illinois Central, Chicago and North-western, and the Western Union R. Rs. It has 2 national and 2 private banks, 4 weekly and 2 monthly newspapers, a good water-power, numerous manufactories, foundries, mills, a woollen-mill, etc., good school buildings, 14 churches, 2 insurance companies, and good hotels. A beet-sugar factory is in full operation, and is a success. It has a fine court-house and the Illinois Benevolent Society. Pop. 7889. THOMAS, BREED & HAWS, PUBS. "JOURNAL."

Freeport, post-v. and tp. of Cumberland co., Me., 17 miles N. E. of Portland, on Casco Bay and on the Portland and Kennebec R. R. It has 4 churches, some shipbuilding and other manufactures, besides commercial and fishing interests. Pop. 2157.

Freeport, post-v. of Hempstead tp., Queens co., N. Y., on the Southside R. R. of Long Island, 22 miles from New York; has a weekly newspaper.

Freeport, post-tp. of Harrison co., O. Pop. 1015.

Freeport (OREGON P. O.), a v. of Washington tp., Warren co., O. Pop. 37.

Freeport, post-b. of South Buffalo tp., Armstrong co., Pa., 28 miles N. of Pittsburg, on the N. bank of the Allegheny River and the West Pennsylvania and Allegheny Valley R. Rs. It has 2 banks for savings and deposit, 2 large grist-mills, large steam-tannery, 2 oil-refineries, 1 whisky distillery, 2 planing and saw mills, 1 sash and door factory, 1 chemical works, 2 woollen-mills, gas-works, 9 churches, 5 hotels, 1 weekly newspaper, the usual number of stores, etc. Pop. 1640.

SIMON SHOOP, PROP. "NEW ERA."

Free Soil, post-tp. of Mason co., Mich. Pop. 142.

Free-Soil Party, a former political party of the U. S., was composed of the Liberty party of 1846, the Barnburner Democrats of New York, and of a considerable number of Northern Whigs who favored the Wilmot proviso, a proposal to prohibit slavery in the territories acquired from Mexico. In 1848, at Buffalo, they nominated Martin Van Buren and Charles Francis Adams for President and Vice-President. The ticket did not receive any electoral votes, and only 291,000 popular votes. In 1852 at Pittsburg they nominated John P. Hale and George W. Julian, who received 157,000 popular votes. In 1856 the Free-Soil party was merged into the new Republican organization.

Free Spirit, Brethren of the. See BRETHREN OF THE FREE SPIRIT.

Free'stone, county of Central Texas, bounded on the E. by Trinity River. Area, 900 square miles. The soil is very productive. Cotton, corn, live-stock, and fruit are extensively raised. It is well watered and heavily timbered. Mineral springs are found at several points. Cap. Fairfield. Pop. 8139.

Free Style, in musical composition, that which admits of certain progressions, harmonies, and traits of ornamentation forbidden by the rules of "strict" counterpoint. (See FLORID STYLE.)

Free Thinker, a name given to the deistical writers of England in the seventeenth and eighteenth centuries. It was bestowed on John Toland, who in 1697 was called, in a letter to Locke, "a candid free thinker." In 1709, Lord Shaftesbury spoke of "our modern free writers." The title of Anthony Collins's work, written in 1713, *A Discourse of Free Thinking, occasioned by the Rise and Growth of a Sect called Free Thinkers*, proves that the name was then in use with a somewhat definite application. However originating, by whomsoever bestowed, it was accepted by the rationalists as descriptive of their position as men who thought freely—that is, outside of the usual lines on ecclesiastical and theological subjects. The reproach that became associated with the term in the common mind was due to the prejudice against the unbridled exercise of reason on the Christian Scriptures and Creed, whatever the special opinions professed might be. The chief names among the English free thinkers are Hobbes, Hume, Shaftesbury, Bolingbroke, Herbert of Cherbury, Tindal, Toland, Chubb, Woolston, and Collins. These names represent widely different phases of opinion, from simple deism to theism of a pure quality, and widely different intellectual attitudes, from philosophical skepticism to the blunt criticism of common sense. The free thinkers were not, strictly speaking, a sect; they entered into no league; they started no propaganda; they established no school; they put forth no creed—not even a creed of negation; they held nothing in common but a belief in the validity of reason in the sphere of faith. They were simply individual scholars, writers, talkers, who freely, with various measure of ability, uttered their doubts in regard to the system of "revealed religion." Their temper differed as widely as their genius or culture. Some were trained scholars, polished writers, wits, men of fashion, citizens of the world, men of letters, political and social philosophers; others were poor, uneducated, unrefined. Some were masters of *persiflage*; others employed none but the homeliest speech. Their deism was of every shade. For the most part, they held very positive religious ideas; they stood by the broad facts of human consciousness, maintained the existence and unity of a personal God, affirmed the perfect order of the universe, and prophesied the future welfare of all mankind. There was not an avowed atheist among them, not a professed materialist, unless it were Coward. They were unanimous in their desire—apparently an earnest one—to elevate religion to a spiritual sphere, and to emancipate it from dogmatism and formalism. Lord Herbert of Cherbury, who had perhaps more influence than any other in shaping the free-thinking mind of England, an elder brother of George Herbert the poet, believed the true religion to be universal, commended by its intrinsic evidence to the human mind, and attested by the intuitions of the soul. His five points of belief were—the existence of one supreme God; the duty of worship; piety and virtue as the means thereof; the efficacy of repentance; the existence of rewards and punishments here and hereafter. If any, like Bolingbroke, doubted the immortality of the soul, they were actuated in part by the thoroughness of their faith in an active law of retribution, which needed no after life for its vindication. Coward, who wrote in the spirit of a materialist, affirmed immortality as a divine gift to man, while denying that it was a natural inheritance.

Free thinking in England was colored by French infidelity, but always preserved a character of its own. The term "free thinker" is misapplied to the Frenchman of the eighteenth century, the contemporaries of Voltaire, the *esprits forts* who were the precursors of the French Revolution. These men, forced into antagonism to a despotic system in Church and State, bent all their efforts to overthrow it. Hence their vehemence of thought and speech; hence their acridity of temper; hence the audacity of their speculations, the severity of their denials, and the philosophical [illegible] of their opposition. They were less free thinkers than [illegible] thinkers. To them the name *d'esprits forts* applies. They did aim at propagandism, they did attempt to found a school, they constituted an active

racy of intellect, a clique of philosophers. They had little sympathy with the common mind, and little faith in the intuitions of the common heart. For English common sense they substituted Parisian wit, and for English seriousness Gallic levity. The English free thinker pushed his inquiries into the wide field of religious speculation; the French *esprit fort* took up an ultimate position outside of all religious confessions, and defended it. Both the Englishman and the Frenchman were by their principles compelled to be champions of human rights. The former expressed the spirit of sturdy self-reliance that characterizes the British mind; the latter, in contending against oppression in Church and State, advocated principles that afterward bore fruit in the Revolution that laid Church and State prostrate. Still, the spirit of the Englishman was more democratic.

The term "free thinker" is even less applicable to men like Strauss, Paulus, Baur, and the German rationalists than to Diderot, D'Holbach, D'Alembert, and Voltaire. For these men, though professing in some respects the same opinions with the Englishmen, arrived at them by different methods, and held them in a different spirit. Closet-students, scholars, and philosophers by profession, they published the result of their labors in a calmly scientific temper, as if unaware of opposing powers. They did not plume themselves on their freedom; they were not apostles of liberty; they made no war on institutions. The Englishman is the only genuine free thinker. The Frenchman is a *philosopher*—the German is a *rationalist*. Both are in advance of the free thinker in clearness of thought and statement, nicety of discernment, and adequacy of learning. The free thinker belongs to the last generation. The scientific thinker, the true thinker, is taking his place. (For the history of free thinking see LECHNER, *Geschichte d. Deismus*, and ADAM STOREY FARRAR, *Critical History of Free Thought*.) O. B. FROTHINGHAM.

Free-Town, town of Western Africa, in lat. 8° 20′ N., lon. 13° 9′ W., is the capital of the English settlement of freed negroes in Sierra Leone, and stands in a low, hot, unhealthy, but extremely fertile and beautiful plain near the mouth of the Bunck, and surrounded by an amphitheatre of lofty, forest-clad mountains. It is well built, though most of its houses are of wood, and contains 24 churches, belonging to 19 different Christian denominations; many schools, and two lighthouses. It is one of the most prosperous towns of Western Africa. Pop. 18,035.

Free′town, a post-tp. of Bristol co., Mass., on a branch of the Old Colony R. R. and on the New Bedford and Taunton R. R. It is 45 miles by rail S. of Boston. Its inhabitants are engaged in market-gardening, cranberry-culture, and lumbering. Charcoal, nails, etc. are manufactured. There are 6 churches, 3 bleacheries, and a mineral spring. Pop. 1372.

Freetown, tp. of Cortland co., N. Y., has a cheese-factory. Pop. 906.

Free Trade, in a literal sense, means trade or commercial intercourse free from artificial interference or restriction. As generally used, however, the term has a wider and more complex meaning, and may be regarded as the expression of a principle of political economy, which holds that the prosperity of a state or nation can best be promoted by freeing the exchange of all commodities and services between its own people, and between its own people and the people of other nations and countries, to the greatest extent possible, from all interferences and obstructions; but more especially from interferences and obstructions of an arbitrary, artificial character, resulting from legislation or prejudice. Free trade, as an economic principle or politico-commercial system, moreover, is the direct opposite to the so-called principle or system of *protection*, which maintains, on the contrary, that a state or nation can most surely and rapidly attain a high degree of material prosperity by "protecting" or shielding its domestic industries from the competitive sale or exchange of the products of all similar foreign industries; the same to be effected either by direct legislative prohibition of foreign commerce, or by the imposition of such discriminating taxes on imports as shall, through a consequent enhancement of prices, interfere to a greater or less extent with their introduction, free exchange, and consumption. An explanation of either of these terms, therefore, involves a presentation of the arguments, based on theory or experience, which may be adduced in support of the respective economic systems for which they are the expressions, and a review of the premises of the one almost necessarily requires a conjoint statement of the claims of the other.

It is also essential to clearly appreciate, at the outset of any explanation, the relation which "free trade" and "protection," regarded as economic systems, sustain to the subject of taxation and revenue—a matter about which there is no little of popular misconception. The nature of this relation may be stated as follows: The command of revenue being absolutely essential to the existence of organized government, the power to compel contributions, or, as it is termed, "to tax," is inherent in every sovereignty, and rests upon necessity. The truth of this principle the advocates of free trade and protection alike fully recognize. The former, however, maintain that in the exercise of this right by the state or sovereignty the object of the tax should be rigidly restricted to supplying the necessities created by legitimate public expenditures—or, in other words, that taxes should be levied for revenue purposes exclusively—and that, subject to such limitations, the question as to what forms taxation had best assume becomes a mere question of experience and expediency, preference being always given to those forms which involve the least waste, cost, and personal annoyance in collection, which are most productive in revenue, and which interpose the minimum of interference and restriction on the inter-exchange of commodities and services. Free trade as an economic principle is not, therefore, as is often assumed and supposed, antagonistic to the imposition of equitable duties on imports, provided the end sought to be attained is simply revenue, and the circumstances of the state render such form of taxation expedient. Protection, on the other hand, on the ground of advantages accruing directly or incidentally, advocates and defends the imposition of taxes on imports for purposes other than revenue. Protection, therefore, to the exact extent to which it attains its object, is obviously antagonistic to revenue, inasmuch as revenue is only received on those commodities which *come in*, while protection is only secured when the importation of commodities is restricted or made difficult. The adjustment of a tariff for revenue in such a way as to afford what is termed "incidental protection"—an idea much favored by American politicians—is based on the supposition that by arranging a scale of duties so moderate as to only restrict and not prevent importations, it is possible to secure a sufficiency of revenue for the state, and at the same time stimulate domestic manufactures by increasing the price of competitive foreign products. That the double object thus aimed at is capable of attainment cannot be doubted, but that the project is also one of the most costly of all methods of raising revenue will appear evident if it is remembered, that while revenue to the state accrues only from the tax levied on what is imported, the tax arising from the increase of price is paid equally by the nation upon all that is sold and consumed in competition with the foreign article. A tariff for revenue so adjusted as to afford incidental protection is therefore a system which requires the consumers, who are the people, to pay much in order that the state may receive little.

With these preliminary statements the essential points of the argument in favor of free trade as contradistinguished from protection may be stated as follows, the experience of the United States, where the principles of protection have been recently applied more systematically and extensively than ever before, being particularly referred to in the way of illustration:

1st. The highest right of property is the right to exchange it for other property. That this must be so will appear evident if it is remembered, that if all exchange of property was forbidden each individual would be assimilated in condition to Robinson Crusoe on his uninhabited island; that is, he would be restricted to subsist exclusively, or in the main, on what he individually produced or collected; be deprived of all benefits of co-operation with his fellow-men, and of all advantages of production derived from diversity of skill or diversity of natural circumstances. In the absence of all freedom of exchange between man and man civilization would obviously be impossible; and it would also seem to stand to reason that to the degree in which we impede or obstruct the freedom of exchange—or, what is the same thing, commercial intercourse—to that same degree we oppose the development of civilization.

2d. Any system of law which denies to an individual the right to freely exchange the products of his labor, by declaring, as is generally the custom, that A, a citizen, may trade on equal terms with B, another citizen, but shall not under equally favorable circumstances trade with C, who lives in another country, reaffirms in effect the principle of slavery, for both slavery and the artificial restriction or prohibition of exchanges deny to the individual the right to use the products of his labor according to his own pleasure, or what may seem to him the best advantage; or, in other words, the practical working of both the system of human slavery and the system of protection is to deprive the individual of a portion of the fruits of his labor without making in return any direct compensation. The argument

that is generally put forth by the advocates of protection in justification of legislation restricting freedom of exchange, or in defence of the pithily expressed proposition, "That it is better to compel an individual to buy a hat for five dollars, rather than to allow him to purchase it for three," is, that any *present* loss or injury resulting from such restriction to the individual will be more than compensated to him *indirectly*, as a member of society or citizen of the state. But this plea is the same in character, and just as legitimate, as that which was formerly put forth in defence of the system of negro slavery—namely, that the system was really for the good of the persons enslaved, and that any suffering or deprivation endured by the slave for the good of society—meaning thereby the masters—would be fully compensated to him, through moral discipline, in the world to come. It is also to be noted that this same species of argument—*i. e.* indirect or future individual or society benefit as a justification for present personal restriction or injury—has always been made use of in past ages as a vindication and in warrant for persecution on the part of the state for heresy or unbelief, and also for the establishment of state religions and enforced conformity thereto.

31. The general result for which all men labor is to increase the abundance or diminish the scarcity of those things which are essential to their subsistence, comfort, and happiness. Different individuals have different aptitudes, or are endowed with different natural capacities for making the various forces of nature and varieties of matter available for production. One man is naturally fitted to excel as a farmer, another as a mechanic, the third as a navigator, the fourth as a miner, engineer, builder, or organizer and director of society, and the like. The different countries of the earth likewise exhibit great diversity as respects soil, climate, natural products, and opportunity. It would seem clear, therefore, in order that there may be the greatest material abundance, that each individual shall follow that line of production for which he is best fitted by natural capacity or circumstances; and that, for the determination of what that line must be, the promptings of individual self-interest and experience are a far better guide than any enactments of legislatures and rulers possibly can be; and, finally, that the greatest possible facility be afforded to producers for the interchange of their several products and services. So true, indeed, are these propositions that mankind in their progress from the rudest and most incipient social organizations to higher degrees of civilization invariably act in accordance with them, and, as it were, instinctively. Robinson Crusoe upon his uninhabited island and the solitary settler in the remote wilderness follow of necessity a great variety of occupations, as that of the farmer, hunter, builder, blacksmith, fisherman, tailor, and the like. But as rapidly as the association of others in the same neighborhood admits, the solitary man abandons his former diversity of employment, and devotes himself more or less exclusively to a single department of industry, supplying his want of those things which he does not himself produce by exchanging the surplus product of his labor for the surplus product of his neighbors, who follow other and different industries. To take advantage of natural facilities for intercommunication between man and man for the purpose of exchanging services or commodities, it is to be further observed, that settlements in all new countries commence, if possible, in close proximity to navigable waters, and that if commenced inland, one of the first efforts of the new society is the construction of a path or road which will enable its members to hold communication with some other settlements or societies. Next, as population and production increase, the rude path or trail gives way to a well-defined road, the ford to a bridge, the swamp to a causeway, the pack carried upon the backs of men and animals to the wagon drawn by horses, the wagon to the railway-car, the boat propelled by oars and sails to the boat propelled by steam, and finally the telegraph, annihilating space and time; all efforts and achievements for the single object of facilitating intercommunication between man and man, and removing obstructions in the way of interchanging human services and commodities. Free exchange between man and man—or, what is the same thing, free trade—is therefore action in accordance with the teachings of nature. Protection, on the other hand, is an attempt to make things better than nature made them. Free trade, or the interchange of commodities and services with the minimum of obstruction, by rendering commodities cheap, tends to promote abundance. Protection, by interference or placing obstructions in the way of exchanges, tends to increase the cost of commodities to the consumer, and thereby promotes scarcity. Protection, effected by legislative restriction on exchanges, acts, therefore, in the sense of all those things which render transportation onerous; or, in other words, it is an obstacle in the same sense as a bad road, a precipitous range of mountains, an intervening desert, or a wide expanse of ocean abounding in risks to navigation; the general effect of all which is to augment in various degrees to consumers the difference between the producing and consuming price of commodities. All the people of the United States instinctively rejoice at the announcement of every new discovery in the construction or propulsion of vessels, whereby the time and cost of transporting commodities across the Atlantic from Liverpool to New York, or across the Pacific from China and Japan to San Francisco, are diminished; and yet they do not revolt at the inconsistency of imposing taxes, for purposes other than to meet the necessities of the state, on the landing of the commodities thus transported; which are precisely equivalent in effect, as regards the consumer, to substituting slow-sailing vessels of small tonnage in the place of ocean steamers, or of so widening the expanse of ocean to be traversed that the time employed in transportation (and the consequent increased cost of freight and risk) shall be expressed by months rather than by days. A few illustrations derived from the actual experience of the U. S. are here pertinent to the argument.

Upon the coast of Nova Scotia, within a short distance of the United States, there are coal-mines of great value as respects quantity and quality, and which, unlike any others in the whole world, are located so advantageously in respect to ocean navigation that almost by the action of gravity alone the coal may be delivered from the mouth of the pit upon the deck of the vessel. For many years the government of the United States has imposed a tax on the landing of this coal within its territory, of one dollar and fifty cents per ton. Now, if we assume that coal upon a well-managed railroad can be transported for one cent per ton per mile, the effect of this tax upon the people of New York and New England is precisely equivalent to a removal of these coal-mines of Nova Scotia from a point on the seaboard to a location one hundred and fifty miles inland. But it would also seem to stand to reason that if the removal of these mines one hundred and fifty miles into the interior was a benefit to the people of the United States, a further augmentation of their distance from the seaboard to five hundred or a thousand miles would be a still greater blessing, and that their absolute annihilation would be the most superlative good of all.

Again, some years since an English engineer, Mr. Bessemer, devised a new process for the manufacture of steel. He did not claim to make anything new; he did not claim to make steel of a quality superior to what was made before; but he did succeed in showing mankind how to make an indispensable article in the work of production *cheap*, which was before *dear*. Immediately on the assured success of the invention the advocates of protection in the United States asked Congress to impose such a duty on the import of this steel as would, through a consequent increase of its price to American consumers, almost completely neutralize the only benefit accruing from the knowledge and use of the new process—namely, its *cheapness*—and succeeded in obtaining, and still (1875) have a duty that in a great degree accomplishes such a result.

From the above propositions and examples it would seem evident that the direct effect of a protective duty, when it is really operative, is to compel, on the part of the community employing such an agency, a resort to more difficult and costly conditions of production for the protected article; and also, that when a state or community adopts the protective policy it also commits itself to the endorsement of the principle that the development and propagating of obstacles is equivalent to, or the surest method of, developing or propagating riches—a policy and a principle which, if logically and practically carried out, would lead to disuse of all labor-saving machinery.

The advocate of protection, however, meets this averment, as well as the argument embodied in the coal and Bessemer steel illustrations above given, by saying that by prohibiting or restricting the importation and use of foreign coal and steel a demand will be created for a corresponding additional quantity of similar American products. The immediate result of this will be that an additional opportunity will in consequence be afforded to American citizens desirous of following the occupations of coal-miners or transporters or steel-makers; and, the results of their labor and expenditure remaining in the country, the national wealth will be thereby augmented, whereas if the same amount of labor and expenditure is diverted to, and takes place in, a foreign country, the results will be exactly opposite.

In answer, now, to this, it may be said, *First*, That the amount of consumption in the two instances, and consequently the results of consumption, will not be the same: for whatever increases the price of a useful commodity diminishes its consumption, and, *vice versâ*, whatever di-

minishes the price increases consumption. *Second*, To admit the desirability of creating an opportunity of employing labor through the agency of a tax on all consumers of coal and steel to do work that would yield to the same consumers a greater product of the same articles if performed elsewhere, or an equal product at less cost, is to admit that the natural resources of a country are so far exhausted that there is no opportunity for the truly productive employment of labor—an argument which, however effective in overpopulated countries, can have no possible application in a new country like the U. S., whose natural resources, so far from being exhausted, are yet, as it were, unappropriated and unexplored. Again, a tax levied in pursuance of legislative enactment for the maintenance of such labor is clearly in the nature of a forced charity, while the petitioners for its enactment answer in every particular to the definition of the term "pauper"—namely, one who publicly confesses that he cannot earn a living by his own exertions, and therefore asks the community to tax themselves or diminish their abundance for his support. *Third*, The only true test of the increase of national wealth is the possession of an increased quantity of useful things in the aggregate, and not in the amount of labor performed or the number of laborers employed, irrespective of results. A tariff from its very nature cannot create anything: it only affects the distribution of what already exists. If the imposition of restrictions by means of taxes on imports enables a producer to employ a larger number of workmen and give to them better wages than before, it can only be accomplished at the expense of the domestic consumers, who pay increased prices. Capital thus transferred is no more increased than is money by transference from one pocket to another, but on the contrary is diminished to just the extent that it is diverted from employing labor that is naturally profitable to that which is naturally unprofitable. And herein is exposed the fallacy of the averment that duties levied on the import of foreign commodities protect home industry. It may be conceded that certain industries, as the result of such duties, may be temporarily stimulated, and the producers obtain large profits by a consequent increase in the price of their products; but then it is at the expense of those who pay the increased price, who are always the domestic consumers.

To further make clear this position, the following illustration, drawn from actual American experience, is submitted: For a number of years subsequent to 1860 the government of the U. S., with a view of protecting the American producer, imposed such a duty on foreign salt as to greatly restrict its import and at least double the price of the article, whether of foreign or domestic production, to the American consumer. The result was, taking the average price of No. 1 spring wheat for the same period in Chicago, that a farmer of the West desirous of buying salt in that market would have been obliged to give two bushels of wheat for a barrel of salt, which without the tariff he would have readily obtained for one bushel. If, now, the tax had been imposed solely with a view to obtaining revenue, and the farmer had bought imported salt, the extra bushel given by him would have accrued to the benefit of the State; and if the circumstances of the government required the tax, and its imposition was expedient and equitable, the act was not one to which any advocate of free trade could object. But in the case in question the tax was not imposed primarily for revenue, as was shown by the circumstance that imports and revenue greatly decreased under its influence, and the salt purchased by the farmer in Chicago was domestic salt, which had paid no direct or corresponding tax to the government. The extra bushel of wheat, therefore, which the farmer was compelled to give for his salt accrued wholly to the benefit of the American salt-boiler, and the act was justified on the ground that American industry, as exemplified in salt-making, was protected. And yet it must be clear to every mind that if the farmer had not given the extra bushel of wheat to the salt-boiler, he would have had it to use for some other purpose advantageous to himself—to give to the shoemaker, for example, in exchange for a pair of brogans. By so much, therefore, as the industry of the salt-boiler was encouraged that of the farmer and the shoemaker was discouraged; and, putting the whole matter in the form of a commercial statement, we have the following result: under the so-called "protective system" we have a barrel of salt and two bushels of wheat passed to the credit of what is called "home industry," while under a free system we have a barrel of salt, two bushels of wheat, and a pair of shoes. Protection, therefore, seeks to promote industry at the expense of the products of industry; and its favorite proposition, that though under a system of restriction a higher price may be given for an article, yet all that is paid by one is given to some other person in increased employment and wages, has this fallacy—namely, that it conceals the fact that the price paid by the consumer would have been equally expended upon something and somebody if the consumer had been allowed to buy the cheap article instead of the dear one; and consequently the loss to the consumer is balanced by no advantage in the aggregate to any one. "When a highwayman takes a purse from a traveller, he expends it, it may be, at a drinking-saloon, and the traveller would have expended it somewhere else. But in this there is no loss in the aggregate; the vice of the transaction is that the enjoyment goes to the wrong man. But if the same money is taken from the traveller by forcing him to pay for a dear article instead of a cheap one, he is not only despoiled of his just enjoyment as before, but there is a destructive process besides, in the same manner as if the loss had been caused by making him work with a blunt axe instead of a sharp one. Whenever, therefore, anything is taken from one man and given to another under the pretence of protection to trade, an equal amount is virtually thrown into the sea, in addition to the robbery of the individual."

To render the illustration derived from the transaction in salt, above given, more complete, attention is asked to the following additional historical circumstances. In the valley of Kanawha, West Virginia, there are salt-springs which furnish brine in abundance and of great strength and purity. The same springs also furnish conjointly an inflammable gas, which flows with such force and quantity that it is used both to lift the salt-water into tanks at considerable elevation and to subsequently evaporate the brine by ignition under the furnaces, without the necessity of resorting to the use of any other fuel whatever. Salt at this point can therefore be produced at a nominal cost, and with advantage even over solar evaporation, inasmuch as all expense of pumping the salt-water into vats in the first instance is entirely obviated. During the war, in order to deprive the army and the people of the Southern Confederacy of a supply of salt, the springs in question at Kanawha were temporarily destroyed by the Federal forces; and an important natural supply of salt to the country being thus cut off, the manufacturers of salt in Ohio, from springs less advantageously productive, obtained for a time a larger market and higher prices for their more costly competitive products. With the close of the war and the reopening of the Kanawha salt-works, the advantages thus gained at the expense of the salt-consumers bid fair to be put an end to; but in order to perpetuate them the Ohio salt-manufacturers united, and, having at a large annual expense leased the Virginia springs, abandoned and absolutely forbade their utilization.

4th. As has been already shown, any increase in the price of domestic products consequent on the imposition of taxes on the import of corresponding products of foreign origin is paid by the domestic consumer. Hence, a result alike deducible from theory and proved by all experience—that not only does protection to a special industry not result in any benefit to the general industry of a country, but also that its beneficial influence on the special industry itself is not permanent, but temporary. Thus, all taxes tend to diffuse themselves, and, if levied permanently and with any degree of uniformity, do diffuse themselves almost with infallibility. The price of no article can be permanently advanced by artificial agencies, or otherwise, without an effort on the part of every person directly or indirectly concerned in its consumption to protect and compensate themselves by advancing the price of the labor or products they give in exchange. If sufficient time is afforded, and local exchanges are not unduly restricted, this effort of compensation is always successful. Hence, from the very necessity of the case no protective duty can be permanently effective; hence, also, it is that protected manufacturers in every country always proclaim, and no doubt honestly feel, that the abandonment of protection, or even its abatement, would be ruinous. Of this the recent experience of the U. S. affords a most curious and convincing illustration. Thus, in 1862–63, in order to meet the expenses of a great war, the government imposed excise or internal taxes on every variety of domestic manufactures, and in accordance with the principles of equity, imposed what were claimed to be corresponding taxes on the import of all competing foreign products. Soon after the close of the war, however, when the cessation of hostilities diminished the necessity of so large revenues, the internal taxes were all repealed, but in no one instance was there a protected manufacturer found who took any other position than that a repeal of the corresponding tariff would be most disastrous to his business. The tariff, as originally raised to compensate for the new internal taxes, was therefore left in a great degree unchanged. That the principle here laid down, of want of permanency in protective agencies, is furthermore admitted by the protected manufacturers themselves as a result of their own experience,

is also proved by the following striking testimony forced out under oath before a government commission from one of the foremost of their number in 1868—the late Oakes Ames of Massachusetts:

Question. "What, according to your experience, was the effect of the increase of the tariff in 1864 on the industries with which you are specially acquainted?" *Ans.* "The first effect was to stimulate nearly every branch—to give an impulse and activity to business; but in a few months the increased cost of production and the advance in the price of labor and the products of labor were greater than the increase of the tariff, so that the business of production was no better, even if in so good a condition, as it was previous to the advance of the tariff referred to."

5th. Upon no one argument have the advocates of protection relied more in support of their system than that contained in the assumption already referred to—that if there were no restrictions on trade the opportunity to labor created by protection, and the results of the expenditure of the earnings of such labor, would be diverted to other countries to their benefit, and to the corresponding detriment of that country which, needing protection by reason of a necessity for paying higher wages or other industrial inequalities, abandons it; or, to speak more specifically, it is assumed that if the U. S. were to adopt a policy of free trade, England would supply us with cotton and metal fabrications; Germany, with woollen goods; Nova Scotia, with coal; the West Indies, exclusively with sugar; Russia, with hemp and tallow; Canada, with lumber; and Australia, with wool—that thereby opportunity to our own people to labor would be greatly restricted, and the wages of labor reduced to a level of the wages of foreigners. Specious as is this argument, there could not be a greater error of fact or a worse sophism of reason. None of the commodities mentioned will be given by the producers resident in foreign countries for nothing. *Product for product* is the invariable law of exchange, and we cannot buy a single article in any market except with or by a product of our own, or for money which has been obtained by the exchange of some product for it. Nothing, therefore, can or will be imported unless that in which it is paid for can be produced at home with greater final advantage. Hence, also, it is in the nature of a truism to assert that it is for the interest of every community that its industry should be directed to the production of such articles as are attended with greater final advantage, in preference to those which are attended with less; as inevitably would be the result if the business of production and exchange was not obstructed by legislative enactments, but left to the guidance of individual self-interest.

From these premises we are warranted in regarding the following deductions as in the light of economic axioms: 1st. A nation or community can attain the greatest prosperity, and secure to its people the greatest degree of material abundance, only when it utilizes its natural resources and labor to the best advantage and with the least waste and loss, whatever may be the nominal rate of wages paid to its laborers. The realization of such a result is hastened or retarded by whatever removes or creates obstructions or interferences in the way of production and exchanges. 2d. The exports on the whole of any country must and always do balance its imports; which is equivalent to saying that if we do not buy we cannot sell, while neither buying nor selling will take place unless there is a real or supposed advantage to both parties to the transaction. 3d. As a nation only exports those things for which it possesses decided advantages relatively to other nations in producing, it follows that what a nation purchases by its exports it purchases by its most efficient labor, and consequently at the cheapest possible rate to itself. Hence, the price paid for every foreign manufactured article, instead of being so much given for the encouragement of foreign labor to the prejudice of our own, is as truly the product of our own labor as though we had directly manufactured it ourselves. Free trade, therefore, can by no possibility discourage home-labor or diminish the real wages of laborers.

The favorite protectionist argument, that if trade is unrestricted, and the people of a country, under the inducement of greater cheapness, are allowed to supply themselves with foreign commodities, the opportunities for the employment of domestic labor will be correspondingly diminished, is an argument identical in character with that which has in past times often led individuals and whole communities to oppose the invention and introduction of labor-saving or "labor-dispensing" machinery. To sift thoroughly this sophism, it is sufficient to remember that labor is exerted not for the sake of labor, but for what labor brings, and that human wants expand just in proportion to the multiplication of the means and opportunity of gratifying human desires. If the wages of a day's labor would purchase in the market one hundred times as much as at present, can any one doubt that the demand for the necessaries and luxuries of life would be increased a hundred-fold? If the people of the U. S. could obtain the products of the labor of other countries for nothing, could the labor of the whole world supply the quantity of things we should want? In short, the demand for the results of labor can never be satisfied, and is never limited except by its ability to buy; and the cheaper things are the more people will purchase and consume. Nothing, therefore, can be more irrational than the supposition that increased cheapness, or increased ability to buy and consume, diminishes or restricts the opportunity to labor. If by the invention of machinery or the discovery of cheaper sources of supply the labor of a certain number of individuals in a department of industry becomes superfluous or unnecessary, such labor must take a new direction, and it is not to be denied that in the process of readjustment temporary individual inconvenience, and perhaps suffering, may result. But any temporary loss thus sustained by individuals is more than made up to society, regarded from the standpoint of either producers or consumers, by the increased demand consequent on increased cheapness through greater material abundance, and therefore greater comfort and happiness. About the time of the invention and introduction of the sewing-machine into Europe the benevolent people of a city in Germany where the industry of needlewomen was a marked specialty formed an organization to lessen in a degree the injury which it was believed would inevitably accrue from the supplementation of a great opportunity to labor by the poor which was threatened. After the lapse of a few years, however, when society, as represented by the whole people of the city, obeying their natural instincts, had determined to have, and had obtained, a cheaper source of supply for their needle-products than before, the organization referred to instituted an investigation, the result of which showed that by reason of a greater consumption of sewed goods, consequent on their cheaper supply, the number of persons engaged in the operating of sewing-machines was greater than what had formerly found employment by the needle, and that wages had increased rather than diminished.

6th. The averment that prohibition or restriction of foreign imports encourages diversity of domestic industry, is answered by saying, that when any trade can be introduced or undertaken for fiscal or public advantage, private enterprise is competent to its accomplishment. "To ask for more is only to ask to have a finger in the public purse." It may be possible to conceive of specific cases in which it might be politic for a government to give an advantage for a limited time and for a definite object. But protection, as an economic system, cannot rightfully claim any support from such an admission, inasmuch as its demand is that the public shall be obliged to support all manufacturing enterprises upon no other ground but that they cannot support themselves.

7th. Protection, it is alleged, has a tendency to make what are termed manufactured products cheaper. A very fit and cogent answer which has been made to this assertion of the opponents of free trade is, that if protection is to be recommended because it leads ultimately to cheapness, it were best to begin with cheapness. Another answer is to be found in the circumstance that not a single instance can be adduced to show that any reduction has ever taken place in the cost of production under a system of protection, through the agencies of new inventions, discoveries, and economies, which would not have taken place equally soon under a system of free trade; while, on the contrary, many instances can be referred to which prove that protection, by removing the dread of foreign competition, has not only retarded invention, but also the application and use of improvements and inventions elsewhere devised and introduced. Thus, referring to the experience of the U. S., where the system of protection has in general prevailed for many years, it is a well-known fact that the department of industry which has been distinguished more than any other by the invention and application of labor-saving machinery is that of agriculture, which has never been protected to any extent; and for the reason that the country which raises a surplus of nearly all its agricultural products for sale in foreign countries never can be. On the other hand, in that department of industry engaged in the primary manufacture of iron, which has always been especially shielded by high restrictive duties, not only from foreign competition, but also from the necessity of the exercise of economy and skill, the progress in the direction of improvement has been so slow that according to the report of the geological survey of Ohio for 1872–73 there is hardly a furnace in that great iron-producing State that can be compared with the best European furnaces, either in respect to construction, management, or product; many

Ohio furnaces unnecessarily wasting one-fourth of the metal in the ore in the process of smelting.

It is also pertinent to this department of the subject to notice the idea adopted by a school of American economists or politicians, that it is for the advantage of a country to endeavor to effect a reduction of prices by the creation, through legislation or otherwise, of an excessive or artificial stimulus to production. That the creation of an artificial stimulus to domestic production—such as is almost always temporarily afforded by an increase of the tariff or by war, which necessitates extraordinary supplies—does have the effect in the first instance to quicken certain branches of production, and subsequently reduce prices through the competition engendered, cannot be doubted; but experience shows that in almost every such instance the reduction of prices is effected at the expense or waste of capital, and that the general result, in place of being a gain, is one of the worst events that can happen to a community. Thus, the first effect of creating an extraordinary domestic demand is to increase prices, which in turn affords large profits to those in possession of stock on hand or of the machinery of production ready for immediate service. The prospect of the realization of large profits next immediately tempts others to engage in the same branch of production—in many cases with insufficient capital, and without that practical knowledge of the details of the undertaking essential to secure success. As production goes on, supply gradually becomes equal to, and finally in excess of demand. The producers working on insufficient capital or with insufficient skill are soon obliged, in order to meet impending obligations or dispose of inferior products, to force sales through a reduction of prices, and the others, in order to retain their markets and customers, are soon compelled to follow their example. This in turn is followed by new concessions alternately by both parties, which are accompanied by the usual resort of turning out articles or products of inferior quality, but with an external good appearance—slate being substituted in the place of coal; cinder in the place of iron; shoddy in the place of wool; starch and sizing in the place of cotton; pasteboard in the manufacture of boots and shoes in the place of leather; and clay in the manufacture of paper in the place of fibre. And so the work of production goes on, until gradually the whole industry becomes depressed and demoralized, and the weaker producers succumb, with a greater or less destruction of capital and waste of product. Affairs having now reached their minimum of depression, recovery slowly commences. The increase of the country causes consumption to gradually gain on production, and finally the community suddenly becomes aware of the fact that supply has all at once become unequal to the demand. Then those of the producers who have been able to maintain their existence enter upon another period of business prosperity; others again rush into the business, and the old experience is again and again repeated. Such has been the history of the industry of the U. S. under the attempt to restrict the freedom of trade by high duties on imports, frequently modified; and such also was the effect of the war from 1861–65. To use a familiar expression, it has always been either "high water" or "low water" in the manufacturing industry of the country—no middle course, no stability. What the people have gained at one time as consumers from low prices they have more than compensated at another by the recurrence of extra rates, and as producers by periodical suspensions of industry, spasmodic reduction of wages, and depression of business.

Meantime, the loss to the country from the destruction of capital and the waste and misapplication of labor has been something which no man can estimate. One of the most striking illustrations of this experience, selected from many examples afforded by the U. S., is the following: In 1864–65 it was found that the supply of paper of domestic manufacture was insufficient to meet the consumption of the country, and that the supply from abroad was greatly impeded by an unusually heavy duty imposed in time of war on its import. The price of paper in the country accordingly rose with great rapidity, and the profits of the paper-manufacturers who were then in possession of the machinery of production became something extraordinary. The usual effect followed. A host of new men rushed into the business and old manufactories were enlarged, so that during the years 1864–66 it was estimated that more paper-mills were built in the U. S. than during the whole of the twelve years previous. As a matter of course, the market became overstocked with paper, prices fell with great rapidity, many abandoned the business through inclination or necessity, and many mills and much machinery were sold for less than the cost of construction; while in the spring of 1869 the paper-makers met in convention to consider the desirability of decreasing the production of paper—or, what is the same thing, of allowing their capital and their labor to remain unemployed—on account of the unprofitableness of the business. In October of the same year a storm of great violence swept over the northern portion of the country, and in the flood which followed many mills engaged in the manufacture of paper were so injured as to temporarily render them incapable of working. A leading journal in one of the paper-manufacturing districts, devoted to the advocacy of protection, in commenting on the effects of the storm, used this language: "There seems to have been unusual fatality among paper-mills, but this disaster will work to the advantage of those who escaped the flood, and we doubt not that those that did stand will do a better business in consequence of the lessened supply;" or, in other words, the condition of this particular industry had become so bad through the influence of a fiscal policy based on the theory of protection that the occurrence of a great public calamity, with a vast attendant destruction of property, had come to be regarded in the light of a public blessing.

8th. It is clear that one of the essential attributes of a just law is that it bears equally upon all subjected to its influence, and that an unjust law must necessarily be also injurious. A system of law imposing protective duties must, in order to be effective, be partial and discriminating, and therefore unequal and unjust; for if a law could be devised which would afford equal protection to all the industrial interests of a nation, it would benefit in fact no interest by leaving everything relatively as before; or, in other words, the attempt to protect everything would result in protecting nothing.

Any system of laws founded on injustice and inequality cannot, furthermore, be permanent. The possibility that it can be further changed to meet the further demands of special interests, and the instinctive revolt of human nature against legal wrong and partiality, continually threaten its stability. Hence, a system of industry built upon laws establishing protection through discriminating taxes can never have stability of condition; and without such stability there can be no continued industrial prosperity. Apart from these considerations, in a free government, also, where the people enjoy the right to choose and to change their law-makers at comparatively short intervals, the opinions of the masses will change according to the light they receive; and as their opinion changes, so must necessarily the policy of the government. Tariffs framed to regulate and direct industries can therefore never be permanent under governments that admit the right of the people to vote and to think. Nothing less than a despotism, and an ignorant despotism at that, can maintain a protective tariff at any given standard for any lengthened period. On the other hand, one of the strongest arguments in behalf of freedom of trade is, that it makes every branch of industry independent of legislation, and emancipates it from all conditions affecting its stability other than what are natural, and which can in a great degree be anticipated and provided against.

9th. "A tariff on imports," it is sometimes alleged by the advocates of protection, "obliges a foreigner to pay a part of our taxes." To this it may be replied that if there were any plan or device by which one nation could thus throw off its burden of taxation in any degree upon another nation, it would long ago have been universally found out and recognized, and would have been adopted by all nations to at least the extent of making the burden of taxation thus transferred in all cases reciprocal. If the principle involved in the proposition in question, therefore, could possibly be true, no possible advantage could accrue from its application. But the point itself involves an absurdity. Taxes on imports are paid by the persons who consume them; and these are not foreigners, but residents of the country into which the commodities are imported. A duty on imports may injure foreigners by depriving them of an opportunity of exchanging their products for the products of the country imposing the duty, but no import-taxes will for any length of time compel foreigners to sell their products at a loss, or to accept less than the average rate of profit on their transactions; for no business can permanently maintain itself under such conditions. Where a nation possesses a complete monopoly of an article, as is the case of Peru in respect to guano, and to a great extent with China in the case of tea, the monopoly always obtains the highest practicable price for its commodities, and the persons who find their use indispensable are obliged to pay the prescribed prices. The imposition of a tax on the import of such commodities into a country may compel the monopoly, for the sake of retaining a market, to reduce their prices proportionally; and in such cases the nation imposing the impost may to a degree share the profit of the monopoly. But the price to the consumers is not diminished by reason of the import-duty, and the cases in which any interest has such a complete control over the

supply of a product as to enable it to arbitrarily dictate prices are so rare as hardly to render them worthy of serious consideration in an economic argument.

10th. Another powerful argument in favor of free trade between nations is, that of all agencies it is the one most conducive to the maintenance of international peace and to the prevention of wars. The restriction of commercial intercourse among nations tends to make men strangers to each other, and prevents the formation of that union of material interests which creates and encourages in men a disposition to adjust their differences by peaceful methods rather than by physical force. On the other hand, it requires no argument to prove that free trade in its fullest development tends to make men friends rather than strangers, for the more they exchange commodities and services the more they become acquainted with and assimilated to each other; whereby a feeling of interdependence and mutuality of interest springs up, which, it may be safely assumed, does more to maintain amicable relations between them than all the ships of war that ever were built or all the armies that ever were organized. Of the truth of this the experience of England and the U. S. in respect to the "Alabama claims" is a striking example. The moral and religious sentiments of the people of the two countries undoubtedly contributed much to restrain the belligerent feelings that existed previous to the reference of the claims to arbitration; but a stronger restraining element than all, and one underlying and supporting the moral and religious influences, was a feeling among the great body of the people of the two nations that war, as a mere business transaction, "would not pay;" and that the commerce and trade of the United States and Great Britain are so interlinked and interwoven that a resort to arms would result in commercial ruin and permanent and incalculable impoverishment to both countries.

11th. The question here naturally arises, if the above propositions in favor of free trade are correct, and if the doctrine of protection is as false and injurious as it is represented to be, how happens it that free trade does not at once meet with universal acceptance? and how is the adherence of many men of clear intellect and practical experience to the opposite doctrine to be accounted for? One of the best answers to these questions was given by the celebrated French economist Bastiat, in an article written many years ago, entitled *That which is Seen, and That which is Not Seen*, in which he showed that protection is maintained mainly by a view of what the producer gains and a concealment of what the consumer loses; and that if the losses of the million were as patent and palpable as the profits of the few, no nation would tolerate the system for a single day. Protection accumulates upon a single point the good which it effects, while the evil which it inflicts is infused throughout the community as a whole. The first result strikes the eye at once; the latter requires some investigation to become clearly perceptible. The doctrine of protection is also an inheritance of the past, and has all the support which custom, dogma, and prescription can give it. Mankind also divide themselves into two classes —producers and consumers, buyers and sellers. The interest of producers and sellers is that prices shall be high, or that there shall be scarcity; the interest of consumers and buyers is that prices shall be low, or that there shall be abundance. But every person will at once admit that it is for the general interest that there shall be abundance, rather than scarcity. But in the case of individuals controlling large agencies for production, their interests as producers and sellers of large quantities of commodities may be made greater than their interests as consumers, if by the aid of legislation the price of what they produce can be raised, by discriminating laws disproportionately over what they consume, or to the cost of production. Men of this class are generally rich beyond the average of the community, and therefore influential in controlling legislation and in determining fiscal policies; and it is but natural that in so doing they should consult their own interests rather than the interests of the masses.

12th. It only remains to briefly notice the testimony of history in respect to the influence of free trade as an economic principle upon the development of nations and the progress of civilization.

In the earlier ages in Europe the principle that trade or commerce is mutually advantageous, and that after every fair mercantile transaction both parties are richer than before, was not understood. On the contrary, the generally accepted theory among both nations and individuals in respect to trade was pithily embodied in the old proverb, "What is one man's gain must be another man's loss." Commerce, therefore, it was assumed, could benefit one country only as it injured some other. In accordance, therefore, with this principle, every state in Christendom, in place of rendering trade and commerce free, exerted itself to impose the most harassing restrictions on commercial intercourse, not only as between different countries, but also as between districts of the same country, and even as between man and man. Country was accordingly separated from country and town from town as if seas ran between them. If a man of Liege came to Ghent with his wares, he was obliged first to pay tolls at the city's gates; then when within the city he was encumbered at every step with what were termed "the privileges of companies;" and if the citizen of Ghent desired to trade at Liege, he encountered the same difficulties, which were effectual to prevent either from trading to the best advantage. The revenues of most cities were also in great part derived from the fines and forfeitures of trades, almost all of which were established on the principle that if one trade became too industrious or too clever, it would be the ruin of another trade. Every trade was accordingly fenced round with secrets, and the commonest trade was termed, in the language of the indentures of apprentices, "an art or mystery." If one nation saw profit in any one manufacture, all her efforts were at once directed to frustrate the attempts of other nations to engage in the same industry. She must encourage the importation of all the raw materials that entered into its production, and adopt an opposite rule as respected the finished article. At the close of the sixteenth century England undertook the woollen manufacture. By the act of the 8th of Elizabeth the exporter of sheep was for the first offence to forfeit his goods for ever, to suffer a year's imprisonment, and then have his left hand cut off in a market-town on market-day, there to be nailed up to the pillory. For the second offence he should be adjudged a felon, and suffer death. At a later period, in the reign of Charles II., it was enacted that no person within fifteen miles of the sea must buy wool without the permission of the king; nor could it be loaded in any vehicle, or carried, except between sunrising and sunsetting, within five miles of the sea, on pain of forfeiture. An act of Parliament in 1678, for the encouragement of woollen manufactures, ordered that every corpse should be buried in a woollen shroud. In 1672 the lord chancellor of England announced the necessity of going to war with the Dutch and destroying their commerce, because it was surpassing that of Great Britain; and even as late as 1743 one of England's greatest statesmen (Somers) declared in the House of Lords that "if our wealth is diminishing, it is time to ruin the commerce of that nation which has driven us from the markets of the Continent, by sweeping the seas of their ships and blockading their ports." By the treaty of Utrecht, which concluded the great war of England and Spain against Louis XIV. and his allies, England, being able to dictate the terms, secured the adoption of a section by which the citizens of Antwerp were forbidden to use the deep water that flowed close by their walls; and it was further expressly stipulated that the capacious harbor of Dunkirk, in the north of France, should be filled up and for ever ruined, so that French commerce might not become too successful.

There was, however, one notable exception to the all but universal acceptation in Europe during the fifteenth, sixteenth, seventeenth, and eighteenth centuries of the doctrine, that the commercial and industrial prosperity of nations was dependent on monopolies and interferences with trade-production and exchanges; and that exception was found in the case of Holland. In a remarkable pamphlet entitled *The True Interest and Political Maxims of the Republic of Holland*, published by Cornelius de Witt, and translated into English in 1746, this great statesman of the Netherlands shows "that the Dutch, though not producing a bushel of wheat, ate the whitest bread in Europe; and, though not producing a sheaf of hemp, a single plank, or any iron, had the best fleet which then sailed the sea; because Holland had wealth to pay for these commodities; and possessed this wealth because its trade and all exchanges were left unfettered, unimpeded, unlegislated upon; and that by this free trade the Netherlands became both the most peopled and the richest country on the earth, and loans could be effected there for a lower interest than anywhere else."

With the progress of civilization, and the consequent diffusion of information, the arbitrary restrictions on trade above noticed, which were formerly so common in Europe, have almost entirely disappeared, and men now wonder that any benefit could ever have been supposed to have accrued from such absurd and monstrous regulations. But the change to a more liberal state of things, though constant, has been slow, and the policy of the Middle Ages, in the process of modification and extinction, gave place to the so-called and more modern policy of "protection," which, while clearly recognizing the impolicy of interfering with domestic exchanges, regards foreign trade as something different from any other trade, which it is for the interest

of the state to interfere with and regulate. But under the same influences of a progressive civilization this system too, in like manner, is disappearing.

In this work of progress Great Britain took the lead in 1841; not from a change in popular sentiment due to better acquaintance with theoretical principles, but from a realization on the part of all classes of the people of the results which the recognition and practice of the policy of protection during a period of many years had entailed upon the country. These results Mr. Noble, in his work, *Fiscal Legislation of Great Britain*, thus describes: "It is utterly impossible," he says, "to convey by mere statistics of our exports any adequate picture of the condition of the nation when Sir Robert Peel took office in 1841. Every interest in the country was alike depressed; in the manufacturing districts mills and workshops were closed and property depreciated in value; in the seaports shipping was laid up useless in the harbor; agricultural laborers were eking out a miserable existence upon starvation wages and parochial relief; the revenue was insufficient to meet the national expenditure; the country was brought to the verge of national and universal bankruptcy." England, therefore, as it were, under compulsion, and with very grave doubts on the part of many of her ablest financiers and economists, under the lead of Sir Robert Peel abandoned protection as the national policy, and gradually adopted the opposite principle of free trade with all the world. The same author above referred to, writing in 1865, draws the following picture of the results of the change of policy referred to, based on the experience of near a quarter of a century: "It has rendered agriculture prosperous, largely augmented rent, vastly extended manufactures and employment, increased the wages of labor, and, while securing the collection of an increased revenue, has by improving the value of property lessened the burden of taxation. It has been shown, also, that each successive development of this beneficent legislation has extended these results."

The experience of Belgium is even more instructive. During the French occupation of this country under the First Napoleon the protective system was carried out, practically and under military rule, to a degree rarely if ever equalled. Not only was the introduction of all foreign goods into the country strictly forbidden, but all goods of foreign production found within the state were seized and burned, and the persons concerned in their importation summarily and severely punished. The result of such a system was that when the Dutch reassumed the sovereignty in 1814 the whole country had become desolated and to a considerable extent depopulated. The Dutch, however, brought in a new fiscal and commercial policy, one cardinal feature of which was a limitation of duties on imports to *three* per cent. on raw materials and six per cent. on manufactured articles. Under this liberal legislation the principal manufactures of Belgium again sprang into existence. But a deep-rooted antagonism between the Dutch and the Belgians led to a separation of the two countries in 1830, when, mainly through a hatred of the old government and its policy, the previous free-trade legislation was repealed, and from 1830 to 1855 high protective and discriminating duties were imposed on imports. But in 1851 the finance minister, in his place in Parliament, declared that if this policy was continued it would prove the ruin of the whole system of domestic industry; and in 1855 the Parliament and the people so fully acquiesced in his opinion that protection in Belgium was swept away at once and for ever, and the duties on imports arranged purely with a view to revenue.

In 1860, France followed the examples of England and Belgium, and abrogated to a very great extent the restrictions which it had formerly imposed on foreign commerce. Although consequent disaster to French industrial interests was by many confidently predicted, the result showed that the progress of the trade of France with foreign countries was more than twice as great during the seven years immediately succeeding the full operation of the new policy as it was during the twenty-one years immediately previous. Speaking more specifically, France in 1859, under a restrictive system, exported manufactured articles to the value of $260,000,000; in 1867, under a freer system, this same class of exports had increased in value to $556,000,000. In 1859 the general foreign trade of France was returned as amounting to $1,082,000,000; in 1866 it was $1,625,000,000. In fact, so marked has been the increased commercial prosperity of France under a comparatively liberal fiscal policy that the French nation, although strenuously urged to abandon it after the disasters of the war of 1872, and under a pressing necessity for more revenue, have nevertheless refused to do so.

Similar illustrations might also be given from the history of the commercial and fiscal experience of the states comprising the German Zollverein. In short, all the leading commercial nations—the United States only excepted—have of late years relaxed their commercial systems, and progressed in a greater or less degree towards free trade. In the U. S., on the contrary, the principles of the protective system have since 1860 been reapplied, and are still maintained, with a degree of rigidity and on a scale of magnitude which have no precedents in recent commercial history. The general result has been (1875) to assimilate the industrial condition of the country to the condition of Great Britain in 1841 (before described), when the protective system was from necessity abandoned. In place of effecting national industrial independence, or emancipation from national dependence on foreign skilled labor, as it was confidently claimed that the system would do, it has, in fact, produced the exact contrary result; the import of the products of foreign skilled labor having greatly increased, while the export of similar products has comparatively and absolutely diminished. The inability to export such products, moreover, has practically limited the growth of the so-called manufacturing industries of the country to the demand for domestic consumption, and forbidden any enlargement of them consequent upon the increasing ability and desire of other nations to consume, and the increased facilities for effecting international exchanges. As a further legitimate sequence, the commercial marine of the U. S. has been all but annihilated, as is shown by the fact that while in 1860, 71 per cent. of the total foreign trade of the U. S. was carried in American bottoms, in 1873 the proportion was less than 30 per cent. One of the most striking illustrations that could possibly be presented of the evil effect of commercial restrictions in limiting trade and industry, and consequently national development, is to be found in the history of the commercial relations between the U. S. and the British North American provinces. Thus, in 1852–53, in the absence of anything like commercial freedom, the aggregate exchanges between the two countries amounted to only $20,691,000. The subsequent year a treaty of reciprocity went into effect, whereby the people of the two countries were enabled to trade and exchange their products with little or no obstruction in the form of import-duties. The result was that the aggregate of exchanges rose the very first year of the operation of the treaty from $20,691,000 to $33,494,000, which subsequently increased, year by year, until it reached the figure of $55,000,000 in 1862–63, and $84,000,000 in 1865–66. In this latter year the treaty of reciprocity was repealed, and restrictive duties again became operative. The result was that the annual aggregate of exchanges immediately fell to $57,000,000, and in 1873, seven full years after the expiration of the treaty, when both nations had largely increased in wealth and population, the decrease of trade consequent on the abrogation of the treaty had not been made good.

Again, in 1873, the freight—meaning thereby commodities—transported on the railroads of the U. S. was probably in excess of 200,000,000 tons. If we assume each ton to be worth, on the average, $50, the value of the exchanges effected through the agency of the railroads of the U. S. was in excess of $10,000,000,000; or, in other words, the population of the country being 40,000,000, every 4,000,000 of the people exchanged commodities among themselves, through the agency of railroads, to the extent of $1,000,000,000. It is true that much of this freight was transported backward and forward in different forms over the same routes, and did not all represent a direct movement between the producers and consumers; but it is safe to assume that not a ton was transported a single mile except for the real or supposed advantage of the owner. Now, on the North American continent there are about 4,000,000 of people inhabiting the British provinces and 40,000,000 inhabiting the territory of the U. S. The line which separates them is an imaginary or geographical one, and not a physical one, and, were it not for commercial restrictions arbitrarily imposed by the legislators of the two countries, men and commodities could pass as freely as they now do between different sections of the provinces or different States of the American Union; and yet these same restrictions were sufficient in 1873 to reduce the aggregate value of the commercial exchanges between the 4,000,000 of people in Canada and the 40,000,000 of people in the U. S., through every variety of instrumentality, to the sum of $82,000,000; while the same number of people on one side of the line, in the U. S., exchanged between themselves, through the agency of railroads alone, to the extent of $1,000,000,000. It is also curious to note of the people of the U. S. that so well satisfied are they of the principles of free trade when applied to domestic transactions, that they will not allow the creation or maintenance throughout the whole of the broad territory they inhabit of the slightest artificial obstruction to the freest exchange of products or to the freest commercial or personal movement; and

that, too, notwithstanding the different States and Territories into which the country is divided differ among themselves in respect to wages of labor, prices of commodities, climate, soil, and other natural conditions, as widely as the U. S. as a whole differs from any other foreign country with which it is engaged in extensive commercial intercourse. And yet we have the striking and anomalous circumstance that a very large number—perhaps a majority—of the American people regard trade with foreign nations as something very different from trade among themselves, and as such, therefore, to be subjected to entirely different laws and conditions. But a slight examination ought, it would seem, to satisfy, that foreign trade presents no element peculiar to itself, but only the same elements which domestic trade presents, and that, consequently, the same laws and conditions that are applicable to domestic exchanges are equally applicable to foreign exchanges. Men, moreover, do not engage in any trade, foreign or domestic, for mere enjoyment or pleasure, but for the material gain which accrues to both parties. They desist from it also so soon as the mutual advantage ceases. The relation, then, which government ought to sustain to the whole question of exchanges is well expressed in the answer which the merchants of France gave to Colbert more than a century and a half ago, when he asked their advice and opinion "how he could best promote commerce"—"*Laissez-nous faire*" ("Let us alone").

(For further information on the subject of free trade reference is made to the following publications: BASTIAT'S *Sophisms of the Protectionists* (American translation); *Catechism on the Corn Laws*, THOMPSON, London (scarce); *Does Protection Protect?* GROSVENOR; *Reports of the Special Commissioner of the Revenue of the U. S.*, 1865–70; *The Parsee Letters*, published by the *New York World*; *Notes on the Fallacies Peculiar to American Protectionists*, LIEBER; and the various treatises on political economy by MILL, MACLEOD, CAIRNES, AMASA WALKER, PERRY, etc.) (See PROTECTION and TARIFF.) DAVID A. WELLS.

Free'ville, a v. of Dryden tp., Tompkins co., N. Y., at the crossing of the Southern Central and Ithaca and Cortland R. Rs.

Free-Will, or **Freedom of the Will** (see WILL). Freedom, with reference to the will, has been variously defined, the definition as a rule being the result of a theory, not a preliminary to it. The conflict has been in part on the question whether the will is free. (See FATE, NECESSITY.) But more generally it has turned upon the question, What *is* the freedom of the will? each party here conceding its freedom, but not in the sense claimed by the other. The point of division is this: Does the will necessarily and solely decide under the influence of determining causes or motives external to itself, or is its ultimate decision a self-conditioned, self-determined act? The objection ordinarily made to the first view is that it reduces the will to a necessity which destroys accountability; the objection to the latter view is that it seems to give absoluteness to the finite, a power of origination to the creature, or to make the human will a final cause, and thus to remove it out of the category of all other created things. The great argument for the second view is the seeming consciousness and the indisputable sense of accountability. The great argument for the first view is its consonance with the law of causality. (See CAUSE.) In theology the question of free will is associated with the doctrines of the FALL, GRACE, PREDESTINATION, and SIN. (See those articles.) In the history of the doctrine the names of Augustine and Pelagius are specially representative. The Greek Church had a semi-Pelagian leaning; the Latin Fathers tended to the views which came into full expression in Augustine. The mediæval theology prevailingly leaned to semi-Pelagianism. It praised Augustine, but followed Pelagius. In the Reformation the Lutheran and Calvinistic churches took strong ground against the entire Pelagian tendency, while Erasmus and Zwingli were in various respects in affinity with it. The theory of SYNERGISM (which see) was an attempt at harmonizing the two views. The latest theology is largely synergistic. The churchly theologians of our time, standing fast, in the main, by the old confessional position, yet give more prominence than the old divines did to the reality and value of the general operations of God's grace and providence on men at large, in supplying the defects of moral nature, and in preparing them for the more specific regenerating work of grace. (For the philosophical aspect of the question see FATALISM, MATERIALISM, PANTHEISM.) The two latest works of marked ability on the subject are by Scholtens and Luthardt, the former maintaining, the latter rejecting, the doctrine of determinism. (For literature of the subject see WILL.) C. P. KRAUTH.

Freewill (or **Free**) **Baptists.** This title properly covers several organizations of Baptists, such as Freewill Baptists, Free Baptists, General Baptists, and Separate Baptists, as they agree in doctrine and are in intimate fellowship. Their doctrinal peculiarities are a belief in a general atonement, the possibility of salvation to all men, the freedom of the will, involving man's ability to choose or refuse to accept Christ, and the original, inalienable right of true believers to commemorate the death of our Lord and Saviour in His supper. In other respects they do not differ from the larger Baptist body. They are tenacious for a converted church membership, the baptism of believers only, immersion only for baptism, the independence of the local churches, the right of every member, male and female, to vote and speak in the business and social meetings of the churches, and the separation of Church and State.

Previous to 1750 the Baptists in America lacked the elements of growth. In more than a hundred years they had not attained to a membership of over 3000 in the whole country, and these were mainly immigrants from Great Britain, scattered from Maine to the Gulf of Mexico. Some of them held to limited, and some to general, atonement; some were for open, and some for close communion, but they were all sadly deficient in spiritual power. In no proper sense can they be regarded as the legitimate parents of the existing Baptist family, which has now grown to millions, they having contributed to this great body of Christians little more than a name. Both branches of Baptists really had their birth in the great revivals under Edwards, Wesley, and Whitefield. The Methodists and Baptists had a common spiritual parentage; have grown with marvellous and about equal rapidity under the mighty impulse received from the great revivalists. They were born in revivals, and have grown by their continual recurrence. From 1745 to the end of the century many separate congregations were formed of persons who were not satisfied with the cold, formal, powerless life in the regular New England churches. The new churches were known as New Lights and Separatists. A large portion of them ultimately rejected the doctrine of infant baptism, and adopted immersion only as baptism, which made them Baptists in fact, and led them finally to take that name. Their zeal and spiritual power were such that they soon filled the whole land with their doctrine, and planted churches with marvellous rapidity. Great freedom of thought, independence of inquiry, and boldness of utterance prevailed among them, and no little diversity on many points of doctrine and practice. Some were high Calvinists, others believed in general atonement; some rejected unimmersed believers from the Lord's table, others invited them. Discussions were often sharp, but zeal for souls overshadowed every other impulse and gave character to all their measures. As early as 1751 there were several churches in Rhode Island and Connecticut that held to a general atonement and free communion. In 1785 they formed the Groton Union Association, which in 1790 contained 10 churches and 1521 members. From this location and this type of Baptists colonies went out to various sections, preaching a free gospel and the oneness of saints. Shubael Stearns, with others, went to North Carolina in 1751, and planted churches which spread all through Virginia, Tennessee, and South Carolina, and extended over the whole South and Southwest. They were known as Separate Baptists. From 1780 to 1800 a movement was inaugurated to effect a union between them and the section known as regular Baptists, which was mainly successful, under an agreement that they should not be required to subscribe to the severer doctrines of Calvinism. But some of the Separatists declined to enter into the union; a portion who did do so afterwards withdrew. A section of them in North Carolina and Tennessee afterwards took the name of Freewill Baptists, another portion took that of General Baptists, while some held, and still hold, to the old name of Separate Baptists. Previous to 1783 a colony removed from the churches in Westerly, R. I., and Stonington, Conn., to Rensselaer co., N. Y., under the lead of Benjamin Carpe. A church was formed, great revivals followed, and churches multiplied, spreading westward through the State and into Canada. They took the name of Free Communion Baptists, but have since dropped "Communion," and use the briefer name of Free Baptists. They were not Calvinistic, really, though generally believing in the "perseverance of the saints." In 1779 a discussion arose among the Baptists in New Hampshire on the doctrines of Calvin, which resulted finally in a division. Benjamin Randall, a young man converted under the preaching of Whitefield, was called to an account for holding to a general atonement and the ability of sinners to accept of Christ; and he was disfellowshipped. He united with a church in Strafford, which endorsed his views, was ordained at New Durham in 1780, and in connection with others of like faith labored with great zeal and abundant success for the conversion of sin-

ners and the founding of churches. Their opponents called them "Freewillers," but they rejected that name, claiming that they were Baptists, and continued to do so until 1800, when the name had become so fixed upon them that they adopted it without further opposition.

Neglect to provide an educated ministry, and to give their ministers a proper support, so that they could give their whole time to the gospel, has seriously hindered the growth of Free Baptists. They have confined their labors chiefly to rural districts, and in the great rush of population to cities and villages have been constantly depleted and kept weak. But in the last twenty-five years they have rapidly changed for the better in these respects; education has become general, and the ministry is fairly supported. They now have three colleges, and a fourth in process of erection, two theological schools, and a large number of academies of a high order. Bates College, at Lewiston, Me., has an invested capital of over $500,000; Hillsdale College, at Hillsdale, Mich., a capital of over $200,000; Ridgeville College, at Ridgeville, Ind., a capital of about $100,000; and the new college at Rio Grande, O., a capital already secured of about $150,000. The aggregate membership of the several bodies of Free Baptists is not far from 150,000. They sustain a vigorous mission in India, employing thirteen missionaries and quite a number of native helpers. The difference between Free Baptists and the larger Baptist body is rapidly decreasing; the doctrines of general atonement, freedom of the human will, and free communion are received with more and more favor among all classes of Baptists; and it is fondly hoped that the time is at hand when all will be united in bonds of fraternal fellowship. G. H. BALL.

Free'zing, the change from a liquid to a solid state, resulting from the abstraction of heat. The zero of the centigrade thermometer, equivalent to 32° F., is the freezing-point of water in ordinary conditions. It has been shown by Dr. James Thomson and his brother Sir William that the increase of pressure upon water, and upon all substances which expand in freezing, will lower the freezing-point. Under a pressure of 13,000 atmospheres water will not freeze at Fahrenheit's zero. On the other hand, such substances as paraffin, which contracts in freezing, have the freezing-point raised by pressure. Artificial freezing can be best induced by the liquefaction of solids or the evaporation of liquids. These processes absorb heat—that is to say, they render it *latent*—and by abstracting it from the surrounding substances freeze the latter. In most cream-freezers the liquefaction of a mixture of pounded ice and salt is the means employed. In artificial ice-making machines the evaporation of ammonia or of the most volatile ethers is the essential element. The most efficient freezing-mixture now known is that of liquid nitrous oxide and carbon disulphide, which has produced a temperature of —220° F. (For freezing of the person see FROST-BITE.)

Freezing, Artificial. Artificial freezing has been performed, as a mere laboratory experiment, ever since the middle of the seventeenth century. In 1665, Robert Boyle, fellow of the Royal Society, published his success in the repeated freezing of water and other liquids by various chemical mixtures. He attempted mercury, but remarks, "we could not at all freeze this extravagant liquor, though we tried it more than once." Leslie's freezing of water by sulphuric acid in a vacuum in 1810, and Faraday's long-subsequent achievement of solidifying water by sulphurous acid evaporating in a red-hot crucible, are only two of the many well-known varieties of this class of experiments. In what follows we shall briefly refer to four natural principles or methods by which the freezing of water has long been attempted on a considerable scale, and with more or less success for economic purposes.

1. *The Intermixing of Various Chemical Substances.*—Thus, a solution of nitrate of ammonia in water depresses temperature 46° F. The nitrate may be recovered by evaporation, and employed again. (For other and considerably more frigorific combinations, see article FREEZING MIXTURES.) They all depend upon producing a solution the specific heat of which is greater than that of the components that enter into the solution. But the superior efficacy of the ordinary mixture of common salt with comminuted ice is mainly due to the consequent liquefying of the ice, by which an absorption of 142° (79° C.) of caloric is necessary for the latent heat of liquefaction.

2. By far a more powerful and a more manageable principle is the absorption of caloric into vapor expanding and escaping from a volatile liquid. The vapor of water is supereminent in requiring no less than 967° (537° C.) of *latent heat*, while ammoniacal vapor requires 925° (514° C.), and sulphuric ether about 164° (91° C.). Yet another facility afforded by the more highly volatile liquids is the low temperature at which volatilization or ebullition takes place under the ordinary atmospheric pressure. Thus, sulphuric ether boils at 95° (35° C.). Faraday published in 1825 his observation that certain of the hydrocarbons boil at or near the freezing-point of water. Pure ammonia boils at —36° (—38.5° C.), while carbonic acid becomes unmanageable by the great tension of its vapor at ordinary temperatures.

3. The re-expansion of compressed air, as well as of other gases, is powerfully refrigerative. The heat developed by compression is first to be absorbed by cold water. Then the re-expansion against pressure *extinguishes* caloric in the gas sufficient, if abstracted from its own weight of water, to depress the latter in temperature at the rate of one degree for each unit of energy expended in expansion, or for the amount of work necessary to raise the same weight 772 feet against gravity. It was a natural although erroneous expectation of the early experimenters upon this principle of refrigeration—and of Leslie himself—that the compressed air when expanded to its original tension would show a depression of temperature of as many degrees as had been abstracted during the compression. But since the physical theory of this subject has been more fully investigated, such an expectation has been shown to be unwarranted.

4. A frigorific agency, not dependent like the foregoing upon either mechanical force or chemical reactions, is afforded, under favoring circumstances, by radiation into the cosmical spaces. Robert Boyle quotes from "the diligent Olearius," more than two centuries ago, a statement that ice was ordinarily produced in the hot climate of Ispahan, the capital of Persia, in layers a finger thick, by pouring water at successive intervals in the night "upon a shelving pavement of freestone or marble." It has moreover long been known that in Bengal and other provinces in India ice is obtained for domestic use by exposing at night shallow earthen vessels resting upon a flooring of dry stalks and leaves in pits two feet deep. Information has also recently come to us through Baptist missionaries in Eastern China as to the existence of a similar practice in that region. In these instances merchantable cakes are produced by superimposing the thin layers one upon another, to unite by simple regelation. This method has been attempted both in England and France with success as a mere experiment, but not to the extent of economic value. It is a study for philosophers to explain how it could succeed, even as an experiment, in a warm or temperate atmosphere. There is testimony, however, that, in advance of the modern ice-machines, Persia, India, and China have been the homes of an economic ice-production; and for purposes of luxury vessels of ice produced by chemical mixtures have long been in Europe, and in Paris especially, an article of use at table, in addition, there and everywhere, to the ices and creams congealed in vessels surrounded by ice and common salt.

To the utilization of chemical affinities for frigorific purposes the only requisites are a simple commixture or solution of the substances employed, and a flow of the cold mixtures upon or along metallic sheets or surfaces containing the substances to be cooled. Non-conductors of heat are employed for protection externally against radiation and the atmospheric warmth. In the employment of volatile liquids the evaporation is effected by drawing off or exhausting the vapor from the cooling vessel as fast as it is formed, either by a gas-pump or by the affinity of a liquid or other substance which will absorb the vapor with great avidity. Such, for example, is the affinity of water or of chloride of silver for ammoniacal gas, or of sulphuric acid or anhydrous chloride of calcium for watery vapor. Another mode of disposing of the vapor might be, in certain instances, to condense it upon a cold surface present in the evaporating vessel or in communication with it. A familiar illustration of this last expedient is the philosophical apparatus known as the "cryophorus;" another is the common laboratory paradox of making water to boil in a flask by affusion of cold water on the outside.

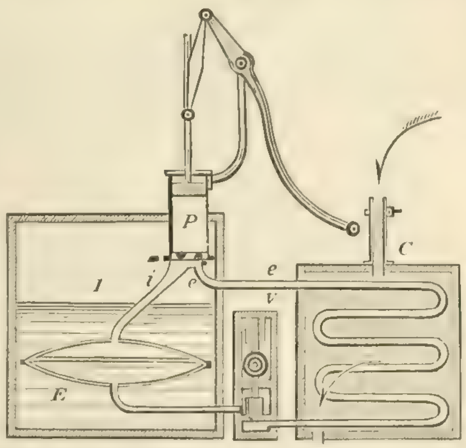
Within the last quarter of a century the utilization of the foregoing principles and processes has risen to the rank of a new art and manufacture. Its principal centres or localities at the present time are New Orleans, La., and Victoria and Sydney, with one or two other prominent localities, in Australia. At New Orleans some 50 tons a day are now the average production, at a first cost of $7 to $8 a ton, and a selling price of $15 to $20. The production, both there and in Australia, where a different process is used, approximates to seven tons of ice produced for every ton of coal consumed. In the U. S. and in Asia there are many scattered machines, concerning which we have no distinct information. Our object is to supply a succinct account of this new art from its origin to the present time.

The purposes to which refrigeration on a large scale may be usefully applied are numerous. Prominent among them are the preservation of perishable articles in storage, of

meats and fruits in transit by railroads or in ships, the cooling of liquors and condensing of vapors in brewing and distilling, and the regulation of temperature in buildings. Each of these purposes will have its own methods and forms of apparatus. But, inasmuch as these miscellaneous applications are but incidents and offshoots of the main invention, as well as because none of them have hitherto been characterized by any signal success, the following descriptions will be confined to the apparatus and operations specially adapted to the manufacture of ice.

Historically, as well as naturally, the progress of this branch of invention has related, first, to methods *for producing cold*, and afterwards to the methods of *applying the cold* with commercial economy. The first available apparatus for the *continuous production* of cold was the invention of a citizen of the U. S. in England, where his invention was patented in 1834.* Perkins proposed to operate by a gas-pump P (Fig. 1) which should evaporate sulphuric ether in a vessel E surrounded by water or other liquid in I, and force the ether vapor, through *e*, with compression, into a metallic coil in C, cooled by water flowing outside in contact with it. The cold and pressure restore the ether to its liquid condition, and the superior pressure in C forces this liquid, through the weighted valve in the vessel V, back into E, to be evaporated anew. The liquid in I will be cooled, and, in case it is water, may be congealed on the outside of E. But the apparatus is obviously not adapted to congelation, but only to refrigeration on a small scale.

Fig. 1.



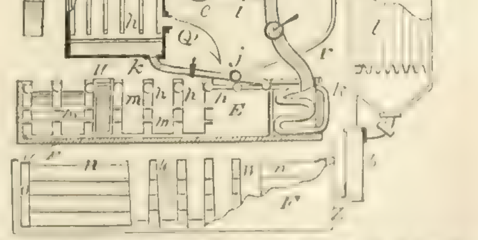
Perkins was soon followed by imitators, especially in France, but, with one exception, they added nothing essential. This exception was the French patent of E. Bourgois, taken out in 1846 for the employment of the hydrocarbons, among other volatile liquids, as Perkins had employed ether, and by an apparatus operating on the same principles, although widely different in form and construction. This apparatus, also, like the former, was obviously meant for very limited uses. Its suggested use of the hydrocarbons was no doubt derived from Faraday's discovery, made known in the *Philosophical Transactions* of 1825, that certain of those liquids have the valuable property, for this use, of being far more volatile than ether, and even of boiling at or near the freezing-point of water.

None of these inventions availed anything for commercial use; yet the American Perkins has undoubted priority, for as much as relates to the continuous production of cold. But in 1848–49 another citizen of the U. S.,† without any knowledge of the Perkins method, reinvented it in a form and with an apparatus fitted to the largest practical use by steam or other power. His invention embraced — as shown by his English patent (No. 13,167) of July, 1850, and the specifications of his fundamental U. S. patent of 1853 — those novel forms of apparatus for *applying the cold*, when produced, to the manufacture of ice in commercial quantities, without one or another of which no ice-machine in the world now operates for this manufacture. The first ice machines covered by this patent were constructed on a small scale at the Cuyahoga Works at Cleveland, O., in 1850. Thence onward to 1856 larger machines were operated, which realized the result, at that time truly surprising, of turning out in a few hours of any day of the summer season nearly a ton of sound, clear, and merchantable ice, in blocks a foot square and six inches thick. This thickness more than doubles what is now attempted by working ice-machines; and it imposed a load which, with other hindrances, interfered with the immediate introduction of the machine into the Southern States of the Union; but public attention was excited both at home and abroad, to these "Cleveland results."‡ In 1858 the English machine of James Harrison, which he had patented in Mar., 1856, was brought out in London,§ and soon after set up in Australia. It was patterned after one of the modes of construction described in Twining's fundamental patent of 1853, and to this day, both in Australia and elsewhere in the British provinces, all the ice-machines are understood to copy that pattern with certain improvements in details by the original constructor, Daniel Siebe. A sketch of the Harrison machine will be given in outline further on.

The commercial adaptations of Twining's invention, both to the cold-producing and the cold-applying uses on the largest scale, are exhibited in the annexed figure (2). In this sketch the deeply shaded parts represent the same as shown in the patent of 1853, but the fainter outlines are modifications, although covered by that patent, by which the best "Cleveland results" were obtained.

In the shaded parts of Fig. 2 the double-acting gas-pump P draws through *i*, from the "freezing cistern" E, the vapor of "a volatile liquid — as alcohol, ether, sulphuret of carbon, etc."—and forces it through *e* into the pipes *h* of the "restorer" C, where it is restored to a liquid condition by the aid of cold water flowing through Q into and pervading the condensing vessel C, and wasting through Q′, as shown. But the restored liquid re-enters E automatically through the regulated pipe and cock *k*. After coiling around in the anterior compartment, to be cooled by exposure to the issue of cold vapor into *i*, the pipe is prolonged so as to form the so-called "percolator" *p*. Now, the freezing cistern E is a tight box—of which there may be any number side by side—divided across by the equally tight "water-chambers" *m*, open at top. These may be filled with water to be frozen, or, better, they may receive separate "water-vessels" (or moulds) W, with brine or other uncongealable liquid between to assist conduction. The chambers *m* do not fill entirely across, but hug one side of E, from side to side, alternately, so as to afford a zigzag channel along and through E and around *m*, through which a cold vapor or liquid may course across and back alternately, and refrigerate the contents of *m*. This is one form of operation; and the vacant spaces shown between the chambers, and supported across by stays, are sections of the channel.

Fig. 2.



A second form or mode of applying the cold is the following: The "percolator" *p* traverses the upper back angle of E inside throughout, and opposite to each cross vacancy between the chambers *m*, and through them at top, throws off lateral branches, shown in circular section at *p*, *p*, and pierced with minute orifices, which eject the volatile liquid supplied from C through *k*, upon the interior surfaces of the containing plates or sides of *m*, to run down these surfaces in a condition favorable to evaporation, and cool through the plates the liquid in the chambers. In certain cases it was provided that these interior surfaces might be coated with thin absorbent sheets.

* Jacob Perkins, inventor of a new steam-generator and of other novelties much noted at the time. For cooling, see his patent No. 6662.

† Alexander C. Twining, LL.D., then professor of mathematics, natural philosophy, etc. in Middlebury College, Vt.

‡ See the *Cleveland Herald*, and especially "Ice by Machinery" in the *New York Scientific American* of Sept. 13, Nov. 15, and Dec. 13, 1856.

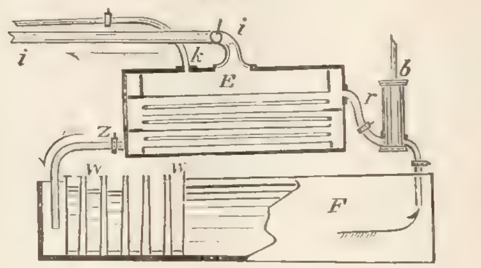
§ See the *Illustrated London News* of May 27, 1858.

A third mode specified in the same patent was the simple one of partially filling the above described channels between and around m by the volatile liquid, the latter as it evaporates escaping through i, while the waste is resupplied through k.

Still a fourth form or method was described, but reserved for another patent, which was subsequently taken; this will be mentioned below. First, however, let it be observed that the best Cleveland results were obtained by a freezing cistern or refrigerator F, in which flattened or oval copper tubes n were ranged one above another, forming parallel vertical sheets or "stacks," between which the vessels W were set, side by side, in an uncongealable liquid, as shown in outline merely. The cold liquid was circulated by a force-pump b, which drew it from the separate evaporating vessel E′, and returned it to the colander at top of the same, to run down on the cloths l, and be cooled anew. The circulating liquid was ether, and it became cooled, while running down the cloths or sheets l, by its own partial evaporation, maintained by F. This vapor, after condensation in c, is returned by k into r by simply turning the uniting cock j.

The English machine of Harrison is shown by Fig. 3 in its distinctive features. The following quotation from the above-described fundamental U. S. patent of 1853 exactly anticipates and describes its plan and operation—viz.: "There may be an auxiliary cistern of a tubular, or coiled, or other convenient form, which may hold or be open to ether, and be surrounded by the alcoholic or other suitable mixture or liquid to be cooled by contact with the auxiliary cistern, and by the exhaust of a (the gas-pump) evaporating ether within the latter. The liquid thus cooled may flow or be drawn out of its containing vessel into d (the freezing cistern), and there perform the freezing office heretofore ascribed to the ether." In Fig. 3 the cooling or

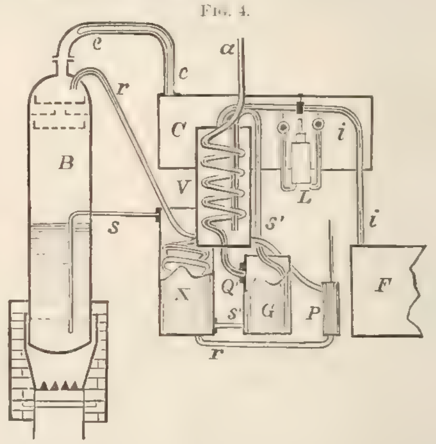
Fig. 3.



evaporating vessel is E. The horizontal pipes within it are submerged in ether; and a circulation back and forth is maintained by the force-pump b, and determined by the interior partitions, so that the brine or uncongealable liquid to be cooled is drawn from the trough F by b, and forced back into it through z. Meanwhile, the ether is constantly evaporated by a gas-pump through i, and the restored vapor sent back in a regulated current of liquid through k. The water-vessels or moulds are arranged side by side in F, and the cold brine or medium from E flows through it with a slight descent. The vessels nearest z are first frozen, and removed, after which the lower vessels are successively and mechanically pressed forward, and the newly-filled vessels placed at the vacancy thus formed at the lower end of the trough. Our object does not call for, nor our space allow, further details.

It was not until after the English machines had become an assured success, and publicly known as such, that M. Ferdinand P. Carré of Paris, France, undertook his enterprises in refrigeration, which were at first simply a reproduction of the American inventions above described, but resulted in the successful application to the ice-manufacture of his very effective apparatus and combination for producing cold by ammoniacal gas, without mechanical appliances for evaporating and recondensing. Carré's fundamental principle and process had been known on a small scale by Faraday, and they had been made known by him by publication in the *Transactions of the Royal Society* so early as 1823. In fact, Carré's simple intermittent apparatus, as patented in 1859 in France and in 1860 in the U. S., exhibits no considerable advance upon that of Faraday. But the ultimate development of the ammonia-machine, as shown in his English patent of Oct. 15, 1860, must ever form an epoch of the highest importance in the history of the ice-manufacture. Attempts have been made to deprive M. Carré of the credit of his invention. Nearly five years subsequent to the date just mentioned a patent was applied for in the U. S. by Messrs. J. Mignon and S. H. Renart, in their own claim, for the selfsame contrivance, and the application was granted; yet, notwithstanding this, we have done M. Carré the justice to ascribe to him the full credit of the apparatus which is familiarly known by his name. We have to regret that a similar spirit of fairness has not been exhibited toward our own countrymen by foreign writers, even when speaking under the responsibility of official obligation. The early machines of Carré, as has just been stated, and his early patents, were simply the ether cold-producing apparatus of Perkins, combined with the cold-applying apparatus of Twining; yet the French commission appointed in 1858 to examine and report on this ether-machine did, through M. Gaugain, ascribe the credit wholly to Carré, as was claimed by him, and as such sequestered it for the honor of France. Yet the ammonia-machine itself, both as originally patented by Carré, and subsequently patented again under a different claim in America, is, in all its apparatus for the application of cold, from beginning to end—in other words, from the escape of the gas out of the retort in which it is expelled from its aqueous solution, up to its final discharge from the refrigerator into the vase of absorption—simply a reproduction in every essential detail of the U. S. patent of 1853. Carré's real improvement consisted in the choice of such a volatile substance as, by its peculiar affinities, permitted him to dispense with mechanical compression on the one hand to reduce it to the liquid state, and with mechanical exhaustion on the other, to remove it, after it has served its purpose, from the refrigerator. We present below the distinctive features of this invention.

Fig. 4.



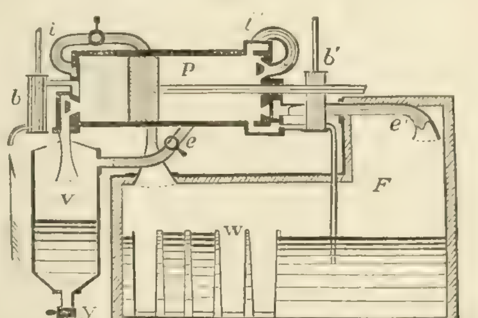
The retort B contains aqua ammoniæ in a state of ebullition over a furnace. The expelled ammonia, after being purged of watery vapor by permeating a shower of relatively cool return liquid coming through r into colanders at top, is forced through e into the pipes of the condenser or liquefier c, and condensed by cold water flowing around those pipes, similarly to the like in Fig. 2. We refer to the descriptions of that preceding figure for the consecutive treatment and performance of the volatile liquid after its issue in vapor from the retort till its escape from the tubular refrigerator F by evaporation in its parallel vertical sheets or stacks of metallic pipe. These last are analogous to n, and they admit the moulds W between them, with the uncongealable liquid perfecting contact between the moulds and the refrigerating surfaces. Returning to Fig. 4, we have the cold vapor drawn through i into the vase of absorption V by its affinity for, and solution in, the cooled and weak liquid which enters at top through s'. The heat evolved by this solution is abstracted by cold water flowing through the coil Q Q′. This solution, or "rich liquor," is drawn out by the exhaust and force-pump P, and thrown back into B. On its way it acquires heat by rising in a coil up through the "exchanger" X, which is traversed in the opposite direction by hot "weak liquor" coming from the retort through S. Equally, the hot liquor parts with caloric, and afterwards is further cooled in the coil s' which traverses G, surrounded by cooling water. Lastly, it is discharged into V at top, to perform the requisite absorption of the cold gas from F. That cold vapor, on its way, has contributed to cool the water for freezing, which is contained in a long sleeve, not shown, but surrounding the entire upper segment of i. But the rich liquor is showered into B through r and top colanders.

The Carré machine, notwithstanding this simplicity and directness of action, is encumbered by its great first cost of construction, and is subject to leakage and a rapid corrosion of the pipes, which have not a lifetime of more than five to six years. Its chief disadvantage, however, is the drawback upon evaporation imposed during much of the year in hot climates, by a reaction in the refrigerator from the vase of absorption of the large amount of pressure due to the high temperature of the natural cooling waters. A

very simple and inexpensive remedy for this defect has, it is true, been invented and patented by the originator of the Cleveland results; but the sagacity of operators has not yet made it available to their manufacture. This is partially exhibited at L, by the broken lines in the figure. These tracings show simply a small transfer pump between V and F, which interposes a bar to the excess of pressure in the vase, and will by opposite and corresponding action at once invigorate absorption in that vessel and evaporation in the refrigerator.

It remains to describe another American invention—an atmospheric ice-machine of great theoretical beauty. It was invented by Dr. John Gorrie of New Orleans, and patented both in this country and in England about 1850. It forms the basis of the present Windhausen machine: which last is, to our view, apparently the less simple of the two, whether in construction or operation, although perhaps the more effective. But its merits—for certain valuable refrigerating purposes at least—are not yet ascertained to their full probable extent. Fig. 5 exhibits the Gorrie invention, using, however, but a single air-pump, whereas the original plan embraced an antagonist pump as well. There is a freezing room F in which the moulds W are set in a bath of uncongealable liquid, as shown, and with air of freezing temperature, or nearly that, above. The piston of P, while moving towards the head, draws in air from F, and by its return stroke first compresses the air, and then forces it with great pressure into the strong reservoir V, while the force pump *b* injects in spray a mass of cold water, which is also forced into V, and there separates from the air and escapes through the regulated aperture *y*. But the same return stroke opens the exit-pipe *e* for the compressed air in V to expand into P, and assist its mechanical operation. At the same time *b′* injects a mass of the uncongealable liquid drawn from the bath below, and forces it back intensely cooled by the expanded air into F through *e*, together with the air received from V. (Fig. 5.) A large machine of this

FIG. 5.



description, with antagonist pumps, was early made in England, but in the operation it performed but half the promise, and was ruptured during action—perhaps by accumulation of the injected liquids. Very probably, however, the Gorrie invention has never yet received its best form and development.

In addition to the foregoing, a passing notice is due to the machine of Charles Tellier. This, it is true, does not differ essentially from the ether machine which has been described already. In fact, a complete explanation of Tellier's operation will be found in the third mode of that described above under Fig. 2—that is to say, the mode in which the chambers *m* are directly filled with water to be frozen without emptying the moulds W or the uncongealable liquid; and in which the evaporating channels between the chambers are kept nearly full, or sufficiently supplied with volatile liquid which the gas-pump is constantly evaporating. Two things, however, are peculiar. The first is, that when the chambers are frozen throughout, and the evaporating channels emptied of the liquid, vapor enough of the condenser or restorer *c* is admitted to these channels to condense upon the interior surface of the plates and thaw the ice cakes loose. The other is, that methylic ether is employed as the volatile liquid. It possesses the advantage of a boiling-point at atmospheric pressure, several degrees below the freezing-point of water, and yet of condensing with a manageable tension at ordinary temperatures. It is easy to conceive of good results from a machine operated under such conditions.

A comparatively inferior consideration is due to the sulphuric-acid apparatus of Mr. Edmond Carré of Paris, which operates on the principle applied by Leslie two-thirds of a century ago. This apparatus is described fully in the report on the Paris Exposition above referred to, at p. 367. But the constantly recurring necessity of renewing the acid employed for this apparatus prohibits practically its extended use. Speculatively, it may deserve mention also that an analogous idea, but free from the like objection, is found in Twining's English patent of 1850. An apparatus is there drawn and described, on a scale adequate to continuous economic operation, in which water, slowly percolating into shallow vessels in a vacuum, is partially evaporated, and its vapor arrested by a cold surface from which the frosty deposit is removed by revolution across fixed edges, the water in the pans being solidified into cakes.

The foregoing descriptions have been prepared with a more careful endeavor to discriminate justly between opposing claims, because the priority due to American inventors has in every instance been appropriated to foreign patentees, and the periodical press of our own country has too generally failed to correct the injustice. It is true, indeed, of the ammonia or Carré machine that in respect to the means employed for the production of cold, it is in many respects original, availing itself very felicitously of the peculiar properties of the substances employed as the vehicle of heat, and exhibiting a high degree of ingenuity and of skill in the adaptation of means to ends on the part of its inventor; but for the manufacture of ice it is safe to say that neither that machine nor any other in the world does, or at present can, be economically maintained in operation without a fundamental indebtedness to American patents.

F. A. P. BARNARD.

Freezing Mixtures. When solids are liquefied (fused or dissolved) they absorb a certain quantity of heat, which is thus rendered latent—is no longer indicated by the thermometer. This heat is called *latent heat of fusion or fluidity*. If we mix equal weights of water at 0° C. (32° F.) and water at 79° C. (172.4° F.), the temperature of the mixture will be the mean of the two temperatures, or 39.5° C. (103.1° F.). But if we repeat the experiment with snow or pounded ice at 0° C. and water at 79° C., the temperature of the whole will be only 0°, *but the ice will have been melted*. A quantity of heat, represented by 79° C. (174.2° F.), will have been apparently lost in melting the ice. If we place in a warm room two vessels, one containing a kilogramme of water at 0° C., the other a kilogramme of snow at 0° C., we shall find when the snow is melted that its temperature is only 0°, while the temperature of the water in the other vessel has risen to 79° C. (174.2° F.). This principle is true of all solids: they absorb in melting a certain quantity of heat, without indicating by the thermometer any increase in temperature. The following table exhibits the latent heats of fluidity of a few solids, expressed in heat-units—*i. e.* the quantity of heat necessary to raise one kilogramme of water 1° C.:

Latent Heat absorbed by 1 Kilogramme in Melting.

Ice	79	units.
Sulphur	80.5	"
Spermaceti	82.22	"
Lead	90	"
Beeswax	97.22	"
Zinc	274	"
Tin	277.77	"
Bismuth	305.55	"

The solution of most salts in water is attended with absorption of heat as the salt is liquefied. The following table contains a few illustrations of this principle:

Mixture.	Thermometer sinks—	[illegible]
Nitrate of ammonia 1 part Water 1 "	From +50° F. to +4° F. " +10° C. to −15.55° C.	46° F. 25.55° C.
Chloride of ammonium 5 parts Nitrate of potassa 5 " Water 16 "	From +50° F. to +10° F. " +10° C. to −12.22° C.	40° F. 22.22° C.
Chloride of ammonium 5 parts Nitrate of potassa 5 " Sulphate of soda 8 " Water 16 "	From +50 F. to +4° F. " +10° C. to −15.55° C.	46° F. 25.55° C.
Nitrate of ammonia 1 part Carbonate of soda 1 " Water 1 "	From +50° F. to −7° F. " +10° C. to −21.67° C.	57° F. 31.74° C.

The most remarkable salt in this respect is the sulphocyanide of ammonium. Phipson (*Chem. News*, xviii. 109) states that on dissolving this salt in an equal weight of hot water at 96° C. (204.8° F.), he was surprised to see the outside of the vessel covered with hoar frost, and on introducing a thermometer into the solution he found its temperature to be 2°–3° C. below zero (28.4–26.6° F.); 98°–99° C. of heat (208.4°–210.2° F.) had been required to liquefy the salt. By employing acid instead of water still greater reduction of temperature results:

Mixtures.	Thermometer sinks—	Cold produced
Sulphate of soda...... 3 parts. Nitric acid, dilute .. 2 "	From +50° F. to — 3° " +10° C. to — 19.44°	53° F. 29.44° C.
Phosphate of soda.... 9 parts. Nitric acid, dilute.. .. 4 "	From +50° F. to — 12° " +10° C. to — 24.44°	62° F. 34.44° C.
Sulphate of soda ...... 8 parts. Hydrochloric acid. . 5 "	From +50° F. to — 0° " +10° C. to — 17.78°	50° F. 27.77° C.
Sulphate of soda. . 5 parts. Sulphuric acid, dilute 4 "	From +50° F. to + 3° " +10° C. to — 16.11°	47° F. 26.11° C.
Sulphate of soda...... 6 parts. Nitrate of ammonia 5 " Nitric acid, dilute.... 4 "	From +50° F. to — 14° " +10° C. to — 25.55°	64° F. 35.55° C.

In a suitable apparatus a mixture of 6 parts sulphate of soda (Glauber's salt) and 5 parts hydrochloric acid will freeze 5 parts of water. The best results are obtained when considerable quantities are employed. The lowest temperatures are produced by mixing snow or pounded ice with the salt employed. The salt causes the snow to melt, with the absorption of its heat of fusion, and the water produced dissolves at the same time the salt, which in turn absorbs its latent heat. Such mixtures are used for freezing ice-cream and water-ices, champagne, etc., and for condensing very volatile vapors. The temperature of ice-cream is often 15° F. or lower; 2 parts of pounded ice and 1 of salt are used for ice-cream; 3 parts of crystallized chloride of calcium (cooled to 0° C. = 32° F.) and 2 of snow will freeze mercury, producing a temperature of — 45° C. = — 49° F.

The following are mixtures which may be used for freezing:

Mixtures	Thermometer sinks—	Cold produced.
Snow or pounded ice 2 parts. Common salt...... .. 1 "	To — 5° F. " — 20.55° C.	
Snow or pounded ice 5 parts. Common salt .... 2 " Sal-ammoniac......... 1 "	To — 12° F. " — 24.44° C.	
Snow or pounded ice 24 parts. Common salt . ... ..10 " Sal-ammoniac......... 5 " Nitre .... 5 "	To — 18° F. " — 27.78° C.	
Snow or pounded ice 12 parts. Common salt .... 5 " Nitrate of ammonia 5 "	To — 25° F. " — 31.67° C.	
Snow .... 3 parts. Sulphuric acid, dilute 2 "	From +32° F. to — 23° " + 0° C. to — 30.55°	55° F. 30.55° C.
Snow.................... ... 8 parts Hydrochloric acid . 5 "	From +32° F. to — 27° " + 0° C. to — 32.78°	59° F. 32.77° C.
Snow...................... 7 parts. Nitric acid, dilute... 4 "	From +32° F. to — 30° " + 0° C. to — 34.44°	62° F. 34.44° C.
Snow...................... 2 parts. Chloride of calcium, cryst.............. ... 3 "	From +32° F. to — 50° " + 0° C. to — 45.5°	82° F. 45.55° C.
Snow.................. . 3 parts. Potash......... .... 4 "	From +32° F. to — 51° " + 0° C. to — 46.1°	83° F. 46.11° C.

(For further information on this subject consult COOKE'S *Chem. Physics;* GANOT'S *Physics;* URE'S *Dict.*, "Freezing;" WATT'S *Dict.*, "Heat.") C. F. CHANDLER.

Fregel'læ, an ancient Volscian town, colonized by Rome in 328 B. C. It stood on the right bank of the Liris, probably nearly opposite Ceprano, and commanded the passage of the river. It was large, opulent, and faithfully devoted to the interests of Rome, but in 125 B. C. it was utterly destroyed by L. Opimius, in consequence of an insurrection. Its ruins doubtless afforded materials for building Fabrateria and other towns near by.

Fregenal' de la Sier'ra, town of Spain, in the province of Badajoz, Estremadura. Pop. 6948.

Frei'berg, town of Saxony, on the Münzbach, at the foot of the Erzgebirge. It is situated in one of the richest mining-regions of Europe, no less than 1500 mines of silver, copper, and lead being worked in the neighborhood, and is the centre of the administration for the Saxon mines. Its mining school, having thirteen professors, a library of 18,000 volumes, a most excellent collection of minerals bequeathed to it by Werner, is a very celebrated institution, and visited by students from all European countries. Pop. 21,673.

Frei'burg, town of Germany, in the grand duchy of Baden, on the western slope of the Black Forest. Its cathedral, commenced in 1122 and finished in 1514, with a tower 367 feet high, is one of the finest specimens of Gothic architecture in Germany. It has a well-frequented university, and some manufactures. Pop. 24,599.

Freiburg, canton of Switzerland, between Berne, Vaud, and the Lake of Neuchatel. Its area is 565 square miles; its population 110,832, of which 93,951 are Catholics and 16,819 Protestants; about 90,000 speak French and 20,000 German. The southern part is mountainous, though none of the peaks reach the snow-line; the northern part is more level. The whole canton abounds in excellent pastures, and although it has some manufactures of straw-plait, leather, and tobacco, cattle-breeding and dairy husbandry are the main business of the inhabitants. The cheese from this canton is said to be the best produced in Switzerland.

Freiburg, a quaint but picturesque old town of Switzerland, the capital of the canton of Freiburg, on the Sarine, over which is built a suspension bridge 906 feet long, 28 feet wide, and 175 feet above the water. Its cathedral is a fine building, with a famous organ having 7800 pipes. Its tanneries and dye-houses are remarkable. Pop. 10,904.

Freiburg (*Unterm Fürstenstein*), town of Prussian Silesia, 35 miles by rail W. S. W. of Breslau. It is a picturesque walled town, with thriving manufactures. P. 6792.

Freight. This term is employed in a variety of significations. In common parlance it denotes goods or cargoes transported from one place to another by carriers, while in its usual legal acceptation it applies to the price to be paid for such transportation. It is also sometimes employed to designate the compensation paid for any use of vessels, including the carriage of passengers. It will only be necessary, however, to consider it with reference to the second of these meanings. The nature of the obligation to pay freight, its amount, and the time of payment may be varied to a great extent by the stipulations in the contract of affreightment, evidenced by the charter-party or the bill of lading. Thus, the shipper of goods may hire the entire capacity of a vessel or some specific portion for a gross sum agreed upon or at certain rate per ton, and he will then be bound to pay for the entire space engaged, even though it be not used, the amount paid for the space not occupied being termed "dead freight." Or the agreement may be to pay only according to the quantity of goods actually shipped, and the sum due might then be varied at the option of the shipper. If no definite stipulations were made in regard to the freight, a contract for its payment would still be implied by law, and its amount would be determined by the usage of trade and the circumstances of the particular case. The general principles governing the contract of affreightment, and not often modified by particular agreement, are—that the ship-owner after receiving a cargo on board has a right to retain it until the completion of the entire voyage of transportation; that his right to claim freight does not exist until the final destination is reached; and that he has then a lien upon the goods for the satisfaction of his proper charges. A partial completion of the voyage only will not give the ship-owner or master a right to insist upon the payment of any freight whatever. The consignor may demand an entire fulfilment of the contract and delivery of the cargo at its destination, and if compliance be refused he may retake his goods and is discharged from all obligation. The lien of the carrier differs from most liens of a maritime nature, in that it depends upon the possession of the goods, and if delivery be made he has only a personal claim against the consignee or consignor. But if there is only a partial delivery of the cargo, the lien on the remainder is not destroyed, but subsists as a security for the entire claim. A carrier's lien is generally enforced in a court of admiralty. The amount of freight-money payable is sometimes diminished by the arrival of the goods at their destination in a deteriorated condition or diminished in quantity. If the injury is occasioned by the negligent stowage or packing of the cargo, or by any default on the part of the master, the damage sustained may be deducted from the freight. But if the deterioration occurred by reason of natural causes, and could not have been prevented by reasonable care, as if the loss should be occasioned by natural waste, decay, or evaporation, or by unavoidable perils of the sea, the carrier is not answerable for the accident, and no diminution from the entire freight is allowed. If articles arrive in substantially the same form as when shipped, even though there may have been a change in their quality affecting their value, it is a general rule that full freight has been earned. Under no circumstances can a cargo which has arrived be abandoned to the ship-master because its value has been so much diminished as to be less than the sum demanded for transportation. If the carrier is responsible for the loss, a counter-claim may be set up against him to neutralize his demand, or, as in England, a separate action may be instituted. If the carrier is not in fault, the goods must be received and the entire freight liquidated.

An apportionment of freight sometimes results as the consequence of a disaster upon the voyage, by which a vessel is compelled to put in at an intermediate port for repairs. The carrier has a right in such cases to retain the goods if he desires, complete his repairs with reasonable expedition, and proceed to his destination, or he may send

them forward by some other vessel and thus earn full freight. But if, notwithstanding the carrier's readiness to complete the transportation, the owner of the cargo desires to have it returned to him, and the carrier consents, there is still a claim for a *pro rata* freight, determinable, according to the general rule, by estimating the amount of the voyage completed upon the arrival of the ship at the port of necessity. But if in such a case the owner should absolutely refuse to allow retention of the goods by the ship-master, and take them from him against his will, freight for the entire voyage may be demanded, because the shipper is alone in fault. And if, on the other hand, the owner of the vessel is in the wrong by refusing to proceed with his voyage according to the terms of the agreement, he is entitled to no compensation whatever.

It is a general principle of the marine law that the earning of freight is a necessary prerequisite to the payment of the seamen's wages, or, as the terse legal maxim expresses it, "freight is the mother of wages." The reason of this rule is based upon the policy of stimulating the sailors to a careful performance of their duties and to the exertion of every effort to prevent disaster to ship or cargo, that the voyage may be successfully completed. But the application of the rule is not extended farther than this reason for its adoption would justify. For if the loss of freight be attributable to the wrongful act of the ship-master or the owner of the cargo, it would be grossly unjust to deprive the seamen of their just compensation; and though the vessel should be wrecked and abandonment become necessary, yet if the sailors used all practicable measures to ensure her safety and reach port, their claims for wages could be enforced. The rule that wages shall depend upon the earning of freight has been abolished in England by statute, but the same result is practically obtained by the provision that a failure on the part of a seaman to exert himself to the utmost to save the ship and cargo shall defeat his claim. In the U. S. the common-law doctrine has not been altered. (See SHIPPING.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Frei'ligrath (FERDINAND), b. June 17, 1810, at Detmold, Germany; entered upon a mercantile life, performing also literary work which attracted much attention. His first volume of poems (*Gedichte*, 1838; 20th ed. 1862; 31st, 1874) won him a pension, which he renounced in his *Glaubensbekenntniss* (1844), a work so full of republicanism that he was prosecuted, and fled to London. He returned and took part in the revolution of 1848; was imprisoned and tried for the political opinions expressed in his poems, and, though acquitted (in the first jury-trial ever held in Prussia), was compelled to leave the country; returned to London 1851, and in 1868 removed to Stuttgart. Among his works are *Ça Ira* (1846); *Die Revolution* (1848); *Neuere Politiche Gedichte* (1849), a masterly translation of Victor Hugo's poems; translations of Burns, of Longfellow's *Hiawatha*, and many English poems. His more recent songs, such as *Hurrah, Germania*, and *Die Trompete von Gravelotte*, are, like all his works, highly popular. D. Mar. 18, 1876.

Freind (JOHN), M. A., M. D., F. R. S., b. at Croton, North Hants, England, 1675; was trained at Christ Church, Oxford, where he became chemical professor in 1704; attained great distinction as a physician of London; now chiefly remembered for his valuable *History of Physic* (1725–26). D. July 26, 1728.—His brother, ROBERT FREIND, D. D. (1667–1751), was a celebrated Latin scholar; and WILLIAM FREIND, D. D., Robert's son, was a dean of Canterbury and a prominent preacher.

Freins'heim, or **Freinshe'mius** (JOHN), a learned classical commentator, was b. at Ulm in 1608; studied at Marburg and Giessen; went to Strasburg, where he found a patron in Bernegger, rector of the college; published an edition of Florus, with useful notes, in 1632; was made professor of eloquence in the university of Upsala, and after five years' service was librarian and historiographer to Queen Christina. Compelled by ill health to leave Sweden, he was appointed in 1656 honorary professor at Heidelberg, where he d. Aug. 31, 1660. His labors were devoted mainly to the elucidation of the Latin historians. Besides Florus, he edited Quintus Curtius (Strasburg, 1640, 2 vols. 8vo), in which the missing books were supplied by himself; he supplied also in a continuous narrative, from scattered hints in other writers, the missing books of Livy, first published together by Doujat in the Delphin edition (1679–82). These *Supplements* have been reprinted in some of the later editions of those authors.

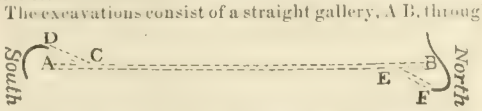
H. DRISLER.

Frei'sing, or **Frei'singen,** town of Upper Bavaria, on the Isar, 21 miles N. E. of Munich, has a gymnasium, theological, normal, and agricultural schools, and an interesting old cathedral. Pop. 7778.

Fréjus [Lat. *Forum Julii*], an ancient town of Var, France, on the Mediterranean, 45 miles N. E. of Toulon, on the railway to Nice. It is a bishop's see, and has some Roman remains. Its harbor, once a Roman naval station of importance, is almost entirely filled by silt from the river Argens. Pop. 2887.

Frejus, Col de, Tunnel of, or **Tunnel of Mont Cenis.** The Col de Fréjus is a depression in the crest of the Cottian Alps, lying about 16 miles S. W. from the summit of the Mont Cenis pass, and rising to the height of about 9500 feet above the sea. In consequence of a popular misapprehension as to the exact locality of the gallery excavated under this col by the governments of Italy and France between the years 1857 and 1871, this great work has been known until recently as the Mont Cenis tunnel, but it is now acquiring its proper designation as the tunnel of the Col de Fréjus or Mont Fréjus. Although surpassed in length by some mining adits, this tunnel is the longest subterranean route yet constructed for commerce and travel. Its execution was attended with many difficulties, the greatest perhaps consisting in the abrupt rise of the mountain on both sides to the height of 5283 feet, or a mile perpendicular above the culminating point of the excavation—a circumstance which rendered the sinking of shafts along the line impossible. The work could consequently be carried on only upon two faces, and the sole ventilation was from the orifices at the termini. Ventilation was obtained by ingenious contrivances to be noticed hereafter, and the fear which had been entertained of encountering large accumulations of water was not realized, only two small springs, both slightly mineral, having been met with. Geologists had predicted the character of the rock to be traversed, and their calculations were nearly verified. For a distance of not far from 6 miles from the southern entrance the excavation was in calcareous schist, then followed about 1000 feet of calcareous gypsum and dolomitic rock, then about the same distance of refractory quartzite, and finally about 1¼ miles of anthriciferous formation.

The excavations consist of a straight gallery, A B, through



the mountain, and two junction-galleries, C D and E F, to connect with the railway at Bardonneche in Piedmont on the southern, and Modane in Savoy on the northern side. The straight gallery A B is 38,173 feet in length; the junction-galleries C D and E F nearly 2500 and 1500 feet, respectively. The termini at A and B are left open for ventilation and convenience of access, but the railway-track is laid along the line D C E F. The length of the subterranean way traversed by the trains is 42,158 feet, or less than 30 yards short of 8 English miles. The total length of excavation in the straight and junction galleries is 44,117 feet, or 8 miles 626 yards.

The entrance at D is 4236 feet above the sea-level. From this point the grade ascends for 2625 feet at the rate of 2.64 feet per mile; then at the rate of 1.73 feet per mile for 7200 feet; then at 2.64 per mile for 8500 feet; then a summit-level of 1082.1 feet at a height of 4244 feet above the sea; then a uniform descending grade of about 115 feet to the mile to the northern terminus, which is at the height of 3801.4 feet above the sea, or 434.60 feet lower than the southern entrance. The difference in grade of course occasions a difference of some minutes in time in the passage of the trains in the opposite directions.

In the southern portion of the tunnel the arch is a curve of seven centres, with its crown at the height of 19.68 feet above the track; a width of 26.24 feet at the spring, and 25.81 feet at the level of the rails, including a sidewalk or footpath 28 inches in width on each side. On the northern division the arch is the segment of a circle, its crown being 1 foot lower than on the southern. The total amount of rock excavation is computed at nearly 1,000,000 cubic yards. The lining or revetment is of stone of the thickness of from 28 to 40 inches. Where the rock is a quartzite (about ⅛th of a mile) there is no lining needed, and no revetment has been constructed. About 16,000,000 brick were used for backing and other subsidiary purposes; about 15,000 tons of lime were employed in the masonry, and 1200 tons of gunpowder in blasting. The total cost is computed at about $15,000,000. From 1857 to 1861 the drilling in the southern division, and from 1857 to 1863 that in the northern division, was executed by hand-labor; after those dates by machine drills driven by compressed air forced into tubes by the power derived from the torrent Medozet near Bardonneche and the Arc at Modane. The air thus supplied not only furnished the necessary mechanical power, but ventilated, and by expansion and escape from the machines cooled the gallery to a moderate temperature. In 1864, the year after the introduction of

the machine-drills, the rate of progress in excavation, including both ends, averaged 7 feet per day; but as experience was gained and mechanical arrangements perfected the rate gradually increased, until in the last year the daily average, including both faces, rose to 14 feet 9 inches, although the distance from the entrance was so much increased.

Near the centre of the tunnel is established an observatory. The temperature at this point is constant at about 85° F., but how far the thermometer is affected by the heat and vapor from the locomotives, the animal warmth from the many laborers and travellers in the tunnel, it is difficult to say. Upon the removal of the last partition of rock between the laboring parties, a strong current of air poured through from the north, and this, as might be expected from the difference of atmospheric pressure at the two extremities, is said to maintain itself constantly, thus greatly facilitating the ventilation.

As early as 1832, when there were no railroads in Italy, a peasant mountaineer named Médail suggested the possibility of connecting Savoy, then a province of the kingdom of Sardinia, with Piedmont by means of a tunnel under the Col de Fréjus. The project was entertained by the local authorities of Chambéry, and in 1845 the Sardinian government was induced to employ engineers to survey and plan the work. Mans, a Belgian, engaged in this service, invented a drilling-machine which was subsequently perfected by Bartlett, Sommeiller, Grandis, and Grandoni. Colladon of Geneva made the important suggestion that the tunnel might be ventilated, and mechanical force at the same time supplied to the drills, by means of compressed air, and established the practicability of this by trial on a relatively small scale. In 1856 experimental borings were made, and the work was regularly commenced in Aug., 1857, and continued day and night, without interruption, until Oct., 1871, when it was completed. On the cession of Savoy to France in 1860 the empire agreed to pay 32,000,000 francs, or half the estimated expense of the work, but the whole labor was performed under the supervision of the engineers employed by Italy.

The connecting line between the tunnel and the railway from Turin to Susa passes through grand scenery, and was a work of great cost and difficulty. Between Bardonneche and Bussoleno on the plain of Piedmont the railway traverses twenty-three rock-tunnels, measuring all together 4¼ miles, and there are numerous bridges, viaducts, embankments, and cuttings of no small magnitude in the course of the same short distance.

(See *Traforo delle Alpi* and other official reports. Popular illustrated works on the subject are Corvino, *Da Torino à Chambéry* (12mo, Turin, 1872); Bignami, *Cenisio e Fréjus* (12mo, Florence, 1871); Bonjean, *Le Mont Cenis* (12mo, Paris, 1871).) George P. Marsh.

Fre'lighsburg, post-v. and port of entry of St. Armand tp., Missisquoi co., Quebec, Canada, near the Vermont line, has a valuable mineral spring and a weekly newspaper. Pop. about 600.

Frelinghuy'sen, tp. of Warren co., N. J. Pop. 1113.

Frelinghuysen (Frederick), b. in New Jersey Apr. 13, 1753; graduated at Princeton 1770; was in Congress in 1775, in 1778–79, and in 1782–83; served with much distinction in the Revolutionary war, rising from the grade of captain to that of colonel; and after the war served as major-general on the Western frontier against the Indians; was a U. S. Senator from New Jersey 1793–96; was an able lawyer, and held various other public offices. D. Apr. 13, 1804.

Frelinghuysen (Frederick Theodore), b. at Milltown, N. J., Aug. 4, 1817, a nephew of Theodore Frelinghuysen, who adopted him as a son; graduated at Rutgers College 1836; was called to the bar in 1839; was appointed attorney-general of New Jersey 1861 and 1866; U. S. Senator 1866–69, and elected again to the U. S. Senate in 1871 for the full term. Resides in Newark, N. J.

Frelinghuysen (Theodore), LL.D., son of Gen. Frederick Frelinghuysen, b. at Millstone, N. J., Mar. 28, 1787; graduated at Princeton 1804; was admitted to the bar 1808; was a captain of volunteers 1812–15; was attorney-general of New Jersey 1817–29; U. S. Senator 1829–35; mayor of Newark 1837 and 1838; removed to New York 1838; chancellor of the University of New York 1838–50; president of Rutgers College, New Brunswick, N. J., 1850–62. D. at New Brunswick Apr. 12, 1862. In 1844, Mr. Frelinghuysen was Whig candidate for Vice-President on the Clay ticket. In public life his acts were ever regulated by exalted moral and religious principles. He favored all measures which might tend to alleviate human misery or misfortune, and was a leader in many charitable and religious enterprises; was for years president of the American Tract, Temperance, and Bible societies and the American Board and other missionary societies. His qualities as a lawyer and statesman were of a high order.

Frelinghuysen (Theodorus Jacobus), b. at Lingen, East Friesland (now in Germany), about 1691; was ordained to the Reformed ministry in 1717; came in 1720 to America, and became the Dutch pastor at Raritan (now New Brunswick), N. J., and preached in that region nearly thirty years with great zeal and success. His five sons, Theodore, John, Jacobus, Ferdinandus, and Henricus, were all ministers of the Reformed Church.

Fre'man, tp. of Woodruff co., Ark. Pop. 487.

Fremont', county of S. Central Colorado. Area, about 1800 square miles. Its surface is diversified by fertile parks and sublime mountains. Coal, iron, silver, copper, petroleum, building-stone, timber, and medicinal springs abound. It is traversed by the Arkansas River and by a branch of the Denver and Rio Grande R. R. Cap. Cañon City. Pop. 1064.

Fremont, the south-westernmost county of Iowa. Area, 500 square miles. Its soil is fertile. Grain, cattle, and lumber are the chief products. The surface is somewhat broken, but contains much prairie. The county is traversed by the Kansas City St. Joseph and Council Bluffs and a branch of the Burlington and Missouri River R. Rs. Cap. Sidney. Pop. 11,174.

Fremont, tp. of Ouachita co., Ark. Pop. 242.

Fremont, tp. of Santa Clara co., Cal. Pop. 2018.

Fremont, tp. of Yolo co., Cal. Pop. 91.

Fremont, tp. of Lake co., Ill., contains Fremont Centre P. O. Pop. 1015.

Fremont, tp. and post-v. of Steuben co., Ind., on the Fort Wayne Jackson and Saginaw R. R., 50 miles N. of Fort Wayne. Pop. of v. 392; of tp. 962.

Fremont, tp. of Benton co., Ia. Pop. 946.

Fremont, tp. of Bremer co., Ia. Pop. 613.

Fremont, tp. of Buchanan co., Ia. Pop. 554.

Fremont, tp. of Butler co., Ia. Pop. 655.

Fremont, tp. of Cedar co., Ia. Pop. 1160.

Fremont, tp. of Clarke co., Ia. Pop. 484.

Fremont, tp. of Fayette co., Ia. Pop. 499.

Fremont, tp. of Hamilton co., Ia. Pop. 390.

Fremont, tp. of Johnson co., Ia. Pop. 965.

Fremont, post-v. of Mahaska co., Ia.

Fremont, tp. of Page co., Ia. Pop. 307.

Fremont, tp. of Winneshiek co., Ia. Pop. 661.

Fremont, post-tp. of Lyon co., Kan. Pop. 549.

Fremont, tp. of Isabella co., Mich. Pop. 342.

Fremont, tp. of Saginaw co., Mich. Pop. 170.

Fremont, tp. of Sanilac co., Mich. Pop. 640.

Fremont, tp. of Tuscola co., Mich. Pop. 664.

Fremont, tp. of Winona co., Minn. Pop. 1006.

Fremont, city, cap. of Dodge co., Neb., on the Union Pacific R. R., at the junction of the Sioux City and Pacific and the Fremont Elkhorn and Missouri Valley R. Rs., 45 miles W. of Omaha. It has a court-house, a manufactory, 2 steam-mills, 2 newspapers, 1 national and 1 private bank, 5 churches, and a fine hotel. There is a splendid bridge over the Platte near the town. Pop. 1195; of Fremont tp. 1703. Fred. Nye, Ed. "Tribune."

Fremont, post-tp. of Rockingham co., N. H., 30 miles S. E. of Concord, has manufactures of carriages, boxes, lumber, etc. Pop. 527.

Fremont, tp. of Steuben co., N. Y. Pop. 1119.

Fremont, tp. of Sullivan co., N. Y., has manufactures of leather and lumber. It contains numerous lakes and streams. Pop. 2218.

Fremont, post-v. of Wayne co., N. C., on the Wilmington and Weldon R. R., 11 miles N. of Goldsboro', has 2 large lumber-mills, a school, 2 churches, a weekly newspaper, cotton-gins, grist-mills, a large wool-carding establishment, 5 benevolent societies, several stores, and a rapidly increasing population. It has a good trade in cotton, lumber, and naval stores, and there is a mineral spring in the vicinity.

E. R. Ellis, Ed. "Free-Will Baptist Advocate."

Fremont, a v. of German tp., Clark co., O. Pop. 218.

Fremont, city, the county-seat of Sandusky co., O., on Sandusky River and on the Lake Shore and Michigan Southern R. R., 30 miles E. of Toledo. It is the terminus of the Lake Erie and Louisville R. R. It contains the county buildings, 1 national and 1 private bank, 2 hotels, 3 weekly newspapers, 7 churches, and manufactures of

cars, engines, boilers, sash, doors, blinds, tubs, staves, and barrels, and other wares. The late Sardis Burchard gave two valuable tracts of land to the city for parks, and presented $50,000 for a public library. The city has also purchased the Fort Stephenson property, the scene of Croghan's victory, as a public park, on which the library building will be erected. The public schools have a high reputation. Pop. 5405.

A. H. BALSLEY, ED. AND PROP. "JOURNAL."

Fremont, tp. of Waupacca co., Wis. Pop. 651.

Fremont (JOHN CHARLES), b. in Savannah, Ga., Jan. 21, 1813. His father was a French immigrant. He received a good education, though left an orphan when four years old, and when seventeen years old graduated at Charleston College, S. C.; taught mathematics; turned his attention to engineering, and was recommended to the government to be employed in the Mississippi survey. He afterwards served at Washington in constructing maps of that region. Having received the commission of a lieutenant of engineers, he proposed to the war department to penetrate the Rocky Mountain region. His plan was approved, and in 1842 he explored the South Pass. Soon after he planned a new expedition to Oregon. He approached the mountains by a new route, examined the region S. of the South Pass, turned aside to the Great Salt Lake, and connected his exploration with that of Wilkes's expedition. He also conducted another party, which discovered new and grand features in Alta California, the great basin called by his name, the Sierra Nevada, the San Joaquin and Sacramento valleys, and determined much of the geography of the far western regions. In 1845 he was again on the road to the Pacific to examine in detail the Pacific slope—a journey which resulted in giving many new facts of importance to the world, and indeed gave California to the U. S. After the conquest of Upper California, in which he bore a conspicuous part, he was involved in a quarrel between two other officers, and was deprived of his commission by sentence of a court martial. The President offered to reinstate him, but he declined. He retrieved his honor by the survey of a route for a great road from the Mississippi to San Francisco; pierced the hitherto unknown country of the Apaches; defeated or terrified the hostile savages; and in 100 days after leaving Santa Fé stood by the Sacramento; was sent as one of the first U. S. Senators from California, serving 1849–51. He was in 1856 the first Republican candidate for President, in opposition to Mr. Buchanan, the Democratic candidate, and though he received a large vote (114 electoral votes to 174 for Buchanan and 8 for Fillmore) he was defeated. In 1861–62 he served in the Union army as a major-general, and by the Cleveland convention of 1864 was again nominated for President, but soon withdrew his name from the candidacy. He has since the war been much occupied in forwarding the interests of a Southern trans-continental railroad. (See *Dictionary of Congress*, by CHARLES LANMAN.) He was made governor of Arizona Territory, June 12, 1878. A. H. STEPHENS.

Fremont' Cen'tre, post-v. of Newaygo co., Mich., on the Muskegon and Big Rapids R. R., and 10 miles N. E. of Newaygo. It has a church, a school, a weekly newspaper, 3 lumber and shingle mills, a chair-factory, a stave-mill, a tannery, and several stores. It is in a fertile region, abounding in pine and hard-wood timber. Fremont Lake, just S. of the town, is a pleasant summer resort.

PLATT & MATTHEWS, PUBS. "TIMES."

Frémy (EDMOND), b. at Versailles in 1814; studied chemistry under Gay-Lussac; was appointed professor in the Museum of Natural History, Paris, in 1850, at the École Polytechnique in 1857; and wrote, among other works, *Traité de Chimie générale, analytique, industrielle et agricole* (7 vols., 1862–65).

French, county in the N. N. E. of Dakota. Area, 1728 square miles. It contains the W. part of Devil's Lake, and has salt deposits.

French, tp. of Adams co., Ind. Pop. 824.

French (AUGUSTUS C.), a native of New Hampshire, was educated at Harvard College; became a lawyer of Illinois, a law prof. of McKendrie College, and was gov. of Illinois 1846–53. D. at Lebanon, Ill., Sept. 4, 1864.

French (BENJAMIN F.), b. in Richmond, Va., June 8, 1799; received a classical and legal education; author of poems and papers in periodicals, and became a planter and merchant of Louisiana. Published *Biographia Americana* (1825), *Memoirs of Eminent Female Writers* (1827), *Historical Collections of Louisiana* (1846 *seq.*), *History of the Iron Trade in the U. S.* (1858), *Historical Annals*, and other works. Was a liberal benefactor of the Fisk Free Library in New Orleans, and afterwards removed to New York.

French (Mrs. L. VIRGINIA), b. on the Eastern Shore of Virginia in 1830, was a Miss SMITH; was educated in Pennsylvania, and in 1848 became, with her sister, a teacher of Memphis, Tenn., where she wrote much under the name of "L'Inconnue." In 1852 she became connected with the *Southern Ladies' Book* of New Orleans. In 1853 she was married to Mr. J. H. French of McMinnville, Tenn., and was for a time editor of the *Crusader*, Atlanta, Ga. Among her works are *Wind Whispers*, poems (1856), *Iztalilxo*, a tragedy, and *Legends of the South*.

French (WILLIAM HENRY), b. at Baltimore, Md., Jan. 13, 1815; graduated at West Point July 1, 1837; entered the army as second lieutenant of artillery; served in the Seminole war in Florida, and on the Canada border during the disturbances 1837–38. During the war with Mexico he served on the staff of Gen. Patterson and as aide to Gen. Pierce, being engaged at the siege of Vera Cruz, the battles of Contreras and Churubusco, and the capture of the city of Mexico; served against the Seminole Indians in Florida 1850–52, and on garrison and frontier duty till 1861, when he was at Fort Duncan, Tex., which post he abandoned and transferred his command to Key West, Fla. Appointed a brigadier general in Sept., 1861, he served in the Army of the Potomac during the Peninsular campaign in Virginia—at Yorktown, the battles of Fair Oaks, Gaines's Mill, Peach Orchard, Savage Station, Malvern Hill, etc.; in the Maryland campaign he was engaged at the battle of Antietam, Sept., 1862; appointed a major-general of volunteers Nov., 1862; he served in the Rappahannock campaign in the battles of Fredericksburg, Dec., 1862, and Chancellorsville, May, 1863; commanded 3d army corps from July, 1863, to May, 1864, when he was mustered out of the volunteer service. Served on the Pacific coast from 1865 to 1872, in command of 2d Artillery. Gen. French has passed through the successive grades to that of lieutenant colonel, he being at present (1875) lieutenant-colonel of the 2d U. S. Artillery, and in command at Fort McHenry, Md.

GEORGE C. SIMMONS.

French Ber'ries, the name given by dyers to the dried berries of various species of *Rhamnus* or buckthorn, which are brought from the Mediterranean countries, and produce a very bright but not very permanent yellow dye. They are also called Persian and Avignon berries. (See PERSIAN BERRIES.)

French Broad Riv'er rises in Henderson co., N. C., near the Blue Ridge, flows N. W. into Tennessee, receives the Nolichucky, turns S. W., and joins the Holston (now called Tennessee) 3 miles above Knoxville. There is delightful scenery along its banks. It is navigable 30 miles to Dandridge by steamboats. It is some 200 miles in length.

French'burg, post-v., cap. of Menifee co., Ky. It is about 50 miles E. of Lexington.

French Chalk, a variety of talc, the hydrated silicate of magnesia.

French Creek, tp. of Edwards co., Ill. Pop. 1132.

French Creek, post-tp. of Allamakee co., Ia. P. 791.

French Creek, post-tp. of Chautauqua co., N. Y., in the south-westernmost corner of the State. Pop. 973.

French Creek, post-tp. of Mercer co., Pa. Pop. 999.

French Creek, tp. of Venango co., Pa. Pop. 1330.

French Horn, a metallic wind instrument, consisting of a tube which is usually convoluted, so as to make it more portable. It increases in diameter from the mouth-piece to the bell or flaring open extremity. It is provided with several longer or shorter mouth-pieces, by means of which the key is varied, and the whole is provided with valves and keys.

French Lake, tp. of Wright co., Minn. Pop. 221.

French Lan'guage and Lit'erature. The French, like the Italian, Spanish, and other Romanic languages, is the old popular Latin in a modern form. It has been developed in France chiefly through Celtic and Teutonic influences, combined with those of climate and condition.

Celtic.—Though the primitive language of the country was the Celtic, it was almost entirely supplanted by the Latin in consequence of the Roman conquest. During the centuries of absolute subjection to Rome the native distinctions were mostly lost. Adopting the Roman customs and laws, the people considered themselves Romans. They spoke only the Latin language, except in a few sections of the country, where the Celtic retained its independence, and where it is spoken in a corrupt form, to some extent, even at the present day (particularly in Brittany). Though comparatively few Celtic words were incorporated in the new speech, yet the influence of race and character upon the Latin was very powerful, and was especially marked in the pronunciation, in the modification of the sounds of

certain letters, or in the introduction of new sounds, as *u*, *é*, *e* mute, and the liquids *l* and *n*.

Teutonic.—The Teutonic influence was introduced chiefly in the fifth century, through the invasion of the country by various German tribes—at first by the Burgundians and Goths in the E. and S., and subsequently by the Franks in the N., who, under their youthful leader Clovis, won a decisive victory over the last Roman governor of Gaul in A. D. 486. The German conquerors, inferior in numbers and in civilization, gradually adopted the language of their subjects. Unable to discern the delicate distinctions of sound which gave to the Latin terminations the various shades of signification, they were content to learn one or two forms of a word, which soon became the representatives of all. The Teutonic influence was therefore marked not so much by the number of new words introduced into the vocabulary (about 450, relating to war, hunting, and the feudal relations), as by the modification of the form of the Latin words by abbreviation, the loss of terminations, the contraction of syllables, etc.

Romance.—This modification of the spoken Latin had been going on insensibly nearly 400 years, when the fact seems to have been recognized that the language of the people was quite distinct from the written Latin which was used in churches, convents, and courts of justice. Therefore, by a decree of the Council at Tours in A. D. 813, the bishops were directed to translate their sermons into Romance (*Roman*), the modified Latin, the popular speech. The Frank kings and their principal followers, who had continued to use the German, were subsequently obliged to adopt the Romance, and after the final division of Charlemagne's empire German was restricted to Germany and the eastern section of Gaul. With the exception of a fragment of a glossary (*Glosses de Reichenau*) written about A. D. 768, the oldest known documents of the Romance are the oath of Louis the German and that of the army of Charles the Bald taken at Strasburg in 842. In them we have a sort of photograph of the language in its transition state. For two centuries the transformation went on rapidly, the language rising to new life as society entered on its new relations in feudalism.

Langue d'Oc and Langue d'Oïl.—The northern and southern sections of the country being practically independent of each other, and characterized by different conditions, the various dialects of each assumed a form and method of pronunciation peculiar to itself. Hence arose in the ninth and tenth centuries the recognition of two general divisions or groups of dialects, named, from the affirmative adverb in each, the *Langue d'Oc* and the *Langue d'Oïl*. The former, in which the Teutonic influence was less marked, was spoken in the entire section S. of the river Loire. It became more and more distinct from the latter, and developed rapidly under the favoring circumstances of climate, condition, and culture till in the eleventh century it began to be employed in Provençal poetry. For the next 200 years its harmonious musical character, as displayed in the songs of the Troubadours, which were sung in all the principal courts of Europe, rendered it extremely and almost universally popular. This popularity declined in the latter part of the thirteenth century, and in consequence of the political subjugation of the people the language soon came to be regarded only as a dialect or patois, which is still spoken in some of the departments of Southern France. The *Langue d'Oïl* was spoken in the provinces of the N. and E. It was considerably modified by the Normans, who made conquests and settlements under Rollo the Dane in 912. Adopting the language of the country, they introduced a few new terms relating particularly to the sea, and quickened it with new life by kindling a lively imagination with the mythology of the Danes, the wonderful stories of dwarfs and giants, of genii and fairies. This language was not uniform, like that of the S., but existed as distinct dialects, with some literature, particularly in the independent provinces of Normandy, Picardy, Burgundy, and the Isle of France. The dialect of the latter, occupying a central position, modified somewhat by the other three, soon took the pre-eminence, owing to the political supremacy of Paris. As the monarchy supplanted the feudal hierarchy, and Paris became the capital not of the Isle of France alone, but of the other provinces, its language was also gradually adopted by writers in all sections of the country, and the other dialects sank to the condition of patois, traces of which still exist in the common speech of the uneducated. Though recognized as the *French* language probably as early as the eleventh century, it did not become widely known in Europe till after the conquest of Constantinople (1204). It then gained great popularity, and was employed by several foreign writers. In it Dante's teacher, Brunetto Latini, wrote his *Tresor*, giving as one reason, "perche la parlatura francesca e più dilettevole è più comuna che tutti li altri linguaggi."

Old French.—During the twelfth, thirteenth, and early part of the fourteenth centuries the language existed in a form now called Old French, which was intermediate between the synthetic Latin and the analytic French. It retained two forms of case, the nominative and accusative, the latter representing all shades of the objective idea. Following the Latin usage, the letter *s* was the sign of the subject in the singular and of the object in the plural number.

Example.	*Singular.*	*Plural.*
Subject,	*amis, murs;*	*ami, mur.*
Object,	*ami, mur;*	*amis, murs.*

After the fourteenth century these distinctions of case were lost, and the objective form alone was used in each number. Many other Latin forms also disappeared, and the language began to assume those characteristics which are peculiar to modern French. During these centuries (twelfth to fifteenth) many Greek and some Oriental words were introduced, particularly in writings on philosophy and medicine. But all learned and scientific terms admitted later than the eleventh century do not generally conform strictly to the laws of formation which obtain in the Old French.

Modern French.—With the fifteenth century commenced the formation of the classic and modern French. Very marked changes were effected in grammatical forms, in orthography, and in syntax. The language became more analytic. It was more simple and less like the Latin. In the sixteenth century the Italian influence was quite marked, and many Italian and some Spanish words were introduced. These additions were richer in simple and comic than in noble and serious terms.

During the previous centuries of formation and growth the French had been generally regarded as suited only to the common people, while the Latin was employed at court and by the educated classes generally, both in conversation and in literature. But with the accession of Francis I. (1515) a very decided improvement was effected. He adopted the French at court, prohibited the use of Latin at the public tribunals, and by royal decree recognized the French as the national language. Thenceforth it received the attention of the great and learned. The transformation which had been wrought in the fourteenth and fifteenth centuries had caused the old literature to be neglected and forgotten, and had thus left the language exposed to greater modification through foreign influence. But Marot and Malherbe, Amyot and Montaigne, did much to increase its vigor, to purify and enrich its form. Rabelais gave it suppleness and vivacity, Calvin firmness and precision. The French Academy exerted its authority, and under its auspices, aided by the pens of Voiture and Balzac, Corneille and Descartes, the rules and standards of pure French became established. This language, forcible and elegant in Pascal, copious and free in La Bruyère, harmonious and noble in Fénelon, majestic and sublime in Bossuet, reached its maturity and comparative perfection in the latter half of the seventeenth century. In the eighteenth century, though considered fixed in regard to correctness of form and perfection of style, the language gained somewhat in copiousness and variety. Under the fiery trials and terrible struggles of the Revolution it found new energy of expression, while during the present century a large number of words have been introduced from England, Germany, and other sources. There have also been some modifications of orthography, but the structure of the sentence, the syntax, the general form and character of the language, have remained unchanged.

Grammatical Changes.—Like the other Romanic languages, the French has lost the Latin system of declension, and supplied its place by the use of prepositions. The article has been introduced (derived from the demonstrative pronoun *ille, illum*, etc.). With three exceptions, comparison is expressed by the adverbs *plus* and *moins* (PLUS and MINUS), followed by the conjunction *que* (QUAM). In the conjugation of verbs new compound tenses have been added, some personal endings have been dropped, the passive voice has been lost, and its place supplied by the past participle, combined with the forms of the verb *être* (ESSE). In place of the Latin adverbial endings E and TER, we find a new form, the Latin ablative MENTE, as *sincèrement* (SINCERA MENTE), with a sincere mind (or manner), sincerely.

Changes of Form.—The form of the Latin has undergone more striking changes in French than in any other Romanic language, owing to a more marked difference in climate, race, and primitive idiom. The Latin word is uniformly abbreviated, but its radical element is generally preserved. These changes, through a tendency to secure greater ease in pronunciation by assimilating, softening, adding, omitting, and transposing letters, have been brought about by a gradual process of transition, extending a thousand years through Merovingian Latin and Old French to its modern

form; as (L.) ADRIPARE, (M. L.) ARRIPARE, (M. L.) ARRIBARE, (F.) *arriver;* (L.) TURBARE, (O. F.) *torver*, (O. F.) *trover*, (F.) *trouver;* (L.) SPATULA, M. L. ISPATULA, ESPATULA, (O. F.) *espatla, espalle, espaule*, F. *épaule;* the last appearing for the first time officially in the 3d ed. of the *Dictionnaire de l'Académie* in 1740.

Accent.—The accented syllable of the Latin is uniformly the last effective syllable of the French word. The exceptions are "learned words" of modern introduction. Examples, ARTICULUM, *article;* MORTALEM, *mortel;* SEDITIONEM, *sédition;* FRAGILEM, *frêle, fragile*.

Vowels.—All vowels, which follow the accent in Latin, disappear in French, or pass into the mute *e;* as CANTARE, *chanter;* HORAM, *heure;* TABULAM, *table;* VIRTUTEM, *vertu*. When two or more syllables precede the accent, the nearest, if short, generally disappears; otherwise, the vowels are retained, though sometimes changed: as BONITATEM, *bonté;* TESTAMENTUM, *testament;* VESTIMENTUM, *vêtement*. The accented Latin vowels quite uniformly undergo the following changes: (*a*) when short, they pass into diphthongs, A, E, I, O, U becoming respectively *ai* (or *e*), *ie, oi, eu, ou*, as AMO, *aime;* FERUM, *fier;* NIGRUM, *noir;* NOVEM, *neuf;* LUPUM, *loup;* (*b*) when long by nature or increment, A, E, O become *e* (*ie* or *ai*), *oi* (or *i*), *eu;* but I and U remain unchanged; as NASUM, *nez;* LEGEM, *loi;* SOLUM, *seul;* AMICUM, *ami;* MURUM, *mur;* (*c*) when long by position, I and U become *e* and *ou* (or *o*), while A, E, O remain unchanged: as FIRMUM, *ferme;* SURDUM, *sourd;* ARBOREM, *arbre;* TERRAM, *terre;* CORPUS, *corps*.

Consonants.—The permutation of consonants is limited to those of the same class or group (as labials, liquids, etc.), the strong passing to the weak, and the weak interchangeable. Thus B and V are interchangeable, but never become *p*, though P may become *b* or *v*, while B and V both may become *f;* as HABERE, *avoir;* VERVECEM, *brebis;* DUPLUM, *double;* RIPAM, *rive;* CAPUT, *chef;* VICEM, *fois*. L and R are interchangeable, M becomes *n*, and N may become *l* or *r;* as ALTARE, *autel;* ULMUM, *orme;* REM, *rien;* ORDINEM, *ordre*. T and D are interchangeable, and T may become *s;* as TUNC, *donc;* VIRIDEM, *vert;* RATIONEM, *raison*. C sometimes becomes *s* or *x;* when initial before A, *ch;* and when followed by T, it forms, like *i*, a diphthong with the preceding vowel; as PLACERE, *plaisir;* VOCEM, *voix;* CAMPUM, *champ;* FACTUM, *fait*. G and DI become *j;* as GAUDERE, *jouir;* DIURNUM, *jour*. Q (or QU) may become *c;* as QUARE, *car;* QUINQUE, *cinq*. There are some exceptions to the general phonetic laws, but they are mostly due to early corruptions in the popular Latin or to some accidental causes not fully understood.

Characteristics.—The chief characteristics of the French language are precision and perspicuity: "What is not clear is not French." Hence its almost uniform use in diplomacy since it was first employed at the conferences of Nimeguen in 1678. For the last 200 years it has to a great extent taken the place of the Latin as the language of intercommunication among scholars and scientific men. As the exponent of the character, habits, and tastes of those who have formed it, the language reveals a nation remarkable for vivacity, sociability, business capacities, and scientific attainments.

LITERATURE.—French literature undoubtedly commenced in the eleventh century, but no existing works have a date prior to the twelfth century. The earliest composers, called Trouvères, were generally men of little education. Having no acquaintance with the literature of Rome or Greece, they sang in an original artless style the sentiments and noble deeds of Christian and feudal heroes. As the poetry developed under the hands of the monks and others with the advance of learning, it assumed a narrative or epic form, depicting the serious and thoughtful character of the people, in striking contrast with the lyric poetry of the Troubadours in the South, which was lively and emotional.

Chansons de Gestes.—Among the early poems of the Trouvères were the *Chansons de Gestes*—songs celebrating the most illustrious deeds of noble warriors. These have been grouped in three cycles, the first relating to Charlemagne and his paladins; the second, to King Arthur and the Knights of the Round Table; the third, to Alexander and the heroes of ancient time. Of the first cycle, the earliest and most important is the *Chanson de Roland*, which describes, in about 4000 verses, the betrayal and defeat of Roland and his braves in the valley of Roncevaux, and the vengeance which was inflicted upon the victors by Charlemagne. In this poem the emperor is always triumphant and invincible, but in later poems he is represented as weak and cowardly in action, though bold in words, indicating the decline of royalty and the increasing power and popularity of feudalism. These historico-legendary poems were written in verses of ten syllables each, arranged in monorhyme stanzas of unequal length. The cycle of Arthur was founded upon Celtic legends, and was written in verses of eight syllables. The principal poems were those of Merlin, "the enchanter," of Lancelot of the Lake, of Perceval, and the search of the Holy Graal. The *Roman de Brut* (1155) was a fabulous history of the kings of Britain from the capture of Troy to 689 A. D. It was partly a translation of an earlier work, and was written in verse by Robert Wace, who wrote also the *Roman de Rou*, a long history of the dukes of Normandy. In the third cycle the heroes of Greece bear the impress of the character, habits, and chivalric sentiments of the Middle Ages. The principal poem, *Alexandre le Grand*, was written in verses of twelve syllables (hence the name "Alexandrine verse").

The *Fabliaux* were short poetical tales—some moral, most satirical and witty, presenting the comic side of life and character. They were numerous and popular, and form an important part of the early literature. Though mostly anonymous, the names of several poets who have rendered them in verse are known, of whom one of the ablest was Rutebeuf.

Allegorical and Didactic Poems.—Among the most noted productions of the feudal period were the *Roman de Rénard* and the *Roman de la Rose*. Both works were remarkably popular, and foretokened the decline of feudalism. They were a satire on the age in which might prevailed over right, and cunning and fraud supplanted bravery and integrity. The former existed in several branches, forming "more than 80,000 verses." The characters were all animals, but the tricks by which the fox beguiles and dupes his enemy and victim, the wolf, together with characteristic moral allusions, give a vivid picture of the spirit and tendency of those times in regard to the institutions then existing. The *Roman de la Rose*, a learned but somewhat tedious poem (of more than 22,000 verses), was written, with an interval of forty years, by Guillaume de Lorris (d. about 1260) and Jehan de Meung (d. near 1320). Under the figure of a dream the former produced an allegory of love—the latter a "sort of encyclopædia."

Lyric Poetry.—The earliest lyric poet of any note was Count Thibaut of Champagne (1201–53), who imitated the Troubadours, but relieved their monotony by the introduction of Northern vigor and wit. Basselin (d. about 1418) wrote comic songs celebrating the praises of wine. Charles of Orléans, a royal poet (1391–1465), sang in beautiful verses the praises of chivalry as it shone in its bright glory before disappearing on the rise of new manners at the dawn of modern civilization. Villon, the type of the Parisian populace of his time, with all its beauties and deformities, was a bad man but an excellent poet. His chief work, *Le Grand Testament*, in connection with the pathos and beauty of many minor pieces, secured for him, in the opinion of Boileau, the first place among the old French poets.

History.—The first important work in prose literature was the *Histoire de la conquête de Constantinople*, by Villehardouin (about 1167–1213). It was a simple story of events described by a man who participated in them, and who simply related what he had seen and heard. In the *Mémoires* (a life of Saint Louis), Sire de Joinville (1223–1317), the model of the feudal baron, delineates with more freedom his own personal impressions, as well as the life of "the most pious king" and the exploits of the last Crusade. Froissart (1337–1410) gives in his *Chroniques* a vivid picture of chivalry in its grandeur and in its decline. This Herodotus of his age, a faithful searcher after truth and an artless story-teller, travelled over Europe, and daily registered what he saw and heard. His descriptions are sometimes Homeric, but his history reveals an utter lack of unity and a strange complication of chronology. With Commines (1445–1509) we see the dawn of history in its modern and philosophical sense. In his *Mémoires* (a history of Louis XI. and Charles VIII.) he presents not mere chronicles, but the causes of events and their results. A depicter of character, he manifested also a political wisdom far in advance of his age. In this connection should be noticed also Christine de Pisan (1363–1420), considered a Cicero in eloquence, a Cato in wisdom; Alain Chartier (1386–1458), "father of French eloquence," author of *Quadriloge Invectif*, a work remarkable for political influence and literary beauty; and Jean Gerson (1363–1429), whose claims to the authorship of the *Imitation of Christ* are by many considered superior to those of Thomas à Kempis.

Drama.—The early dramatic writings (*mystères*) bore a religious character. The subjects were biblical, and the actors and scenery were connected with the Church. The first company, organized in 1402, called "La Fraternité de la Passion," represented the entire life of Christ in a mystery play consisting of 67,000 verses, employing eighty-six actors, and occupying several weeks in the representation. Not long after, a company of lawyers' clerks (La Basoche) began to represent the moralities, allegorical subjects. From

their secular profession being under less restraint, they represented farces and amusing scenes from common life, and thus originated modern comedy. A third company, whose sole object was fun and ridicule, carried their plays to such an extreme of personal satire, license, and abuse that all their dramatic representations were prohibited under severe penalties in 1540.

The early literature was in its most flourishing condition in the thirteenth century. Its glory and influence were not limited to France, but extended throughout Catholic and feudal Europe. French works were everywhere read, translated, and imitated; and their influence may still be traced in the literature of Italy, Spain, England, and Germany. In the fourteenth and fifteenth centuries the institutions of the country were changing—the ideas of the people, and even their language, undergoing modifications. In this transition from the old which was declining to the new which was forming there was not favorable field for literature, and only a few works were produced worthy of notice.

The Renaissance.—While France had thus lost her literary pre-eminence, Italy and Spain had entered upon a brilliant career under the influences which followed the revival of ancient art and learning, the study of the Greek and Roman classics. The literature of those countries, reacting upon that of France, opened a new period in French literature, the Renaissance of the sixteenth century. Some writers like Ronsard (1524–85), and Du Bellay (1524–60), chief of the "Pleiad," strove to give the native speech a classic form and character by too closely imitating the Italian style, introducing new forms from the Latin, and even adopting Greek and Roman customs. This tendency to a style that was unnatural was somewhat counteracted by the writings of Marot (1495–1544), the leading poet of the century. He endeavored to enrich and purify the popular dialect—to bring it and the language of scholars into one harmonious idiom. His translation of the Psalms has been highly esteemed by the French Protestants, while his secular pieces—odes, epigrams, epistles, and fables—are characterized by a lively humor and elegance of expression. Amyot (1513–93) exerted a similar influence in prose by the pure and classic style of his translations, especially of Plutarch. The best history of the times was written in Latin by De Thou (1553–1617). Brantôme (1527–1614) and others wrote valuable *Mémoires.* The *Heptaméron* of Margaret of Navarre (1492–1549) and the *Nouvelles* of Despériers (d. 1544) took the place of the old *fabliaux* in popular esteem. Bodin (1530–96) gained a great reputation by his treatise *De la République,* but the most important work in politics was the celebrated *Satire Ménippée.* This century was especially an age of inquiry and discussion. The dogmas and customs of the preceding age were criticised, and new systems, intellectual, social, and religious, were proposed. Rabelais (1483–1553), "the great jester of France," in his *Vie de Gargantua et de Pantagruel,* satirized almost everything his age accepted in a style that was coarse, licentious, and profane, though inspired perhaps with a true spirit of reform. Montaigne (1533–92) in his *Essais* became the founder of a new branch of literature. He studied man himself, and sought to answer the question *Que sais-je?* His work is interesting and instructive, but his philosophy has a skeptical tendency. Calvin (1509–64) as a Reformer brought the disconnected doctrines of the Protestants into a complete system. His *Institution de la religion Chrétienne* and his wonderful influence in that age secured for him the title of "one of the fathers of the French language."

At the beginning of the seventeenth century, Malherbe (1556–1628), "the tyrant of words and syllables," the creator of a new taste in literature, wrote poetry more remarkable for beauty of language and grace of expression than for originality of thought. His rival, Regnier (1573–1613), gained quite a reputation as a satirist. The *Lettres* of Balzac (1588–1654) and Voiture (1598–1648) were valuable as the expression of society. During the early part of this century Spanish influence was strongly marked, but comparatively few works were written worthy of special notice. Authors were mostly connected with the literary circle of the Hôtel de Rambouillet, or wrote under the patronage of Richelieu.

Age of Louis XIV.—The period occupied by the life and reign of Louis XIV. (1638–1715) was so remarkable in every department of literature and art as to have secured a place among the great epochs of the world, like that of Pericles in Greece and of Augustus in Rome. It was essentially a religious age. The forms of religion were observed and honored, and the literature was pervaded with a Christian spirit which inspired some of its noblest monuments. At the same time the masterpieces of the Greek and Roman mind were studied and imitated, while the absolute will of the king had great influence in directing and controlling the most important movements of the age. Thus, French literature again attained that supremacy in Europe which it had held in the twelfth and thirteenth centuries, but from causes and merits which were quite unlike. In the early time it was through its originality, its perfect and harmonious expression of the sentiments, beliefs, and manners of that age; in the later, it was its perfect form, its elegant style, and, soon after, the boldness of its philosophy, which gave it almost universal favor.

In *Philosophy* the highest place belongs to Descartes, who had just drawn (1637) the attention of the world to his *Discours de la Méthode,* "the first masterpiece of modern French prose." Throwing off the shackles of routine and of past ages, he opened with wonderful genius a new field, and developed a system which was almost universally adopted by the great philosophers of that and the succeeding century. Pascal followed with his *Lettres provinciales* and *Pensées* — the former full of vigor, the latter deep, but disconnected and incomplete. Malebranche met with extraordinary success in his *Recherche de la Vérité,* and aimed to harmonize philosophy with religion in his *Méditations chrétiennes et métaphysiques.*

In *Poetry,* Corneille rose from the intrigues and farces of his contemporaries to the heights of the classic drama. In his *Cid, Cinna, Les Horaces,* and *Polyeucte* he portrayed in elevated style the noblest elements of character — love, honor, patriotism, and religion — and thus secured the title of *Corneille le grand,* the father of modern tragedy. Close beside him in importance (and so close that his countrymen have never decided which was foremost) stood Racine with his *Andromaque, Phèdre, Iphigénie, Esther,* and *Athalie,* portraying the more tender emotions of the heart. Inferior perhaps to Corneille in grandeur of thought, he was superior in the beauty and elegance of his style. Molière, a poet and an actor, a master in comedy, with no rival but Shakspeare, wrote a great variety of plays, of which the most perfect are the *Misanthrope, Tartuffe,* and *Les Femmes savantes,* though less humorous than *L'Avare, Le Bourgeois gentilhomme,* and *Le Malade imaginaire.* La Fontaine, the "inimitable," produced a great number of *fables,* many of which form a perfect drama in miniature. Boileau, the severe critic, wrote *L'Art poétique,* also *Epîtres, Satires,* and *Le Lutrin*—works characterized by practical common sense and tending to elevate the popular taste.

Eloquence was confined to the pulpit, which alone offered a free field for oratorical talent. There Bossuet, Bourdaloue, Massillon, Flèchier, and Fénelon won great honor by their sermons and funeral orations. Fénelon wrote also numerous other works, and rendered his name immortal by producing the *Aventures de Télémaque,* a classic story, a model of style and of morals.

In *History,* Bossuet wrote the *Histoire des variations des Eglises protestantes,* a masterly polemic treatise, and the eloquent *Discours sur l'histoire universelle.* Fleury gave a candid account of Christianity in his *Histoire ecclésiastique,* and Cardinal de Retz described the wars of the Fronde in his *Mémoires.* The unrivalled *Lettres* of Madame de Sévigné gave a vivid picture of the court, of society, and of the times, while a similar view was given in another manner by Mme. de La Fayette in her *Zaïde* and *Princesse de Clèves*—works remarkable for simplicity, truth, and good taste.

In *Morals,* La Rochefoucauld wrote the *Maximes,* which are disconnected, and relate chiefly to self-love as a motive of action. La Bruyère in his *Caractères* sought to promote true reform by separating what is true and noble from the weak and vain.

Belonging partly to this period and also to the succeeding, Le Sage should be noticed for his comedies, the best of which is *Turcaret,* and for his popular romance *Gil Blas,* a true picture of manners. Fontenelle established his fame by his *Dialogues des morts* and *Entretiens sur la pluralité des mondes.* Marmontel was best known as the author of *Bélisaire* and *Les Incas,* though his *Mémoires* and *Éléments de la littérature* are instructive and interesting. The *Mémoires* of St.-Simon and the *Histoire ancienne* of Rollin were noted for originality and good judgment.

The eighteenth century presented a striking contrast to the preceding both in character and literature. It was an age of skepticism and revolt against accepted doctrines and established usages. Writers, occupied with social and political reforms, neglected poetry, and sought the practical rather than the ideal. In this age Voltaire was chief, exercising a controlling influence upon the thought of his time, not only in France but in all Europe. A voluminous rather than a profound writer, he worked in almost every department of literature. His best works are the *Henriade,* an epic poem, *Histoire de Charles XII., Essai sur les mœurs et l'esprit des nations,* and *Siècle de Louis XIV.* Montesquieu wrote the *Lettres Persanes,* sparkling with wit and brilliant in style, in which religion and philosophy, the

laws and customs of society, were made the objects of the finest pleasantry. But genius rather than wit was displayed in his *Considérations sur la grandeur et la décadence des Romains*, a work of sound logic, of profound and comprehensive thought. His *Esprit des Lois*, which is said to have restored the lost charters of the human race, exerted a wide political influence. J. J. Rousseau assumed the *rôle* of reformer. Though acting the part of a cynic rather than a Christian moralist, he advanced new and valuable ideas on education in *L'Émile*, and in his *Contrat social* propounded political theories on the rights of man which produced their fruit in the Revolution of 1789. His *Nouvelle Héloïse*, a romance of the passions, contains some grand descriptions, but is often exaggerated in style and false in theory. His *Confessions*, interesting though sad, reveal an immoral life and an unsound philosophy. But all his works are remarkable for eloquence, for brilliancy of style, and for individuality of thought. Buffon in his *Histoire naturelle* undertook to describe the universe in its full extent and in detail. He reduced disconnected facts to a system, and formed a science which, with some modifications, is still received. His style is beautiful and grand. In some of his descriptions of the greatness and littleness of man and nature his language is sublime. After these four leaders may be noticed Bernardin de St.-Pierre, a great lover of nature and virtue, who unfolded in his *Études de la Nature* and *Harmonies* the laws of the world under a paternal watchful Providence, and wrote *Paul et Virginie*, a literary gem in style and sentiment; André Chénier, lover of antique genius, revealing its modest beauties in more modern style; Delille, celebrated for his translations; Mirabeau, whose orations were of remarkable force and power; Beaumarchais, who displayed the talent of a satirist, moralist, and comic writer in his *Mémoires*, *Le Barbier de Séville*, and *Le mariage de Figaro;* La Harpe, the critic and dramatist; Lebrun, the lyric poet; Condillac, the metaphysician; and Diderot, the materialist, a prolific writer on all subjects, and author, in connection with D'Alembert, of the famous *Encyclopédie*. Helvetius in his work *De l'Esprit*, Baron d'Holbach in his *Système de la Nature*, and Lamettrie in his *L'homme Machine*, all manifested a spirit extremely hostile to religion.

In the nineteenth century literature assumed a new—or at least a greatly modified—form, corresponding to the new political and social condition under which it flourished. The influence of English and German literature was also manifest in a style more free and vigorous. The classic models of the seventeenth century were set aside, and new models created, drawn from nature and from man emancipated and animated with real Christian sentiment. The principles which had been shaken in the preceding age were re-established on a new basis. Chief in this literary reform was Chateaubriand. Rejecting the impiety of Voltaire, purifying the principles of Rousseau, he sought in his *Génie du Christianisme* to bring men back to faith by portraying the benefits of Christianity with such a wealth of brilliant imagery and poetic beauty as to win affection, while his *Martyres* revealed the superiority of Christian to pagan morals and life. Scarcely less was the influence exerted by Madame de Staël with her popular romance *Corinne* and her philosophical treatise *De l'Allemagne*, revealing the forms of German thought and manners, and inspiring love for all that is beautiful and good.

Romanticists.—During the Restoration the literary reform reached its extreme development in *romanticism*, the complete emancipation of literature from conventional rules—the recognition of that which is beautiful in itself, without regard to the usages and models of the past. Among the most prominent in this movement were Victor Hugo and Alexandre Dumas, who, after a severe struggle with the classicists, secured the acceptance of such works as *Hernani*, *Marion Delorme*, and *Henri III.*, in which may be traced the influence of Shakspeare and Schiller, though the imitation was by no means a true resemblance. They were assisted in this work by Alfred de Vigny, author of *Cinq-Mars*, Alfred de Musset, the humorist, and the brothers Deschamps. As lyric poets those authors produced works more rich and varied than the lyric poetry of France could previously boast; but, giving unlimited sway to instinct and fancy, they sometimes degenerated into license, and the results were unequal and incomplete. But of all French poets, Lamartine possessed the most soul, and displayed it in the most perfect poetry. His *Méditations poétiques* and *Harmonies poétiques et religieuses*, written with a marvellous power of description in a style glowing and picturesque, were elevating in sentiment and extremely popular. While the poetry of Lamartine charmed the imagination, the *Chansons* of Béranger delighted the senses. Delicate in sentiment, witty, practical, and patriotic, they reached the popular heart, and rendered their author preeminently the national poet. Delavigne gained a good reputation with his *Messéniennes*, in which he gave a poetic expression to the current of popular thought and feeling. As dramatists, Andrieux, A. Dumas, O. Feuillet, Victor Hugo, J. Sandeau, and E. Scribe have won distinction.

In romance the most successful writers have been V. Hugo, A. Dumas, George Sand (Madame Dudevant), Eugène Sue, Balzac, Jules Sandeau, F. Soulié, O. Feuillet, and Edmond About. Archæology and Oriental literature have been cultivated by Champollion, Baron de Sacy, Renan, and Rémusat. In natural history and mathematics Cuvier stands prominent with his great work on the *Règne animal*, also St.-Hilaire, the zoologist, and Jussieu, the botanist, Dufrénoy and Élie de Beaumont, the geologists and mineralogists, Gay-Lussac, the chemist, Biot, the physicist, Arago, the physicist and astronomer, and Lagrange and Laplace, the mathematicians. In political science De Tocqueville has won a favorable distinction by works relating to American institutions. Nodier, a royalist in politics, was a charming story-teller and a learned philologist. Constant, a Protestant and an orator, was chief of the liberal school. Courier, also a liberal, wrote pamphlets of great force with classic purity in style. In essays and criticism many have gained great distinction. Among the most eminent should be noticed Ampère, Gautier, Girardin, Janin, Renan, Ste.-Beuve, and Taine. In philosophy, Bonald, Joseph de Maistre, and Lamennais opposed the unchristian teaching of the school of Voltaire by treating of law, duty, and God as supreme and absolute. Royer-Collard, Cousin, and Jouffroy sought to harmonize liberty with law, philosophy with religion, by propounding an eclectic philosophy intermediate between the materialism of the eighteenth century and the absolutism of the Catholic school, and thus devoted themselves to the impartial search for truth among the doctrines of all systems. This eclecticism of Cousin has been advocated by Jules Simon, while positivism has been affirmed by Auguste Comte in his *Cours de philosophie positive*.

History.—In this department French literature is particularly rich in this century. Previously, with few exceptions, historical works had been bare chronicles or learned memoirs, seldom combining interest with truth. But in this period history was animated with the new life that had been revealed in poetry. Of the philosophic school the chief is Guizot, revealing in his *Histoire de la Civilisation* a breadth of view, an accuracy of analysis, and a precision of statement which have been unsurpassed. While Guizot explains the reason, the idea of history, De Barante (of the descriptive school) paints a fine picture, almost a romance, in his *Histoire des ducs de Bourgogne*. Augustin Thierry contributed much to historical study, both critical and descriptive, in *Lettres sur l'histoire de France* and *Histoire de la conquête d'Angleterre par les Normands*, the latter being especially descriptive. Villemain, in his *Cours de littérature française* and *Histoire de Cromwell*, gave models of eloquence, as well as of historical composition, delicate in taste, pure in style, and sound in criticism. Sismondi, lacking in sentiment, sometimes too severe in criticism, displays a wonderful amount of learning in his *Histoire des Français*, *Histoire des Républiques italiennes*, and *De la littérature du midi de l'Europe*. Michelet, bold, brilliant, imaginative, learned, in his *Précis de l'histoire moderne* traces the prevailing law and unfolds the results of first causes in a style poetic and attractive, but sometimes misleading. Mignet, in his *Révolution française*, presents ideas rather than men. Ste. Beuve deserves mention here for his *Histoire de Port Royal;* Louis Blanc, for his *Histoire de la Révolution française;* and Henri Martin, for his *Histoire de France*, which in the 3d ed., after more than thirty years of labor bestowed upon it, is the most complete and valuable yet produced. Thiers, endowed with a comprehensive intellect and admirable common sense, quick to see, to understand, and to explain, appropriating information drawn from every source, rose to the first rank by his *Histoire de la Révolution française*. Though his judgment is sometimes warped by his admiration of success, his *Histoire du Consulat et de l'Empire* is a masterpiece in comprehensiveness and perspicuity, in sustained interest, and in grace and naturalness of style. His speeches from the tribune in the Assembly at Versailles, by their vigor of style, range of thought, and impressiveness of appeal, have secured for him the first rank also in statesmanship and oratory. The establishment of the Republic will doubtless open a wider field for oratory than has hitherto been afforded. The speeches of Louis Blanc, Gambetta, Ledru-Rollin, and others have already gained a reputation nearly equal to that of Mirabeau.

(Works of reference: E. Littré, *Histoire de la langue française* (2 vols., 1867); *Dictionnaire de la langue française* (4 vols. 4to, 1873); G. Paris, *Grammaire de la langue française* (1874); A. Brachet, *Grammaire historique de la langue française* (1867) and *Dictionnaire étymologique* (1868); Diez, *Grammaire des Langues Romaines*, traduite

par A. BRACHET, G. PARIS, et A. MOREL-FATIO (1874); PELLISSIER, *La langue française* (1866); GERUZEZ, *Histoire de la littérature française* (2 vols.), *Histoire littéraire de la France* (26 vols. 4to, 1865–73); VILLEMAIN, *Cours de littérature française, au moyen age* (2 vols., 1859); DEMOGEOT, *Histoire de la littérature française depuis ses origines jusqu' à nos jours* (12th ed., 1871); LA HARPE, *Cours de littérature* (12 vols., 1814.) W. L. MONTAGUE.

French Lick, post tp. of Orange co., Ind. French Lick Springs are some twelve in number, and are situated in a delightful valley, 9 miles from Georgia Station on the Ohio and Mississippi R. R. They have copious saline sulphur waters, which are very useful in a wide range of diseases. Pop. 1599.

Frenchman's Bay, in Hancock co., Me., an arm of the Atlantic extending inward 30 miles, with a general width of some 10 miles. Mt. Desert Island lies on the W. side of its entrance, and Schoodic Point on the E. It is deep, free from ice in winter, and abounds in good harbors. Lat. 44° 15′ N., lon. 68° 25′ W.

French Polish, a solution of 1½ pounds of shell-lac in 1 gallon of alcohol, or 12 ounces of shell-lac, 2 ounces of elemi, 3 ounces of copal in 1 gallon of alcohol.

French Prophets, Protestant enthusiasts, who arose in France, principally after the unfortunate termination of the religious wars in the Cevennes. (See CAMISARDS.) They were originally Huguenots, and were for the most part honest, but the sufferings they had endured under persecution had exalted their minds until they believed themselves directly inspired of God. The earliest traces we find of such enthusiasts in Dauphiny and Vivarais as far back as 1688, but they were few in number until the opening of the eighteenth century, when they amounted to many thousands of both sexes. They believed themselves under the immediate influence of the Holy Ghost, went into trances, saw visions, and were by the populace generally treated with superstitious awe and veneration. About 1706 some of their prophets went over into England and Scotland, and rapidly gained converts on British soil. They were even joined by parties of some influence. They predicted the speedy establishment of the Messiah's kingdom, and pretended to possess the gift of tongues and the power of working miracles. Their pretensions, however, brought on their overthrow. They had persisted that Dr. Eames, one of their number who had died, could be raised from the dead, and failing in this they speedily declined in influence and numbers. Their actions, however, left a stigma upon all Protestant refugees in Great Britain. (See HUGHSON, *A Copious Account of the French and English Prophets, etc.* (London, 1814); SMEDLEY, *Hist. Ref. Rel. in France*, iii. 253 *seq.*) The sect also existed in Germany and America, and from this sect in England sprang the SHAKERS (which see). JAS. H. WORMAN.

French Purple, a beautiful dye obtained from lichens. (See ARCHIL.)

French River, in Ontario, Canada, is the outlet of Lake Nipissing, and flows into Georgian Bay, Lake Huron; lat. of mouth, 45° 53′ N., lon. 81° 5′ W. Length, 55 miles. It is a swift stream, whose lower course looks as if it were cut artificially through the rocky walls. There are many rapids, but the stream is the channel of a considerable fur-trade.—Another French River flows into James's Bay through the estuary of the Abbitibbe River.

French's Creek, tp. of Bladen co., N. C. Pop. 1176.

French'town, tp. of Monroe co., Mich. Pop. 2115.

Frenchtown, post-b. of Hunterdon co., N. J., is beautifully situated on the Delaware River and the Belvidere division of the Pennsylvania R. R. It has a national bank, 4 churches, 3 hotels, a number of stores, and 2 weekly newspapers. The most important business is the manufacture of spokes, hubs, etc. There are also manufactures of iron and brass castings, regalias, carriages, sash and blinds, distilled liquors, etc. P. 912. CHAS. S. JOINER, ED. "PRESS."

Freneau (PHILIP), b. of Huguenot ancestry at New York Jan. 2, 1752; graduated at Princeton, N. J., in 1771, and while there was the associate of James Madison. He went upon several mercantile voyages to the West Indies, in one of which he was taken prisoner by the British, and suffered much during his consequent imprisonment. During the Revolution he produced much prose and verse, chiefly of a burlesque character, which afforded a very effective support to the patriotic cause. He was editor of the *Daily Advertiser*, New York, 1791, and of the *National Gazette* of Philadelphia, 1791–93, and translating clerk for Mr. Jefferson, then secretary of state. Freneau was a violent Anti-Federalist; edited in 1795 the *Jersey Chronicle*, and in 1797 the *Time Piece*, New York, after which he again became a shipmaster. He published four volumes of poetry and several collections of letters and miscellanies. He led a somewhat irregular life, and perished in a snow-storm near Freehold, N. J., Dec. 18, 1832. Some of his poems have very considerable merit.

Frenta'ni, an ancient race of Central Italy, Samnite in blood, but not in name, for they were the allies of Rome in the Samnite wars; lived in a fertile hilly region bounded E. by the Adriatic and S. by the river Tifernus. Long the allies of Rome; joined (B. C. 90) in the Social war, and probably were enfranchised with the other Italians.

Frère (CHARLES THÉODORE), a French painter, b. in Paris in 1815; was a pupil of Coignet and Roqueplan, and made his first public appearance at the exhibition of 1834. Two years later he went to Algeria, traversed the desert, visited the lands of the East, and was at the taking of the city of Constantine by the French on Oct. 13, 1837. His pictures mostly represent Eastern scenes and manners, streets, squares, market-places, bazaars, cafés, with an occasional reminiscence of military life. They are of small size and elaborate execution, rich and harmonious in color, correct in drawing, and pleasing in tone. The artist has been twice honored with the medal — once in 1848, and again in 1865. O. B. FROTHINGHAM.

Frere (Rt. Hon. Sir HENRY BARTLE EDWARD), K. C. B., G. C. S. I., D. C. L., a nephew of J. H. Frere, b. in 1815; was educated at the India College, Haileybury; entered the Bengal civil service 1833; became resident in Scinde 1856; served with distinction during the Indian mutiny; was governor of Bombay 1862–67; was sworn of the privy council 1873; president of the Royal Geographical Society 1873–74; negotiated the treaty of 1873 with Zanzibar, by which the latter power agreed to co-operate in efforts to suppress the slave-trade.

Frere (Rt. Hon. JOHN HOOKHAM), M. A., b. in London May 21, 1769; was educated at Eton and Caius College, Cambridge, where he took his master's degree in 1795; at once entered the foreign office; was in Parliament 1796–1802; under-secretary of state for foreign affairs 1799; became envoy to Portugal 1800; envoy to Spain 1802–04; privy councillor 1804; minister to Spain 1808–09; married the countess of Erroll 1816; removed to Malta 1821. D. at the Pietà, Malta, Jan. 7, 1846. He was a poet of much merit, and one of the founders of the *Quarterly Review*; author of *King Arthur and his Round Table* (1817, under the pseudonym of "Whistlecraft"); published *Translations of Several Plays of Aristophanes* (1840), *Theognis Restitutus* (1842), and other writings, mostly humorous. (See his *Works*, with memoir, 1872.)

Frère (PIERRE ÉDOUARD), a French painter in genre, b. in Paris Jan. 10, 1819, pursued the course of study at the École des Beaux Arts; worked in the studio of Paul Delaroche, and in 1843 exhibited his first picture in the Salon. He is a prolific artist, but careful, with a pure sentiment, a delicate taste, and a fine pencil. His subjects are chosen from humble (frequently from domestic) life, comprising interiors with children, chamber scenes, incidents of labor or amusement, graceful idyls of common experience in great variety, the feeling sometimes bordering on the sentimental, but always healthy and sweet. Numerous examples of his work have come to this country, and been eagerly bought. The lithographer has made his best pieces familiar to all frequenters of print-shops. M. Frère has received two third-class medals—in 1850 and 1855—and a second-class medal in 1852. At the close of the exposition of 1855 he was decorated with the cross of the Legion of Honor. O. B. FROTHINGHAM.

Fre'richs (FRIEDRICH THEODOR), M. D., b. at Aurich, Hanover, Mar. 24, 1819; graduated at Göttingen and studied at the leading European capitals; became an exceedingly popular medical lecturer at Göttingen; went in 1851 to Kiel and assumed charge of the hospital; became in 1852 professor of pathology and therapeutics at Breslau and director of the school of clinical medicine. He has since removed to Berlin. His most popular and valuable work is a *Practical Treatise on Diseases of the Liver*, which has been translated into English and French.

Fréron (ELIE CATHERINE), b. at Quimper, France, 1719; was educated at the College Louis-le-Grand, Paris; left the Jesuits, among whom he was a professor, in 1739, for some unknown cause, but still wore the garb of a cleric. Disappointed of a benefice, he entered upon the life of a journalist. His periodical, *Lettres de Mme. la Comtesse de* ——— (1746–49), was suppressed, and soon reappeared as *Lettres sur quelques écrits du ce temps* (1749–54). His *Année Littéraire* (1754–76) was finally suppressed by his enemies, and he d. of chagrin Mar. 10, 1776. He is remembered for his lifelong hostility to Voltaire and the Encyclopédists, who fully returned his hatred; for his zealous championship of ecclesiastical and monarchical ideas; and as one of the founders of journalistic criticism. His works are mostly

criticisms, poems, translations, and papers on subjects of no permanent interest; author of a *History of Mary Stuart* (1742) and a *History of Germany* (1771).—His son, LOUIS STANISLAS (1757–1802), is remembered as a bloodthirsty Jacobin, who became an equally cruel reactionist.

Fres'co [It. "fresh"], or **Fresco-Painting,** a term somewhat vaguely applied to different methods of mural decoration in colors or in *chiaroscuro*, but which, strictly speaking, belongs only to paintings executed on fresh or moistened plaster. In the so-called *buon fresco*, or true fresco, mineral colors, mixed with water or lime-water, are applied directly to the smooth wet face of good lime mortar—the last very thin layer, called the *intonaco*, being of a particularly fine quality—in which case a new chemical combination takes place, and a crystalline surface almost impervious to moisture is formed. The practice of staining walls with colors in this way may be traced even to Egypt and Greece, but it is somewhat doubtful whether it was ever applied to works of high art till towards the end of the fourteenth century. The earliest specimens of *buon fresco* are probably those of Pietro d'Orvieto (continued by Benozzo Gozzoli) in the Campo Santo at Pisa, although Förster credits the evidence that Altichiero and Avanzo had employed this process earlier at Padua. Albert Ilg, in the notes to his translation of Cennini, declares that *buon fresco* was practised even in the Roman period, and occasionally ever since; that it was known in Byzantium; and that the art has been handed down traditionally in the convents of Mount Athos to the present day. However this may be, the works of Giotto and his contemporaries, though always spoken of as frescoes, were not executed in this way. The usual method of painting on plastered walls, in his time, was to allow the plaster to dry thoroughly and then to re-wet such portions of it as the artist could cover with color at a single sitting. This is called by later Italians *fresco secco*, or dry fresco. Many suppose that the old Roman frescoes were generally executed in this way, but there is much difference of opinion on the subject. Some of them are certainly in *tempera*, and others in *encaustic*. (For further information as to the methods employed in producing the frescoes of Pompeii and Herculaneum, and for interesting chemical experiments upon these frescoes, see OVERBECK's *Pompeii* (second revised ed., 1866), vol. i., ch. 3.) After the beginning of the fifteenth century *buon fresco*, or painting on undried plaster, became the favorite art of the greatest Italian masters, and Masaccio, Mantegna, Domenichino, Ghirlandajo, Francia, Perugino, Luini, Fra Bartolommeo, Raphael, Michael Angelo, Correggio, all gloried in it and became glorious through it. The swiftness of execution required by the rapid drying of the mortar, the impossibility of correcting a mistake without removing a portion of the plaster, the vast spaces to be filled, at once demanded and permitted the exercise of the highest artistic faculties; and Michael Angelo went so far as to declare oil-painting to be work for only women and children. One obvious advantage of fresco over oil-painting is that, from the absence of all gloss of surface, the picture may be seen equally well from every point of view; another is its greater durability under the same exposure. The subject to be represented on the wall was first drawn and shaded on paper backed with cloth; this cartoon, as it was called, or a tracing from a portion of it, was then applied to the wall, the outlines were carefully pricked through into the wet plaster, and a fine black powder being blown or sifted into the perforated lines, a distinct drawing was left behind. Old cartoons pierced in this way are still extant, and the black dots can be detected in the outlines of many a beautiful old fresco. Careful inspection will also frequently show where the work of one day is joined to that of another, for the mason was obliged to lay the plaster from day to day as the artist covered it. To name the great frescoes of Italy would be to give the list of a large proportion of her finest pictures. Those of Giotto may perhaps be best studied at Assisi and Padua; those of Fra Angelico, at Florence and Orvieto. The S.S. Annunziata at Florence possesses some of Andrea del Sarto's best frescoes—the exquisite Madonna del Sacco and a series of scenes from the life of Philippo Benizzi. The Camera of San Paolo at Parma contains surpassingly beautiful frescoes by Correggio, not to speak of the domes of San Giovanni and of the cathedral, once miracles of this art by the same hand, but now wellnigh ruined by rain and dampness. The Sistine Chapel at Rome is considered by many as Michael Angelo's crowning work, and the Stanze of Raphael, also in the Vatican, are counted among the noblest efforts of that splendid genius. Perhaps, however, no artistic production has ever received higher praise than Leonardo da Vinci's *Last Supper* in the convent of Sta. Maria delle Grazia in Milan. Unhappily, this wonderful work, though possessing all the freedom, power, and grandeur of the true fresco, was painted in oil, and consequently has almost entirely perished. For the same reason there is little to be hoped for it in the way of restoration by the newly-invented process which has been applied during the present year (1874) to the old water-color frescoes of Assisi, and which is said to have given them almost their original brilliancy.

The objection against frescoes, that they are not movable, is a serious one, but where time can be allowed for the tedious process they may be transferred from the wall to cloth, much in the same way as oil-pictures are removed from wood or from one canvas to another. Small frescoes in exposed places are frequently sawed out of the wall with a sufficient thickness of the plaster to keep them from falling in pieces, and so preserved. This art, though so eminently suited to brilliant architectural decoration, declined after the age of the great masters, and the only Italian painters who have acquired even a moderate reputation for fresco in recent times are Benvenuti, Appiani, and Cammuccini. (See KUGLER's *Hand Book of Painting*.) In Germany, however, *fresco secco* has been lately revived in a novel form through the invention, by Prof. von Fuchs, of a solution of silica called water-glass. Repeated applications of this solution are made to the surface of the best well-dried common mortar; after which it is again allowed to dry thoroughly. The whole surface is then rubbed and polished; after this it is twice rewashed with the water-glass, and once more left to dry completely. Mineral colors, prepared in water, are then applied for the decoration, and the artist can correct or change as freely as if working in oils and on canvas. When the whole is finished the entire surface is carefully sprinkled over with the solution, after which the painting is believed to be secure against atmospheric influences. This kind of fresco is called *stereochromy*, and may be seen in its highest perfection in Munich and Berlin, where Kaulbach, Overbeck, Cornelius, Schnorr, and other great German artists have exerted their best powers. The late attempts at fresco painting in England and America (as, for example, in the Parliament House in London and the Capitol at Washington) have been less successful; the same must be said of recent mural painting in France. (See OVERBECK's *Pompeii* (Leipsic, 1866); also translations, by ALBERT ILG, of *Cennino Cennini* and *Heraclius*, Nos. 1 and 4 in the series; *Quellenschriften für Kunstgeschichte* (Vienna, 1871–73).) GEORGE P. MARSH.

Frese'nius (KARL REMIGIUS), b. at Frankfort-on-the-Main Dec. 28, 1818; studied at Bonn and Giessen, and became Liebig's assistant; entered in 1845 upon a chemical professorship at Wiesbaden; founded the *Zeitschrift für analytische Chemie* in 1862 at Brunswick; author of *Anleitung zur qualitativen Analyse* (1841) and *Anleitung zur quantitaven Analyse* (1846), both works of great value, besides treatises on the various German mineral waters, etc. His principal works are translated into many European languages, and have gone through many editions at home.

Fresnel (AUGUSTIN JEAN), F. R. S., an illustrious French physicist and inventor, b. at Broglie, Eure, in Normandy, May 10, 1788; was educated at Caen and at the École Polytechnique and the École des Ponts et Chaussées, Paris. He was a government engineer for eight years in the Vendée, and as a pronounced royalist was placed, during the "Hundred Days," under the surveillance of the police. He returned in 1815 to Paris, and his researches on the aberration, diffraction, and polarization of light at once placed him in the front rank of physicists. In 1819 he was appointed, with Arago and Mathieu, as one of the lighthouse commissioners of France; in the same year he gained the prize of the Academy of Sciences for a memoir on the diffraction of light—a work which was crowned in 1819. In 1823 he was unanimously chosen to the Academy. In 1824 he was made secretary of the lighthouse commission, and in the same year his health, always feeble, gave way, and he never again was able to work. D. at Ville d'Avray, near Paris, July 14, 1827, and on his deathbed received the Rumford medal of the Royal Society, London.

Fresnel's great life-work was compressed into five years (1819–24). That work, for which commerce, and indeed the whole human race, owes him a debt of gratitude, was the perfecting of the dioptric system of illumination for lighthouses. His system has received comparatively few improvements, and is now almost universally employed in lighthouses. (See LIGHTHOUSE ILLUMINATION, by PROF. JOSEPH HENRY, LL.D., M. N. A. S.)

Fresni'llo, town of Mexico, in Zacatecas, has a good mining school, and is situated in a rich mining district. Pop. 7015.

Fres'no, county of S. Central California. Area, over 8000 square miles. A portion of its surface is very arid and sandy. Wool growing, stock raising, and mining are the chief pursuits. Gold and quicksilver are among the

products. It is watered by numerous branches of the San Joaquin and other streams. Cap. Millerton. Pop. 6336.

Freund (Wilhelm), Ph. D., b. of Jewish parents at Kempen, Prussia, Jan. 27, 1806; studied at Breslau and Berlin; has been an instructor in Breslau, Berlin, Hirschberg, London, and Gleiwitz; author of *Wörterbuch der lateinischen Sprache* (4 vols., 1834–45), the basis of Andrews' and William Smith's Latin dictionaries and of the larger work of Riddle and White; also author of two smaller Latin dictionaries; has been engaged for several years in issuing, under the title *Freund's Schüler-Bibliothek*, a series of annotations to the Greek and Latin authors usually read in the German gymnasia.

Frews'burg, post-v. of Carroll tp., Chautauqua co., N. Y., on the Dunkirk Warren and Pittsburg R. R. P. 379.

Frey, or **Freyr,** in Scandinavian mythology, the brother of Freya and the son of Njörd. He is beloved of all gods and men, and is himself the god of pleasure and fruitfulness. To him Loki gave the ship Skidbladnir, which always had a fair wind, and which, though capacious enough for all the gods, could be folded up and carried in the pocket. He also gave him the swift, golden-bristled boar Gullinbursti, which could traverse air, sea, or land. He is the husband of Gerda, the beautiful daughter of the giant Gymir, for whose love he forfeited his good sword, which the gods sorely needed for their defence. He was especially worshipped in ancient Sweden.

Frey'a, or **Frey'ia** (the "beloved"), the Scandinavian Venus, called also Vanadis, daughter of Njörd, the air god, and wife of the god Odur, for whom she perpetually weeps tears of gold. Half the heroes who die in battle belong to her, doubtless because of old the passion of love was so fruitful a cause of wars. Friday (*dies Veneris*) is Freya's day, or, as others say, Frigga's day. (See Frigga.)

Frey'städtel, or **Galgocz,** town of Hungary, on the Waag, manufactures wooden articles and trades in cattle and timber. Pop. 6098.

Frey'tag (Georg Wilhelm Friedrich), b. at Lüneburg, Germany, Sept. 19, 1788; studied at Göttingen, and became an army chaplain; studied the Oriental languages under De Sacy; was professor of Arabic at Bonn 1819–61; author of Arabic text-books and translations, and of an important *Lexicon Arabico-Latinum* (1830–37). D. at Bonn Nov. 19, 1861.

Freytag (Gustav), Ph. D., b. at Kreuzberg, Prussian Silesia, July 13, 1816; studied at Berlin and Breslau; took his doctorate in 1838, and was a privatdocent at Breslau; produced successful plays, tales, and poems; was editor of the Leipsic *Grenzboten* 1848–70; and held for some years a court position at Gotha. Of his numerous works, the best known in this country are *Sollen und Haben* ("Debit and Credit"), of which there are several English translations; *Bilder aus der deutschen Vergangenheit;* and *Die verlorene Handschrift* (1864), translated by Mrs. Malcolm under the title *The Lost Manuscript*, London, 1865, 3 vols.

Fri'ar [Lat. *frater;* Fr. *frère*, "a brother"], a member of a monastic brotherhood, especially one who belongs to one of the mendicant orders—the Franciscans, Augustinians, Carmelites, and Dominicans. The Dominicans were called *Black* Friars, from their garments, and also *Preaching* Friars. The Franciscans were *Grey* Friars; the Carmelites at one time were called *Barred* Friars, from their striped robes, but in later times they were called *White* Friars. Monks not priests are called friars in Ireland, of whatever order; but after taking priests' orders they lose this distinctive name. The Franciscans are called *Friars Minor*, and there is a small order called *Friars Minims.* (See Minims.) *Crutched* Friars were canons regular of the Holy Cross.

Friar's Point, post-v., cap. of Coahoma co., Miss., on the Mississippi River, 110 miles below Memphis, to which place it has a daily packet-line. It has 1 weekly paper, and good white and colored schools and churches. It is in a rich cotton-growing country. Pop. about 400.

H. J. Sanderson, Ed. "Weekly Delta."

Frick (Charles), M. D., b. in Baltimore, Md., Aug. 5, 1823; d. in that city Mar. 25, 1860. He began life as a civil engineer, but in 1843 commenced the study of medicine; graduated in 1845, and twelve years afterwards was elected a professor in his alma mater, the University of Maryland. He contributed some valuable articles to the *American Journal of Medical Sciences*, and in 1850 published a work on renal diseases. Dr. Frick died young, suddenly in the midst of his usefulness, leaving a blessed memory to all who knew him. He fell a victim to professional zeal. He had always been peculiarly susceptible to throat affections, and a few days after performing tracheotomy on a negro woman he was taken ill. The same operation having been decided upon in his own case, he rose from the bed, made every preparation for it, handed the knife to the surgeon, threw back his head, and indicated by the finger the point to be opened. His ready submission to God's will and noble courage marked the Christian hero.

Paul F. Eve.

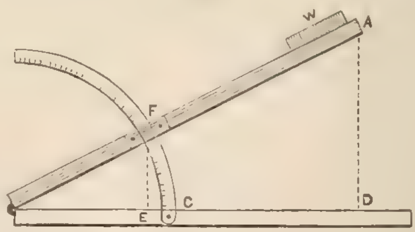
Fric'tion [from the Latin *frico*, to "rub;" Fr. *frottement;* Ger. *Reibung*]. 1. Friction is that force, always acting as a resistance, which is experienced when it is attempted to move one body upon another which is pressed into close contact with it. It is generally supposed to be due to the interlocking of the asperities of the two surfaces, and to abrasion by tearing them off. Thomson* supposes all friction to produce electricity, and Tait expresses the opinion that "it is probable that all friction, perhaps not excepting that caused by actual abrasion, is due to the production of electricity."† Friction is of two kinds—sliding friction, which is encountered when one body is forced to slide upon another; and rolling friction, which is that resistance which is met with when it is attempted to cause one body to roll upon another. The friction of a sled upon the ground or of a sleigh upon snow illustrates the first kind. The resistance of a carriage or of a railroad train consists principally of the rolling friction of the wheels upon the road or upon the track, and of the sliding friction of the wheels with their axles. When two bodies are at rest and in contact, it requires more force to get up relative motion than to overcome friction after that motion has commenced. The "friction of rest" or "friction of quiescence" is therefore greater than the "friction of motion." This difference is most marked with comparatively soft materials and with great pressures. A slight jar will usually reduce the friction of quiescence to that of motion.

2. In order to determine the real expenditure of power in doing work, and to ascertain the efficiency of machines, it is necessary to learn the amount of frictional resistance to be encountered, and to estimate the quantity of work which may be expected to be absorbed by it in each case. It is this force which has most effect in reducing the efficiency of mechanical combinations, and the losses from this cause alone are frequently very serious, amounting to 25, or even 50 per cent.

3. The investigation of the laws of friction and the determination of the "coefficient of friction" have employed many of the most distinguished philosophers and engineers. The earliest extended researches were those of Coulomb, made during the latter half of the last century, and published in 1785.‡ They are given in full in his *Théorie des Machines Simples, etc.*, 1821. The investigations of George Rennie, as published in the *Philosophical Transactions of the Royal Society* in 1829, and those of Gen. Morin, recorded in the *Mémoires de l'Institut* for 1833, were more extended and valuable. The latter, which were made under the direction of the French government, are regarded as most accurate and reliable, and are usually accepted as standard; with his *Nouvelles Experiences* they are quoted by all engineering authorities. Valuable and still later experiments have been made by Hirn § and by M. Bochet.‖

4. In determining the amount of frictional resistance

Fig. 1.

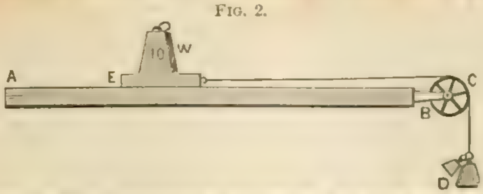


the apparatus used is generally very simple. Fig. 1 represents one of these instruments. A plane A B is placed horizontally, and loaded with a weight W. The plane is then raised at the end A until the weight begins to move. The force of friction of rest has then a ratio to that component of the force of gravity producing pressure, which is equal to the ratio of the perpendiculars A D and F E to the bases B D and B E—*i. e.* the "coefficient" of friction of quiescence is measured by $\frac{W \sin. i}{W \cos. i} = \frac{F}{P} = \tan. i = f$. The angle F B E $= i$ is the "limiting angle of resistance." Similarly, the "coefficient of friction of motion" is determined by noting at what angle motion will just commence, and will continue with uniform velocity after having been started by a slight jar.

* *Bakerian Lectures*, 1856. † *Sketch of Thermodynamics*, p. 63. ‡ Young's *Nat. Philosophy*, vol. ii. § *Polytechnisches Centralblatt*, 1855. ‖ *Annales des Mines*, 5me série, p. xix.

5. The "tribometer" of Coulomb is shown in Fig. 2.

FIG. 2.



This is more convenient in operation, and gives more reliable results, than that just described, in which there is often found difficulty in distinguishing between the friction of motion and that of rest. A horizontal table A B is fitted at one end with a pulley C. A block E slides on this table, and carries a weight W of any desired magnitude. The block is drawn along the surface by a suspended weight D, which is adjusted until just sufficient to produce or to continue motion. The nature of the rubbing surfaces and the amount of pressure upon them are readily changed, and the results obtained are quite reliable.

6. In experimental determination of rolling friction, cylinders, or rollers, of various sizes and weights are used in place of, or are placed under, the sliding block.

7. In ascertaining the friction of axles and of shafts revolving in their journals a shaft capable of being loaded to any required extent and driven at any required speed is used. A thermometer has sometimes been attached to indicate changes of temperature of the lubricant, or any warming of the journal due to the development of heat, into which form of energy the work done in friction is always converted. The first experiments of this character were made at the Brooklyn navy yard by Messrs. King, Stivers, and Price, a board of U. S. naval engineers.

8. A later and more complete apparatus for similar experiments is "Thurston's apparatus for testing lubricants," as made at the Stevens Institute of Technology,* and which is shown in Figs. 3 and 4. It was patented Dec. 24, 1872. A shaft A is carried by a pair of journals B B, and is driven

FIG. 3.

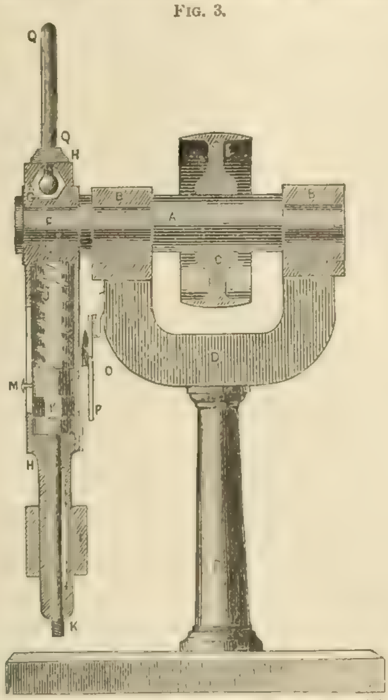
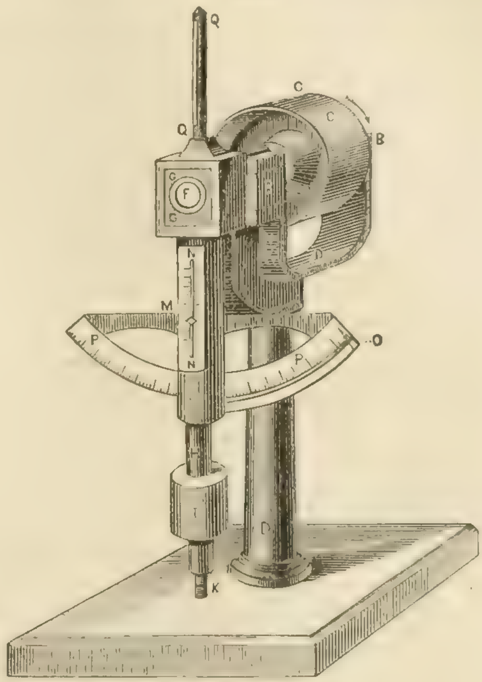


FIG. 4.



Sectional and Perspective Views of Thurston's machine for testing lubricants.

by a pulley C. At the outer extremity is a third journal F, grasped by a pair of "brasses" G G, which are caused to exert any required pressure by means of a helical spring J, compressed by a screw K K, working in the supporting nut L. The degree of pressure is shown by a pointer M traversing the scale N N. The arm H which carries this portion of the instrument is suspended so as to swing about the journal F, and is loaded by a fixed weight I. A pointer O, traversing a graduated arc P P, indicates the deviation of this loaded arm from the perpendicular, and the resulting moment equal to that exerted by the friction of the shaft in its bearing F G. The scale N N bears two graduations, one of which, as just stated, indicates the pressure on the journal, while the other set of figures have such values that when the reading on the arc P P during any experiment is divided by the number on N N opposite that which indicates the pressure on the journal, *the quotient will be the coefficient of friction.* A thermometer Q Q, the bulb of which is inserted in a cavity in the upper "brass" G, serves to indicate the temperature of the bearing at every instant. Thus, coefficients of friction are readily determined for any kind of rubbing surfaces and for any kind of lubricant. The durability of any unguent, its capacity for resisting high temperatures or great pressures, and its general behavior under any conditions of use, may be learned. The relative values of several lubricants are ascertained with facility, testing them under the precise conditions as to pressure, velocity of rubbing, and character of surface to which it is proposed to subject them, and the kind of work to which any one of them is best adapted is indicated by the results of a series of tests under varying conditions.

9. By experiments made as indicated the following law has been proven to exist within certain limits: Frictional resistance is simply proportional to the force with which the rubbing surfaces are pressed together, and is independent of the extent of those surfaces and of the velocity of rubbing. The law is departed from whenever the surfaces are subjected to such intensity of pressure as to become abraded or fractured. It is also inaccurate where the surfaces are separated by an unguent, and are of such great area that the resistance due to viscosity of the lubricant becomes considerable as compared with the resistance of true friction. In this case the resistance varies approximately in proportion to the area of the surfaces in contact. This latter case occurs less frequently than the preceding. Great variations of velocity also cause a modification of the law, the friction becoming slightly less with high speeds.

10. The resistance due to friction is obtained by multiplying the pressure borne by the surfaces in a direction perpendicular to their planes by the coefficient of friction f. The following are values of f for the most frequently occurring cases, as given by Morin:†

No	Surfaces	Unguent	[illegible]	[illegible]
1	Wood on wood . .	None	14 to 2[illegible]	0.25 to 0.50
2	" " " .	Soap	2 to 11	[illegible]
3	Metal " "	None	[illegible] to [illegible]	[illegible]
4	" " "	Water	1[illegible] to 20	[illegible]
5	" " "	Soap	11[illegible]	0.20
6	Leather on metal	None	[illegible]	[illegible]
7	" " "	Greased..	1[illegible]	0.23
8	" " "	Water....	[illegible]	0.36
9	" " "	Oil.......	[illegible]	0.15
10	Smoothest and best lubricated surfaces ..		1[illegible] to 2[illegible]	0.03 to 0.036

* *Journal Franklin Institute*, July, 1873, p. 1. † *Notions Fondamentales de Mécanique.*

The value of f for earth varies from 0.25 for wet clay to 1.10 for gravelly soil; a usual value is 0.50. The coefficient of quiescence very commonly exceeds that of motion about 40 per cent.

11. The maximum pressure which the more frequently used unguents will bear varies with the speed of the rubbing surfaces, the liability to heat being measured by the product of pressure into velocity—*i. e.* by the quantity of energy expended in a given time. At a uniform speed of 200 feet per minute, the maximum per square inch, as determined by experiments on new iron shafts running in loaded bearings, is as follows, when the elevation of temperature of bearing is not above 50° F.:

Winter sperm oil	65 lbs.	Best mineral oil	65 lbs.
Summer " "	75 "	Light " "	50 "
Winter lard	55 "	Lightest " "	30 "

At lower speeds and with very hard and smooth surfaces much higher pressures may be allowed. Steel crank-pins for steam engines are sometimes subjected to a pressure of 1200 pounds or more per square inch, with a velocity of rubbing of about 50 feet per minute; but this should be regarded as a maximum pressure, and should not be approached when possible to avoid it. Sperm oil, lard oil, and lard or tallow are the best lubricants for use on heavy machinery. Lubricants having less "body" are more suitable for light machinery. All of the fixed animal, mineral, and vegetable oils are frequently employed, and plumbago and soapstone are sometimes used.

12. The temperature at which oils lose their fluidity has some influence upon their value in special cases. Winter lard oil begins to thicken at 40° F., and congeals at 25°. Winter sperm thickens at 48°, and becomes solid at 36°. Summer sperm oil thickens at 66°, and freezes at 56°. Heavy mineral oil thickens at 45°, and solidifies at 20°. Light petroleum thickens at 34°, and freezes at 18°. Very light mineral oil thickens at 18°, but remains liquid at 0° F.

13. Since both pressure and velocity of motion have an influence in determining the value of a lubricant, that which is best adapted for any special case should always be selected after trial under the precise conditions of actual use, both of speed and pressure, whenever possible.

14. Work lost in overcoming friction gives rise to heat to the amount of one British thermal unit for each 772 foot-pounds so expended. Where this evolution of heat does not produce overheating of the bearing surface or burning of the unguent, it does no harm. The amount of pressure thrown upon the surfaces exposed to friction should always be carefully kept far below the limit at which heating is liable to occur at the proposed velocity of rubbing.

15. The diameter of the journal of a revolving shaft is fixed by the consideration of the stress which it has to bear; its length is determined by the magnitude of frictional resistances and the limit of pressure admissible. The following formula was first proposed by the writer in 1862, from observation of and experiment upon the crank-shafts of naval steamers:

$$P = \frac{60{,}000ld}{V}, \text{ or } l = \frac{PV}{60{,}000d} \quad \ldots\ldots\ldots\ldots\ldots (1).$$

Rankine in 1865 published the following, as derived from locomotive practice:

$$p = \frac{44{,}800}{60V + 20} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2).$$

In these formulas, l represents the minimum length of bearing in inches; d is its diameter, V the velocity of rubbing in feet per minute, p the maximum pressure per square inch of longitudinal section of the bearing, and P the maximum total load on the journal in pounds. Mr. J. D. Van Buren published in 1869 the formula deducible from (1):

$$l = \frac{PN}{350{,}000} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3),$$

where P is the total working load on the bearing of a crank-pin in pounds, and N the number of revolutions per minute. Mr. T. Skeel in 1873 gave the following:

$$l = \frac{IHP}{130s} \text{ to } \frac{IHP}{150s} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4),$$

in which IHP represents the "indicated horse-power" transmitted by the crank-pin, and s is the stroke of piston in inches. All of these formulas will be found useful for plane as well as cylindrical surfaces.

16. Good practice is generally considered to dictate a limit of pressure as low as 800 pounds per square inch for other metals than steel. With thorough lubrication, which should always be carefully provided, and pressures below the maximum, the kind of metal of which the bearing surfaces are composed does not usually affect, in any appreciable degree, the amount of frictional resistance.

In general, to reduce the amount of power lost in friction, parts should be made as light as possible consistently with proper strength; rubbing surfaces should be given as great an area as possible; the velocity of rubbing and distances moved over should be kept well below the maximum due the pressure; and lubricants should be carefully chosen. A common length of journal for shafting, as made by the best builders, is four times the diameter. With ample surface and effective lubrication, wear becomes imperceptible. Heavy weights are often carried on rollers, and wagons and carriages are mounted on wheels, rolling friction being thus substituted for the more serious form of sliding friction. "Friction-wheels" supporting the shafts of grindstones, or as applied in the "Atwood machine," also illustrate this case.

17. Although, in the operation of machinery and in many other instances, friction is an annoyance and the cause of even very serious losses, it is also frequently very useful. The friction of the driving-wheels of the locomotive upon the track is essential to the useful application of its power. "Friction-gearing," driving by the friction produced by contact and mutual pressures of the smooth peripheries, has now many important applications. Nails, screws, and wedges would have no value except for the frictional resistance which retains them in place when once "driven home." The checking of the recoil of ordnance and of the motion of railroad trains is accomplished by "friction-brakes." Even the act of walking becomes impossible when, as upon smooth ice, the foot finds no frictional resistance to its movements.

18. *Rolling friction* has been found to be governed by a law which is expressed with approximate accuracy by the formula given by Coulomb:

$$F = f\frac{R}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5),$$

in which F represents the resistance, or the required force of traction to overcome it, when R is the load expressed in similar units of force, and r is the radius of the roller on which the load is carried. The coefficient of friction as determined by experiment is represented by f. The experiments of Gen. Morin confirm the deductions of Coulomb, while those of Dupuit and those of Poirée and Sauvage give results in which F varies nearly as the square root of r. The formula above given is generally adopted. Coulomb found the value of f for rollers of elm to be 0.032; Weisbach and De Pambour found the value for railroad car-wheels to be very closely 0.02. The total resistance of railroad trains on level grades and under favorable conditions is usually from 8 to 10 pounds per ton weight of train at all ordinary speeds. For vehicles mounted on wheels the tractive force is $2F$, since the impelling force is applied at the axis and its lever-arm has but one-half the length assumed in the formula. The value of f is subject to great modifications with different surfaces, and by the effect of the load in altering the form of the wheel or the roller, and in indenting and compressing the surface on which it moves.

19. The frictional resistance of *pulleys* arises in a great degree from the rigidity of their cordage. This was found by Coulomb to be proportional to the tension, to increase nearly as the square root of the cube of the diameter of the rope, and to be inversely proportional to the diameter of the sheaves over which the rope passes or of the cylinder around which the rope winds. Weisbach has shown that this rigidity is due principally to the lateral friction resisting the slipping of the fibres among each other, and that it is less with greased or tarred ropes than with dry cordage; and also that wire ropes offer less of this kind of resistance than ropes of hemp.* Where a rope is wound several times around a cylinder, the resistance increases in a geometrical ratio. It is for this reason that the strongest rope may be broken by the friction produced by a few turns taken about a post, as is sometimes seen in the common practice of seamen "rendering" a line around the "bitts" in checking the motion of a vessel.

20. *Fluid friction*, so called, is a resistance due to viscosity of the fluid, and to the resistance of the inertia of those particles which are subjected to change of motion. The resistance of well-formed vessels is caused almost entirely by "fluid friction." The amount of this resistance is given by Rankine† at "1 pound per square foot of surface moving ten knots" (nautical miles) "per hour." By Isherwood‡ it is stated to be "0.45 pound per square foot of surface moving with a velocity of 10 feet per second." This resistance varies directly as the area of surface and nearly as the square of the velocity. The coefficient decreases with increase of velocity. R. H. THURSTON.

* *Zeitschrift für Ingenieur-wesen*, vol. i. 1848. † *Shipbuilding*, p. 81. ‡ *Engineering Precedents*, vol. i. p. 13.

Fri'day [either "Freya's day," *dies Veneris*, or "Frigga's day;" Ger. *Freytag;* Fr. *Vendredi*], the sixth day of the week, following Thursday and preceding Saturday. In the Eastern, Latin, and Anglican churches all Fridays except Christmas (or in some Roman Catholic dioceses all Fridays except those in Advent, but always the Ember Day in Advent) are fasts of obligation, in memory of the passion of our Lord, which is especially commemorated on GOOD FRIDAY (which see). In the folk lore of many nations Friday is considered an unlucky day, doubtless on account of the religious associations connected with it.

Friday Harbor, post v., cap. of San Juan co., Wash. Ter.

Fried'berg, manufacturing town of Prussia, in the province of Brandenburg. Pop. 5621.

Fried'ensville, post v. of Upper Saucon tp., Lehigh co., Pa., and has important zinc works.

Fried'land, town of Mecklenburg Strelitz, Germany, 30 miles N. E. of New Strelitz. It has a brisk trade and thriving manufactures. Pop. 5031.

Friedland, town of Prussia, 27 miles E. of Königsberg. Here the allied Russians and Prussians were defeated by the French June 14, 1807.

Friedland, town of Bohemia, 68 miles N. of Prague. Wallenstein, whose castle is close by, took his title of duke from this town. Pop. 4331.

Fried'länder (DAVID), a Jewish scholar, b. at Königsberg, Prussia, Dec. 6, 1750, was attracted to Berlin by the reform labors of Moses Mendelssohn, after whose decease he became himself the leader of the Berlin Jews in educational and social reforms. He even went so far, at one time, as to propose a union of the Jewish with the Christian Church, but as he had asked that the Jews be admitted into the Christian fold without acknowledging the Messiah, its living Head, the ecclesiastical authorities of Prussia rejected the proposal. The literature occasioned by this proposal is quite extensive; the most valuable pamphlets are mentioned in GRAETZ (p. 174, note 2). Friedländer founded with Itzig, his brother-in law, a free school for the Israelitish youths of Berlin, and he labored in this connection and as an author, as well as a citizen, for the social and political elevation of his people. D. Dec. 25, 1834. (See JOST, *Geschichte des Judenthums*, etc., iii. 316 *seq.;* GRAETZ, *Gesch. der Juden*, x. 162 *seq.*, 171 *seq.*)

JAMES H. WORMAN.

Friend'ly (or **Ton'ga**) **Islands,** a group of over 150 islands, sometimes made to include the Feejee Islands, situated in the Pacific Ocean between lat. 15° and 25° S., and lon. 172° and 177° E. The smaller ones generally are of coral formation, while the larger ones are of volcanic origin. They have few native animals, but plenty of yams, sweet potatoes, and bread-fruits.

Friends, or **Quakers,** a society of professing Christians, better known in the past to the world at large by the name of "Quakers." They at first called themselves "Friends" or "Friends of Truth," and they still retain among themselves the title of the "Society of Friends," by which they are now becoming more generally recognized. The term "Quaker" had its rise from the following incident: George Fox, usually called the founder of the society, in the course of his ministry and persecutions was in 1650 brought before Justice Bennet at Derby, England, "who," says Fox, "was the first that called us 'Quakers,' because I bade him tremble at the word of the Lord." This term, though given in scorn to the Friends, they have never felt ashamed of, remembering its scriptural authority in such texts as these: "The Lord reigneth: let the people tremble;" "Hear the word of the Lord, ye that tremble at His word;" "The earth shall quake—the heavens shall tremble," etc., setting forth the exaltation of God and the dependence and nothingness of man. Thus, the terms "Quaker" and "Quakerism" have become incorporated into the history and literature of the society, and also into general literature, taking a coloring quaint and classical in the prose of Southey, Coleridge, and Howitt, and in the poetry of Lamb, Lloyd, Barton, Longfellow, Whittier, and others. Robert Barclay in 1690 entitled his learned work on the doctrines of the Friends, *An Apology for the true Christian Divinity as the same is held and preached by the people called, in scorn, Quakers;* and Sewell entitled his noted work, *Sewell's History of the People called Quakers.* In a brief sketch of this portion of the Christian Church a cursory glance only can be given at its rise, its early history, its essential doctrines, its church order and government, its influence upon the Christian world, and its present position and prospects. "The rise of the people called Quakers," says Bancroft, "is one of the memorable events in the history of man. It marks the moment when intellectual freedom was claimed unconditionally by the people as an inalienable birthright." It may be added, it marks the period when the conflict for liberty of conscience resulted, through persecutions passively endured, in a permanent victory. Nor can the early history of the Friends be regarded as unique and isolated. The true causes of these spiritual phenomena, and of all others in the progress of Christian truth, are deep-seated and remote. All the religious societies which have arisen since the Reformation appear to have aimed at a more fervent piety than was found among the sects from which they sprang. They strove to realize a greater conformity to the apostolic pattern. In the Reformation itself we find the germs of those principles which were subsequently developed and carried out by the founders of the Society of Friends. Sentiments very similar to those held by Friends on the subjects of the indwelling and guidance of the Holy Spirit, on baptism and other church ceremonies, on wars and oaths, and a ministry based upon education and human appointment, were entertained by individuals at different periods before the preaching of Fox. Early in the seventeenth century there was a marked movement in this direction, which prepared the way for the more full presentation of the gospel in its original simplicity by George Fox and his co-workers. And it may here be remarked, to correct a popular error, that these fundamental doctrines were not set forth before the world by their advocates as new truths, but as pure, unencumbered, primitive Christianity; and further, that George Fox himself did not labor to found and organize a new sect, but was earnest in proclaiming the truth which he felt had been revealed to him. In this work he found ready hearers among those of similar convictions and experience. Thus, being brought to Christ by the revelation of His Spirit in their own hearts, these individuals were brought into unity of doctrine and purpose, one with another, as a Church, of which they regarded Christ alone the Founder, and over which, according to the Scripture, they believed Christ alone to be the Head, and by His Spirit the personal, perceptible, immediate guide in all things. Upon this simple apostolic basis the early Friends became associated, and from this cardinal doctrine of the enlightening and directing power of the Holy Spirit spring all their distinguishing views. And in common with their brethren of the other Protestant churches of their times, to the early Friends it was given not only to believe in Christ, but to suffer for His sake. Although some of the Protestants earlier organized, as the Baptists and Presbyterians, first met the force of persecution, yet upon the unresisting Friends at last the pitiless storm fell most heavily. All this sad ecclesiastical story is of course interwoven with political events. The hopes of greater toleration for Protestants which the short reign of Edward VI. had given birth to were completely extinguished by the inglorious one of his sister Mary. When Elizabeth succeeded to the throne she found herself surrounded by papists strongly attached to their religion and zealous for its support. Refusing to hazard the peace of the realm by too great or sudden alterations, her policy led her to pursue a cautious course in changing the existing order of things, so that the doctrines and forms of worship revived and established by her left the minds of many Protestants dissatisfied. The spirit of inquiry was abroad in increasing vigor and activity, and various classes of dissenters sprang up, united in a strenuous opposition to the Romish Church, combined also with a degree of discontent with the existing established religion. These disputes and dissensions, which had been carried on with increasing acrimony through the reigns of Elizabeth and James I., began to assume under Charles I. a most serious aspect, threatening to destroy the peace of the kingdom. His arbitrary assumptions augmented the difficulties, which finally culminated in the civil war, and in 1648 brought the king to the scaffold, and set up the new form of government. Under the rule of Cromwell and of the Puritans more just and tolerant measures were gaining ground in the minds of men when they received a check by his death in 1658. On the accession of Charles II. to the throne in 1660 flattering promises were made by him of "liberty to tender consciences" "in matters of religion," but they proved delusive. Given up to his own pleasures, he allowed the clergy to carry out their plans for the control of the Church, without inquiring into the sufferings sustained by his subjects. Of these sufferings the Society of Friends, both in Great Britain and in the American colonies, partook largely. It is estimated that during the winter of 1662 between 3000 and 4000 of their members were incarcerated in the foul jails and dungeons of Great Britain. In 1672, Charles II. issued a declaration to suspend the operation of penal laws against nonconformists, which was followed by a bill to exempt dissenters from penal laws, introduced into Parliament in 1680. (For further details respecting this interesting period of church history as regards the Friends, who suffered more severely than any

other class of dissenters, we would refer the inquirer to SEWELL'S *History*, to GOUGH'S *History of Friends in Ireland*, and to BOWDEN'S *History of Friends in America*.) It was during this period of trial to the Church that the Society of Friends was gathered and organized, thriving, like the oak, "amid the rude concussions of the storm." And it was in 1646, during the first stages of these civil and religious commotions, that George Fox, then in his twenty-third year, began his labors as a minister of the gospel. (To the account of his ministry and the details of his life, as recorded in his celebrated *Journal*, we would direct the reader who desires to gain a just conception of his character and of the principles he promulgated. "One of the most extraordinary and instructive narratives in the world," says Sir James Mackintosh of this book. "Every page of George Fox," says Spurgeon, "is pure gold.") With regard to his personal convictions of the truth which he proclaimed, he says, "The Lord God opened to me by His invisible power how every man was enlightened by the divine light of Christ: I saw it shine through all, and that they who believed in it came out of condemnation into the Light of life, and became children of the light; but they that hated it and did not believe it were condemned by it, though they made a profession of Christ." In describing his mission as a minister he says, "I was sent to turn people from darkness to light—to the grace of God and to the truth in the heart that came by Jesus, that all might come to know their salvation nigh. I saw that Christ died for all—was a propitiation for all, and that the manifestation of the Spirit of God was given to every man to profit withal. These things I did not see by the help of man, nor by the letter of Scripture, but I saw them in the light of the Lord Jesus Christ, and by His immediate Spirit and power, as did the holy men of God by whom the Holy Scriptures were written; yet the Holy Scriptures were very precious to me, for I was in that Spirit by which they were given forth." Upon this vital and comprehensive scriptural doctrine, that all spiritual knowledge comes through the revelation of the Lord Jesus Christ by His Spirit, and that He is Head, "personally and perceptibly," over all things to His Church, rests the whole superstructure of the doctrines, mode of worship, and church order of the Friends. This superstructure we will now briefly examine; remarking, first, that nothing is farther from the fact than the idea often met with that Friends avow no settled religious creed. On the contrary, the things most surely believed and professed among them since Fox and Burrough and Howgill and Barclay began their ministry have been openly published in hundreds of volumes of the writings of the Church, and are nothing less than the cardinal doctrines of the gospel in all their fulness as set forth in Holy-Scripture, and as witnessed to by the Holy Spirit in the heart, according to the texts, "He that believeth" "hath the Witness in himself;" "the Spirit beareth witness, because the Spirit is truth," etc. These doctrines have never been offered as speculations or opinions, but as matters of personal and church experience. The apostolic word is *know*: "We *know* we have passed from death unto life;" "We *know* that the Son of God is come, and hath given us an understanding that we may *know* Him that is true." Among many similar bold and clear declarations of faith put forth by early and later Friends may be cited some passages from the letter of George Fox to the governor of Barbadoes in 1671: "We do own and believe in God, the only wise, omnipotent, and everlasting God, who is the Creator of all things and the preserver of all that He hath made—God over all, blessed for ever! We do own and believe in Jesus Christ, His beloved and only-begotten Son, in whom He is well pleased; who was conceived by the Holy Ghost and born of the Virgin Mary; in whom we have redemption through His blood, even the forgiveness of sins; by whom were all things created in heaven and in earth. We believe that He was made a sacrifice for sin who knew no sin—that He was crucified for us in the flesh, was buried and rose again the third day for our justification, and ascended into heaven, and now sitteth at the right hand of God. This Jesus, who was the foundation of the holy prophets and apostles, is our foundation; for we believe there is no other foundation to be laid but that which is laid, even Christ Jesus; who tasted death for every man, shed His blood for all men, and is a propitiation for our sins and for the sins of the whole world, according to the testimony of John when he said, 'Behold the Lamb of God, who taketh away the sin of the world!'" On these cardinal doctrines, as also upon those of the offices of the Holy Spirit, the fall of man, justification by faith, on sanctification, on the inspiration and authority of the Holy Scriptures, the writings of George Fox and his contemporaries, Penn, Penington, Barclay, and others, are full and explicit. They declare that "we believe also in the Holy Spirit, the Comforter, the promise of the Father, whom Christ declared He would send in His name to lead and guide His followers into all truth, to teach them all things, and to bring all things to their remembrance; we believe that a manifestation of the Spirit is given to every man to profit withal; that He convicts for sin, and through obedience to His manifestations gives power to the soul to overcome and forsake sin, and through His transforming power unites the soul to Christ in the new creation, according to the Scripture, 'If any man be in Christ, he is a new creature.' We believe the Holy Spirit opens to the mind the mysteries of salvation, and that the saving knowledge of God and of Christ can only be obtained through the revelation of the Spirit, for the apostle says, 'What man knoweth the things of a man save the Spirit of man which is in him? even so the things of God knoweth no man but the Spirit of God.' We believe in the fall of man; that man was created in the image of God, understanding the divine law and holding communion with his Maker; that through transgression he lost this happy state and heavenly image, and that until renewed by the regenerating power of the heavenly Man, Christ Jesus, he is dead to the divine life in which Adam originally stood; but we do not believe that sin is imputed to any until they transgress the divine law after sufficient opportunity has been given to understand it. Hence it follows that children cannot be sinners from their birth, although they inherit the seed of sin; yet they are also through Jesus Christ heirs of His grace and partakers of His sacrifice made for the sins of the world; and if they die in infancy we believe they are saved through the atonement of our Saviour." On the subjects of sanctification and justification the belief of the Friends has ever been that the great design of our Creator in sending His beloved Son into the world was the redemption of man from the fall, that he might be restored into unity and fellowship with God. "For this end He hath communicated to every man a measure of that light and grace which came by Jesus Christ; and as many as resist not this light, but receive and obey it, it becomes in them a holy, pure, and spiritual birth, bringing forth holiness, righteousness, purity, and all those other blessed fruits which are acceptable to God; by which holy birth—Jesus Christ formed within us—we are sanctified, and are also justified in the sight of God, according to the apostle's words, 'But ye are washed, but ye are sanctified, but ye are justified in the name of the Lord Jesus and by the Spirit of our God.' We consider, then, our redemption in a twofold respect. The first is the redemption performed and accomplished by Christ for us, in His crucified body without us; the other is the redemption wrought by Christ in us, which no less properly is accounted a redemption than the former. The first is that whereby a man as he stands in the fall is put into a capacity of salvation, and has conveyed to him a measure of that power, virtue, spirit, life, and grace that was in Christ Jesus, which is the free gift of God; the second is that whereby we witness and know this pure and perfect redemption in ourselves by the inward appearing of our Saviour by His Spirit to set up his kingdom in our hearts, and to bring us, as we submit to His will and government, into the glorious liberty of the sons of God."

As regards the so-called sacraments of the Church, the Society of Friends never assumed a merely negative position, but one emphatically positive. Its founders in ceasing from man turned to the Lord. The Holy Spirit who led them out of material forms led them into the spiritual substance. While rejecting the typical baptism of water, they accepted in its fulness the heart-cleansing baptism of the Holy Ghost. They renounced the outward ordinance of communion, because in the obedience of faith they had been brought to know of the spiritual supper of the Lord—the bread of life and the wine of the kingdom. These views the Friends regard as the result of the scriptural truth that Christ is all in all to believers, and that they are spiritually complete in Him. The views also of Friends on divine worship they believe to be the inevitable consequence of the fundamental scriptural principle of all worship—that it must be in spirit and in truth. "If we should deny this way of worship," says Isaac Penington, "we should deny Christ: men cannot worship in spirit and in truth as they please, but must wait, in the silence of the flesh, for God's Spirit to quicken them into spiritual worship." Neither is their doctrine of a free gospel ministry negative—as of a ministry merely unpaid, or not depending upon intellectual education or upon human ordination—but of a ministry whose freedom consists in this, that it is exercised under the immediate teaching of the Holy Spirit, and that it stands not in the wisdom of man, but in the power of God. Friends accept the apostolic standard as expressed by Paul: "I certify you, brethren, that the gospel which was preached of me was not after man, for I neither received it of man, neither was I taught it, but by the revelation of Jesus Christ;" and also the ex-

hortation, "As every man hath received the gift, even so minister;" "If any man minister, let him do it as of the ability which God giveth." And upon the same basis of the immediate Headship of Christ in the Church rest the views of the Friends upon church order and government. Gathered out of every sect and rank, the early Friends were not brought together like loose and disjointed stones in a chaotic mass, but it was their belief that it was the will of God by the same divine power which had called them individually to Himself to build them up together, a spiritual house. "We can boldly declare with a good conscience, in the sight of God," says William Penn, "that the same Spirit which leads us to believe the doctrines and principles of the truth, and to hold and maintain them in their primitive and ancient purity, as set forth by the apostles of Christ in the Holy Scriptures,—I say, this same Spirit doth now lead us into the like holy order and government to be exercised among us which was exercised among them." Robert Barclay, too, in his elaborate chapter on this subject, premises, "First, Jesus Christ, the King and Head of the Church, did appoint and ordain that there should be order and government in it. Secondly, the apostles and primitive Christians, when they were filled with the Holy Ghost and immediately led by the Spirit of God, did practise and commend such order and government. Thirdly, the Church of Christ hath the same necessity now as of old to exercise this authority hath the same power to do so, and is led by the same Spirit into the same practices."

Our limits will not permit details upon the order, discipline, and church government of the Friends. We would refer for these to their doctrinal writings and books of "discipline." But it may be here remarked, as a broad practical principle underlying all the transactions of the Church, that it is evidently not in accordance with the high standard of church unity and spiritual guidance which Friends profess to adjust and settle questions that come before them by a numerical majority or vote. It is their custom, therefore, and the only way of proceeding consistent with their doctrines, to endeavor in all the transactions of the Church to wait for and obtain the immediate guidance of the Holy Spirit as the true spirit of judgment. And on any occasion where this unity of feeling is wanting and cannot be attained to they either dismiss the question or defer it for future action. And the writings of the Church fully set forth that the experience of the Friends gives confirming evidence to them that the Lord Jesus by His Spirit grants wisdom profitable to direct, and remains to be the immediate counsellor of His people, collectively as well as individually. The influence of some distinctive principles of the Friends upon the world at large has often been the subject of remark by writers outside of the society. Their early opposition to slavery and the slave-trade, their testimony against all wars as at variance with the gospel of peace, the recognized position and sphere of woman in the affairs of their Church, and their most prominent scriptural doctrine of the personal experimental work of spiritual religion in the heart by and through the immediate perceptible operations and indwelling of the Spirit of God, are views that are finding increasing acceptance throughout Christendom. As to their benevolent and humanitarian efforts as individuals and as a Church—efforts conspicuous, perhaps, in proportion to their numbers—we sometimes hear these commented on as if their association as a religious body was primarily one of simple philanthropy and moral reform. But is it not in justice due to them, and to the operative principles of the gospel which they in common with all other Christians advocate, to assign the self-sacrificing labors of such missionaries as Fox and Penn, Woolman and Wheeler, Allen, Grellet, Foster, and Fry, to that love to God which is the true source of love to man—to that ardent zeal for the honor and glory of God which is inseparable from the welfare of man? On the present position and prospects of the society our remarks must be brief. The sentiment is sometimes volunteered by popular writers that Friends have already done their work, and that their disintegration and disappearance from the field of action is to be looked for. This assumption, it seems to us, does not well accord with the evident fact that in the universal upheaval and unsettlement of religious feeling in the present day there is an increasing inquiry after that radical and unchanging truth that comes by the immediate revelation of God, by His Spirit, to the human soul, as it did in the apostolic times; and this truth involves what is *essential* and *permanent* in Quakerism. Respecting the statistics of its present church membership—stated to be 65,000, including Great Britain and America and some small communities on the continent of Europe and in Australia—it may be remarked that these figures indicate no decrease in the aggregate of numbers. Therefore, with all due allowance made for the existence of disturbing elements, and for that want of entire internal harmony of sentiment—of which, in common with other church organizations of the present day, the society has a share—we see no reason to suppose that the simple, pure, spiritual principles of the gospel as set forth in the Holy Scriptures will ever want experimental witnesses and advocates, or be without an organized Church to make the labors of such advocates effectual. (See QUAKERS.) EDW. BROWN.

Friends Creek, tp. of Macon co., Ill. Pop. 1538.

Friend'ship, tp. of Greene co., Ark. Pop. 394.

Friendship, post-v. and tp. of Knox co., Me., on the sea-coast, 14 miles W. by S. of Rockland. Pop. 890.

Friendship, tp. and post-v. of Allegany co., N. Y., on the Erie R. R., 21 miles N. E. of Olean, has 4 churches, an academy, a newspaper, 10 stores, a furnace, and a national bank, and is the seat of Baxter's Musical University. Principal business, farming and cheese-making. Pop. of v. 474; of tp. 1528. R. R. HELME, ED. "REGISTER."

Friendship, post-tp. of Guilford co., N. C., on the North west N. C. R. R. Pop. 1348.

Friendship, tp. of Clarendon co., S. C. Pop. 1410.

Friendship, post-v., cap. of Adams co., Wis., on the Little Roche-à-Cris River. It contains the county buildings, a fine school house, 2 mills, 2 hotels, a wagon and carriage manufactory, several shops, and a job and newspaper printing-office. The projected Chicago and Superior R. R. is graded to within half a mile of the village. Pop. 76.
S. W. PIERCE, ED. "PRESS."

Friendship, tp. of Fond du Lac co., Wis. Pop. 1101.

Friends of God, a body of religious persons in the fourteenth century who consituted an unorganized brotherhood. Some were laymen, like Nicholas of Bâle, their greatest leader. Others were monks, like Tauler, the great Dominican mystic, Heinrich Suso, and the master Eckart, who was somewhat strongly pantheistic in his views. The movement was apparently, to some extent, affiliated with that of the "Brethren of the Free Spirit," but seems to have avoided the excesses and immoralities ascribed to that body. The Friends of God adhered to the Church, but attempted great reforms within it.

Friendsville, post-tp. of Wabash co., Ill. Pop. 1216.

Friendsville, post-v. of Susquehanna co., Pa. P. 223.

Fri'erson's, tp. of Tuscaloosa co., Ala. Pop. 946.

Fries (ELIAS), b. in Sweden Aug. 15, 1794; became adjunct-professor of botany at Lund 1819; professor there 1828; received the professorship of economy at Upsala in 1834, and that of botany also in 1851; became in 1853 rector of the university. Was chiefly distinguished as a student of the mosses, sea-weeds, lichens, etc.; author of *Systema Orbis Vegetabilium* (1825), *Corpus Florarum Provincialium Sueciæ* (1835), *Summa Vegetabilium Scandinaviæ* (1846–49), etc. D. Feb. 8, 1878.—His son THEODORE is professor of botany at Upsala, and conducted a botanical expedition to Spitzbergen.—Another son, M. E. P. FRIES, is a distinguished student of cryptogamic botany.

Fries (JACOB FRIEDRICH), b. at Barby, near Magdeburg, Aug. 23, 1773, was trained in the Moravian seminary of his native place, and then studied at the universities of Leipsic and Jena; began in 1801 to lecture at Jena, and in 1805, after having travelled in Germany, Switzerland, France, and Italy, was made professor of philosophy and elementary mathematics at Heidelberg; in 1816 returned to Jena as professor of theoretical philosophy, and, though deposed for political reasons (from 1819–24), he remained there until his death, Aug. 10, 1843. In philosophy he followed the doctrines of KANT (which see), but he believed that his master's method needed perfecting, because it confounded psychological ideas with philosophy properly so called, and does not strictly distinguish the aids that psychology furnishes to metaphysics from metaphysics themselves. By a blending of Jacobian conceptions with the philosophy of Kant, Fries developed the doctrine that the sensible is the object of knowledge, the supra-sensible the object of faith (rational faith), and the manifestation or revelation of the supra-sensible in the sensible the object of presentiment. He called his system "philosophical anthropology," since he made all further knowledge dependent on man's self-knowledge. Dr. Edwards thus comments upon it: "The philosophy of Fries commends itself in this, that it preserved the formal logical reflection of Kant, without sharing in the metaphysical insipidity—yea, emptiness—of the contents of that philosophy." (*Bibliotheca Sacra*, 1850, p. 780.) His most important work is *Neue Kritik der Vernunft* (Heidelberg, 1807; 2d ed. 1828–31). (See HENKE, *Jakob Friedrich Fries, aus seinem handschriftlichen Nachlasse dargestellt* (Leipsic, 1867, 8vo); UEBERWEG, *Hist. Philos.* (New York, 1873, ii. 195, 201–203).)
JAS. H. WORMAN.

Frie'ser, von (RICHARD), BARON, president of the Saxon ministry, was b. Aug. 9, 1808, at Thürnesdorf, near Königstein in Saxony, and educated in the royal school of Meissen. He studied first at the mining school at Freiberg, then at the universities of Göttingen and Leipsic, and entered the service of the government in 1834, occupying an inferior position in the ministry of the interior. In May, 1849, when the revolution broke out in Dresden, he distinguished himself by his coolness and his firm adherence to the government, and in the midst of the general confusion took charge of the ministry of the interior, first provisionally, but soon definitely. Differences between him and the minister of state, Von Beust, caused him to retire in 1852, but in 1859 he was recalled and appointed minister of finance. In 1866 he was a member of the committee which governed the country during the war and the absence of the king, and after the war he took charge also of the ministry of foreign affairs. In 1867 was a deputy from Saxony to the council of the North German Confederation. In 1870 he showed great energy in the negotiations with the South German states concerning their becoming members of the German empire, and served effectively in the establishment of the unity of Germany. AUGUST NIEMANN.

Fries'land, province of Holland, bounded N. and W. by the North Sea and the Zuyder-Zee, and E. and S. by Groningen and Overyssel. Its area is 1200 square miles; its population 292,354, of Frisian race, a proud, independent, but loyal people, with a peculiar fitness and fondness for abstract science, especially mathematics. They are Calvinists. The country is low and level, intersected by canals, and offering excellent pastures. Butter and cheese are the main exports; flax and hemp are grown in large quantities. The principal town is Leeuwarden. What is known as East Friesland is a part of Germany, in the province of Hanover. Pop. 25,894. (See FRISIAN LANGUAGE.)

Frieze [perhaps for "*Frisian* cloth"], a coarse woollen cloth having a shaggy nap upon one side, and once much employed for making cloaks and for jackets for laboring men. The Low Countries were a principal seat of the frieze manufacture, and Ireland still manufactures handwoven friezes of good quality.

Frieze [It. *fregio*, "trimming," "decoration"], in classic architecture, the central member of the entablature, between the cornice and the architrave, often enriched with sculptures, but sometimes plain. When swelled or puffed out, as in some modern Italian examples, it is a *pulvinated* or *cushioned* frieze. In any style of building an enriched horizontal band may take the name of *frieze*.

Frig'ate [Fr. *frégate*; Sp. *fragada*], a ship of war rating inferior to ships of the line and larger than sloops of war, and carrying from 28 to 50 guns, the latter usually arranged upon two decks—the main and the spar deck. Steam-frigates of late usually carry a less number of guns. The name was originally applied to a long, sharp vessel of the Mediterranean propelled by both oars and sails.

Frigate Bird, or **Man-of-War Bird,** the *Atagen aquila* (*Tachypetes* or *Fregata aquilus*), a large pelican of nearly all tropical seas. It has a small body, a long tail, and wings often eight or ten feet in expanse, and is capable of very long, graceful, and powerful flight. It can neither swim nor wade, but catches the flying-fish in the air, and causes the gannet and other fishing birds to disgorge their prey, which it dexterously seizes in the air. The frigate bird is glossy greenish or brownish black, with a scarlet pouch on the throat. A second species is reported from the south-west Pacific.

Frig'ga, in the Scandinavian mythology, the wife of Odin and the most venerable of goddesses. She dwelt at Fensalir, and was the goddess of marriage and of fruitfulness. Some say that *Friday* was "Frigga's day;" others say that "Freya's day" is intended. (See FREYA.)

Frig'id Zone [Lat. *frigidus*, "cold"], in geography, the arctic and antarctic regions; the portions of the earth's surface which lie respectively N. of the arctic and S. of the antarctic circle. The N. and S. frigid zones have each an area of very nearly 8,229,748 square miles, and within these zones the sun does not rise and set every day of twenty-four hours. (See EARTH, by PROF. ARNOLD GUYOT, Ph. D., LL.D., M. N. A. S.)

Fringe [Heb. *gedil*, "twisted thread"—*i. e.* a "tassel," Deut. xxii. 12; a "festoon" for a column, 1 Kings vii. 17; *tsitsith*, a "flower-like projection"—*i. e.* "tassel," Num. xv. 38–41; the "forelock," Ezek. viii. 3], an ornament appended to the four corners of the outer garment worn by the Israelites, and put there as a reminder of their allegiance to Jehovah and to assist them in the faithful observance of the Decalogue. As the Hebrew law is said to contain altogether 613 commandments, Jewish tradition has so arranged it that the word ציצית, which is numerically 600, with 8 threads and 5 knots holding these together, should constitute a perfect symbol of the Law; and to this day every orthodox Jew observes the law in the wearing of the fringe. Obliged by untoward circumstances to relinquish the large outer fringed garment, they wear it instead in a smaller form as an under-garment. This explains why the poor woman with the issue of blood was so anxious to touch the hem (fringe) of Christ's garment (Matt. ix. 20); compare xiv. 36 and Mark vi. 56, where the same words, in the original κράσπεδον, is rendered "border"). The Pharisees, delighting in outward show, enlarged the size of the tassels of their fringed garments as marks of special sanctity. (Matt. xxiii. 5.)

Fringed garments, elaborately wrought, were very common among the ancient Egyptians and Babylonians, but they were *ornamental* in purpose. They were especially used in state dresses. (See MAIMONIDES, *Jad Ha Chezaka*, i. 100 *seq.*; the Hebrew Prayer-Book, *Derech Ha Chajim* (Vienna, 1859), p. 21 *seq.*) JAMES H. WORMAN.

Fringe Tree, or **Old Man's Beard,** a beautifully ornamental shrub of the U. S., growing as far N. as Pennsylvania and southward to Florida. It is the *Chionanthus Virginica*, of the order Oleaceæ. Its petals are white and curiously fringed, whence the name. It has an oval purple fruit, and leaves which are extremely variable in shape. Other species are found in Australia and the tropical regions of both hemispheres.

Fringillidæ. See FINCH.

Fri'o, county in the S. of Texas. Area, 1050 square miles. Stock-raising is the chief pursuit. There is much excellent land along the streams, with good timber. The remaining part of the surface is rolling prairie and hills, covered with mesquite-grass. Cap. Frio Town. Pop. 309.

Frio Town, post-v., cap. of Frio co., Tex.

Fris'che Haff ("Fresh-water Sea"), a lagoon with an area of 318 square miles on the coast of Prussia. In ancient days it formed a lake receiving the waters of the Pregel, Frisching, Passarge, and Vistula, and separated from the Baltic by a very narrow band of land, the Frische Nehrung. But in 1510 the Baltic broke through the Nehrung and formed a permanent passage from 10 to 15 feet deep, called the Gatt. Frische Haff is so shallow that all large vessels have to load and unload at Pillau, situated at the Gatt, from which the cargoes are transported over the Haff on lighters.

Fri'si (PAOLO), F. R. S., b. at Milan, Italy, Apr. 13, 1728; became a Barnabite monk; held professorships of philosophy at Casale and the Barnabite College, Milan; became in 1755 professor of morals and metaphysics at Padua; in 1756 professor of mathematics in Pisa; and in 1764 took the mathematical professorship at the University of Milan, where he d. Nov. 22, 1787. He was profoundly versed in mathematics and physics, and possessed a positive character, in consequence of which he was involved in perpetual controversies. His works include a *Disquisitio Mathematica* (1751) upon the physical cause of the earth's figure and motion; *De Atmosphæra cœlestium corporum* (1758); *De Inæqualitate motus planetarum* (1760); *Del modo di regolare i Fiumi e i Torrenti* (1762); and many others.

Fris'ian Language and Literature. The most powerful idea of the European civilization in the nineteenth century is that of nationality. The wars of the first Napoleon awoke it, and in the next generation it was ready for action. Greece, Hungary, Italy, Roumania, and Germany are its works; Scandinavia is one of its promises, Panslavism one of its dreams. It was the secret of the success of Cavour and Bismarck; it is the explanation of the fate of Napoleon III. Its literary influence has not been less than its political. The history of Europe has been rewritten from the standpoint of this new idea, and in order to procure the necessary materials old and forgotten literatures have been excavated and ransacked, and dialects and languages about to die out have been photographed and studied with the utmost care. Among these the Frisian language is one of the most interesting, forming an intermediate link between the Icelandic and the Anglo-Saxon language, illustrating many curious laws of transition, and explaining many peculiar features of character. It comes nearer the English than does any other continental language now spoken.

The Frisians, called by the Romans *Frisii*, in the Middle Ages *Frisones* or *Frisiones*, and by themselves *Frisan*, were a Teutonic race which was first heard of in 13 B. C., when Drusus found them dwelling, together with the Batavi, the Bructeri, and the Chauci, on the north-western coast of Germany, between the mouth of the Rhine and the mouth of

the Ems. He made them tributary, but in 28 A. D. they rose against the Roman dominion, and, although they were subdued, the Frisian answer to Roman oppression was always rebellion. They were at that time an expanding race. They wholly absorbed the Chauci, and as the Frankish tribes drew southward Frisian tribes stepped in and possessed themselves of the land as far as the mouth of the Scheldt. They also spread toward the N., along the coast of the German Ocean, as far as Jutland, where they were known under the name of *Strand Friser*. Soon, however, the Franks turned their arms northward. In 689 the Frisian chief Rathbad was defeated at Dorsted by Pepin de Héristal, and he and his subjects, the *Frisii majores*, or West Frisians (who occupied districts which are now W. of the Zuyder-Zee), were compelled to embrace Christianity. In 734 the same fate overtook that part of the *Frisii minores*, or East Frisians, who lived in the region now between the Zuyder-Zee and the Ems. Charles Martel defeated their chief, Poppo, in a bloody battle, and afterwards sent the holy Bonifacius into the country to preach Christianity among them. Finally, Charlemagne subdued (785) the rest of the East Frisians inhabiting the districts between the Ems and the Elbe. By his *Lex Frisionum* the whole territory of the Frisians was divided into three parts, of which that part situated in the W. fell to Charles the Bald at the division of the Carlovingian empire, and in time was merged into the present Dutch provinces of Holland, Zealand, Guelderland, and Utrecht, losing its Frisian character almost entirely. The two other parts, both situated farther E., but separated from each other by the Ems, fell to Louis the German, and received the names, respectively, of West and East Friesland, of which the former is the present Dutch province of Friesland, and the latter belongs to Hanover. Here the Frisian character prevailed, and the language has survived until our days. The first who called the attention of scholars to the Frisian language was the Danish philologist Rasmus Rask, whose grammar of the language, *Frisisk Sproglore* (Copenhagen, 1825) was translated into Dutch in 1832 by Hettema. It was followed in 1840 by a dictionary by Richthofen, *Altfriesisches Wörterbuch*, an excellent work; while J. Grimm's treatment of the subject is weak and sometimes erroneous. In its oldest form the Frisian language exists only in law-books. Each "gau" or district had its own laws, written in its own dialect, and these law-books are interesting, not only as linguistical remains, but as moral illustrations. While the whole of Southern and Middle Europe adopted the Roman law, the Teutonic races of the North—the Norwegians, Swedes, Danes, and Frisians—developed law-systems of their own, wholly independent of the ideas of Roman jurisprudence. Of the Frisian law-books, the most remarkable are the *Asegabuch*, written in 1200, and valid for all Frisians; the *Emsiger Domen*, from 1312; the *Brokmerbrief* and the *Recht der Rüstringer*, from the middle of the fourteenth century. They have been collected and published in Richthofen's *Friesische Rechtsquellen* (Göttingen, 1840). Specimens of a more recent form of the language are *Friesche Rymlerye*, by Gysbert Japicx (1684); the witty comedy, *Waatze Gribbert's brilloft* (1712), and the novel, *It libben fen Antje Ysbrants* (1714). In our days the Frisian language has disappeared from church, school, court, and educated people's conversation. It is now spoken only by the peasants of a few islands in the German Ocean, such as Heligoland, and of a few isolated parishes of Oldenburg, Hanover, and some towns of the Netherlands, such as Molquerum, Hindeloopen, and Leeuwarden; but is broken up in dialects which are unintelligible outside of their native places. Mr. A. Hettema has written much both in and about the Frisian tongue; his poem, *De Lapekoer* (1822), attracted much attention, and was translated into German in 1847. CLEMENS PETERSEN.

Frisians. See FRISIAN LANGUAGE and LITERATURE; also FRIESLAND.

Fristoe, tp. of Benton co., Mo. Pop. 1401.

Frit, the semifused materials for making glass or glaze. (See GLASS, by C. G. LELAND, A. M., and PORCELAIN, by PROF. C. F. CHANDLER, Ph. D., LL.D., M. N. A. S.)

Frith (WILLIAM POWELL), R. A., an English artist, b. at Studley, near Ripon, in 1819; became an exhibitor in 1839; has since produced many paintings, among which we may notice a scene from the *Vicar of Wakefield*, 1842; *The Village Pastor*, 1845, which made him an A. R. A.; and *The Railway Station*, 1862; entered the Royal Academy in 1852, and received important foreign distinctions.

Frit'illary [from the Lat. *fritillus*, a "dice box," from the dice like marks on the petals], the *Fritillaria meleagris* of Europe, a liliaceous plant common in cultivation. The flower is spotted with purple, red, and yellow; hence it is often called checkered lily. Many varieties are grown in gardens. The crown imperial (*Fritillaria imperialis*) is a fine showy flower of Persian origin. There are some twenty species. Of these, the *Fritillaria atropurpurea*, *pudica*, etc. grow in the U. S. in the far West.

Fritz'sche (CHRISTIAN FRIEDRICH), b. at Nauendorf, Germany, Aug. 17, 1776; was educated at Franke's orphan asylum and at Leipsic; became a Lutheran divine, and in 1830 professor of theology at Halle. Author of *Vorlesungen über den Mendelsohn*; *De anamartesia Jesu Christi* (1835–37); *De Revelationis Notione* (1828); was one of the authors of the *Fritzschiorum opuscula academica* (1838) and *Nova opuscula* (1846). D. at Zürich, 1850. His sons, FRANZ VOLKMAR (see below), KARL FRIEDRICH AUGUST (1801–46), OTTO FRIDOLIN (b. 1812), and ADOLF THEODOR HERMANN (b. 1818), are or were all university professors and authors of learned works, mostly upon topics connected with Latin and Greek literature or the writings of the early Christian period.

Fritzsche (FRANZ VOLKMAR), a distinguished philologist and editor, son of the learned theologian C. F. Fritzsche, was b. at Steinbach, in Saxony, Jan. 26, 1806; studied philology at the University of Leipsic under Beck and Hermann; held the position of assistant teacher (collaborator) for some years in the Thomas school in Leipsic, and was called thence to the professorship of eloquence and poetry in Rostock 1828. His earliest literary labors were connected with the style and writings of Lucian (Leipsic, 1826, 1828), some of whose dialogues he edited (*Dialogi Deorum*, Leipsic, 1829). He subsequently devoted his attention to the Greek theatre and the Greek dramatists, especially the comedians. Besides the *Quæstiones Aristophaneæ* (Leipsic, 1835) and *De Daitalensibus atque de Babyloniis* (Leipsic, 1831), he edited, with a copious commentary, the *Thesmophoriazusæ* of Aristophanes (Leipsic, 1838), and the *Ranæ* (Zürich, 1845). In defence of his old teacher, Hermann, against Otfried Müller, Fritzsche published a *Recension des Buches Æschylos Eumeniden von K. O. Müller* (Leipsic, 1834), to which was added a second part, 1835. H. DRISLER.

Friu'li [Ger. *Friaul*; Lat. *Forum Julii*, now *Cividale*, one of its towns], the name of a territory along the northern and north-eastern Adriatic, which in the Middle Ages formed an independent duchy, but which is now divided into the province of Undine, belonging to Italy, and the district of Görz-Gradiska, belonging to Austria. The Friulians speak a Romanic dialect (the Friulian) containing copious Celtic elements.

Friz'zlesburg, post-v. of Carroll co., Md. Pop. 161.

Fro'ben, or **Frobe'nius** (JOHANN), a learned printer, was b. at Hammelburg, in Franconia, in 1460. He received his education at the University of Bâle, then served as corrector under Amerbach and Petri until 1491, when he established his own printing-office in Bâle. His first publication was a Latin Bible, and he is said to have been the first, or among the first, to introduce into Germany the use of Roman letters. Froben was a warm friend of Erasmus, and the publisher of many of his works (issued collectively by Jerome Froben, 1540, 8 vols. folio). The advantages offered by the press of Froben and the correctness of his publications, among which was a splendid edition of the *Adagia*, were among the inducements that drew Erasmus from England to settle at Bâle, 1515. (DRUMMOND'S *Life of Erasmus*, vol. i., p. 241.) In this year Froben put to press the first *published* edition of the Greek text of the New Testament, edited by Erasmus. (*Tregelles on the Printed Text of the Greek Testament*, p. 19.) He undertook, also, under the supervision of Erasmus, the publication of the more important Latin Fathers—*e. g.* Jerome, on whom Erasmus had bestowed much careful study and labor (1516); Cyprian and Rufinus (1520); Tertullian (1521); Ambrose (1527); Augustine (completed 1528–29). He had intended to supplement these by a similar edition of the Greek Fathers, but he died before his plans were matured (1527). His design was, however, carried out by his sons, Jerome and John, and his son-in-law, Nicolas Bischop (Nicolaus Episcopius). Froben's publications, mostly in folio, are noted for their general correctness. The character of the old printer is presented in a pleasing light by Erasmus in one of his letters (*Ep.* dccccxxviii.). (See DRUMMOND'S *Life of Erasmus*, London, 1873, vol. ii., p. 273 *seq.*) H. DRISLER.

Fro'bisher (SIR MARTIN), an English navigator, b. at Doncaster, Yorkshire, the first Englishman to sail in search of a north west passage. After an unsuccessful endeavor for fifteen years to obtain the necessary assistance, he was finally aided in his enterprise by Dudley, earl of Warwick, and others, and sailed from Deptford in June, 1576, with three vessels of small size. On July 28, Frobisher reached that part of Greenland which he named Meta Incognita, and Aug. 11 passed through the strait to which he gave his name. Among the minerals brought back by him, gold was discovered, and in consequence a second expedition

was fitted out, which sailed from Harwich May 31, 1577: the result of this expedition caused a third to be made in 1578, which, however, arrived so late in the season as to be compelled to return at once. This was the last of Frobisher's voyages. In 1585 he accompanied Sir Francis Drake to the West Indies, and for his services against the Spanish Armada was knighted in 1588. In 1591 he was sent to aid Henry IV. against the Spaniards and Leaguers, and in an attack upon them at Croyzon, near Brest, was mortally wounded, and d. at Plymouth Nov. 7, 1594, soon after having returned his fleet in safety. G. C. SIMMONS.

Fro'bisher Strait, an arm of the sea in British North America, between Hudson Strait and Northumberland Inlet, extending westerly from the ocean at the entrance of Davis Strait; it is 240 miles long, and has a mean width of 30 miles.

Froe'bel (FRIEDRICH) was b. Apr. 21, 1782, at Oberweissbach, in Thuringia, where his father was the laborious pastor of seven villages. His mother died before his remembrance, and his half orphanage had a prevailing influence on his destiny, giving him a very sad childhood, that quickened his sensibility and stimulated him to reflection, which he manifested by asking strange questions concerning human discords. An affectionate elder brother, to divert his mind from such subjects, undertook to teach him the sexual system of botany, and show him how, by the union of opposites, harmony and beauty gradually grow out of differences. Not long after, being put to school by a maternal uncle, in the first hour of it he heard a discourse by the teacher on the text, "Seek ye first the kingdom of God and His righteousness, and all these things shall be added unto you;" this gave to him the joyful conviction of there being a law, which, gradually discovered and intelligently obeyed, would bring peace and harmony into the human universe; and when, in 1792, he heard a rumor rife among the peasantry, that the world was coming to an end, he says he did not believe it, because the will of God had not been brought about—a wonderful thought for a child ten years old. At thirteen he was apprenticed to a forester, who taught him wood-lore and mathematics, in which he made great attainments. Later, he went to the University of Jena, and studied the natural sciences; and became in 1813 curator of the mineralogical museum of Berlin, where he made acquaintance with his first wife, whose tastes drew her to the museum, and who learned of Froebel much of the laws of life, which were the theme of his thought. He left the museum to enlist in the army, but he never was in a battle. He prized, however, the opportunity of learning the military drill, and made the acquaintance in camp of Middendorf, Langethal, and Birop, who later became lifelong coadjutors with him in the work of education. It was after the war, when he was in Frankfort-on-the-Main with the intent of going into an architect's office, that he met the educator Grüner. It was at the time of the reform of education in Germany, and his camp-companions were teaching in Frankfort. In the frequent discussions of methods Froebel's originality struck Grüner, who persuaded him to give up architecture and take a class in his school. He visited Pestalozzi then for the first time, but two years after went again, taking with him the two sons of a Frankfort gentleman, who had been confided to him to be educated. He remained at Yverdun this time nearly two years, making himself a pupil with his two pupils. After that, he and Middendorf began a school in Keilhau with six pupils, two of whom were these two boys, and the others the children of his brothers, one of whom had died. Karl Froebel, one of these children, now an old man keeping school in Edinburgh, describes this school as a paradise of children, but says that during the whole period of his stay (from 1816 to 1826) it was in a chronic state of bankruptcy. The plan was to educate the children by putting them at work, and making nature itself and what they produced artistically by horticulture and their own hands, *their books*. It was while here that Froebel married his first wife and former pupil in mineralogy. They never had children of their own, but she made his school a happy family for the twenty years that she lived with him. But they did not confine themselves to Keilhau, where Middendorf only remained steadily and after the death of Froebel. They had schools in Switzerland at Watersee, Burgdorf, and Willisau. Some time during this interval Froebel went to Göttingen University and studied comparative philology, making himself thoroughly acquainted with Latin, Greek, and Sanscrit, and all to complete his own education for his duties. In 1839 he lost his faithful wife, and it was not till 1840 that he founded his first kindergarten at Brandenburg. Twenty-three years before he had published his first work, *Menschenerziehung* ("Human Education"), in which may be discerned the seeds of the kindergarten. He there gives the process of human development in the child, echoed in history. But at that time it was his idea that the child until he was seven years old should be exclusively educated by the mother. Later, he saw that it was simply impossible for mothers with several children and other family duties to devote themselves to the development, mental as well as moral and physical, of each child, but that from the time children were three years old till seven, it was a relief for both parties to have them gather into companies, to be taken care of for several hours of every day by a kindergartner, thoroughly instructed in the process of development and the method of the kindergarten. (See KINDERGARTEN.) For the next twelve years he devoted himself to the education of kindergartners and the establishment of kindergartens. The last attempt was at Hamburg, where he was invited in 1850. He elaborated the method, and has left it a gospel to childhood, for its principle is that free creativeness is at once the means and end of human education, and begins in spontaneous play, so guarded and guided as to coincide with God's creativeness. He married one of the kindergartners whom he educated, and she kept a kindergarten in Hamburg for twenty years after his death, which took place June 21, 1852, at Rudolstadt, where he had a school for training kindergartners. It was in the course of these last twelve years that he published another most characteristic work, *Die Mütter-und Kose-Lieder* ("Mother's Cosseting Songs"), illustrated by plates and notes addressed to the mother, interpreting to her her instincts, and giving her hints for her motherly prattle with her little children. The reform of education begun by Rousseau, and carried on by Fichte, Pestalozzi, and Diesterweg, finally culminated in Froebel's discovery of the method, as well as principle, of educating the human being in its first years purely by means of its own spontaneous activities, genially interpreted to him by guiding him to produce effects corresponding to the works of God. ELIZABETH P. PEABODY.

Froebel (JULIUS), nephew of Friedrich, b. in Griesheim, Germany, in 1806; studied at several German universities; held professorships of mineralogy and other sciences at Zürich 1833–44; edited a radical political paper; removed to Prussia, but was obliged to go to Dresden for political reasons, and his pamphlets on public affairs were suppressed; took part in the revolution of 1848, and entered the Frankfort Parliament; was arrested and tried for a political offence at Vienna, but escaped conviction; removed to Switzerland, and thence to the U. S.; was editor, newspaper correspondent, lecturer, and merchant in New York, Nicaragua, Northern Mexico, and California; in 1857 went to Germany, and became again involved with the authorities; removed to London; became in 1862 an editor in Vienna; and in 1867 founded a journal in Munich, and in 1873 became German consul at Smyrna. Author of *Grundzüge eines Systemes der Krystallogie* (1843); *System der Socialen Politik;* 2 vols. of American travels (1857–58); *Theorie der Politik* (1861); *Die Wirthschaft des Menschengeschlechts* (1870), and other works.

Frog [cognate directly with the Anglo-Saxon *frogga*, and intermediately with the German *Frosch* and Dutch *vrosch*, and contrasting with the Latin *rana* and its related terms], a name applied to many of the leaping tailless Batrachians. The frogs are the typical representatives at once of a class (the Batrachians or Amphibians) and an order (the Anura or Salientia), and are divisible into several distinct families and numerous genera and species. As representatives of the family Ranidæ, the true frogs are distinguished by a peculiar sternal apparatus, the manubrium being a robust bony style, the xiphisternum generally similar, and the arciform cartilages wanting; the skull has no fronto-parietal fontanel; there are no teeth on the lower jaw; the tongue has a broad free margin, is attached in front and free behind, and is more or less deeply notched behind; the ear is perfectly developed, the tympanum, cavum tympani, and Eustachian tubes being present; there are no parotoid glands. The family is represented by a number of genera, the largest of which is that of the typical frogs (*Rana*), of which there are about forty species, found in almost all portions of the world except Australasia and South America.* (For metamorphoses of frog see cut in article BATRACHIA.) Nearly a dozen are found in the U. S.: the best known are—1, the common bull-frog (*Rana Catesbyana*); 2, the shad-frog (*Rana halecina*); 3, the wood-frog (*Rana sylratica*); 4, the marsh-frog (*Rana palustris*); and 5, the spring-frog (*Rana fontinalis*). (1) Much the largest of these, and only rivalled in size by a species (*Rana tigrina*) of the East Indies, is the bull-frog. This, like its fellows, feeds upon worms, mollusks, and insects, and it is said that to those in the Zoological Gardens of London are sometimes given sparrows, which they greedily devour; its color is green, bronzed

* A single species of *Rana* only is found in South America.

with olive, and with dusky blotches. (2) The shad frog is

The Common Frog (*Rana temporaria*).

recognizable by its eye-like spots, which are dark brown bordered with yellow, and in allusion to which it is also called leopard-frog; the name shad-frog has been derived from its appearing in spring nearly at the same time as the shad. (3) The wood-frog may be known by its reddish-brown color, and by a dark bridle-like stripe passing from the snout and through the eye backward: it is most abundant in woods, and is very closely related to or identical with the *Rana temporaria* of Europe. (4) The marsh frog has about four to six rows of quadrate dark spots on the back and sides, and is also called the tiger or pickerel frog. (5) The spring frog is of a bright green color, with a yellow throat, and with a very large tympanum; it is one of the most common species, and one of the most esteemed as a delicacy for the table. Although not universally popular, there is an increased tendency to the appreciation of the frog as a delicacy for the table in this country, as there has long been in France; and in most of our large cities frogs can be obtained in select places in proper season. The abhorrence which is sometimes expressed respecting the use of frogs' flesh for the table can be only due to irrational prejudices, for it certainly yields a most tender and delicate morsel. In France, as is notorious, as well as in Southern Europe, it is generally a favorite article of diet, and forms the object of an extended industry. Frog-geries abound in which the animals are raised and kept. In the materia medica frogs' flesh was formerly quite popular among European physicians as an antiscorbutic. The common frogs have long been favorite subjects for experimentation among physiologists, the delicacy of their tissues enabling the circulation of the blood to be readily perceived; they are also celebrated in connection with the history of galvanism, Galvani having been led to his discovery by the consideration of the phenomena exhibited by them when experimenting with the common European species. THEODORE GILL.

Frog Fish. See ANGLER.

Frog-Spawn, properly the name of the well-known gelatinous mass enclosing the ova of frogs; but the name is extended in rural districts to some of the large green fresh water Algæ, which form slimy masses in streams and ditches—notably to those of the family Batrachospermaceæ, of which *Batrachospermum moniliforme* is a very common species both in Europe and the U. S.

Frog-Spittle, Cuckoo-Spit, or **Toad-Spit,** a frothy substance often seen on grasses, weeds, and even trees, very closely resembling human saliva in appearance. On examination it will be found to contain one or more grubs, the larvæ of various leaf hoppers—insects of various families of the Hemiptera. In Europe the larva of *Cicada spumosa* is a very common cause. In the U. S. the genera *Helochara* and *Aphrophora* are among the froth-producers. This froth consists of the sap of the plant. These insects are great pests to vegetation, and very numerous in species. The popular names for this frothy substance arose from old and entirely unfounded fancies.

Froissart (JEAN), b. at Valenciennes, France, in 1337; was destined by his father for the Church, and took holy orders, but falling in love with a lady of high rank, went to England, where he was (1361–66) secretary and chapel-clerk to Queen Philippa, a liberal patroness. He travelled much in Flanders, France, Scotland, Italy, and other countries; became canon of Chimay 1390. The time of his death is not known. He compiled for the duke of Brabant a collection of ballads and songs called *Meliador*, but is chiefly memorable for his immortal *Chronicles*, the most important written historical monument of the Middle Ages that we possess. Froissart's *Chronicles* are of great value, but are not so much an accurate history as a faithful picture of his times, and of their places, customs, and people. They range over all Western Europe, for Froissart, a churchman and scholar, living in unsettled times before the feeling of nationality had been well developed, is quite destitute of patriotic feeling. The favorite English version of this fine old author is that of Johnes (1803–05, often reprinted), but the old translation by Lord Berners (1523–25) is correct and much more spirited. Buchon's edition (1824) is the best of the original French text.

Frome, town of England, in Somersetshire, on the Frome. It has considerable manufactures of broadcloth and cassimeres. Pop. 9752.

Fromentin (ELIGIUS), b. in France, became a priest and Jesuit; came to the U. S., married and settled in New Orleans; was U. S. Senator from Louisiana 1813–19; became a judge of the New Orleans criminal court in 1821, and was appointed soon after U. S. judge in West Florida during Jackson's governorship; resumed legal practice in New Orleans, and d. there Oct. 6, 1822.

Fromentin (EUGÈNE), b. at La Rochelle, France, Dec., 1820; has attained distinction as a painter of well-executed Algerine and Arabian scenes, remarkable for brilliancy of color. Author of *Dominique* (1863), a novel, and of several other volumes, chiefly descriptive of his travels as an artist. D. at Paris Aug., 1876.

Fronde [Fr. for a "sling;" the name was probably given from an incident in a street-fight early in the struggle; according to others, from the calumnious squibs and slanders hurled by the anti-Mazarin party at the court], a faction of French nobles who opposed Cardinal Mazarin during a part of the minority of Louis XIV. The breaking up of the feudal system and the policy of Richelieu had finally led to a centralized despotism, against which (Aug. 27, 1648) the people of Paris rose in arms. In the October following the popular demands were acceded to, but the malcontent nobles seized the opportunity of trying to overthrow Mazarin and regain their old power. The struggle lasted from 1649 to 1652, and as far as military results were concerned were favorable to the nobles, and they had the grandest opportunities for making a great constitutional reform; but as they had no strong leadership, no fixed principles, and no definite object except self-aggrandizement, Mazarin in 1653 snatched from his mutually jealous and strangely frivolous enemies the fruits of their victory. The war of the Fronde was one of the most ridiculous and useless contests in history. (See *Les Mazarinades*, a large collection of lampoons on the court; ST. AULAIRE, *Hist. de la Fronde*, 1841; the histories of BARANTE and FITZPATRICK; COUSIN, *La Fronde en Paris*.)

Front'al Bone [from the Lat. *frons, frontis*, the "forehead"], in the vertebrate skeleton, one of the most important bones of the skull. It is regarded as representing the neural spine of the second cephalic vertebra. In man it has two parts, a vertical and an orbito-nasal portion, the former the bony portion of the forehead, the latter forming part of the roof of the orbits of the eyes. It is developed from two centres, and at birth is divided vertically into two lateral halves by the frontal suture, which sometimes persists through adult life. The vertical part consists of an outer and inner hard layer, separated to some extent by a diploë, a soft cancellous tissue furnished with large veins. Just above the eyes the diploë is wanting, and its place is occupied by the frontal sinus, a cavity in two parts, each of which communicates with the nasal passages.

REVISED BY WILLARD PARKER.

Frontenac, county of Ontario, Canada, bounded on the S. by Lake Ontario and the river St. Lawrence. Area, 323 square miles. It is traversed by the Rideau Canal and the Grand Trunk Railway. Cap. Kingston. Pop. 28,717.

Frontenac, de (LOUIS DE BUADE), COMTE, b. in 1621 in France; served in the army in Italy, Flanders, Germany, and Candia, and received many wounds. In 1672 was appointed governor general of Canada by Louis XIV., having already won a wide renown for valor. He was a relative of Madame Maintenon and the husband of a court beauty, who used her influence against him. His first governorship of New France (1672–82) was marked by the building of Fort Frontenac (now Kingston, Ont.) and the expeditions of La Salle, Marquette, and Joliet; but Frontenac, a man of great abilities, was hampered by the action of

his intendant and of Laval, bishop of Quebec, so long the virtual ruler of Canada. He was accordingly recalled, but in 1689, Canada being almost ruined under his successors, he was sent out again. He now punished the Iroquois terribly, destroyed, through his lieutenants, the English marine in Hudson's Bay, ravaged Newfoundland, terrified all the English-speaking coast-towns as far S. as New Jersey, captured Pemaquid, Casco, Salmon Falls, Schenectady, and in 1690 repulsed the forces of Phips before Quebec—an event which Louis XIV. commemorated with a medal. This able soldier d. at Quebec Nov. 28, 1698.

Frontier′, county in the S. S. W. of Nebraska, watered by branches of the river Platte. Area, 972 square miles. Cap. Stockwell.

Fronti′nus (SEXTUS JULIUS), a Roman writer, distinguished also in civil and military affairs, was b. about 40 A. D., though the exact year is not known. His first appearance in public life was as *prætor urbanus* in A. D. 70, under Vespasian. Tacitus, in his *Life of Agricola*, tells us that he was appointed to the chief command in Britain, and that he conducted himself with ability, subduing the warlike tribe of the Silures. He was succeeded by Agricola, and on his return to Rome escaped the suspicions and jealousy of Domitian by living a retired and studious life. He was twice honored with the office of consul, and in A. D. 97 was appointed by Nerva *curator aquarum* (superintendent of aqueducts), to which appointment no doubt we owe his most valuable publication. He died probably in 103. Frontinus has left us a work on military tactics, presented in the form of a series of anecdotes of distinguished kings and commanders, entitled *Strategematicon libri IV.* To each of the four books a brief preface is prefixed detailing the chief subject of the book. More important than this is the other extant work of Frontinus, *De Aquæductibus urbis Romæ liber*, in which he describes the construction and maintenance of those vast and expensive structures which made Rome enviable among ancient cities for its ample water-supply. Besides these, several treatises on land-measurement are attributed to Frontinus, fragments of which are contained in the collection of Agrimensores, or *Rei Agrariæ Auctores*, by Goesius (Amsterdam, 1674, 4to), and in *Gromatici Scriptores*, by Lachmann and Rudorff (Berlin, 1840–52, 2 vols.). The best editions of the *Strategematica* are those of Oudendorp (Leyden, 1731, and again 1779) and of Schwebel (Leipsic, 1772); of the *De Aquæductibus*, those of Polenus (Padua, 1722, 4to) and of Dederich, with German translation (Wesel, 1841); a new recension of the text of both works by Dederich (Leipsic, 1855). H. DRISLER.

Frontlet. See PHYLACTERIES.

Fron′to (MARCUS CORNELIUS), a distinguished public speaker and rhetorician, was b. at Cirta, in Africa, in the reign of Domitian or Nerva. Having removed to Rome, he soon attained high distinction as a teacher of eloquence, and won the special favor of Hadrian and Antoninus Pius, by whom he was entrusted with the education of the imperial princes, M. Aurelius and L. Verus. In 143 he held for a short time the office of consul, but he declined, on the plea of ill-health, the charge of a proconsular province. He was held in high honor by his contemporaries, and ranked among the most distinguished orators. He even had a body of followers, who took him as their model, and were called after him, *Frontoniani*. He d. about the year 168. Until 1815 no remains of Fronto were known to exist, except a doubtful treatise, *De Differentia verborum*. But in that year Mai discovered in the Ambrosian Library at Milan a palimpsest MS. which contained a number of the letters of Fronto, which he published. Subsequently, being transferred to the Vatican in Rome, Mai discovered there more than a hundred additional letters, a portion of the correspondence of Fronto with the emperor Antoninus Pius and with his former pupils, Marcus Aurelius and Lucius Verus. He issued a new edition of his work, in which these were incorporated (Rome, 1823; reprinted 1846). A complete edition of the writings of Fronto, founded on a new recension of the MSS., was published by S. A. Naber (Leipsic, 1867). H. DRISLER.

Front Roy′al, post-v. and tp., cap. of Warren co., Va., is situated at the base of the Blue Ridge, on the line of the Manassas branch of the Orange Alexandria and Manassas R. R. It contains 4 churches, 2 hotels, some 10 stores, sumac-mills, and a large steam-tannery, and has 1 religious and 1 secular newspaper. In its vicinity are large flouring-mills, steam-tanneries, and spoke and rim factories. Pop. of v. 705; of tp. 1872.

CLARK, LOVELL & BAILY, EDS. "WARREN SENTINEL."

Froschweiler. See WORTH.

Frosino′ne, town of Italy, identical with the ancient Volscian *Frusino*, about 50 miles S. E. of Rome, and is a bishop's see. Pop. 9234.

Frossard (CHARLES AUGUSTE), b. Apr. 26, 1807, received his military education at the École Polytechnique in Paris and at the school of artillery and engineering in Metz. He entered the army Oct. 1, 1827; participated as a lieutenant in the campaign in Belgium in 1831 and 1832; became a captain in 1833; distinguished himself in Algeria; was appointed adjutant to the engineering corps in France in 1837; and was in 1846 engaged in the erection of the fortifications of Paris. In 1847 he became an officer of ordnance to King Louis Philippe; took part in the siege of Rome in 1849; became a colonel in 1852; director of the department of fortification in Oran in 1853; and in Jan., 1855, he received the command of the second engineering corps of the Crimean army. He conducted the engineering operations for reducing the Malakoff, was wounded, and in May, 1855, promoted to a generalship, and received, after the fall of Sebastopol, the cross of a commander of the Legion of Honor. In the winter of 1855–56 he commanded the engineering department of the army of the Orient, and in June, 1856, he accompanied Count Morny on his embassy to the crowning of the emperor Alexander of Russia. In the Italian war in 1859 he was chief of the whole engineering department, and after the war he received the grand cross of the Legion of Honor. Shortly afterwards he was appointed to the conspicuous and influential position of governor to the imperial prince. After this active and successful career, Frossard had the misfortune in the war against Germany (1870–71), as commander of the second army corps, first to arrange the comedy of the attack on Saarbrücken (Aug. 2, 1870), and then to be thoroughly beaten out of the place on Aug. 6. He led his corps back to Metz, and participated in the battles of Vionville and Gravelotte (Aug. 16 and 18, 1870). On the capitulation of Metz (Oct. 27, 1870) he fell into German captivity. He has written *Rapport sur les opérations du 2me corps de l'armée du Rhin dans la campagne de 1870* (Paris, 1871). D. Sept. 3, 1875. AUGUST NIEMANN.

Frost [allied to *freeze;* Ger. *Frost*] properly designates frozen dew, rime, or hoar-frost, often called *white frost*, to distinguish it from *black frost*, which is the effect produced upon herbs and leaves by the freezing of their juices. The freezing of soil-moisture is popularly called frost also, and we even see in books of science such expressions as "the effect of frost on iron." Here "frost" can only mean cold weather or low temperature. Hoar-frost is frozen dew, or rather a deposit of minute ice-crystals in the place of dew, for the freezing does not follow the formation of the dew-drop. The conditions for the formation of white frost are precisely those requisite for the formation of dew (see article DEW, by F. A. P. BARNARD), except that those conditions (radiation of heat, etc.) act more powerfully on account of the lower temperature of the earth and air. The presence of considerable bodies of water diminishes frost powerfully, because water by day absorbs and by night radiates much heat. Thus, Western Michigan is rendered a good peach-region by the W. winds, tempered by the influence of Lake Michigan. Thick clouds, or even a dense smoke, will act as a blanket over the earth, and diminish or prevent the deposit of frost. The fact that low lands are usually visited by frost much earlier in the autumn and later in the spring than the neighboring hill lands is believed to be partly due to the constitution of the soils. Dark alluvial soils radiate heat the more readily. Again, the colder air settles down upon the low grounds, and the hills are more exposed to the winds, which tend to prevent the formation of dew. The hygienic effect of frost is generally salutary. Malarial fevers are favorably modified by it, and the spread of cholera and of yellow fever is usually checked at once. Some forms of milk-sickness in cows are, however, attributed to feeding upon forage which has been touched by black frost.

Frost (JOHN), LL.D., b. at Kennebunk, Me., Jan. 26, 1800; graduated at Harvard in 1822; taught in Boston and Cambridgeport, Mass.; removed in 1828 to Philadelphia, where he was a teacher until 1845. He produced a prodigious number of books, some of which had a large sale. Among these are a *Pictorial History of the World*, *Pictorial History of the U. S.*, *Lives of American Generals*, etc. D. in Philadelphia Dec. 28, 1859.

Frost (WILLIAM EDWARD), R. A., b. at Wandsworth, Surrey, England, Sept., 1810; attained distinction as a portrait-painter, but since 1839 has chiefly painted mythological pictures. In 1870 he was chosen to the Royal Academy. His *Prometheus Bound* (1839) won the gold medal of the Academy, and his *Una Alarmed by Fauns* (1843) won a prize of £100, and was purchased by the queen. D. June 4, 1877.

Frost-bite and **Free′zing** are conditions caused by the action of cold upon the animal economy. Frost-bite is local and partial—freezing is general and more or less

complete. Severe frost-bite may lead to gangrene, but the milder forms often result in nothing worse than chilblains, which are very annoying, but not dangerous. General freezing, if rapid, may result in speedy death; but more frequently the vital functions pass for a time into a state of abeyance, which may last, it is said, for some days, and then be terminated by death. In recovering frozen and unconscious persons it is held that a very slow restoration of the normal temperature is safest, apparently because sudden warmth arouses those dormant energies which demand immediate aeration of the blood, which failing, death at once ensues. It is, however, suggested that very rapid warming might, in many cases, secure all the advantages of slow restoration of temperature, and experiments on some of the lower animals seem to favor this idea.

REVISED BY WILLARD PARKER.

Frost'burg, post-v. of Allegany co., Md., is situated on a plateau between Savage and Dan's mountains, 1255 feet above Cumberland and 1792 feet above tide, immediately over the great coal-basin of Western Maryland, and 17 miles by the Cumberland and Pennsylvania R. R. from Cumberland. It has 14 churches, a large school, numerous stores and shops, 2 foundries, a fire-brick manufactory, 2 hotels, and 1 newspaper. Pop. of tp. 6131.

J. B. ODER, ED. "FROSTBURG MINING JOURNAL."

Froth Fly. See FROG-SPITTLE.

Froth'ingham (ELLEN), daughter of N. L., b. in Boston Mar. 25, 1835, devoted herself to the study of the German literature and language, and has distinguished herself by remarkably fine translations of three difficult masterpieces—Lessing's *Nathan der Weise* (1868), Goethe's *Hermann und Dorothea* (1870), in verse, and Lessing's *Laokoon* (1874). Miss Frothingham has lived and studied in Germany, but resides in Boston.

Frothingham (JAMES), b. in Charlestown, Mass., 1786; began as a chaise-painter in his father's chaise manufactory; went on from color to drawing, then to making likenesses in chalk, until he came out a painter in oils. After a little incidental instruction in preparing and applying colors, the young man of twenty entered on a professional career as a portrait painter, which, though not remunerative or eminent, was in a high degree respectable. His best patrons were in New York and Salem. His copies of Stuart's *Washington* gained for him much commendation, but his own portraits are not without decided merits in fidelity and in color.

Frothingham (NATHANIEL LANGDON), D. D., b. in Boston, Mass., July 23, 1793; entered Harvard College at the age of fourteen in the class of 1811; in 1812 received the appointment of teacher of rhetoric and oratory at Harvard; prepared for the ministry, and in 1815 became pastor of the First church in Boston; visited Europe in 1826, and afterwards in 1849; retired from the pulpit in 1850, and devoted himself to literature, living, with the exception of eighteen months abroad in 1859–60, in Boston. Dr. Frothingham was a frequent contributor to the *Christian Examiner* and other religious periodicals. A volume, *Sermons in the Order of a Twelvemonth* (1852), contains some of his most finished pulpit productions; his pamphlet discourses number fifty or sixty. He wrote many choice hymns, which are favorites with Unitarian congregations; published two volumes of *Metrical Pieces*, one in 1855, the other in 1870, all marked by refinement of sentiment and felicity of diction; and contributed to literature poetical translations from the Greek, Latin, Italian, and German. His rendering into English of the minor poems of Goethe, Schiller, Rückert, Von Zedlitz, and Von Auersperg, is considered of high excellence. Dr. Frothingham was one of our earliest students of German, and did good service in introducing the finest German thought to American readers. D. in Boston Apr. 4, 1870, after a long affliction of blindness.

Frothingham (OCTAVIUS BROOKS), third son of N. L., was b. in Boston Nov. 26, 1822; was educated at the Public Latin School; graduated at Harvard College in the class of 1843; studied theology at Cambridge; was settled in Salem, Mass., Mar. 10, 1847; removed to Jersey City, N. J., in Apr., 1855; and after a ministry of four years, in the spring of 1859 went to New York, and established the Third Unitarian society, of which he still continues pastor. Mr. Frothingham belonged to the extreme left or radical wing of the Unitarians for a time, but became at last a rationalist, and assumed the attitude of an independent preacher. From the beginning he has been president of the Free Religious Association, of which he was one of the founders in 1867, the aim whereof was the emancipation of religion from all sectarian limits, the reconciliation of faiths, and the application of the scientific method to the study of theology. This position places him outside of Christianity as a special religion, and forbids his calling himself by any particular name. Mr. Frothingham is the author of several books—*Stories from the Lips of the Teacher* (1863); *Stories of the Patriarchs* (1864); *A Child's Book of Religion* (1866); *The Religion of Humanity* (1873); *The Life of Theodore Parker* (1874); *The Safest Creed*, a volume of discourses (1874). He has published also a lecture, *Beliefs of the Unbelievers*, and upwards of 100 pamphlet sermons, besides numerous contributions to papers and magazine literature. For a year he was art-critic for the New York *Tribune*, and is a regular contributor to the *Index*, an organ of free religion printed in Boston, and representing the latest phase of dissent from the theological system of Christendom. In 1864 he translated a volume of *Essays* by Ernest Renan.

Frothingham (RICHARD, JR.), b. at Charlestown, Mass., Jan. 31, 1812; for many years a prominent Democratic legislator and journalist of Boston, Mass.; mayor of Charlestown 1851–53; member of constitutional convention of 1853; author of several historical works, mostly relating to the Revolutionary period in Mass. D. Jan. 29, 1880.

Froude (JAMES ANTHONY), LL.D., b. at Dartington, Devon, England, Apr. 23, 1818; educated at Westminster and Oriel College, Oxford, where he graduated with honor; became a fellow of Exeter College 1842; was ordained a deacon in 1845, but soon changed his religious opinions, which had been extremely High Church; published *Shadows of the Clouds* (1847), a tale, and *Nemesis of Faith* (1849), which were condemned by the authorities of the university, and he, as a consequence, lost an appointment as teacher in Tasmania. In 1850 he began to write for *Fraser's Magazine*, the *Westminster Review*, and other periodicals. His greatest work, *The History of England from the Fall of Wolsey to the Defeat of the Spanish Armada* (12 vols., 1856–70), is remarkable for the novel views taken of many of the leading characters who figured during the time of which it treats, and for the abundance of fresh material introduced. In 1869 he was made rector of the University of St. Andrew's. In 1871 he resigned the editorship of *Fraser's Magazine*, and in 1872–73 lectured in the U. S. Besides the above works he has written *The Book of Job* (1854); *Short Studies on Great Subjects* (1867); a little book on *Calvinism* (St. Andrew's, 1871); *The English in Ireland in the Eighteenth Century* (3 vols., 1872–74).

Fro'zen Wells. Certain wells in the Northern U. S. contain ice during the whole or part of the year, sometimes rendering the drawing of water impracticable. Examples are in Brandon, Vt., Owego, N. Y., Lyman, N. H., and Ware, Mass. The first is 35 feet deep, dug in 1858 through gravel and marly clay. The frozen mass of gravel is about 15 feet thick, showing itself at 14 feet below the surface. In the winter the water freezes entirely over, and in the summer the stones of the walls are lined with ice several inches thick, the temperature rarely rising above the freezing-point. At numerous localities in the same region, also in the Alps, the Jura, and the Ural Mountains, ice accumulates in rock-caverns and among the fragments at the base of precipices, sometimes sufficiently abundant to be an article of commerce. The caverns usually have two lateral openings. This causes a current of air, which evaporates the water upon the sides and floor of the cavern, thus producing congelation, since in this way an immense amount of heat is taken up into the latent state. Less ice is formed in the winter than in the summer in the caverns. At Monte Testaccio in Rome this principle is employed for the artificial manufacture of ice. It has been suggested that the freezing of water in the wells may be due to the interpenetration of the interstices of the gravel with air which has motion in one or the other direction according to circumstances, and thus removes so much heat as to freeze the water. In the Brandon example particular excavations near the well may possibly give rise to the air-currents, and deposits of clay may prevent the access of external heat. Or if the ice be not annually renewed by means of the currents, it is possible the frozen area may be a remnant of the glacial sheet which enveloped most of the northern continents during the Drift period. Under favorable conditions such masses may be preserved for thousands of years, and form a nucleus to which more frost may be added at certain seasons of the year.

C. H. HITCHCOCK.

Fructidor ("fruit month"), in the French republican calendar of 1792–1806, the twelfth and last month in the year, extending from Aug. 18 to Sept. 16. In the year 5 (1796–97) occurred the "*coup d'état* of the 18th Fructidor" (Sept. 4, 1797), in which Augereau, acting for the majority of the Directory, removed the minority from that body.

Fruc'tose, or **Fruit-Sugar** (also called **Inverted Sugar**), a mixture of equal numbers of molecules of dextro-glucose and lævo-glucose. It occurs in ripe acidulous fruits, and is produced from cane-sugar (saccharose) by the action of acids:

$$\underset{\text{Saccharose.}}{C_{12}H_{22}O_{11}} + H_2O \quad \underset{\text{Dextro-glucose}}{C_6H_6O_6} + \underset{\text{Lævo-glucose}}{C_6H_6O_6}.$$

Dextro-glucose rotates the plane of polarized light to the right 56°; lævo glucose to the left 104°; hence, a mixture of the two in equal quantities rotates to the left. As cane-sugar rotates the plane to the right, the action of acids, producing fruit sugar, is called inversion. (See GLUCOSE and SUGAR.) C. F. CHANDLER.

Fruit [Lat. *fructus*], in a wide sense, is the perfected ovary of a flowering plant, with its proper envelopes. Some fruits, like the strawberry, result from the blending of many ovaries with a fleshy receptacle. In others, as the fig, the fleshy receptacle is hollow, and the whole inflorescence, including many pericarps, is blended in the fruit. A fruit consists of the seed and its surrounding PERICARP (which see); and fruits receive various general names according to the nature of the pericarp. Thus, we have the achenium, the samara, the drupe, the pome, the berry, the sorosis, the pepo, and many other forms of fruit, of which the more important are noticed in this work under their alphabetical heads. (See FRUIT-CULTURE, by F. R. ELLIOTT.)

Fruit-Culture. *Its History.*—The first records of fruit-culture give the fig, almond, peach, orange, citron, apples, pears, cherries, plums, quinces, service-berries, gooseberries, grapes, mulberries, strawberries, currants, raspberries, and all the nuts now in cultivation. The first list of varieties contains 22 sorts of apples, both sweet and acid. The variety without kernels, of which some noise has been made lately, was then known. The pears numbered 36 varieties, summer and winter, melting and granulous or hard; peaches had only reached 4 sorts; quinces, 3; medlars and services, 5; apricots and almonds, 4 each. The plums were mostly of dry or prunic varieties, together with what we now call damsons. No white or green sweet, juicy sorts were then known. Cherries numbered 8, and among them a hard-fleshed sweet one, like that we now call bigarreau, was known, as well as the black and red. These last were probably mazzards. The sour or morello class was known. Of the olive 4 sorts are noted. In grapes no varieties are enumerated, they being then only recorded where the fig and orange were grown. The early records only state they were many, and of colors from greenish-white to black. Of mulberries they had 2 varieties of black, and of the blackberry only 1. Strawberries were so abundant in the fields that they were not cultivated. Hazel-nuts and filberts, walnuts, soft and hard shelled, were grown, but our hickory and butternut and black walnut were not then known. They do not belong to the climate from which our first record of fruit-growing is taken. Of chestnuts they had 6 sorts. The grape and the olive were the only fruit-crops grown for profit. The list here referred to gives the status of fruit-culture in about 300 or 400 of our present era. In Italy, some 200 years after the above, the peach and cherry had reached 20 varieties each, and the plum we now cultivate as green gage was known. The morello cherry had become well known. The grape was abundant, and trained upon high trellises or tall poles, connected by a few slats at the tops, and then interlaced by the vines. In the N. of Italy the pear and quince were grown to weigh from two to three pounds each. Virginia and California may to-day equal the product of 1200 years ago, but they do not surpass it. Melons were largely grown in great variety 800 to 900 years since. These, with other fruits suited to the warm climates, were more grown and esteemed than those of the temperate sections. The Romans were the first introducers and disseminators; to them France, England, etc. are indebted. In the sixteenth century the practice of hastening the ripening of fruits by laying hot limestones underneath the branches of trees and watering with hot water was known. France has grown and distributed more fruit trees than any other nation. Her nurseries amount to about 16,000 acres; her orchard-gardens, like those of the U. S., have never yet been correctly enumerated, but at a rough estimate perhaps 200,000 acres would not more than cover the number. Only the common fruits are natives of Germany, although it now grows many of the choicest, first obtained from Italy, and from which have been produced fine sorts from seeds. The S. of Germany, as a rule, is the only part suited to the finer fruits, although in sections of Austria and Prussia fruits grow as well as they do in South Germany. The apple, pear, cherry, etc. were grown there in A. D. 800, and grafting was then practised, as well as the making of wine and cider. In Erfurth, where Reichart expended his talents, fruit-growing as early as 1100 became popular, and received government protection. In 1105 a proclamation required every landholder to plant yearly at least twelve fruit trees, so that for many years from 30,000 to 40,000 trees were annually planted. The increase of fruit-culture from this time forward for some fifty years was astonishing. It then flagged, owing to wars and troubles of various sorts. The pestilence of 1683 was one of the agents in checking vine-culture especially. Russia has done little in the growing of fruits in the open air, although apples, some of fine quality, are produced, and a few pears and cherries; these are mostly around Moscow and St. Petersburg. The cranberry, the currant, and the quince are grown in certain sections, and some varieties of the grape are grown profitably on the banks of the Pruth, and at or near Soudak in the Crimea, where the prospect is that the grape can be grown so successfully that not only the fruit, but superior wines, will be abundant for consumption. Upon the banks of the Molotschna, which falls into the Don, grapes are grown, and the wines from them appreciated. Poland, like Russia, has to rely mainly upon the apple, pear, and currant, and can claim little for outdoor hardy fruit-growing. Spain, where more varieties of fruits can be grown than in any other territory, deserves little credit on account of progress; either everything grows so readily that care and labor are unnecessary, or the climate takes from the people all desire of exertion for improvement. The only work she has ever issued touching horticulture in Spain was in 1546. Some of the finest wines of the world are made in Spain. Greece can grow almost all varieties of fruits, and abounds in peaches, olives, grapes, etc. Turkey, in the vicinity of the Bosphorus, is fine for fruits. The native fruits of the British Islands were of a poor nature, and the improved varieties were introduced by the Romans. England had no fruit of value until the close of the tenth century, and then little besides the grape. About the first work touching fruits was in 1500, but in 1521 appeared a work by Arnold treating of grafting, planting, and altering of fruits. In 1557, Tusser gave a list of fruits, enumerating nearly every species, but speaks hesitatingly of the success of all but a few when grown in the open air. In 1629 was the first English record of varieties in cultivation, and was by Parkinson, but many of them were never grown in the open air. He enumerated 58 sorts of apples, 64 of pears, 61 of plums, 21 of peaches, 5 nectarines, 6 apricots, 36 cherries, 23 grapes, 3 figs, besides quinces, medlars, walnuts, etc. The covering of melons, while ripening, with straw at night, as now practised in sections where the days are clear and warm and the nights cool, was advised by him. Scotland and Ireland at the same period showed about the same progress as England, but rarely grew others than apples, pears, cherries, gooseberries, currants, etc., counted as hardy fruits. The orchards, nurseries, and commercial gardens of the British Islands perhaps equal those of France, and may be summed up as comprising most of the hardy fruits, while the tender sorts, as peaches, figs, etc., are mostly grown under artificial protection. With the various sections, leaving what we term the British Islands above noted, we have Asia, Asia Minor, and Persia, but we find nothing relating to fruit-growing that shows any idea other than to eat of what Providence has given for their healthful support. The Chinese in early times grew few fruits but such as were natural to their climate—oranges, mangoes, etc. At the present time they grow nearly all varieties of fruits. North America, including Canada and the U. S., and even Mexico, had most of its fruits introduced by the French and the Romish missionaries. Some few apples, pears, etc. were brought by the Pilgrims who landed on the New England coasts, and others, as peaches, etc., by the early Virginians. The monks or Catholic priests introduced the European vine, although the wild varieties were all through the country, as well as wild cherries, plums, apples, etc. The French may be said to have been strictly the pioneers in apple and pear growing, and to-day many of the varieties standing in the front rank date their introduction back to the French; and the basis of fruit-culture in this country may be said to date from about 1650. Most of the grapes now grown in California were introduced by the Jesuit fathers, and it may be said that wherever the Romish missionaries settled the grape was a specialty with them. The earliest of their works as to the culture and introduction of the vine in any country is near A. D. 800. The first record of commercial nurseries for the growth and sale of trees in the States was about 1798, and they numbered four or five; now (1874) the number of cultivators may be estimated at 500, who occupy, say, 500,000 acres. The estimate of the orchards of the country can be only an estimate, as there is no definite record of even any one State or Territory. The writer, from the best records he can find, would place them at, say, 900,000 acres—this to include all the fruits. In the first obtainable list of fruits in the U. S. apples numbered 133; apricots, 6; cherries, 15; nectarines, 5; peaches, 38; pears, 66; plums, 18. This list was made in 1798, and we find little change, nor any list of grapes or the small fruits, until after 1815, when

the culture of fruits became a feature of interest to every intelligent cultivator of the soil.

South America, with a climate of great capabilities for the growing of fruits, has done but little. There is hardly a fruit but can be grown there by merely planting, but the people are too languid and devoid of refinement to improve and cultivate when the rough natural products of the country supply their wants. The vine and the peach, with the olive and orange, are the principal cultivated fruits. The history of fruits in the West Indies and in Australia discovers the fact that in the former only tropical fruits are successful, while in Australia almost any fruit can be grown successfully, but those of the northern temperate climates, like our Middle States, cannot be grown with the flavor, aroma, and keeping qualities that they have here. The lists of fruits and dates already given are those of the earliest history of which we have record, but all the nations have advanced in collections of varieties, and also in systematic knowledge of culture. France, the British Islands, and the U. S. have without doubt increased most rapidly in varieties, while Germany has produced the most new valuable pears, and the U. S. the most apples, hardy good grapes, and peaches. The lists in the books of varieties now grown give, as to their origin, one fourth of the pears, apples, plums, cherries, quinces, and peaches to England; of hardy grapes she has produced none, but of apricots, currants, and nectarines perhaps more than any other country. Germany has produced the most varieties of pears during the past 200 years, while France has grown and offered for sale more sorts of fruits than any other country except the U. S. The lists now enumerated and described in the States may be estimated as about 10 of almonds and about 2360 of apples; and besides these there are nearly an equal number of names that stand as synonyms. Of pears there are of distinct varieties about 1270, and about 1410 of synonyms, some of these latter being attached to two or more varieties. Peaches are described to the number of over 300 varieties, while the local synonyms are one-half that number. Many of the old varieties are, however, not to be found in any collection. Nectarines now number 30 varieties, with 71 synonyms. Cherries number about 230, to which there are 327 synonyms. Apricots are comprised in 50 varieties, with 74 synonyms. The list of strawberries now numbers over 300, while many have been lost or discarded. Hardy native grapes number over 300, and currants about 30.

Statistics of Orchard or Fruit-culture.—The U. S. census has since 1850 given decennial statements as to the value of orchard products for all counties in the U. S. A few States and counties have attempted to gather similar statistics, but so far nothing has been published of reliability except the statement of Michigan. That State gives, as its orchard and small fruit-crop products for 1874—

Money value	$3,537,278
The wine value, from grapes	22,015
Total	$3,559,293

Now, if we carefully study the extent of territory of each State, and its suitableness to fruit-culture, with the period in which cultivation has prevailed, we think the following may be an approximate estimate for 1873–74:

The six New England States	$6,000,000	North Carolina	$100,000
New York	7,000,000	South Carolina	20,000
New Jersey	2,000,000	Georgia	100,000
Delaware	1,500,000	Alabama	25,000
Maryland	1,500,000	Florida	25,000
Pennsylvania	3,000,000	Mississippi	20,000
Ohio	6,900,000	Arkansas	10,000
Indiana	3,000,000	Louisiana	70,000
Illinois	4,600,000	Texas	30,000
Michigan	3,559,293	Kentucky	60,000
Wisconsin	200,000	Tennessee	40,000
Iowa	150,000	Nebraska	10,000
Kansas	30,000	Minnesota	10,000
Missouri	1,500,000	Oregon	250,000
Virginia	1,200,000	California	6,000,000

The sum-total values of the fruits grown yearly in the territory of the U. S., and including Texas, we think we have carefully and moderately estimated, and it foots up $46,724,293. As before said, Michigan is the only State that pretends to give statistics of the value of her fruit products, and upon a belief that she has told the truth, we have made up our estimate of other States and Territories. In connection, it may be fairly stated that fruit-food is a part and parcel of the support of human life, sought for and eaten by all and every man, woman, and child.

Authorities.—Of those upon fruits and fruit growing we shall attempt to go back to but few outside of the U. S. Of the English authors, we note Arnold in 1521, Tusser in 1570, Knight in articles from 1795 to 1803, Bridgeman in 1720, Forsyth in London in 1821, and Ronalds in 1831. In this country, Coxe in 1817, we think, was the first; then Prince in 1828, Manning and Kenrick in 1844, Fessenden in 1828, Thomas Bridgeman in 1844, A. J. Downing in 1845 (2d ed., revised and corrected by his brother, Charles Downing, in 1870), J. J. Thomas in 1846, P. Barry in 1847, F. R. Elliott in 1853, Warder on the apple in 1867, Fuller on small fruits, Cole and Waring on general fruits, Fuller, Mead, Hurman, and Strong on grapes.

Production of Trees from Seedlings and Cuttings in the Nursery.—The production of new varieties is from seeds, taken usually from the hardiest and best varieties of their kind. Improved sorts are usually gained from seeds taken from fruit of trees of varied sorts allied in nature and standing near each other, or by artificial impregnation of the inflorescence of varieties allied to each other, but that do not naturally intermingle. The largest number of best fruits have come from nature's own commingling. The growing of seedlings of all the fleshy fruits, as apples, pears, plums, peaches, grapes, etc., is simply to gather the best seeds, and from the time of gathering to keep them packed in moist sand or moss, exposed to out-door temperature, and shaded from the sun. The same care is required with all the nut fruits. The latter should never be permitted to become dry, while the seeds of the pear and apple can be so permitted (but it is better not), and then before planting carefully soaked in tepid water until the germ starts. The best time for sowing seeds is just as the ground in spring is free of frost. Nearly all seeds should have one to one and a half inches of soil over them, and while the peach, plum, apple, etc. will grow without it, all the nut family should have light mulching over them of half-rotted leaf-mould or tan-bark. The currant, gooseberry, and grape can be grown from what are termed cuttings—*i. e.* pieces of wood of the past year's growth, having upon each three to four buds. The best season for making and planting these cuttings is in the autumn as soon as the wood and foliage are ripe. The ground is then warm, and if well prepared, the cutting placed in the ground, leaving only one bud an inch above the surface, the earth trodden hard at its base, and then drawn up loose and covered with a mulch of litter two inches deep, successful growth will be the result in spring.

Planting and Treatment in the Field.—The ground should be first carefully cultivated and made loose deeply, well enriched one year before planting. Just before planting it should be thoroughly and deeply ploughed or dug. The trees or plants, vines, etc. should be taken up carefully, and when planting make the hole so that the tree has one inch of earth above that in which it originally stood. The base of the hole should be like an inverted bowl—*i. e.* highest and rounding at the centre. The roots should carefully spread, so that no one lies upon another, and the earth should be spread and intermingled by pressure of the outspread fingers of the operator, who upon his knees on the outside of the hole should hold the tree upright with one hand and spread the roots while he mingles and presses the earth closely with the other until the roots are all covered; then the surface-soil, two to four inches deep, should be lightly spread, and never trodden upon by the foot. The firm packing of the lower roots is a guarantee that the tree will not be moved by the winds without staking, and if the base is so packed in the setting with the fingers that the earth is against every part of a root, not one tree or vine would ever die from the removal and replanting. If the planting is performed in autumn, then, as soon as the frost has penetrated two inches into the ground, there should be spread over the ground, two feet from the base of the tree, a mulch of litter, saw-dust, tan-bark, etc. If the planting is done in spring, the mulch should not be applied until heat and drought seem to require it to shade the soil around the roots from the sun; but the surface soil should from week to week be lightly raked over with a fine short-toothed iron rake. In following years it is best to keep the surface of the ground, whether orchard or vineyard, frequently stirred, either by plough or cultivation, for six to ten years. The keeping of the ground in condition for a supply of food to the trees, etc. may be done by sowing with corn, buckwheat, rye, clover, etc., and ploughing it under as soon as it reaches one foot high.

The Pruning of Trees and Vines.—Great diversity of opinion exists touching the how and when to prune trees or vines. If the operator will study nature in the pruning of fruit trees, he will note that any cutting of limbs from the time the buds start their growth in spring until they have ripened the last bud of the season creates disease of the roots, sometimes exhibiting itself in what is called canker, sometimes in blight, etc. Again, in the forming of the body, and in determining the height at which the branches should spring, we should consider *first*, the order of nature; *second*, the necessities of culture. Nature, when trees stand and grow in the open ground, where the sun and air reach all points, starts the branches from one to two feet from the

ground. This shades the foundation from the sun, and holds a balance of lever-power against high winds. The successful cultivator should heed this point when in his orchard he is required to keep the ground cultivated; and, so heeding it, should grow all the varieties propagated to make dwarf trees—*i. e.* the apple upon the paradise or Doucain stock, the pear upon the quince, the peach on the plum, etc., with branches one to two feet from the ground. The standard apple, pear, plum, peach, etc. in open field orchards should, on the other hand, have their first branches start at four to five feet from the ground. In the pruning of inner branches, and the shortening-in of such as seem to grow more than the rest of the tree, the best time is a week or two before the swelling of the buds in the spring. Where a great deal is to be done, a part may be performed as soon as the wood has ripened its terminal bud in the autumn, and the leaves begin to fall. The pruning of grapevines was commenced in this country from the methods followed with a different species of grape upon the Rhine, and from the practice common in glass structures, where variety and fine bunches are more sought for than a productive crop; but American grapes cannot be confined like the European, neither can health or longevity be maintained by following European teachings. In pruning our native grapes, as soon in autumn as the fruit and wood has mainly ripened is the time to operate. The stems to be left should be not too large nor very long, but of good medium size, well ripened to a deep rich brown; they should not be, upon vigorous vines, less than three to four feet long, and each stem should have the two or three lower buds rubbed out, leaving three to five fruiting buds upon the remainder of the stem or cane; and when vines are left four feet long and having seven or eight buds, the two lower ones should be rubbed out, and then the five left have two rubbed out at equal divisions. This done, no further pruning is needed for the year. Keep the vines from the ground by tying to wires or stakes.

Lists of Fruits for Planting.—It is not practicable to prepare lists of varieties of fruits adapted to different sections of the country, for the reason that from Maine to California no select list would be accepted or popular as a whole. As an illustration of the differences of locality, the Family apple grown in the State of New York becomes ripe in November. It originated in Georgia, and there ripens in July. In thirty and more years of experience and observation of varieties grown in nearly every State, having had them gathered and sent from time to time to note and compare, we have come to the conclusion that no list can be made complete and satisfactory unless its author describe the soil in which the fruit should be grown, its time of ripening in each section or locality, and its value as a family or market fruit. As to what varieties to plant, we say: First, prepare your ground; then, having made up your mind for what purpose you want to grow fruit, go among the growers within fifty miles of your location; compare their soil, position, and elevation with your own; ask what varieties are with the growers most successful and profitable; make notes of each reply; go home and balance up the list. In all this, however, remember that for family use there are to be planted few of a kind, while for market the value of each variety must be estimated by size, color, quality, and firmness for transportation. A medium-sized fruit, with more or less of red or golden yellow upon it, is usually the most profitable. Large, white, tender-skinned, or sweet fruits are not generally profitable.

Gathering and Keeping of Fruits.—No variety of fruit should be gathered when there is any moisture upon it. Strawberries, raspberries, and blackberries are to be gathered just when fully ripe. Peaches, if for shipment, should be left upon the trees until they are well colored and will give to the pressure of the inside of the thumb. If wanted for family use, either for the table or canning, they should remain upon the tree until they are really soft and juicy. The same holds with plums, apricots, and nectarines. These four named sorts may be counted ripe when the side next the sun is a little soft. Care should be taken in all fruits not to rub off the bloom by handling in the gathering. The best way is to hold a soft-lined basket in the left hand underneath the fruit, and with the right hand loosen it carefully at the junction of the branch and stem. The ripeness of pears is decided by the lifting of the fruit, when, if nearly or quite ripe, it will separate readily at the junction of the stem with the spur. Most if not all pears will do this, when if left upon the tree they would hang from six to twenty days, and when gathered be found decayed at the core and all their flavor destroyed. If gathered when the stem readily separates from the spur by raising, they are hard, but by laying them in a dry, cool room between layers of flannel or any woollen fabric, a few days only will ripen them into color and juiciness. The very late autumn and winter varieties should hang upon the tree until near the time of a sharp frost. They should then be gathered, and each pear wrapped in soft paper, packed in boxes four to six inches deep and holding each two tiers, or about a peck, then placed in a cool, dry room, and kept just above frost. Many varieties now carelessly and hastily ripened and sold in October and November can be kept until December and March. The gathering of early-ripening summer apples is done when a soft jar of the limb causes them to drop from the spur. The later-ripening summer varieties, as well as the early varieties of autumn, should be gathered as soon as they show the color belonging to them, and on opening are found with dark-brown seeds. So gathered, and kept in a cool, dark, airy place, they will remain good a long time. The late fall apples and the early winter sorts will do to gather at about the same time, or say as soon as the seeds show a brownish-black color. They should be kept separate, and examined twice a week. As soon as a moisture appears upon any fruit, it should be taken out, wiped dry, and disposed of. The best winter-keepers should be gathered just before severe frosts. They should be laid carefully in barrels or shallow boxes as gathered from the tree, the barrels or boxes stacked upon rails or bars, to keep them from the ground, then covered with boards to keep off the rain, when usually they may be left without injury until midwinter.

F. R. ELLIOTT.

Fruit'land, tp. and post-v. of Muskegon co., Mich. Pop. 228.

Fruit'port, post-v. of Muskegon co., Mich., on Spring Lake, at the mouth of Grand River, 5 miles E. of Lake Michigan, on the Chicago and Michigan Lake Shore R. R., 116 miles from Chicago. It is in the great fruit-region of Michigan, has a magnetic mineral spring, and is a place of summer resort. It has fine hotel accommodations.

Fruit'ville, tp. of Currituck co., N. C. Pop. 600.

Fry (BENJAMIN ST. JAMES), Methodist clergyman and journalist, b. June 16, 1824, studied at Woodward College, O.; joined the ministry in Ohio Conference in 1847; served as chaplain in the U. S. army from 1861 to 1864, and was chosen by General Conference to be editor of *The Central Christian Advocate*, St. Louis, in 1872. *Lives* of Bishops McKendree, Whatcoat, C. Roberts, and *Property Consecrated*, a prize essay, were written by him.

Fry (CARY H.), b. in Kentucky; graduated at the U. S. Military Academy in 1834, entering the 3d Infantry as brevet second lieutenant; resigned in 1836 and practised medicine, but on the outbreak of war with Mexico aided in raising the 2d Kentucky Volunteers, and was appointed its major. In the battle of Buena Vista the regiment performed distinguished service, and upon the fall of its colonel and lieutenant-colonel, Major Fry was left in command. His regiment being disbanded June, 1847, he resumed the medical profession until 1853, when he was appointed a paymaster in the army, and for five or six months in 1862 was acting paymaster-general. For twenty years he did faithful service, and was deputy paymaster-general and brevet brigadier-general U. S. A. at the time of his death, which occurred at San Francisco, Cal., Mar. 5, 1873. G. C. SIMMONS.

Fry (ELIZABETH), daughter of John Gurney, and wife of Joseph Fry of London, was b. at Bramerton, Norfolk, England, May 21, 1780; was bred up a Friend, and under the ministrations of William Savery, an American Quaker, she in 1798 became awakened to a new religious life; was married in 1800, and then resumed her former habit of visiting the poor and sick, afterwards extending her attention to seamen, prisoners, outcasts, and the vicious classes, not only in London, but in all parts of Great Britain and Ireland, and later even in many continental countries. In 1813 she became an occasional preacher, and notwithstanding the great extent, importance, and success of her benevolent labors, she found time to train with care and thoroughness a large family of her own. She d. at Ramsgate Oct. 12, 1845. (See her *Memoirs*, by T. TIMPSON, 1846; by her daughters, 1847; by S. CORDER, 1853.)

Fry (JAMES B.), an American officer, b. Feb. 22, 1827, in Carrollton, Greene co., Ill.; graduated at the U. S. Military Academy 1847; was commissioned as brevet second lieutenant in the Third U. S. Artillery, and joined it in the city of Mexico during the Mexican war; served as assistant instructor of artillery at the Military Academy in 1847, and again in 1853–54, and as adjutant of the Military Academy 1854–59; appointed assistant adjutant-general 1861; chief of staff to Brig.-Gen. McDowell during his campaign of 1861, taking part in the first battle of Bull Run; as chief of staff to Maj.-Gen. Buell in 1861–62, taking part in the battle of Shiloh, the advance upon and siege of Corinth, the operations in Northern Alabama, and the battle of Perryville; provost marshal-general of the

U. S. (brigadier-general) from 1863 to 1866 under enrolment act of 1863, passed to enforce military service after the system of voluntary enlistment had proved inadequate. As provost marshal-general he put into the army by conscription, substitution, and voluntary enlistment 1,120,621 men; arrested and returned to the army 76,562 deserters; made an exact enrolment of the national forces, showing that there remained in the country liable to conscription, but not called out, 2,254,063 men; and collected, under a money-commutation clause of the enrolment act, $26,366,316.78. His *Final Report of the Operations of the Bureau of the Provost Marshal general of the U. S., from the commencement of the business, Mar. 17, 1863, until the Bureau terminated by law, Aug. 28, 1866,* is published in parts i. and ii. as a Congressional document. Promoted through various grades to lieutenant-colonel in the adjutant general's department and brevet major-general U. S. army; served since 1866 as adjutant-general of the military divisions of the Pacific, the South, and the Atlantic. G. C. SIMMONS.

Fry (WILLIAM HENRY), an American journalist and composer, b. in Philadelphia Aug., 1815, son of Wm. Fry, proprietor of the Philadelphia *National Gazette*. At an early age the musical talent of the son was manifested, and in 1835 his first orchestral compositions, consisting of four overtures, were performed by the Philadelphia Philharmonic Society, and an honorary medal conferred by it upon the author; became associated with his father's paper in 1839, and editor of the Philadelphia *Ledger* 1844. His first opera to be produced entire was *Leonora*, performed in Philadelphia in 1845, an Italian version of which was given in New York in 1858. From 1846 to 1852, Fry resided in Europe, principally in Paris, and was engaged as correspondent to several leading American journals. Returning to America in 1852, he delivered that year a course of lectures upon the history of music, illustrated by the symphonies *The Breaking Heart* and *A Day in the Country*, composed for the occasion; these, with others of his compositions, were performed by the celebrated band of M. Jullien in his concerts. He also composed a *Stabat Mater* with complete scores, vocal and orchestral, and many unpublished pieces. Upon his return from Europe he joined the editorial staff of the New York *Tribune*, where he continued until his death, which occurred Dec. 21, 1864, at Santa Cruz, West Indies, where he had gone for the benefit of his health. G. C. SIMMONS.

Fryeburg, tp. and post-v. of Oxford co., Me., on the Portland and Ogdensburg R. R., 49 miles N. W. of Portland. It has an academy, and manufactures of leather, carriages, etc. Pop. 1507.

Fryeburg Academy Grant, tp. of Oxford co., Me. Pop. 38.

Fryx'ell (ANDERS), a celebrated Swedish historian, was b. at Hesselskog, Dalecarlia, Feb. 7, 1795, and studied philosophy and theology at the University of Upsala. From 1822 to 1836 he was director of one of the most prominent educational institutions of Stockholm, and in 1824 he wrote a grammar of the Swedish language, which is used in all the higher schools of the country. In 1836 he was appointed provost of North Wermland, an ecclesiastical position in the Lutheran Church intermediate between minister and bishop; but in 1847 he resigned this office in order to devote himself entirely to historical studies. History is cultivated in Sweden with great interest and with superior talent, but among the many able and even brilliant productions which this branch of Swedish literature contains, Fryxell's *Berättelser ur Svenska Historien* (34 vols.) occupies a foremost place. In the Scandinavian countries this book is much read and highly esteemed, and parts of it have been translated into German and French. Its style is fluent and lively, its narrative brisk and graphic, and as the author has made very extensive studies of archives not only in Sweden, but in Poland, Prussia, and Denmark, his work is exceedingly rich in details at once new and authentic. In his leading views he forms an opposition to Geijer, who may be considered as the historian of the democratic party. In the Swedish history the aristocracy has played the most conspicuous, and at times a most brilliant part, but although it has kept itself tolerably free from such crimes as have tarnished the reputation of the French and Polish aristocracies, it has in the last century been the subject of very severe attacks from the historians of the democratic party. These attacks occasioned Fryxell to write his book *Dur aristokrat-fordömandet in Svenska historien* (4 vols., 1845–50), in which he defends the Swedish aristocracy, without defending the crimes it may have committed or the general injustice of its political preponderance. The book gave rise, nevertheless, to a very fierce contest between the two historical schools, which spread from science into politics, and from politics into personalities. CLEMENS PETERSEN.

Fu'ad Pa'cha, a Turkish statesman, a son of the poet Izzet Molla Kischedji-Zadek, was b. at Constantinople in 1814. In 1840 he was secretary to the embassy in London, and then, until 1848, interpreter in the ministry and commissioner-general in the principalities of the Danube. In 1849 he became minister of the interior, and from Aug., 1852, to Mar., 1853, from May, 1855, to July, 1857, and in Jan., 1858, he occupied the position of minister of foreign affairs. He participated as a plenipotentiary in the Conference at Paris. In 1860 he punished the Druses and Mohammedans for their persecution of the Christians, and in Nov., 1861, was appointed grand vizier. In Feb., 1862, he took charge of the finances, and in Feb., 1867, was appointed minister of foreign affairs for the fourth time, while his friend, Aali Pacha, was appointed grand vizier. Fuad Pacha was a man of French education and tendencies, a great admirer of France and Napoleon III., and the chief support of the reform party in the Turkish empire. In 1868 he induced the sultan to make a tour in Western Europe and to visit the courts of Paris, London, and Vienna, in order to make him see with his own eyes the advantages of European civilization. In his political activity he was very successful, especially in crushing the revolution of Crete in 1867 under very difficult circumstances, as the sympathy of the great powers was very doubtful. But at the end of 1868 symptoms of a fatal disease showed themselves in his constitution, and he d. in Nice, France, Feb. 3, 1869. He wrote a grammar of the Turkish language, which has been translated into several languages. AUGUST NIEMANN.

Fucaceæ. See SEA-WEEDS.

Fu'ca, de (JUAN), a Greek navigator whose real name was APOSTOLOS VALERIANOS, a native of Cephalonia; was many years in the Spanish service, and in 1592 discovered the channel known as the Strait of SAN JUAN DE FUCA (which see). This he professed to consider a passage joining the Atlantic and the Pacific. D. in Zante in 1602.

Fuch'sia, a genus of dicotyledonous plants, belonging to the natural order Onagraceæ, and named after Leonhard von Fuchs, a celebrated German botanist (b. in Suabia in 1501, d. in Tübingen, where he was a professor, in 1566). The popular name of the genus is "ear-drop," from the appearance of the pendulous flowers. These are very showy, and of a red, violet, or rose color in their native state. They sport and hybridize easily, and hence result the numerous varieties known in floriculture. Those with white or cream-colored tints are the most highly prized. The tube of the calyx is showy in appearance, like the corolla, and is extended much beyond the ovary. It is bell-shaped or tubular, with four spreading lobes. The petals are also four in number, and the stamens eight. The style is long and thread-shaped, and surmounted by a club-shaped stigma. The flowers are on axillary peduncles. The plants are mostly smooth, with opposite or whorled leaves. They are either tender shrubs, climbers, or trees, natives of South America as far as Fuegia, and also of the southern parts of North America; and New Zealand has some native species. Their best known habitat is the Andes of Chili and Peru. The species now in cultivation have been so much changed by art that it is often difficult to recognize their origin. They may be divided into short and long flowered and panicled fuchsias. The plant forms a berry which is sweet or only pleasantly acid, and which is eaten in the countries where it is native. A black dye is said to be formed from the wood in Chili. Fuchsias are easily propagated by cuttings, and have become so abundant that they are within the reach of even the poorer classes, in whose windows or small garden-plots they are often seen growing. They thrive in a light rich soil. They grow well in the open air in the summer time, but in the northern U. S. have to be housed in winter. There is no class of plants except the geraniums with which the gardener has been able to do so much. There appears to be no limit to the curious freaks of color which they may be made to assume, and it is even said that they occasionally become striped. They are familiar to all in conservatories and in floral ornamentation. W. W. BAILEY.

Fuch'sine, aniline red. See ANILINE COLORS, by PROF. C. F. CHANDLER, PH. D., LL.D., M. N. A. S.

Fu'cino, or **Cela'no** [Lat. *Fucinus*], **Lake and Tunnel of.** This lake lies about 50 miles eastward of Rome, at the height of 2200 feet above the sea, in a mountain-basin in the Apennines having no known natural outlet. The ancient and mediæval accounts of the dimensions of Lake Fucino and of the fluctuations of its level are conflicting; but though its waters were undoubtedly partially carried off through natural conduits or fissures or porous strata in the subjacent rock, its depth and superficial extent have at all times been subject to great variation arising chiefly from the varying humidity or dryness of the seasons. In 1816

it covered 42,000 acres, with a maximum depth of 75½ feet; in 1835 its area was but 33,000 acres, its greatest depth 34 feet. The occupation and cultivation of the debatable zone, of about 9000 acres, between these extremes was of course attended with risk of loss, and at low water the freshly bared soil sent up miasmatic exhalations prejudicial to the healthfulness of the adjacent country. To obviate such evils, and to gain an addition of fertile soil for agricultural purposes by permanently reducing the lowest known level of the lake, Julius Cæsar contemplated the excavation of a tunnel under the mountain-ridge on the western side of the basin to discharge the superfluous water into the river Liris, now called the Garigliano, the bed of which is 62 feet lower than the bottom of the lake. The work was actually commenced by Claudius, and substantially completed after eleven years of labor. The length of the Claudian tunnel was 18,506 feet, or rather more than 3½ miles, with an inclination of about $\frac{1}{1000}$, and a cross-section measuring 102 square feet, admitting a delivery of 424 cubic feet to the second. The tunnel was admirably engineered, and, with the important exception of the exclusive use of the chisel instead of blasting, the methods of excavation, as appears by ancient bas-reliefs and by utensils occasionally found along the line, much resembled those employed at the present day, though the shafts, both vertical and oblique, for extraction, access, and ventilation, were much more numerous than it would now be found economical to sink. The execution of the work by the constructors, as is now ascertained, was most unfaithful, and though the emissary appears to have served its purpose for some time, it was soon obstructed and fell into total decay. Indeed, the fact that a species of fish peculiar to the lake was never found in the Garigliano until after the recent reconstruction of the tunnel, has led some to question whether the Roman gallery was really ever opened at all. At various subsequent periods attempts were made to restore the tunnel, but it does not satisfactorily appear that anything was effected until the present generation, when, by the enterprise and liberality of Prince Alessandro Torlonia of Rome, the entire line has been rebuilt at a cost of more than $6,000,000, and on a far grander scale than that of the ancient imperial work. The new tunnel, which is designed not simply to lower, but to drain the entire lake, follows the original course, and, though at a somewhat lower level, includes the entire ancient channel, every vestige of the Roman tunnel having been necessarily removed in excavating the new. It is constructed with the utmost solidity, being everywhere lined with a thick revetment of cut stone; its cross-section measures 215 square feet, allowing a discharge of 2400 cubic feet to the second; and, as its axis is lower than that of the Claudian emissary, and the bottom of the lake has been considerably raised in later ages by wash from the shores, the new tunnel is longer than the old by 2200 feet. Hence, its total length falls little short of 4 miles. From the entrance of the emissary a canal 8 miles long and 62 feet wide at bottom, requiring 4,000,000 cubic yards of cutting, has been excavated to the deepest part of the lake, which will soon be drained to the bottom. The technical difficulties arising from various causes—among which the infiltration and pressure of the water, and especially the loosening and shattering of the earth and rock along the line by the falling in of the old tunnel, deserve particular notice—were extreme, and it may be doubted whether modern engineering has anywhere triumphed over more formidable obstacles, whether as regards intrinsic difficulty or danger of life to those engaged in the execution. To the honor of Prince Torlonia, at whose sole cost this stupendous enterprise has been accomplished, it ought to be mentioned that in encouraging the laborers by his actual presence in the tunnel at the most dubious and perilous crises of the work, he has displayed a personal heroism even more admirable than the munificence which has marked his financial arrangements. The original engineer of the Torlonian emissary was De Montricher, the designer and constructor of the celebrated aqueduct of Marseilles, after whose death worthy successors were found in Bermont and Brisse. (See Kramer, *Der Fuciner-See*, 4to, Berlin, 1839; Leon de Rotrou, *Prosciugamento ad Lago Fucino*, 8vo, Vienna, 1871.) George P. Marsh.

Fucus. See Sea-weeds.

Fu'cusine, an organic base, $C_{15}H_{12}N_2O_3$, obtained from sea-weeds.

Fu'el [Fr. *combustible*; Ger. *Bernstoff*]. Every substance is a fuel which may be used for the generation of heat by its combustion in air. Many chemical reactions evolve heat from factors which are in no proper sense fuels; *e. g.* lime slaking with water, sulphuric acid mingled with water, quicklime drenched with sulphuric acid, and other like cases, evolve much heat from molecular motion in substances wholly incombustible. Properly speaking, only carbon and hydrogen, and the compounds of these two factors with each other, and with oxygen, nitrogen, etc., are fuels. This classification includes all the forms of coal, coke, charcoal, wood, turf, oils of every kind, and combustible gases, such, for example, as escape from artesian borings in oil-bearing and saliferous strata. It excludes sulphur, whether free or evolved from the roasting of ores, although this element is practically utilized as a source of heat in some chemical and metallurgical processes, as in burning sulphur to form oil of vitriol.

With the exception of animal oils (and even these remotely form no exception), all descriptions of fuel are of vegetable origin. This assumes the vegetable origin of all forms of fossil fuel, which is now generally admitted. However various the forms conferred by the processes of life, we find by analysis only carbon, hydrogen, oxygen, and nitrogen, with water, and variable but generally very small quantities of mineral elements. Submitted to ultimate analysis, we obtain only carbonic acid, water (with sometimes traces of ammonia from the nitrogen), and an ash. By the proximate analysis of organic bodies—*e. g.* in their destructive distillation, as in the process of coaling of wood and coking of bituminous coals—we obtain combustible gases, as marsh-gas, heavy carburetted hydrogen, carbonous oxide, and free hydrogen, carbonic acid, acetic acid, and free carbon, which represents by its skeleton the form of the wood or other fuel used in the process.

Fuels differ very greatly in the amount of volatile matters they contain or which are produced from them in the process of combustion. Thus, wood and turf contain a large percentage of free water, which is driven out or evaporated during combustion, while, in common with bituminous coals and lignites, they evolve also a large volume of combustible gases, tar, and other pyrogenic products. Such fuels burn with abundant flame, often with smoke, from imperfect combustion, and are well adapted to the generation of steam, the production of illuminating gas, and are preferred in many metallurgical processes. On the other hand, anthracite coal—of the harder variety—coke, natural or artificial, and charcoal from wood, burn with but little flame and no smoke, evolve little or no watery vapor, and from their firmness under the weight of a load and the high temperature they evolve are specially adapted to smelting iron and other metals, and to the production of a steady, intense, and long-continued heat for any purpose. Fuels also differ much in the amount of *ash* left by their combustion. In a few cases the ash is less than 1 per cent. of the weight of the fuel (*e. g.* albertite). The best coal yields 5 per cent. of ash or thereabouts, while many more contain 10 or even 20 and more per cent. of incombustible mineral matter. The presence of foreign matter of an incombustible nature in fuel is a loss of useful effect, not only by reducing the actual amount of carbon, etc., but in that it requires a certain amount of fuel to fuse the ash into a slag, which then encumbers the fire by clinkers. Water is another foreign element which greatly reduces the value of fuels. The common experience of the superior excellence of well-seasoned wood over green or recently cut wood is a familiar example. Water not only impedes combustion by reducing its temperature, but a large amount of heat is removed and rendered useless in converting the water into vapor. Furnaces have been constructed, however, for the purpose of consuming wet fuel, such as tan-bark, bagasse of sugar-cane, etc., in which, by an ingenious arrangement of parts, a high temperature and intense combustion are maintained, even when very wet fuel is used. One of these will be noticed hereafter. Even coal contains some moisture, and the varieties of lignite a much larger amount, while even well-dried wood retains 20 per cent. of water. Fuels containing oxygen also produce water in the act of burning, thus consuming a further quantity of heat. Even the hydrocarbon gases distilled in the combustion of coal are produced at the expense of a certain number of units of heat. It has therefore been asserted—and is often assumed to be true—that the total economical or useful effect of a fuel may be calculated from the known quantity of fixed or non-volatile carbon which it contains. It is, however, demonstrable that this statement, however theoretically correct, is not supported by experiment, as we shall see farther on.

The value of the Pennsylvania anthracite (see Anthracite) over all other coals as an agent for the production of high heats, especially in the high furnace and in the reduction and smelting of metals, is now generally admitted. The superior evaporative power of anthracite was first demonstrated by the researches of Prof. Walter R. Johnson in 1844, by an elaborate series of experiments undertaken for the U. S. navy, and published in a *Report to the Navy Department of the U. S. on the Evaporative Power and other Properties of American Coals* (28th Cong., 1st Sess., Senate Doc., pp. 607, 860, Wash-

ington, 1841). These researches were not confined to anthracite coals, but were extended also to natural coke, artificial coke, mixtures of anthracite and bituminous coals (Class I.); to free-burning bituminous coals of Maryland and Pennsylvania (Class II.); bituminous coking coals from Eastern coal-field of Virginia, in the neighborhood of Richmond (Class III.); and finally to foreign bituminous coals and those of similar constitution W. of the Alleghany Mountains, and dry pine wood (Class IV.).

The highest evaporative power, as in the production of steam, is not, however, found in anthracite, but in the semi-bituminous coals, like those of Broadtop and the Cumberland region, and the coal of the Cruzot Basin, in which the proportion of hydrogen or volatile hydrocarbon is not greater than can be perfectly consumed in the furnace and flues of steam-boilers. This fact was first demonstrated by the researches of Johnson, and has since been confirmed by those of Sir Henry de la Beche and Dr. Playfair in their report on the coals suited to the steam navy of Great Britain (1848). The latest researches on this subject are those of Messrs. Scheurer Kestner and Meunier on the coals of Rhenish Prussia and Belgium (abstracted in *Comptes Rendus*, tom. 66–69, and *in extenso* in the *Bulletins de la Soc. Industrielle de Mulhouse*). The calculations of Mendenhall on the heating powers of some Ohio coals (*Geol. Survey of Ohio*, 1870) point in the same direction, as also those of Raymond on the lignites of the West.

Bituminous Coal.—This coal contains a variable quantity of volatile matter, expelled as combustible gases when heated in close vessels, and leaves behind coke of variable strength, according as the coal is treated, and varying also with the amount of volatile matter expelled, and its physical and chemical constitution. Heated at lower temperatures, many of the coals of this class produce hydrocarbon oils, while coal-tar is a product of their destructive distillation at all temperatures, whence the name *bituminous*. When these coals agglutinate to form a hollow fire, they are called caking coals or fat coals. The mass softens and becomes pasty under heat and semi-viscid. This softening takes place below redness at the stage of incipient decomposition, and is attended with the escape of gas, which often blows bubbles, leaving the mass porous, and escapes in jets of smoke and yellow, smoky flame. With a higher heat in close vessels (gas-retorts) the escape of gas ceases gradually, and finally leaves a porous brittle mass of gray-black color and submetallic lustre, which is coke. The gas expelled in this way from bituminous (gas) coals varies from 25 per cent. to 50 per cent., and in the cannel coals rises even to 60 per cent.; the more common average being about 35 per cent. for gas-coals. The semi-bituminous coals of Pennsylvania and Maryland yield only from 12 to 20 per cent. of volatile matter. The *non caking* or *free burning* bituminous coals are like the caking coals in appearance, and often closely resemble them in ultimate composition, but they leave no proper coke. This is the character of the *lignites*, so called, of Colorado and Wyoming, more particular mention of which is made beyond.

Cannel Coal (which see) is a fuel of inconstant properties, owing its character, apparently, to local peculiarities of origin. *Torbanite*, *albertite*, *wollongongite*, and *grahamite* are bituminous minerals of exceptional richness in volatile hydrocarbon. The *torbanite*, or "bog-head" cannel, seems like a clay saturated with bituminous matter. It yields over 68 per cent. of gas and nearly 23 per cent. of ash, and only 8.8 of fixed carbon. *Albertite*, on the contrary, leaves only 0.10 per cent. of ash, and is regarded by Dana as an asphaltum, although commercially sold as an enriching coal. It is probably an inspissated and oxygenated petroleum filling a fissure in the rocks, and is not a bed. Wollongongite (described on the last page of the present article) is another remarkable substance whose value as a gas-enricher is noticed in the article on Gas Lighting (which see). *Grahamite* is another asphaltum-like hydrocarbon, from near Parkersburg in West Virginia, described by Henry Wurtz. Grahamite seems to have had an origin similar to albertite, and like it fills a fissure, and is not a bed. It has been largely used for enriching illuminating gas, as "Ritchie mineral," but is now said to be exhausted.

The following comparison of the illuminating power of various well-known cannel and other gas-coals of England and the U. S. is taken from a paper by the writer on the "wollongongite" (*Am. Jour. Sci.* July, 1869). The standard sperm candle in use among gas engineers consumes 120 grains of sperm per hour. The total economical value of any gas-coal is obtained by multiplying the candle-power of the gas produced from one ton of the coal into the volume of the gas: thus, as the wollongongite yields 13,716 cubic feet of gas, *one* foot of which has an illuminating power of 26.54 candles, therefore we have $26.54 \times 120 \times 13716 \div 7000 = 6251.26$ pounds of sperm as the value of the gas from one ton of this mineral:

					[illegible]
Wollongong cannel..	=	lbs. of sperm	per ton,	6251.26	26.54
Boghead cannel.......	=	"	"	*1967.10	
" "	=	"	"	†2755.6	10.38
" "	=	"	"	‡1235.	5.29
Albert coal, N. B.....	=	"	"	§3016.37	11.73
Peytona cannel........	=	"	"	§1440	8.4
Lesmahago cannel...	=	"	"	1529	8.77
Capeldrae	=	"	"	1670	10.01
Donibriste	=	"	"	1277.5	7.51
Wigan	=	"	"	627.4	3.04
Pelton Main (caking)	=	"	"	532	3.12
Ramsay's (Newcastle)	=	"	"	553	3.33
Westmoreland, Pa....	=	"	"	§541.25	3.32

Brown Coal [Ger. *Braunkohle*, *Pechkohle*; *lignite*].—This variety of coal differs from bituminous coal chiefly in containing a larger amount of constitutional oxygen, more combined water, and in being, generally, more friable. Its powder is distinctly brown, and not black, whence its name; but it is sometimes of a pitchy black color and fine lustre. It is found in more recent geological horizons than the coals before named. The deposits of this variety of coal opened in Colorado, Wyoming, and Utah Territories, are remarkable for extent, thickness, and uniformity, affording an inexhaustible supply of excellent fuel in a region for the most part destitute of forests and remote from all other sources of fuel-supply. Similar beds are found also in California and elsewhere on the Pacific coast. The brown coals are not caking coals, but are free-burning coals, yielding much gas, and are good steam coals, but not well adapted to carry the burden of the high furnaces for iron, although perfectly well adapted to general metallurgical use and to the Siemens gas furnace. Their calorific force is also remarkable, as will be seen further on.

Chemically considered, all the coals are oxygenated hydrocarbons, the amount of oxygen they contain gradually increasing from the anthracites, where it is as low as 1 to 2 per cent., in the caking and non-caking coals, 4 to 12 per cent., and in the brown coals, 18 to 30 per cent. or more, averaging in the last-named variety about 22 per cent. In a few of the anthracites there appears to be an entire absence of oxygen, and the presence of so large a preponderance of pure carbon seems hardly consistent with the view expressed by Berthelot, that the anthracites are in their totality hydrocarbon compounds like other coals, but rather that a portion of these compounds normal to the so-called bituminous coals has escaped the caking process which has more or less completely converted them by heat under pressure into anthracite. The fact, first thoroughly demonstrated by the brothers Rogers, that the volatile matter in the anthracites regularly increases in the Appalachian beds as the flexures of the strata die out going westwardly, until they are undisturbed in the bituminous coal-fields on the western slopes of that line of upheaval, seems to leave no reasonable doubt at once of the cause and its effects, which afford us the only rational explanation of the phenomena in question. The researches of Pumpelly, Richtofen, and others in the vast coal-fields of China have demonstrated that anthracite coal exists in geological horizons much more recent than was formerly supposed true—even as late as the Cretaceous and Tertiary eras—and that its existence there is clearly due to the coking of bituminous or brown coals by heat.

Charcoal and Coke have already been described under their appropriate heads (which see). Charcoal prepared from hard woods at a high temperature is the purest form of carbon available as a fuel, being entirely free of sulphur and yielding only a little alkaline ash, with a small amount of silica. Burning to carbonic acid by oxygen, it forms the standard of comparison for the heat evolved by other less pure forms of fuel. By the experiments of Favre and Silbermann it gave per pound of fuel 8080 calories (Cent.), equal to 14,544 calories F. Coke is less efficient than charcoal, just in proportion to the amount of ash it leaves, and this is usually about 15 per cent. But owing to its much greater strength under the crushing weight of the high furnace, as well also as its greater cheapness, it is the preferred fuel for the high iron furnace. The sulphur it retains from the pyrites found in the crude coal may be almost completely removed by proper mechanical treatment of the coal before coking. For this purpose the coal is crushed and washed in an apparatus similar to that used in the concentration of metallic ores, by which the pyrites is removed by virtue of its greater density, and the coke prepared from coal so treated is found to yield iron of a very superior quality, owing to its almost complete freedom from sulphur. In the process of coking in suitable ovens

* Advertisement of the proprietors. † Dr. Fyfe.
‡ Manhattan Co. § My own results.

the fine coal unites into compact prismatic masses, of a sub-metallic lustre, sonorous when struck, like cast iron.

Liquid Fuels.—The hydrocarbon oils found so abundantly in Pennsylvania and elsewhere, and produced artificially by the distillation of bituminous schists, offer a valuable resource for fuel in certain situations where their abundance enables them to compete with solid fuel. For example, the light naphtha forming from 20 to 25 per cent. of the first product of the distillation of Pennsylvania petroleum is extensively employed in the oil-regions as a steam fuel and for the distillation of the crude oil in its first stages of treatment. For this purpose the naphtha in vapor is burned from jets in wrought-iron pipes arranged beneath large boilers and pierced with numerous fine holes, the supply of air being regulated to secure a complete combustion. The exact value of light naphtha thus used as a source of heat has not apparently been practically determined in comparison with other liquid fuels. But a series of experiments are cited in the *Report of the Commission appointed to Inquire into the Several Matters relating to Coal in the United Kingdom* (1871), in which the materials employed were crude petroleum, crude paraffine oil, dead oil or creasote, and their calorific power and evaporative efficacy, determined by trials in the large way under steam-boilers, as compared with coal, under the direction of Prof. W. J. Macquorn Rankine. The results are given in the following table:

For one pound of—	Total quantity of heat generated.	Quantity of heat available for producing steam.	Quantity of water heated from 60° to 212° F., and converted into steam at 212° F.	Temperature of the fire or flame.
	Heat-units.	Heat-units.	Lbs.	F.
Crude petroleum.....	20,000	16,847*	15	4646°
Crude paraffine oil..	20,000	16,847*	15	4646°
Heavy oil—oil from either slate or coal.	20,000	16,847*	15	4646°
Dead oil, or creasote.	16,626	14,567*	13	4495°
Coal { from..............	13,890	10,001†	8.95	2500°
Coal { to..................	14,833	10,817	9.67‡	2500°

The use of the vapor of the liquid hydrocarbons used under boilers, and even under the iron stills employed in the distillation of coal-tar of gas-works, as well as of petroleum products, has given most satisfactory results, reducing the time required for distilling a given charge fully one-half, and acting almost without injury to the stills, which are rapidly injured by the use of coal-fires. This difference is probably in great measure due to the much smaller amount of air required to feed the vapor-flame than is used for a coal-fire; 300 cubic feet of air (24 pounds) to the pound of coal being required, while not over half that amount is required to burn the hydrocarbon vapor supplied by a blast of its own production in place of the draft of a high chimney required for air burning coal. The oxidation of the iron surface is thus largely saved, and the injury from sulphur in coal completely saved by the use of the hydrocarbon vapor. The conclusions reached by the commission referred to are that the evaporative efficacy of liquid fuel for generating steam is much greater than that of coal; and that on board ships there is an important saving of space for storage, as well as in labor of stoking, removing ashes, etc., with a proportional reduction of running expenses; while steam could be raised much quicker by the use of liquid fuel, and save the cost of banking up fires, and the immersion of the vessel more evenly maintained by tanks between the outer and the inner skins of the vessel, to be filled with water as the oil is removed. On the other hand, certain obvious dangers attend the storing and use of volatile hydrocarbons, while the odor of the heavy or dead oils would be very annoying, however carefully stored on board ship. These objections do not appear to have been overcome, while for various purposes on land they have little force. Thus, in ironworks dead oil has been used with advantage in the furnaces for heating iron plates, etc. It has been found possible to produce a higher, steadier, and more even heat with liquid fuel than with coal, while 8 hundredweight are said to have replaced a ton of coal, and the time occupied in heating the iron is said to have amounted to only one-fourth, or even one-fifth, that required with coal. So that there was a manifest economy in the number of furnaces required to do a given amount of work. Thus, for instance, while the heating of a half-inch plate sufficient for bending would require from 15 to 20 minutes with coal, it would require only four or five minutes with the liquid fuel; and a 4-inch armor platé requiring three hours to heat with coal required only 38 minutes with the liquid fuel. The "scale" of magnetic oxide of iron formed in the process of heating is much less when liquid fuel is used than with coal, for the reason that there is less free oxygen from the air present, while the vapor of the hydrocarbon affords a reducing flame. In fact, the use of liquid fuel when burnt with a blast affords the same advantages as the gas furnace introduced by Mr. Siemens, of which we speak farther on. The unprecedented increase in the production of petroleum not only in Pennsylvania, but in other parts of the world also, and which seems far from having reached its limits, renders the use of liquid fuel a subject, at the present time, of considerable importance. It is largely a question of relative cost, and it is obvious that it must needs be a very low cost indeed which will enable any description of liquid fuel to compete with coal. Crude petroleum at $2 per barrel of 43 gallons costs per ton of 2240 pounds about $22, against bituminous coal at $7 in New York, or fully three times the cost of coal, weight for weight. It is therefore obvious it is only in certain unusual conditions that there can be any possibility of using petroleum in place of coal, as where coal is very dear and petroleum very cheap, or where, as at the oil-works, crude naphtha has little or no value, and is practically a waste product; or, lastly, where the nature of the process is such as in reheating furnaces and other metallurgical processes, that a reducing flame and the absence of sulphur are important considerations.

Gas.—The use of a natural flow of marsh-gas from artesian borings as fuel is possible only in certain limited areas, but is by no means an uncommon circumstance. But the introduction of Siemens' gas furnace has demonstrated that the use of fuel in the state of gas offers for many purposes singular advantages both as respects economy, efficiency, and convenience. Natural gas, chiefly marsh-gas (C_2H_4), was early observed in the salines of the Kanawha, and has been successfully used as fuel to heat the kettles of certain salt-works. In the town of Erie, Pa., gas obtained from artesian borings has also been used under steam-boilers to produce steam; and the marsh-gas from an artesian well near Rochester has been conveyed into that city for economical purposes. In the oil-regions of Pennsylvania the use of the gas escaping from the artesian wells is frequent for producing steam. The town of Fredonia in New York was as early as 1830 lighted by a natural flow of marsh-gas. In 1863 a company was formed at Birmingham, England, to provide a supply of heating gas from coal for domestic and manufacturing purposes at the rate of 6*d*. per 1000 cubic feet, but the bill necessary to carry it into effect was thrown out in the committee of the House of Lords, because their lordships thought that if this was as good a plan as it was represented to be, the existing gas companies would be sure to carry it into effect. This was a favorite plan of Mr. C. W. Siemens, the inventor of the regenerative furnace, who proposed to place his gas-producer at the bottom of coal-pits, providing a gas-shaft to conduct the gas to the surface, thus saving the lifting of the coal, while giving to the ascending column of gas an amount of forward pressure sufficient to carry it several miles to the place of consumption. This plan would not only effectually ventilate the coal-mines, without involving any danger, but would also save the loss on the small coals now useless, and amounting to fully one-fifth of the whole product, which now is left unused in the pit. A similar plan has been proposed by Mr. Henry Wurtz in this country for utilizing the coal-dust which in the anthracite regions of Pennsylvania forms mountains of waste carbon. For this purpose Mr. Wurtz proposed to produce hydrocarbon gas from vapor of water acting on the anthracite at a red heat, sending the gas ($H_2 + CO$) to the points of consumption in large conduits, aided by mechanical pressure if needful to propel the gas. An important economy of fuel now completely unutilized might thus be obtained. A similar plan for the distribution of heating gas has lately been taken up in Berlin, Prussia.

The dynamical theory of heat as proposed by Joule and Mayer about 1846, led Mr. Siemens to take up a line of investigation with a view to a realization of some of the economic results which that theory rendered possible, and the fruit of these investigations is seen in "the regenerative gas furnace" now so well known, and which may be truly said to have worked a revolution in the methods of producing, applying, and economizing heat. The burning of a pound of carbon in pure oxygen to carbonic acid, as before stated, evolves 8080 calories or units of heat (= 14,544 English units). As each unit of heat is convertible into 774 units of force or mechanical energy, it follows that one pound of carbon represents really $14,544 \times 744 = 10,820,736$ units of potential energy. The

*It is here assumed that the oil is burnt with only just enough air for combustion, and that the effete gas is discharged at 600° F.

† Burnt, as usual, with twice the air necessary for combustion.

‡ The evaporative duty here assigned to coal is probably higher than that actually obtained on the average in steam vessels, to the extent of about 20 per cent.; seven pounds of water converted into steam per pound of coal consumed being nearer the actual average obtained with coal in steam vessels.

mechanical power set free in the combustion of one pound of pure carbon is as much, therefore, as would be required to raise nearly 11,000,000 pounds weight one foot high. This would sustain the work called a horse power for about $5\frac{1}{2}$ hours. This is a result quite unattainable in practice, of course, since, if for no other reason, we can never employ the two elements of combustion in a state of purity, and the oxygen is unavoidably mixed with about four times its own volume of inert nitrogen.

To realize how wide the margin for improvement was in the application of heat for smelting and metallurgical purposes prior to the invention of the regenerative gas furnace, and what this invention has done to economize fuel, it is only necessary to consider a few simple facts. The heat needed to smelt a ton of iron or steel, or to raise the temperature of a like quantity of iron bars to the welding point of malleable iron, is obviously very much more in excess of the amount theoretically required for these purposes than is required in the production of steam, because it is unavoidable that the products of combustion in the ordinary form of heating furnaces should leave the furnace at the temperature of combustion, while only the small excess stored up in the heated iron could be utilized. The remainder escaped unutilized into the chimney, and was lost. Taking the specific heat of iron at .114 and the welding heat at 2900° F., it would require $.114 \times 2900 = 331$ units of heat to heat up one pound of iron. Assuming that a pound of common coal develops 12,000 heat-units, one ton of coal should heat up to the welding point 36 tons of iron. But the ordinary reheating furnace heats only about $1\frac{3}{4}$ tons of iron, and therefore produces only about one part in twenty-one of the maximum theoretical effect. In melting steel in pots, in the ordinary Sheffield furnace for that purpose, $2\frac{1}{2}$ tons of coke are consumed to one ton of steel melted. Assuming the melting-point of steel at 3600° F., and its specific heat at .119, it takes $.119 \times 3600 = 428$ heat units to melt a pound of steel; while with 12,000 units at the heat-producing point of common coke, one ton of such coke should theoretically melt 28 tons of steel. In other words, the Sheffield pot furnace utilizes in the melting of steel only $\frac{1}{70}$th part of the theoretical heat of combustion. Here there was obviously a wide margin for securing an important portion of this great loss, and the regenerative gas furnace is the means which in the hands of Messrs. C. W. and Frederick Siemens has so far solved the problem, in part at least. (See article FURNACE.)

The regenerator or accumulator of heat Mr. Siemens recognized as due, so far as the philosophical principle is concerned, to the Rev. Dr. Sterling of Dundee in 1817. The same principle was recognized and applied in France by the patent of M. Franchot (1836) in an atmospheric engine which had what he called a "calefactor," a series of pipes through which the escaping warm air passed and imparted its heat in part to a current of cool air arising around them in an opposite direction. Capt. Ericsson's caloric engine (1850) had a regenerator formed of meshes of iron wire—100,000,000 meshes for each engine—which accumulated the heat from the escaping air and imparted it to the returning air again. Mr. Siemens' regenerators accomplish for high temperatures what these earlier contrivances accomplished for low temperatures. But it was Dr. Robert Hare of Philadelphia, inventor of the compound or oxyhydrogen blowpipe, who in 1802 first announced the principle that in order to obtain the maximum effects of heat "the body to be heated must be sustained in an atmosphere of burning gas," and that charcoal impinged upon by a jet of oxygen did not fulfil this condition. Hence, Hare, after discussing the fundamental defects of Lavoisier's methods, says with great sagacity, "To avoid these evils, it was thought desirable that means might be discovered of clothing the upper surface of any body which might be subjected to this species of operation with some burning matter, of which the heat might be equal to that of the incandescent carbon with which the lower surface might be in contact; or by which bodies might be exposed on solid supports to a temperature equal or superior to that of the porous charcoal uniting with oxygen. It soon occurred that these desiderata might be attained *by means of flame* supported by the hydrogen and oxygen gases; for it was conceived that, according to the admirable theory of the French chemists, more caloric ought to be extricated by this than by any other condition. . . . Such was the reasoning which originated the desire of employing the flame of the hydrogen and oxygen gases. But before this could be accomplished, it was necessary to overcome the difficulty of igniting a mixture of these aëriform substances without the danger of an explosion." (TILLOCH'S *Phil. Magazine*, xiv. 1802.)

In the Siemens furnace the objects to be heated are sustained on a solid support in an atmosphere of burning gas, the oxygen of the atmosphere arriving by one inlet, and the combustible gases by another, and the two uniting in a true Hare's blowpipe flame to do their work. The accessory contrivances, so essential in the economy of fuel, for the alternation of the flow of gas and air through the regenerative cellular flues of fire-brick, are evidences of a high degree of inventive skill applied to the solution of a problem which, in its essential features, was clearly set forth by Robert Hare in 1802.

It is evident from these facts, which could be greatly extended did space permit, that for many purposes gas is the best form in which fuel can be applied for producing the highest temperature with the least loss of heat, and that the gas regenerative furnace of Siemens is the invention which has advanced us in the right direction more than any other improvement yet made in the generation and application of heat.

WOOD.—The value of wood as fuel depends mainly on its density in the dry state. Wood is composed of carbon, hydrogen, and oxygen, with a small proportion of nitrogen, and the mineral matter derived from the soil, constituting, when burned, its ash. Fresh or green wood contains from one-fifth to one-half its weight of water, which diminishes its value as fuel more than its proportion by weight, since a certain amount of heat is absorbed in converting this water into steam. Exposed to dry air, wood gradually loses a portion of its water, but being, by its porous nature, peculiarly liable to absorb moisture, it will take up a portion of water from damp air, so that, however well "seasoned" wood may be, it is never free from hygroscopic moisture, and is always in a condition of unstable equilibrium in this respect. Hence, furniture and the woodwork in houses in a climate subject to such extremes of temperature and moisture as that of the U. S. is ever liable to change its dimensions between summer and winter. Air-dried wood may be deprived by artificial heat of a further portion of its moisture (kiln-drying). Rumford, who heated various kinds of air-dried wood at the temperature of 240° F. until they ceased to lose weight, obtained the following results:

100 parts of		100 parts of	
Oak wood lost	16.64	Fir wood lost	17.83
Elm " "	18.20	Birch " "	19.38
Beech " "	18.56	Lime " "	18.79
Maple " "	18.63	Poplar "	19.55

Rumford determined the amount of water absorbed by dry wood in the different seasons of the year in France, with the following results:

Species of wood	100 parts in weight of dry wood cut into thin shavings and exposed to the air contained water—		
	In summer, at a temp. of 62° F.	In autumn, at a temp. of 52° F.	In winter, at a temp. of 45° F.
	Parts.	Parts.	Parts.
Poplar	6.25	11.35	19.55
Lime	7.78	11.74	17.50
Oak	8.97	12.46	16.64
Elm	8.86	11.12	17.20

From a comparison of these results it appears that woods when exposed to the air at a temperature of 45° F. contain twice the quantity of water they do when the temperature of the air is at 60° F. Rumford found that a sound oak beam which had been in a dry place for over 150 years still contained over 10 per cent. of water, and that a cubic inch of such wood contains more than half a cubic inch of air.

An elaborate series of experiments was made by Mr. Marcus Bull in 1823–24 to determine the heat evolved in the combustion of the principal varieties of wood used as fuel in the U. S. He tested over forty sorts of wood, determined the specific gravity of the dry wood; its weight per cord (128 cubic feet) in pounds avoirdupois; the product of charcoal from 100 parts of dry wood by weight; the specific gravity of the dry coal; the weight of coal in one bushel; and the pounds and bushels of charcoal from one cord of dry wood. The fuel was burned in a small stove in a room surrounded with another apartment to cut off radiation, and the comparisons were made by observing by the differential thermometer the times during which 10° of heat were maintained in the room by the combustion of one pound of each fuel. He found that the shellbark hickory (*Carya alba*) gave the maximum result measured in terms of *value*; for while the *times* in which equal *weights* of different woods maintained a uniform difference of 10° of temperature varied only between 6 hours and 6 hours and 40 minutes, the *value* measured in terms of equal volume varied between $10 for the shellbark hickory and $4 for Lombardy poplar (*Populus dilatata*) per cord measure. Bull's results have not found place in the literature of fuels generally, and are referred to usually in the most cursory manner. We therefore append his tabular statement, containing his most important results on the more frequently occurring American woods. For a description of his methods of calorimetry reference may be had to his memoir (*Am. Phil. Trans.* iii. 1 63, 1826).

Common names of woods.	Botanical names.	Specific gravity of dry wood.	Pounds avoir. of dry wood in one cord.	Product of charcoal from 100 parts to weight of dry wood.	Specific gravity of dry coal.	Pounds of dry coal in one bushel.	Pounds of charcoal from one cord of dry wood.	Bushels of charcoal from one cord of dry wood.	Time 10° of heat were maintained in the room by the combustion of one pound of each wood.	Value of one cord of each wood, as compared with shellbark hickory as the standard, at $10 per cord.
									H. M.	
White ash	Fraxinus Americana	.772	3450	25.74	.547	28.78	888	31	6.40	$7.70
Apple tree	Pyrus Malus	.697	3115	25.	.455	23.41	779	33	6.40	7.00
White beech	Fagus ferruginea	.724	3236	19.62	.518	27.26	635	23	6.	6.50
Black birch	Betula lenta	.697	3115	19.40	.428	22.52	604	27	6.	6.30
White birch	Betula alba	.530	2369	19.	.364	19.15	450	24	6.	4.80
Butternut	Juglans cinerea	.567	2534	20.79	.237	12.47	527	42	6.	5.10
Red cedar	Juniperus Virginiana	.565	2525	24.72	.238	12.52	624	50	6.40	5.60
American chestnut	Castanea vesca	.522	2333	25.29	.379	19.94	590	30	6.40	5.20
Wild cherry	Prunus serotina	.597	2668	21.70	.411	21.63	579	27	6.10	5.50
Dogwood	Cornus florida	.815	3643	21.	.550	28.94	765	26	6.10	7.50
White elm	Ulmus Americana	.580	2592	24.85	.357	18.79	644	34	6.40	5.80
Sour gum	Nyssa multiflora	.703	3142	22.16	.400	21.05	696	33	6.20	6.70
Sweet gum	Liquidambar styraciflua	.634	2834	19.69	.413	21.73	558	26	6.	5.70
Shellbark hickory	Carya alba	1.000	4469	26.22	.625	32.89	1172	36	6.40	10.00
Pignut hickory	Carya porcina	.949	4241	25.22	.637	33.52	1070	32	6.40	9.50
Redheart hickory	Carya "	.829	3705	22.90	.509	26.78	848	32	6.30	8.10
Witch hazel	Hamamelis Virginica	.784	3505	21.40	.368	19.36	750	39	6.10	7.20
American hornbeam	Carpinus Americana	.720	3218	19.	.455	23.94	611	25	6.	6.50
Hard maple	Acer saccharinum	.644	2878	21.43	.431	22.68	617	27	6.10	6.00
Soft maple	Acer rubrum	.597	2668	20.64	.370	19.47	551	28	6.	5.40
Large magnolia	Magnolia grandiflora	.605	2704	21.59	.406	21.36	584	27	6.10	5.60
Chestnut white oak	Quercus bicolor	.885	3955	22.76	.481	25.31	900	36	6.30	8.60
White oak	Quercus alba	.855	3821	21.62	.401	21.10	826	39	6.20	8.10
Shellbark white oak	Quercus obtusiloba	.775	3464	21.50	.437	22.99	745	32	6.20	7.40
Barrens scrub oak	Quercus Catesbæi	.747	3339	23.17	.392	20.63	774	38	6.30	7.30
Pin oak	Quercus palustris	.747	3339	22.22	.436	22.94	742	32	6.20	7.10
Scrub black oak	Quercus ilicifolia	.728	3254	23.80	.387	20.36	774	38	6.30	7.10
Red oak	Quercus rubra	.728	3254	22.43	.400	21.05	630	30	6.20	6.90
Black jack oak	Quercus nigra	.694	3102	22.37	.447	23.52	697	29	6.20	6.60
Rock chestnut oak	Quercus Prinus monticola	.678	3030	20.86	.436	22.94	632	28	6.	6.10
Yellow oak	Quercus Prinus acuminata	.653	2919	21.60	.295	15.22	631	41	6.10	6.00
Spanish oak	Quercus falcata	.548	2449	22.95	.362	19.05	562	30	6.20	5.20
Yellow pine	Pinus mitis	.551	2463	23.75	.333	17.52	585	33	6.30	5.40
Jersey pine	Pinus inops	.478	2137	24.88	.385	20.26	532	26	6.40	4.80
Pitch pine	Pinus rigida	.426	1904	26.76	.298	15.68	510	33	6.40	4.30
White pine	Pinus Strobus	.418	1868	24.35	.293	15.42	455	30	6.40	4.20
Yellow poplar	Liriodendron tulipifera	.563	2516	21.81	.383	20.15	549	27	6.10	5.20
Lombardy poplar	Populus dilatata	.397	1774	25.	.245	12.89	444	34	6.40	4.00
Sassafras	Sassafras officinale	.618	2762	22.58	.427	22.47	624	28	6.20	5.90
Wild service	Amelanchier Canadensis	.887	3964	22.62	.594	31.26	897	29	6.20	8.40
Sycamore	Platanus occidentalis	.535	2391	23.60	.374	19.68	564	29	6.30	5.20
Black walnut	Juglans nigra	.681	3044	22.56	.418	22.	687	31	6.20	6.50

The elementary composition of wood of different sorts presents a very close resemblance. Thirteen different woods offer the following mean result: carbon, 49.22; hydrogen, 6.25; oxygen, 44.02; nitrogen, 0.90. The differences are within 1 per cent. for the extremes; oak contains about 2 per cent of nitrogen. The *ash* of wood varies from 8 per cent. in fir to 2½ per cent. in oak. It contains potash, with a little soda as distinguishing constituents (hence, *potashes*), much lime and magnesia, with variable but small proportions of iron, manganese, phosphoric acid, chlorine, copper, etc.

Peat and Turf.—In many northern countries the vegetation of mosses, ferns, sedges, confervæ, rushes, reeds, and numerous small plants accumulates in swamps, morasses, and low places, each winter adding its quota to the mass of decomposing vegetable matter, in its turn the soil of a new vegetation the ensuing spring. Thus, considerable accumulations are formed in process of time, the lower portions of which are black, unctuous, and somewhat dense, and are called *peat*, while the upper layers are spongy, fibrous, and less perfectly decomposed, and are called *turf*. In Holland, North Germany, Ireland, Scotland, and some parts of North America this material is rather extensively used as fuel. Air-dried peat contains from 15 to 20 per cent. of water, and its ash varies from 4 or 5 to 25 per cent., or more, averaging in the denser varieties about 15 per cent. The ash is very poor in potassa and soda, abounds in lime and free sand, while it is remarkable for containing notable quantities of phosphoric acid and sulphuric acid, and sometimes it contains iron pyrites in quantity sufficient to permit its use for the manufacture of green vitriol. (*Karsten.*) No means have yet been devised by which peat can be economically manipulated to compete with coal as fuel at present prices.

Calorific Power and Calorific Intensity are terms employed with a well-defined meaning in treating of the combustion of fuel. *The calorific power of* a body is the total number of heat-units it is capable of imparting, *e. g.*, to water, when it is burned in pure oxygen. The combustion of fuel means only its union with oxygen. But this action never happens in practice without the presence of the inert nitrogen of the air, and of vapor of water and of other products of combustion, all of which require, each, a specific amount of heat to raise them to the average temperature of combustion; and this *specific heat* is obtained at the expense of the heat evolved by carbon and hydrogen of the burning body uniting with oxygen. If the specific heat of water is taken as unity, the results of the best experiments give for the specific heat of oxygen 0.218, nitrogen 0.244, hydrogen 3.405, steam 0.475, carbonous oxide (CO) 0.248, carbonic acid (CO_2) 0.216. The true temperature of combustion will therefore be the quotient found by dividing the total calories (heat-units) generated by the burning of a unit of carbon or of hydrogen in pure oxygen by the sum of the products of the weights of the products of combustion by their respective specific heats. Thus, 1 kilo. of carbon combining with 2⅔ kilo. of oxygen, forming 3⅔ kilo. of carbonic acid (CO_2), generates 8080 units of heat. The weight of the CO_2 into its specific heat $= 3\frac{2}{3} \times 0.216 = 0.792$, and the temperature evolved would be $\frac{8080}{0.792} =$ 10202° C., which is its Calorific Power. But considering the nitrogen of the air, which takes no part in the combustion, the statement of weights into specific heat for the products of combustion would be 0.792 for the CO_2 produced $+ 8.88 \times 0.244 = 2.167$ for the nitrogen = total 2.96, and the temperature produced would be $\frac{8080}{2.96} = 2730°$ C.; which quantity is called the Calorific Intensity of carbon, as distinguished from its Calorific Power. So for hydrogen burning in oxygen to form steam, 29,032 heat-units are generated (or if the steam is condensed 34,462 units), the temperature (theoretical) of the combustion will be $\frac{29632}{9 \times 0.475 - 4.275} - 6931$. If, however, the hydrogen burns in air, the common case, the addition of the nitrogen will reduce the temperature to

$$\frac{29632}{(9 \times 0.475) = (4.275) + (26.64 \times 0.244 = 6.5) = 10.775}$$

= 2750, or about the same temperature as is produced by the perfect combustion of carbon in air. These are max-

imum temperatures, and much exceed any results obtained in the arts, as there is a large amount of heat lost by radiation, conduction, fusion of cinders, evaporation of water in fuel, etc. It will be understood that while the calorific power of carbon and hydrogen are respectively 8080° and 29632° C., their calorific intensity (or *pyrogenic power*) is 2730° and 2750° C.

The value of any fuel as a source of heat may be determined *theoretically*, if its chemical composition is known by the methods of calculation just illustrated. But there are so many circumstances, some of them not well understood, affecting the results so obtained that we must look to the results of actual trial in some form of experimental apparatus. The calorimeter of Rumford, modified and perfected by Favre and Silbermann and others, has been chiefly employed in these researches. (See HEAT.) Berthier, assuming the accuracy of Welter's theory, that the heat evolved by combustion is directly proportional to the amount of oxygen consumed, proposed to estimate the calorific power of fuel by burning it into CO_2 by means of the oxygen contained in litharge, and to ascertain the amount of oxygen abstracted by weighing the button of lead produced. With carbon alone, and in the absence of other reducing agents, this method is capable of producing accurate results. While it fails in absolute accuracy in many cases, yet owing to its simplicity it is much used for near approximations.

The evaporation of water in a well-constructed steam-boiler affords more trustworthy results for determining the value of fuels than any laboratory methods are capable of producing or than can be deduced by computation from the chemical constitution of the fuel. This statement is confirmed by the results of Walter R. Johnson (1844) already quoted, of the British commissioners (1871), and of Scheurer-Kestner and Meunier (1869). Space is wanting to quote these results in any desirable fulness. A single example from the last-named research must suffice, as showing how unsafe it is to calculate the value of a fuel on its elementary composition alone. The example chosen is the comparison offered between the exactly identical chemical composition of the coal of Ronchamp and that of Cruzot, and the calorific value of these two coals as determined by their power to evaporate water. The masses of these two coals would justify the inference that they were of identical value, while there is an experimental difference between them of 500 calories in evaporative power.

	Cruzot.		Ronchamp.	
Carbon	88.40		88.42	
Hydrogen	4.41		4.41	
Oxygen and nitrogen	7.19	100	7.17	100
Heat of combustion	9117		9628	

This identity of chemical composition disappears when the two coals are examined separately for their volatile portion and coke (ash being deducted), thus:

	Cruzot.	Ronchamp.
Fixed carbon	80.01	71.60
Volatile carbon	8.41	16.80
	88.40	88.42

Of all the coals examined by Messrs. Scheurer-Kestner and Meunier, that of Cruzot gave the highest heating power, and yet by the elementary composition there should have been no difference between it and the coal of Ronchamp. These authors say that in our present state of ignorance on the subject of the constitution of coals and their molecular structure, no safe conclusions can be drawn from theoretical considerations, but that in all the fuels of which they have determined the heat of combustion the results obtained have exceeded the theoretical sum of the heats of combustion of the elements. Hence the importance of more extended researches upon the value of our coals by the method of evaporation of water.

The calorific value of the lignites of Western America has been lately discussed by Prof. R. W. Raymond, commissioner of mines. (*Report 1873*, p. 370.) The results obtained from a calculation of the elementary constitution of these fuels places them much higher in the scale of calorific value than was anticipated. That from Cañon City, Col., for example (and there are others nearly as good), has a calorific power of 7439 and calorific intensity of 2683, which differs from that of pure carbon by only 641 and 47 calories respectively. We are as yet almost completely ignorant of the molecular structure and evaporative power of these valuable fuels, which are the only resource for the metallurgy and industry of a vast area destitute of all other resources for artificial heat. *Wollongongite*, which we have alluded to above, is a hydrocarbon mineral resembling succinite (of the nature of amber) from Australia. It occurs in cubical blocks without lamination; breaks in broad conchoidal surfaces, extremely tough and resounding like hard wood under the blows of the hammer. H. = 2 to 2.5. G. = 1.04 – 1.49. Lustre, resinous, somewhat silky. Color, greenish-black and brownish black. Streak, light brown to yellowish. No odor when rasped. Tasteless. Sectile, the thin shavings curling up under the knife. Not electric by friction of the mass, but the chips cut off by the knife are highly electric. Translucent in thin shavings, and under the microscope transmits amber-yellow light. Alone in a test-tube does not melt, decrepitates, and distills a copious flow of oil of a yellow color and heavy odor, giving off much gas. Insoluble in alcohol, ether, or benzole, but is slightly dissolved in carbonic disulphide, to which it imparts a slightly yellowish tinge. It is readily kindled in thin splints by a match, burning with a brilliant flame and much smoke. The analysis in a platinum crucible yields the following results: Volatile matter, 82.5; fixed carbon, 6.5; ash, 11.0 = 100.0. From these characters this substance obviously resembles succinite, and is probably as well entitled to a place in the system as albertite, bathillite, or torbanite.

Formerly, fuel was interesting to mankind chiefly as the means of producing artificial heat in cold climates and for its use in the culinary art, which distinguishes civilized man from the savage. But the wonderful advance in modern times in chemical and metallurgical arts, and, above all, the universal introduction of steam as a motor and a vehicle for the transportation of heat, has given to fuel a value before unknown, leading not only to the development of all its available sources of supply, but to the study of its economical application with a view to obtaining from it the greatest useful effect and benefit possible. The phenomena and laws of combustion, and the methods of calculation of calories, are more fully discussed under HEAT; here we have confined ourselves chiefly to the considerations which concern the economic value of fuel.

For a fuller discussion of this subject consult PERCY's *Metallurgy*, vol. i., and the French ed. of the same, 1864 (*Traité Complet de Métallurgie*); KNAPP, *Chemical Technology* by RONALDS and RICHARDSON, vol. i., pp. 8–99; PECLET, *Traité de la Chaleur*, 3me ed., 1861, 3 vols.; W. R. JOHNSON, *Experiments on the Evaporative Power and Other Properties of American Coals* (1843), Cong. Doc. 28th Cong. 1st Sess. (Senate, 386); WATTS's *Dictionary*, Art. "Fuel;" AD. WURTZ, *Dictionnaire de Chimie*, "Houille;" MARCUS BULL, *Experiments to Determine the Comparative Quantities of Heat Evolved in the Combustion of the Principal Varieties of Wood and Coal used in the U. S. for Fuel*, etc., *Trans. Am. Phil. Soc.*, Phila., iii. pp. 1–63, read Apr., 1826; COUNT RUMFORD (Benjamin Thompson): Rumford's most important papers on fuel and its use will be found in vols. ii. and iii. of *The Works of Rumford*, published by the American Academy of Arts and Sciences, Boston, 1870–73; in vol. iii. are his well-known papers *Of the Management of Fire and the Economy of Fuel*, pp. 1–167, and his Essay X., *On the Construction of Kitchen Fireplaces and Kitchen Utensils*, etc.; DE LA BECHE and LYON PLAYFAIR, *First Report on the Coals suited to the Steam Navy* (Jan. 5, 1848), and *Appendix* by PROF. J. WILSON; *Experiments on the Evaporative Power of the Coals*, by PROF. WILSON and MR. W. J. KINGSBURY; *Experiment for Determining the Coefficient and Evaporative Power of Wood*, etc., by J. ARTHUR PHILLIPS; *Chemical Analyses of Coals*, by F. C. WRIGHTSON; *Ultimate Analyses of Coals*, by MR. H. HOW; and lastly, *Calorific Value of Coals*, by J. A. PHILLIPS, all in *Memoirs of the Geol. Survey of Great Britain*, ii. pp. 539–630, 1848; *Report of the Commissioners appointed to Inquire into the several Matters relating to Coal in the United Kingdom*, 1871. *Blue Book C.*, 435, 3 vols. (See minutes of Committee B *On Waste in Combustion* for testimony of Mr. C. W. SIEMENS, WM. MENELAUS, ISAAC LOWTHIAN BELL, Sir WILLIAM ARMSTRONG, Dr. W. FAIRBAIRN, Capt. ANDREW NOBLE, Dr. NEIL ARNOT, E. A. COWPER, HENRY BESSEMER, and others.) For an important memoir *On the Combustion of Coal*, quoted in the text, see M. A. SCHEURER KESTNER ET MEUNIER (*Bull. Soc. industr. de Mulhouse*, 1869), cited in *Comptes Rendus de l'Acad. des Sci.*, t. 66, 67, 68, and 69, 1866–69; KERL's *Metallurgy*, by CROOKES and ROHRIG, in 3 vols.: vol. iii. *Steel—Fuel—Supplement*, John Wiley & Son, New York, 1870, 8vo. Chapter second of this treatise, covering 264 pages, offers a full and satisfactory discussion conveniently accessible to American readers, with the important advantage of full references to all the more important sources of original information. JOHN ARTHUR PHILLIPS, *Metallurgy* (1874), Art. "Fuel;" ISAAC LOWTHIAN BELL, *Chemical Phenomena of Iron Smelting*, London, 1872; THOMAS BOX, *Practical Treatise on Heat*, London, 1868; CHARLES SCHINZ, *Researches on the Action of the Blast Furnace*, translated by MAW and MULLER, London, 1870, etc., etc. (See also in the present work the articles ANTHRACITE, COAL, CHARCOAL, COKE, CANNEL COAL, LIGNITE; also the articles GAS LIGHTING, FURNACE, HEAT, FLAME, METALLURGY; while the fuels suitable for various special uses are noted in the different articles on industrial processes and appliances.)

B. SILLIMAN.

Fuen'te de Can'tos, town of Spain, in the province of Badajoz, has important copper-mines in the vicinity. Pop. 6385.

Fue'ro [Sp. for "forum"—that is, a seat of justice], the Spanish name for the old local codes of certain towns and districts, chiefly in the N. of Spain. The fueros are very ancient, and are regarded with jealous affection by the places that possess them. They are mostly of Basque and Gothic origin.

Fuer'te de Andal'gala, town of the Argentine Confederation, in the province of Catamarca, has obtained some importance from the discovery of rich copper-mines in its vicinity. Pop. about 5000.

Fuerteventu'ra, one of the Canaries, lying S. of Lanzarote, from which it is divided by the Strait of Bacayna. Its area is 758 square miles, with 10,996 inhabitants. Cabras, a town on the E. coast, has a good harbor.

Fug'ger, a celebrated German family, now represented by two lines of princes and several lines of counts and "most illustrious counts."—JOHANN FUGGER, a rich weaver of Augsburg in the fourteenth century (d. 1409), was the founder. His descendants became leading bankers, miners, and merchants, and the family was ennobled in 1504. Several were distinguished soldiers and statesmen, and many were liberal patrons of art. The Fuggers are Roman Catholics.

Fughet'ta [It.], in music, a composition in fugue style, but usually shorter, less elaborate, and with more freedom of movement and structure than the regular fugue.

Fu'git, tp. of Decatur co., Ind. Pop. 1630.

Fu'gitive from Jus'tice, one who, having committed a crime within one jurisdiction, flees into another to escape punishment. Between the different civilized nations numerous treaties have been formed providing for the arrest of such fugitives and their delivery to the authorities of the country in which the crime was committed, upon proper demand. A return of criminals fleeing from one State of the Union into another may, in like manner, be effected under the provisions of the U. S. Constitution and the laws of Congress. (A full discussion of this subject will be found under the title EXTRADITION.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fu'gitive-Slave Law. At the time of the adoption of the U. S. Constitution the necessity of making provision for the protection of a right of property in slaves against inter-State interference, as an indispensable prerequisite to the formation of any stable and harmonious union, was generally recognized. Slavery was firmly established throughout a large section of the country, whose inhabitants considered its maintenance as essential to the welfare of their domestic interests and the development of their resources. But unless some restraint were placed upon the legislation of those States in which slavery did not exist, and of those in which it might, at some future day, be abolished, one part of the country, it was evident, might be made a refuge and an asylum for the slaves from another, and their reclamation prohibited. It had been established as a principle of the law of nations that the institution of slavery, being in derogation of natural rights, must be considered as a mere municipal regulation, whose sustentation could only be made obligatory within the limits of the nation in which it existed. The power which would be possessed by any State whose policy was opposed to slavery of taking advantage of this doctrine, and making proclamation of freedom to all slaves coming within its borders, might, and probably would, be employed to incite slaves to flight or insurrection, and rights of property of great value might thus be destroyed. These anticipations were manifestly reasonable in view of the fact that under the previous Confederation the rendition of slaves had generally been secured only with great difficulty, and on some occasions had been found altogether unattainable. Constant strife and animosity would undoubtedly have been the result of leaving the question of slavery to be determined by the legislation of the States themselves, especially since the growing sentiment of the injustice of any form of human bondage would have been a continually increasing motive for its repression. To prevent these probable evils a provision was inserted in the Constitution, at the instance of representatives of the slaveholding States, in the following terms: "No person held to service or labor in one State, under the laws thereof, escaping into another, shall, in consequence of any law or regulation therein, be discharged from such service or labor, but shall be delivered up on claim of the party to whom such service or labor may be due." No reference was made to the existence of slavery in express terms, inasmuch as it was the determination of the convention in which the Constitution was framed that it should contain no direct recognition or legalization of the system; but the desired purpose was attained as effectually as if the word "slave" had been distinctly employed. The understood intention of this provision was that fugitive *slaves* might be reclaimed, and, in the opinion of Judge Story, it was considered so fundamental an article that without its adoption the Union could not have been formed. In the exercise of the constitutional power thus created, Congress in 1793 passed a law providing measures for the recapture of slaves by their masters. Summary proceedings of a ministerial nature were instituted, by which a recovery might be obtained with all practicable expedition, and heavy penalties were imposed for hindering or obstructing a slave-owner or his agent in seizing fugitives and carrying them back again into servitude. The machinery of the courts was put at the disposal of the slave-proprietors to effect the restoration of their property.

In the interpretation of this act by the courts it was decided that the subject of the surrender of fugitives from service was exclusively within the sphere of congressional legislation, and could not be abridged or interfered with by any action on the part of the States; and the provisions in the act were adjudged to be constitutional both by the tribunals of the general government and of some of the States separately. The practical and necessary effect was that the free States were deprived of all power to remedy or stay within their borders practices which were felt to be most serious evils. The clause in the Constitution, it was determined, manifestly contemplated the existence of a positive unqualified right on the part of the owner of the slave which no State law or regulation could in any way qualify, regulate, control, or restrain. "The right to seize and retake fugitive slaves, and the duty to deliver them up, in whatever State of the Union they may be found, is, under the Constitution, recognized as an absolute positive right and duty, pervading the whole Union with an equal and supreme force, uncontrolled and uncontrollable by State sovereignty or State legislation." (*Prigg* v. *Commonwealth of Pennsylvania*, 16 Peters R. 512.) It was held that the owner of a slave was clothed with the authority to seize and recapture him wherever he might be found, without any resort whatever to judicial process, provided the recapture could be made without any breach of the peace or illegal violence. The slave might be retaken upon Sunday or in the night-time, or from a dwelling in which he was under protection; and if the owner were resisted in his attempt to make the capture, he was authorized to use sufficient force to overcome the unlawful opposition. In the first years after the enactment of this law the enforcement of its provisions was accomplished with but little difficulty, since the condition of public opinion was marked by a general uniformity of belief as to the desirableness of slavery as a social institution, and the protection of a master's claim to a fugitive was considered as the maintenance of a lawful right of property. But the great industrial and social development of the free States, together with the influences of a natural feeling of humanity, could not suffer the previous state of opinion to continue. It is not surprising, therefore, that the act of 1793 became difficult of enforcement, and that numerous and sometimes irresistible obstacles were opposed to those attempting to carry its provisions into effect. Hence resulted great resentment and constant irritation at the South, which the earnest appeals of the few advocates of abolition in the free States, and the determined opposition manifested to the extension of slavery to the Territories, served continually to heighten. To preserve their institution, and hoping to effectually overcome the growing tendency to interfere with the means for its protection which had previously been enjoyed, the slave States demanded a more stringent and efficacious law to secure the rendition of escaped slaves. The hostility to slavery had not as yet attained such general extension and acceptance as to prevent this demand from being granted, and in 1850 a new fugitive slave law was passed. As this new enactment contained substantially the same provisions as the law of 1793, as well as more stringent regulations, an exposition of its contents will give a comprehensive survey of the entire legislation for the reclamation of fugitive slaves from the time when the first law upon the subject was passed down to the abolition of slavery during the war of 1861–65. The judicial functions exercised under the act were vested in certain U. S. officers called commissioners, and in the judges of the circuit and district courts and of the superior courts of Territories. Upon the escape of a fugitive his owner or a duly-authorized agent was empowered to obtain from either of these officials a warrant for his apprehension, or to make the arrest without process, provided that were possible. After the arrest the slave was required to be brought before the commissioner or court, in order that the claim of the alleged owner might be summarily determined.

Upon the exhibition of satisfactory proof of the rightfulness of the owner's title by the introduction of testimony or of depositions taken in the State from which the slave had fled, together with proof by affidavit of the slave's identity, of the fact that he owed service to the claimant, and that he had escaped, it was made the duty of the judicial officer before whom the proceeding was instituted to deliver to the owner a certificate stating the substantial facts which had appeared upon the investigation, and authorizing the immediate removal of the fugitive to the State from which his escape had been made. The testimony of the slave himself was declared inadmissible. The final certificate granted was made conclusive of the right of removal, and all power of appeal was denied. Any attempt to prevent an owner or his agent from arresting his slave, or to rescue the fugitive after being taken into custody, or the rendering of any assistance to a slave in making his escape, or the concealment and protection of him with knowledge that he was a fugitive, were declared highly penal, and the slaveholder was also authorized to bring a civil action for damages. All citizens were commanded to aid the proper officers in the execution of the law and in overcoming resistance wherever their services might be desired.

An examination of these various provisions will disclose the immense power with which slaveholders were entrusted. The judicial proceedings were made entirely *ex parte;* efficient safeguards were not provided to prevent the commission of perjury; all right of appeal was prohibited; and citizens who might be inclined to interfere to protect the slave from injustice and violence were deterred by the imposition of heavy penalties. The constitutionality of this law was sustained, and it was adjudged enforceable under like circumstances and in the same manner as had been decided with reference to the previous law of 1793. The evils arising from the severity of the fugitive laws wrought their own remedy, and the excesses committed under them were undoubtedly beneficial in the end. These awoke the North to a clear sense of the enormity of slavery, and were chiefly instrumental in effecting that change of public opinion which culminated in the formation of the Republican party in 1856, and its elevation to supremacy in the national government in 1860. The civil war which followed had slavery as its ultimate cause, and achieved the extinction of slavery as its leading result. The fugitive-slave laws, flourishing as they did in contravention of the civilization of the age, must ever be a painful reminiscence in the nation's past history, but the entire destruction of slavery could never have been accomplished so speedily had not their severity aroused the large masses of the people to indignation and a purpose of resistance.

George Chase. Revised by T. W. Dwight.

Fugue [It., Sp., and Lat. *fuga;* Fr. *fugue;* Ger. *Fuge*], a branch or species of musical composition, in which a certain theme or subject (consisting of a short melodious phrase) is first given out by one of the parts, and then taken up successively by the other parts, elaborately treated in various keys and with various harmonies, with the view of developing its beauty or interest by presenting it in a diversity of aspects and relations. "The designation of *fugue,*" says Albrechtsberger, "doubtless originated from one part apparently *flying* before another, while the pursuing part, or answer, imitates the intervals of the first subject, generally precisely on the fifth above or fourth below, or on the octave above or below." Fugues are written for two, three, four, or more voices or parts, each of which in turn takes up the leading theme, and afterwards continues its course as tributary to the general harmony. Besides the *simple* (*i. e.* a fugue with only one theme or subject) there are also *double* fugues, with two or more subjects. Fugues are also distinguished as *strict* or *free;* fugues in double counterpoint of the octave, tenth, or twelfth, etc.; and others in which the *motion* of the theme is changed into the *reverse* or the *retrograde*, as will be hereafter illustrated. A *choral* fugue is one in the course of which a plain choral song or chant is introduced as a new element, standing out in bold and stately form amid the interworking of the other parts, and giving an air of grandeur and sublimity to the whole composition.

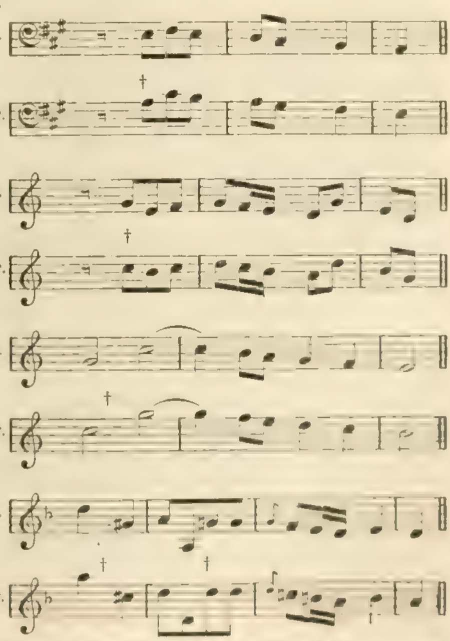
The principal or leading theme of a simple fugue is called the "subject," or "*dux*." The fugue commences with this, either in the bass or some other part, at the pleasure of the composer. The subject thus given out by the leading part is taken up by one of the other parts and in another key (or grade of the scale), usually by the dominant in answer to the tonic, or by the tonic in answer to the dominant. This is called the "answer." Meanwhile the first part proceeds in notes forming an accompaniment to the answer, and for this reason it is called *comes*, or the companion. See this illustrated in Ex. 1, where the comes is given in small notes:

Ex. 1.

The comes may also be so constructed as to form in itself a second *subject*, to be worked out and interwoven with the harmonic web of the fugue in like manner with the principal subject. In this case the composition becomes a *double* fugue, having two leading themes. It is important that the comes should *not* be written in notes equivalent in time to those of the dux or subject, but with shorter or longer notes, or with a different style of movement, in order that the "subject" may be clearly distinguishable from its accompaniment. A fugue subject also should have such strongly marked features, either in time, rhythm, or melody, as to make it distinctly recognizable whenever it recurs in the progress of the fugue. It is desirable also that it should be capable of *augmentation* and *diminution*—*i. e.* of having its notes extended to double their length or contracted to one-half. If the fugue is to contain a *stretto* (or compression), the first notes of the subject should be so chosen as to render this practicable and easy. But of this, and of augmentation, diminution, etc., further notice will be taken presently. In writing a proper "answer" to the theme or subject, certain rules were prescribed by the old masters and very strictly observed. The leading rules were these: that "when the principal subject commences on the tonic (key-note), and ends on it or on its second or third above, the answer is usually written a fifth above or fourth below (which is the same thing) as soon as the first subject is ended, or even before it is completed. When the subject moves from its principal key to the dominant, the answer which follows must move from the fifth to the tonic, and *vice versâ*. When the subject begins and ends in the dominant, the answer must begin and end on the tonic." To carry out these rules, however, it will be found that the answer cannot always be an *exact* imitation of the subject, but will require a change of one or two of its notes, which will thus differ in progression from the corresponding notes of the subject. Hence, a progression of a *second* in the subject may be changed into a *third* in the answer, a fourth into a fifth, a seventh into an octave, and *vice versâ*. The following instances are from Albrechtsberger and Beethoven, and the mark † indicates the change:

Ex. 2.

Subject. / Answer. / Subject. / Answer. / Subject. / Answer. / Subject. / Answer.

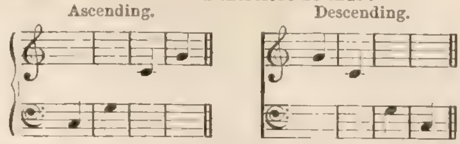


(See also Ex. 1 at the mark †.) Though the observance of these rules seems indispensable in certain cases, yet it is evident that when the subject or theme is the expression of some distinct and well formed musical idea, the arbitrary change of one or more of its intervals must seriously impair its beauty, and produce a kind of antagonism or contradiction between the theme and its response. For this reason modern writers are far less stringent than the ancient masters in enforcing the rules in question, believing that there are other ways of reaching the end proposed, and that the

melody of the theme must not be disturbed except under the stress of great necessity.

The next point is the "exposition," or first entrance of the several parts of the fugue. This is very much at the composer's pleasure, but there is nevertheless a certain discretion to be exercised in determining the order in which the parts shall enter. Theorists agree in this, that "the most usual and beautiful manner of introducing the parts of a fugue is to let them succeed each other in their natural order, ascending or descending, although other introductions are permitted. These successions should occur alternately on the tonic and dominant." In a four-part fugue the natural order would therefore be thus:

Ex. 3.



An instance of the entrance of parts in this order, *ascending*, is given in the next example:

Ex. 4.

The following is a regular *descending* entrance of the parts:

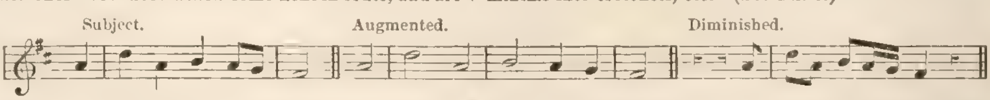
Ex. 5.

In case this natural order of the parts is not observed, it is desirable that the theme should be answered in the part contiguous to it, or most resembling it, as the tenor by the bass or alto, and the alto by the soprano or tenor, thus avoiding the harsh effect and thinness resulting from too great distance and contrast between the subject and the response. For this reason the order of tenor, bass, soprano, and alto, or alto, soprano, bass, and tenor, is preferable to the mixed succession of bass, soprano, tenor, and alto, or soprano, tenor, bass, and alto, etc. When the subject has been taken up by all the parts, and the four threads of the harmony thus prepared for further progress, the ingenuity and skill of the composer and his power of invention are called into action for the interweaving and drawing out of the web in new forms of beauty, graceful excursions into related keys, both major and minor, the judicious "repercussion" or re-entrance of the leading theme in the various parts, the development of every element of interest in it by new harmonic embellishments, contrasts of light and shade in its treatment, imitations, reversions, sequences, and other artistic devices, till the whole structure grows into one consistent form of beauty, symmetrical in its several parts and complete in the unity of its governing idea.

In the progress of the work, the first transition, or change of key, is usually by modulation into the scale of the dominant. The other related keys—viz. the relative minor, subdominant, supertonic, and mediant in *major* fugues, and the relative major, subdominant, submediant, and subtonic in *minor* ones—are those which come next in order, and are used by the composer when and where his course of thought may require them. In modern fugues modulations into various other keys are often made with fine effect, as from C major to C minor, A♭, B♭, E♭, F minor, A major, and even into D♭ and other remote scales. Great judgment, however, is necessary in the use of all extraneous keys in reference to the time allotted them, lest the original key of the fugue should be forgotten or rendered doubtful, and its relations to the transient keys be so disturbed as to impair the unity and final effect of the whole composition. As a mere continuous repetition of the original theme in various keys and parts would soon become monotonous and wearisome, a skilful fugue-writer always avoids this by the use of digressions and other devices, such as the augmentation or diminution of the theme, double-counterpoints, imitations, both simple and canonical, the temporary abandonment of the theme, and a resuming of it only after hinting at it (as it were), and making several trials to grasp it. The stretto and the organ-point also are important elements of interest, the latter, in particular, being often among the grandest features of a well-wrought fugue.

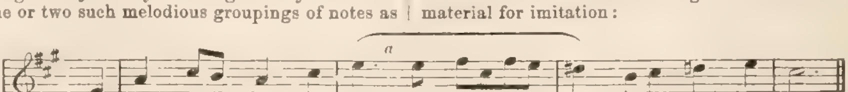
On several of these points it may be expedient to append a brief explanation. The "augmentation" of a theme or subject is (as already said) the extension of its notes to double their original length, as of quavers into crotchets, crotchets into minims, and minims into semibreves. "Diminution," on the contrary, is the contraction of the notes into half their original length, as of semibreves into minims, minims into crotchets, etc. (See Ex. 6.)

Ex. 6.



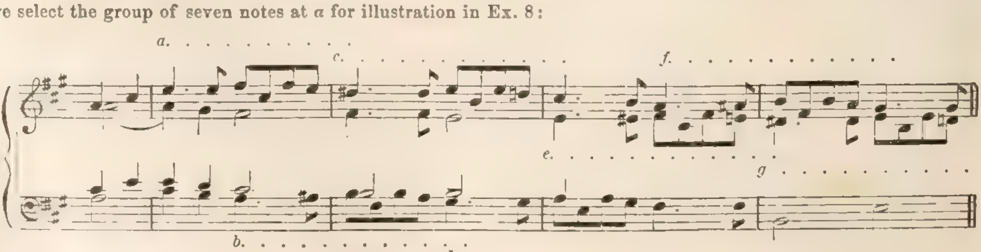
"Imitation," as occurring in the progress of a fugue, is a repetition of a short fragment of melody on different grades of the scale, and by the same part or various parts in succession. A fugue-subject may be so ingeniously formed as to contain one or two such melodious groupings of notes as may thus be separately treated by way of digression or episode. In imitation great exactness is not always required, a strong general resemblance being sufficient in this species of ornament. In the following theme each bar contains material for imitation:

Ex. 7.



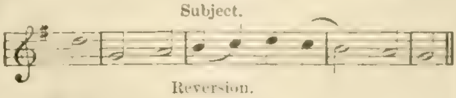
But we select the group of seven notes at *a* for illustration in Ex. 8:

Ex. 8.



Here the group *a* . . . . . is imitated in the bass at *b*, in the soprano at *c*, in the bass again at *d*, in the alto at *e*, in the soprano at *f*, and in the alto again at *g*, the whole forming an outgrowth and playful reinforcement of a single idea or musical thought. "Reversion" is, as it were, the turning of the subject *upside down*, so that the ascending notes now descend, and the descending notes ascend, as in this example:

Ex. 9. Subject.

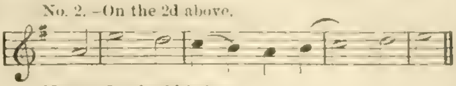


Reversion.

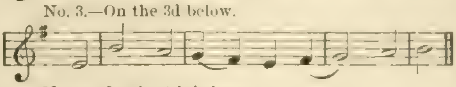
No. 1.

Such reversions may be effected on other intervals or grades of the scale besides that of the original subject, thereby carrying the harmony also into other keys, and producing unexpected variety, thus:

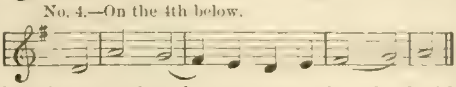
Ex. 10. No. 2.—On the 2d above.



No. 3.—On the 3d below.

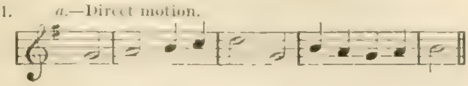


No. 4.—On the 4th below.



Of these four reversions, however, two only—viz. the 2d and the 3d—are in *exact* correspondence with the original in respect to the succession of *whole* tones and *semitones*. These two are therefore called *strict* reversions. The others—viz. the 1st and 4th—are *free*, or less exact in their resemblance to the pattern. The reader may compare the places of the semitones as indicated by the mark ‿. "Retrograde" motion is another of the curious methods resorted to by the old fugue-writers to produce variety, and present their themes in every possible form, even including distortion. Retrogression does not consist in any change of the notes themselves, but in reading the subject (or a portion of it) *backward*, as at *b* in the example:

Ex. 11. *a*.—Direct motion.

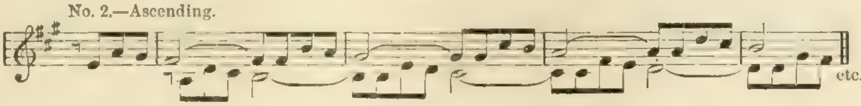


b.—Retrograde.

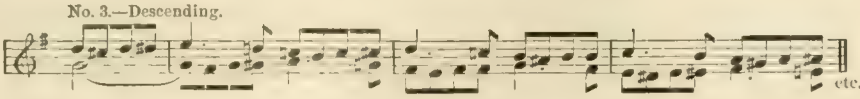
This may also be used as a continuous phrase or period, the latter strain answering the former, or *vice versâ*. Imitations of this sort may, like the preceding "reversions," be used in various keys, and also on various grades of the scale, without change of key. "Sequences" are of frequent use in fugues, and, aside from their own peculiar and often beautiful effects, are better fitted than any other device to give force to a musical thought by clear and pleasing iteration. A sequence is simply a series or chain of notes formed by the repetition (any number of times) of a musical group or melodious figure, with accompanying harmony, the whole rising or falling by regular steps of the scale. The sequence is usually founded on a succession of thirds and sixths (or of chords of the seventh) in equal motion, and may be either diatonic or chromatic. Illustrations of both are seen in the next example:

Ex. 12. No. 1.—Descending.

No. 2.—Ascending.



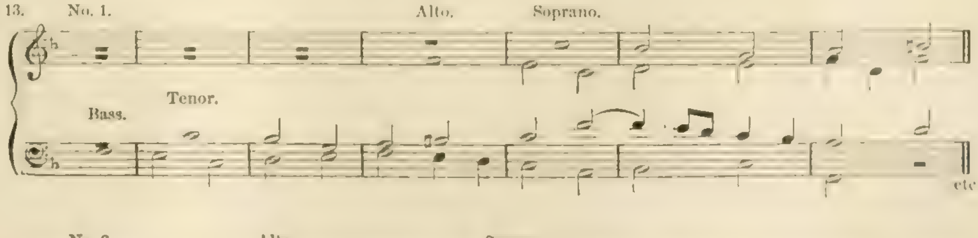
No. 3.—Descending.



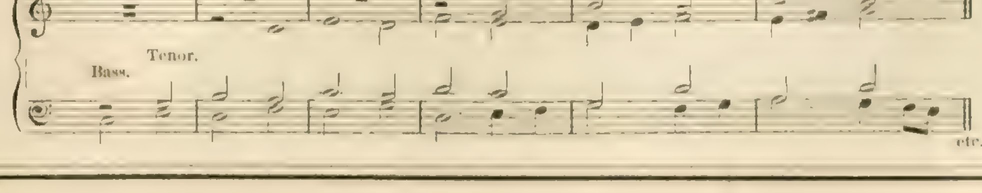
No. 4.—Descending.

Another means of relieving the monotony occasioned by the continual repetition of the theme is the use of *intermediate* or *intervening* subjects—*i. e.* new lines of thought suggested by the principal subject, or calculated to set it off by contrast. Such digressions are often rich in form and ornamentation, and may be so contrived as to convey *hints* of the fugal theme in various keys and relations, thus creating a new interest in it and a longing for its recurrence. The "stretto" generally occurs near the end of the fugue, though many long fugues have more than one stretto. It is formed by the principal subject commencing as at the beginning, and the other parts taking it up in succession at the shortest practicable distance, as of one or two bars, or even less. The following strettos from Albrechtsberger will furnish sufficient illustration on this point:

Ex. 13. No. 1.



No. 2.



No. 3.

The "organ-point," one of the grandest features of the fugue, is "a series of harmonic combinations (chiefly consisting of suspensions) formed over one long-sustained bass-note." (*Beethoven.*) Being, as it were, the culminating point or climax of a long preceding train of harmony, the principal organ-point has its place near the end of the fugue, with the dominant for its bass. After this generally follows a stretto, and frequently another organ-point, founded on the tonic, to extend and embellish the final cadence. The organ-point furnishes room for an almost unlimited display of rich and varied combinations, the unity of which is nevertheless always perceptible, through the restraining effect of the governing bass-note. Specimens of organ-points, both diatonic and chromatic, are given in the example following:

Ex. 14. No. 1. *Wanhal.*

No. 2. *Beethoven.*

No. 3. *Beethoven.*

A full and accurate knowledge of the peculiarities of this species of composition is best acquired by the study and careful analysis of the masterly fugues of Marpurg, Bach, Handel, Albrechtsberger, Cherubini, and other profound writers of this school. WILLIAM STAUNTON.

Ful'co, or **Foulques** (anglicised *Fulk*) **of Neuilly,** one of the greatest pulpit-orators of the Middle Ages, and the chief preacher of the fifth crusade, flourished in the second half of the twelfth century. In the first years of his priestly office he led a life of miserable slackness, if not of gross vice, but in seeking to supplement his imperfect ministerial education by attending the lectures of Peter the Chanter, a theologian distinguished for his piety, Fulco's heart was touched, and he tried to atone for his past life by the severest asceticism. In a coarse cowl and girt with leather he journeyed as a preacher of repentance, and fearlessly condemned the vices of learned and unlearned, high and low. His words wrought such compunction that people scourged themselves, threw themselves on the ground, confessed their sins, and declared themselves ready to reform their lives and redress the wrongs they had done. "Many," says Jacob of Vitry, "inflamed with the fire of love and incited by his example, began to teach and to preach, and to lead not a few to repentance." Such a man was eminently qualified to advance the interest of the crusade movement which was just then being preached by Pope Innocent III. Peter the Chanter had been looked to as the great preacher of the fifth crusade, but his sudden death at the very inauguration of the movement led Innocent to select Fulco, and he was asked not only to preach repentance, but to request men to give proof of penitence by hastening to the land of promise. Fulco promptly complied with the papal commission, and of all "orators who blew the sacred trumpet" he was the most successful. He did not, however, live to see the results of the crusade. He died of fever at Neuilly while the crusaders were still at Venice, in 1201. (See VILLEHARDOUIN, *Histoire de la Conquête de Constantinople* (trans. by T. Smith, London, 1829, 8vo); MILMAN, *Hist. Latin Christianity*, bk. ix. ch. vii.; COX, *The Crusades* (New York, 1874).) JAS. H. WORMAN.

Ful'da, town of Germany, in the electorate of Hesse-Cassel, on the Fulda. Its cathedral, built in the style of St. Peter's church in Rome, is a beautiful and interesting building. Pop. 9339.

Ful'ford (Rt. Rev. FRANCIS), D. D., b. at Sidmouth, England, in 1803; was educated at Exeter College, Oxford, where in 1825 he received a fellowship. He afterwards held prominent positions in the Church of England, and in 1850 became lord bishop of Montreal and metropolitan of Canada. D. at Montreal Sept. 9, 1868. He was an eloquent preacher, and published *Sermons*, *Progress of the Reformation*, etc.

Fulgen'tius (FABIUS CLAUDIUS GORDIANUS), SAINT, bishop of Ruspe in Numidia, "the Augustine of the sixth century," b. at Telepte in Africa 468 A. D., was intended for civil life, but became disgusted with the world and retired to a monastery at Byzacena, and later lived at Sicca. About 500 he visited Rome. On his return to Africa he founded a monastery, and became greatly distinguished for learning and devotion. In 504 he was made bishop of Ruspe, and now became one of the ablest apologists of Catholic Christianity. The Arian Vandals predominating, he got frequently into difficulty, and was twice banished to Sardinia. In 523 a favorable change in the government brought about a recall of Fulgentius and all other expelled bishops, and thenceforward he enjoyed the possession of his see till A. D. 533, when he died. He was renowned for piety, learning, and every virtue. He is commemorated in the Church of Rome on Jan. 1. His writings are mostly against Arianism and Pelagianism. His most important work is *De veritate prædestinationis et gratia Dei*, directed against the Pelagianism of Frustus of Rhegium. Fulgentius explained "the system of Augus-

tine with consistency, but carefully avoided the harsh points of the Predestinarian view." (NEANDER, *Ch. Hist.* ii. 650; cf. HAGENBACH, *Hist. Doctr.*, § 114.) Yet even Fulgentius held in this very work that all unbaptized children, even such as die in the womb, are consigned to damnation. WIGGERS, *Darstellung des Semipelagianismus* (Hamburg, 1833), ii. 356. Editions of his writings: Bâle, 1556, 1566, 1587; Antwerp, 1574; Cologne, 1618; Lyons, 1633, 1652, 1671; best, that of Paris, 1684, 4to; Venice, 1742, fol., and in MIGNE, *Patrologia Latina*, t. lxv. JAMES H. WORMAN.

Fulgentius (FABIUS PLANCIADES), a Latin grammarian of whose life nothing certain is known. He is supposed, from his writings, to have been born or to have lived in Africa about the beginning of the sixth century A. D. Under his name three works have come down to us, which, though written in a slovenly and diffuse style and full of inaccuracies, still have a value in preserving certain details elsewhere omitted. The first of these works is entitled *Mythologicon* or *Mythologiarum libri III.*, of considerable service in the study of ancient mythology, but full of strange explanations. The second is *Expositio Sermonum Antiquorum*, or, more correctly, *De abstrusis Sermonibus*, a brief list of rare or obsolete expressions, with explanations, most of which have no value. The third is *De Expositione Virgilianæ Continentiæ* (contents, subject-matter), or *De allegoria librorum Virgilii*, an allegorical explanation of Virgil's *Æneid*, as representing human life. Fulgentius appears further, from some expressions, to have been a Christian, and is sometimes confounded with Fulgentius, bishop of Ruspe, whose theological writings are extant. (See account of him in preceding article.) Another work has come down to us in part which is ascribed by Teuffel (in his *Hist. Rom. Lit.*) to this Fulgentius, though the name of the author is given as FABIUS CLAUDIUS GORDIANUS FULGENTIUS, and he is generally considered to be distinct from the grammarian and the bishop. The title of the work was *Liber voluminum xxiii. de ætatibus mundi et hominis*, in as many books as the letters of the alphabet, with the trivial intent, apparently, of enabling him to omit in each book one letter. Of the 23, only 14 have been preserved; edited by J. Hommey, Paris, 1696. The works of the grammarian Fulgentius are best edited in the *Auctores Mythographi Latini*, by Van Staveren, Leyden, 1742. (See *Fulgentius de abstrusis Sermonibus*, by Dr. L. LERSCH, Bonn, 1844; LINK, *Der Mytholog. Fulgentius*, Würzburg, 1867; JUNGMANN, in *Ritschl's Act. Soc. Philol. Lips.*, vol. i., Leipsic, 1870.) H. DRISLER.

Ful'gurites [Lat. *fulgur*, "lightning"], tubes of vitrified sand found in sandbanks and sandy soils. They are produced by the intense heat of electrical discharges, which fuses the sand together. (See SILICA.)

Ful'ham, a western suburban parish of London, in Middlesex, on the Thames opposite Putney, and in the Kensington district. It contains an old palace of the bishops of London. Pop. 23,378.

Ful'kerson, post-tp. of Scott co., Va. Pop. 1576.

Full, in music, complete, entire, usually implying loudness. "Full," in church music, denotes those movements or pieces which are to be sung by all the voices in chorus, as contradistinguished from solos, duets, trios, or verse passages. Full *organ* is the loud or great organ, with all or nearly all of its stops in use. Full *swell* is the same in reference to the "swell" of an organ. Full *harmony* is that in which all the parts are complete, without omission of intervals; this requires four parts at the least. Full score is a copy of a composition with all its parts entire.

WILLIAM STAUNTON.

Ful'ler (ANDREW), b. at Wicken, Cambridgeshire, England, Feb. 6, 1754; became the Baptist pastor of Soham in 1775, and in 1782 removed to Kettering; bore a prominent part in the propagation of Calvinistic doctrines of a less extreme type than generally prevailed at that time in his denomination, and was one of the leaders in the revival of the foreign mission work among the English Protestants. Author of *The Gospel Worthy of all Acceptation*, 1784; *Dialogues and Letters*, 1806; *Calvinistic and Socinian Systems Compared*, 1793; *The Gospel its own Witness*, 1800; and of many other treatises. His complete *Works* (8 vols., 1824) have been often reprinted. D. at Kettering, North Hants, May 7, 1815. Fuller's writings are all characterized by intense devotion to "evangelical" Christianity, by vigorous common sense, and by a subtle insight into men and things. He has been styled "the Franklin of theology." An edition of his works in 3 vols. 8vo is published by the American Bible and Publication Society.

Fuller (ARTHUR BUCKMINSTER), b. at Cambridgeport, Mass., Aug. 10, 1822, was a brother of the celebrated Margaret Fuller (Marchioness d'Ossoli); graduated at Harvard University 1843; studied theology at Cambridge Divinity School, and removed to Illinois as teacher and preacher; was pastor of a Unitarian church in Manchester, N. H., 1848–53; in Boston, 1853–59, and then settled at Watertown as a pastor. At an early period of the civil war he volunteered his services, and was appointed chaplain of the 16th Mass. Vols. He exerted a truly wonderful influence among the men, by whom he was greatly loved, not only for his kindness and care, but for his patriotism and fearlessness. At Fredericksburg he accompanied a few companies of his regiment across the Rappahannock under a deadly fire, when he was killed by a sharpshooter Dec. 11, 1862. He was the editor of his sister's works, and was the author of several published discourses.

Fuller (JOHN W.), b. at Cambridge, England, July, 1827, came in 1833 to the U. S. with his father, a Baptist preacher; was a bookseller in Utica, N. Y., and Cleveland, O.; became colonel of the 27th Ohio Volunteers 1861; served (1861–65) with distinction in the Western armies; became a brigadier-general of volunteers 1864, and a division commander in the 17th corps; brevet major-general of volunteers 1865.

Fuller (MARGARET). See OSSOLI.

Fuller (RICHARD), D. D., b. at Beaufort, S. C., Apr. 28, 1804; graduated at Harvard in 1824; became a lawyer when twenty years old, and at once attained great reputation and success. After recovery from a severe illness he united with the Protestant Episcopal Church, but in 1833 entered the Baptist ministry at Beaufort. Since 1847 he was the pastor of the Seventh Baptist church, Baltimore, Md., and was regarded as one of the ablest and most eloquent preachers of his denomination. Author of *Letters on the Roman Chancery* (1840, addressed to Bishop England); *Correspondence on Domestic Slavery* (1845, addressed to Dr. Wayland); a treatise on *Baptism and Communion* (1849), volumes of sermons, etc.; and was one of the editors of the *Psalmist*, a hymn-book. D. at Baltimore, Md., Oct. 20, 1876.

Fuller (RICHARD FREDERIC), brother of A. B. Fuller, b. at Cambridge, Mass., May 15, 1821; graduated at Harvard 1844; became a lawyer of Wayland, Mass., where he d. May 30, 1869. Author of *Visions in Verse*, and a *Life* of A. B. Fuller, 1864.

Fuller (THOMAS), D. D., b. at Aldwinkle, North Hants, England, June, 1608; graduated at Queen's College, Cambridge, with the highest honors; became a master in 1628, fellow of Sidney-Sussex and prebendary of Sarum 1631; was a member of the convocation 1640; was made chaplain to Charles II. in 1660. Through the civil war he was chaplain in the king's army. Author of *David's Hainous Sinne* (a poem, 1631); *History of the Holy War* (1639); *Good Thoughts in Bad Times* (1645; 2d "century" of the same, 1646); *Good Thoughts in Worse Times* (1646); *Mixed Contemplations in Better Times* (1660); *Pisgah-sight of Palestine* (1650); *Holy and Profane State* (1642); *Church History of Britain* (1655), and *Worthies of England* (1662); and a few less important works. His writings are remarkable for quaintness of style, for wit, sagacity, learning, and moral elevation; and the *Good Thoughts*, *Worthies*, *Church History*, and *Holy and Profane State* are English classics. D. Aug. 15, 1661.

Fuller (TIMOTHY), b. at Chilmark, Mass., July 11, 1778; graduated at Harvard in 1801; studied law with Levi Lincoln, and entered upon successful practice in Boston; was a prominent Democratic orator; State senator 1813–16; was in Congress 1817–25; Speaker of the House in Massachusetts 1825, and one of the governor's council in 1828; was the father of Margaret, Arthur B., and R. F. Fuller, and published several orations, speeches, etc. D. at Groton, Mass., Oct. 1, 1835.

Ful'ler's Earth, a greenish-white oolitic clay, chiefly found in Bedfordshire, Kent, and Surrey in England, and at many points on the Continent. From one-fourth to one-fifth of the mass is alumina, the rest chiefly silica and water, with some lime and other ingredients. It was formerly much used by cloth dressers for cleansing the oil from woollen fabrics. Though in part superseded by soap, it is still used to a considerable extent by European manufacturers because it is much cheaper than soap, and if of good quality is scarcely less effective. Cimolian earth and various argillaceous substances share this detergent property.

Ful'lersville, a village of Fowler tp., St. Lawrence co., N. Y., was once the seat of iron works, etc. Pop. 149.

Ful'lerton (WILLIAM), A. M., an eminent lawyer and jurist, was b. at Wawayanda (then a part of Minisink), Orange co., N. Y., May 1, 1818; graduated at Union College, Schenectady, N. Y., in 1838; became a successful lawyer, and was for some time partner of Hon. Charles O'Conor; was appointed one of the judges of the supreme court of New York in 1867, and elected without opposition to fill a vacancy, and held the office until 1868, when he

returned to legal practice in New York City, where he now holds a prominent place in his profession.

Ful'ling, an operation by which fabrics made of carded wool are shrunk, thickened, and partially felted. The woven goods are scoured and boiled (to remove knots and lumps), then soaped very thoroughly, and finally either beaten in the fulling-stocks or passed through great rollers. This operation is much like the previous scouring, except that fuller's earth, hog's dung, and urine are used in the scouring, while soap and hot steam are used in the fulling proper. The fulling process lasts from 48 to 65 hours. When complete, the threads of the cloth are scarcely perceptible, the tendency to unravel is overcome, and the cloth shrinks often nearly one-fourth in length, and sometimes about one-half in breadth. The shrinkage is much less when dyed wool has been used.

Full Power. In diplomacy this name is given to a document emanating from a regular government, and certifying that a diplomatic agent is authorized to conclude a treaty or other diplomatic arrangement with another government. It sometimes forms a part of a letter of credence, but usually is a separate paper. The letter of credence is the introduction of the diplomat to the government to which he is sent. The "full power," which is to be exhibited, but not handed over, shows what he is empowered to do. An important question has long been agitated, whether, if the agent makes a treaty or convention in accordance with his full power, he binds his principal conclusively. (For a discussion of this point we refer to WHEATON'S *Elements*, part iii., §§ 256-263, and to what is said in the article INTERNATIONAL LAW, PART I., under treaties of peace.) T. D. WOOLSEY.

Ful'mar, a name given to several sea birds of the genus *Fulmarus*, web-footed birds that feed upon fish, dead whales, cirripeds, mollusks, etc. The best known is the *Fulmarus glacialis*, fulmar or fulmar petrel of the North Atlantic. This bird is much sought for by the fowlers upon the cliffs of St. Kilda, who gather its eggs (which are highly prized), its feathers and down, and the fish-oil in its stomach, which is commercially valuable. Another species is the *Fulmarus giganteus* of the Pacific, a bird as large as a goose. The genus has been made, by the late George R. Gray, to include thirty-six species, under eleven sections, some of which other authors recognize as distinct genera.

Ful'minates. The fulminates are salts of fulminic acid. Fulminic acid is not known in the free state. Its probable formula is $C_2N_2H_2O_2$. It forms salts with a great number of bases, but only a few of them are of importance.

Fulminating Mercury, Mercuric Fulminate, Fulminate de Mercure, Knallquacksilber.—Fulminating mercury has the composition indicated by the empirical formula $Hg''C_2N_2O_2$. It is best prepared by the action of a strongly acid solution of mercury nitrate upon alcohol. Dissolve 1 part of mercury in 12 parts of nitric acid (sp. gr. 1.3); pour this solution into 11 parts of alcohol of 85 to 88 per cent.; place the vessel containing the mixture over a water-bath until the solution becomes turbid, darkens in color, and begins to show signs of ebullition, giving off dense white fumes; remove it from the bath, and the action will continue with vigorous effervescence and abundant evolution of heavy white ethereal fumes. The solution should not fill more than one-third of the vessel, in order to avoid boiling over. The reaction should be allowed to continue until heavy white fumes are no longer given off, and the solution becomes clear or nearly clear. Fill up with cold water, and on standing a short time the fulminate will settle to the bottom of the vessel. Wash by decantation or upon a filter. If during the reaction red fumes are given off, cold alcohol must be added in small quantities. The operation should be conducted at a distance from a flame or fire, as the fumes evolved are very inflammable. Thus produced, fulminating mercury is a brownish-white crystalline powder. It can be recrystallized from boiling water in white silky needles. Theoretically, there should be obtained from 1 part of mercury 1.42 parts of fulminate, but in practice no more than 1.18 to 1.24 can be produced. Some of the mercury remains in the solution, and some escapes with the vapors. The vapors given off are very complex, containing, besides mercury, a large quantity of nitrous ether (sweet spirits of nitre), nitrogen and oxides of nitrogen, carbonic acid, acetic acid, formic acid, acetic ether, formic ether, aldehyde, etc. Fulminating mercury is only very slightly soluble in cold water, but more soluble in boiling water. It is dissolved by ammonia.

Fulminating mercury is highly explosive, and its explosion is easily brought about. Its explosive action is so sudden that it may be said to detonate. It explodes when heated to 186° C. or if exposed to a strong blow. If between iron and iron, a moderate blow suffices, but if on wood, or between wood and copper, the explosion is accomplished with difficulty. It is fired by contact with strong nitric or sulphuric acid (if perfectly dry), and by a spark from flint and steel or by the electric spark. It is also very sensitive to friction. If wet with water it will not explode, and may be handled with safety. Its explosive force is somewhat greater than that of gunpowder, but its explosion is so much more rapid that its explosive effect is very different; for, while it is more violent than gunpowder, its sphere of action is of very limited extent. Fulminating mercury is therefore of no practical value as an explosive agent in blasting or gunnery, but the readiness with which it may be fired makes it of great importance as a means of causing the explosion of other substances. In addition, experiment has shown that fulminating mercury is especially fitted for this use. All the principal explosive agents in use are more sensitive to it than to any other substance, and under its influence many of them exercise a much greater effect than when fired in any other way. Fulminating mercury is thus used in percussion-caps, primers, friction-primers, fuzes, exploders, etc. In percussion-caps, primers, and friction-primers it is rarely used pure, but is mixed with saltpetre, mealed powder, or other bodies.

Percussion Powder (*U. S. A. Ordnance Manual*).—Drain 2 pounds fulminate on blotting-paper till it retains 20 per cent. of moisture. Add 60 per cent. of its weight of refined, pulverized nitre; thoroughly mix and dry. In the fuzes or exploders largely used for firing nitro-glycerine and its preparations (dynamite, giant powder, lithofracteur, dualin, etc.) and gun-cotton, fulminating mercury, or something nearly equal to it, must be employed in order to obtain the proper effect. It is much the best and safest way to use the fulminate itself. The preparations often used in place of it are more dangerous and less effective. For this purpose the fulminate is used pure, and in quantities of about 15 grains to each exploder.

Fulminating Silver, Argentic Fulminate, Fulminate d'Argent, Knallsilber.—Fulminating silver is prepared like fulminating mercury, silver nitrate being used instead of mercury nitrate. It has the composition indicated by the empirical formula $Ag_2C_2N_2O_2$. The greatest care must be used in its preparation, as it is much more easily exploded than fulminating mercury. Very large vessels must be taken, and in stirring wooden sticks must be used, not glass rods. Fulminating silver can be exploded when wet, although not so easily as when dry. When perfectly dry it explodes on the slightest provocation. It should be kept in paper boxes loosely covered. Its explosion is very violent, but very local.

Fulminates of the other metals may be prepared from fulminating mercury by the appropriate reactions, but no use is made of them. Fulminating copper has sometimes been used in sensitive fuze compositions. (See also EXPLOSIVES, by GEN. H. L. ABBOT, U. S. ARMY.) W. N. HILL.

Ful'ton, county of Arkansas, bordering on Missouri. Area, 658 square miles. The soil is very fertile, though broken into a series of ridges. Corn, wheat, tobacco, fruit, and live-stock are produced. The county abounds in valuable metallic ores, which have, however, not received extensive exploitation as yet. Cap. Salem. P. 4843 (in 1870, since which time the area has been considerably reduced).

Fulton, county in the N. W. of Georgia. Area, 200 square miles. It has the Chattahoochee River on its N. W. side. The surface is uneven, the soil good. Grain is the chief crop. The county has important manufactures, and is traversed by numerous railroads, centring at Atlanta, the county-seat and capital of the State. Pop. 33,446.

Fulton, county in the W. of Illinois. Area, 870 square miles. The Illinois River flows along its S. E. border, and Spoon River intersects the county, which is very fertile and well timbered. Cattle, grain, and wool are staple products. Harnesses, lumber, carriages, and flour are manufactured. There is considerable prairie-land, some water-power, and abundance of coal. The Lewiston branch of the Chicago Burlington and Quincy and the Toledo Peoria and Warsaw R. Rs. traverse the county. Cap. Lewistown. Pop. 38,291.

Fulton, county in the N. of Indiana. Area, 366 square miles. It is traversed by the Tippecanoe and its branches. Its surface is level and well timbered. Cattle, grain, wool, hay, and lumber are abundantly produced. There is much iron ore and good water-power. The county is intersected by the Chicago Cincinnati and Louisville R. R. Cap. Rochester. Pop. 12,726.

Fulton, the south-westernmost county of Kentucky. Area, 200 square miles. The surface is somewhat broken, the soil fertile. Corn and tobacco are the chief crops. The Mississippi River and the Nashville and North-western R. R. furnish abundant means of transportation. Cap. Hickman. Pop. 6161.

Fulton, county of E. Central New York. Area, 541 square miles. It is hilly and rolling, and mountainous in the N. part. Branches of the Mohawk afford abundant water power. The southern part has much fertile land, but is chiefly adapted to pasturage. Cattle, wool, potatoes, dairy products, and hay are the agricultural staples. The manufactures include gloves, mittens, leather, dressed skins, and lumber. Building stone is abundant. Cap. Johnstown. Pop. 27,064.

Fulton, county of Ohio, bordering upon Michigan. Area, 337 square miles. It is a level and fertile region, producing grain, cattle, wool, hay, butter, and cheese. Lumber is sawed extensively. The county is traversed by the Michigan Southern Air-Line and other railroads. Cap. Wauseon. Pop. 17,789.

Fulton, county of Pennsylvania, bordering upon Maryland. Area, 380 square miles. It is mountainous and densely timbered, with fertile soil in the valleys, producing grain and wool. Cap. McConnellsburg. Pop. 9360.

Fulton, post-v. of Hempstead co., Ark., on the Red River and on the Cairo and Fulton R. R., 125 miles S. W. of Little Rock.

Fulton, tp. of Polk co., Ark. Pop. 196.

Fulton, post-v. and tp. of Whitesides co., Ill., at the river terminus of the air-line branch of the Chicago and North-western R. R., and at its junction with the Western Union R. R. The Mendota branch of the Chicago Burlington and Quincy R. R. also terminates here, as will the projected Clinton Lafayette and La Salle R. R. It has direct communication with the Northern and Southern markets both by river and rail, and E. and W. by its railroads. It is also the southern terminus of the Diamond Joe line of steamers, which during the season bring down millions of bushels of grain from Wisconsin, Minnesota, and North-western Ill. and on their return trip take up large quantities of merchandise, agricultural implements, etc. The Diamond Joe line have a large boatyard here. Fulton has 1 newspaper, an excellent graded school, a large elevator, 2 pipe-factories, a stoneware factory, 2 saw mills, 2 carriage-factories, a bed-spring factory, and its lumber interests are very large. The Northern Illinois College is situated here. Pop. of v. 1875; of tp. 2162.

George Terwilliger, Ed. "Fulton Journal."

Fulton, tp. of Fountain co., Ind. Pop. 916.

Fulton, tp. and post-v. of Muscatine co., Ia., on the Chicago Rock Island and Pacific R. R., 16 miles W. of Davenport. Pop. of v. 108; of tp. 1276.

Fulton, tp. of Webster co., Ia. Pop. 106.

Fulton, city of Fulton co., Ky., at the crossing of the Memphis and Paducah and the New Orleans Chicago and St. Louis R. Rs. It has 3 churches, 2 seminaries, 3 benevolent societies, a weekly newspaper, 26 business-houses, and manufactures of wagons, tobacco, flour, lumber, etc. Cotton-ginning and wool-carding are also carried on. Incorporated 1873. J. N. Bolen, Prop. "Gazette."

Fulton, tp. of Gratiot co., Mich. Pop. 1170.

Fulton, post-v., county-seat of Itawamba co., Miss., on the Tombigbee River, at the head of high-water steamboat navigation. Pop. 132.

Fulton, city and tp., cap. of Callaway co., Mo., 15 miles from the Missouri River, on the Chicago and Alton R. R., midway between Jefferson City and Mexico. It is the seat of Westminster College, the deaf and dumb and the insane asylums of the State; also 2 State institutions, male and female, under the control of the Presbyterian Church. It has 2 savings banks and 2 weekly newspapers. Principal business, farming and stock-raising. Pop. 1585; of tp. 4565. J. B. Williams, Ed. "Telegraph."

Fulton, post-v. of Oswego co., N. Y., on the Oswego River, 25 miles N. of Syracuse and 12 miles from Oswego, on the Oswego Canal, Midland R. R. and the Delaware Lackawanna and Western R. R. It has 2 national and 1 savings bank, 2 newspapers, 2 hotels, a good water-power, several flouring-mills, and other manufactories. There are also 7 churches, a first-class seminary, and 5 common school buildings. Pop. 3507. Benner Bros.,

Props. "The Fulton Patriot and Gazette."

Fulton, tp. of Schoharie co., N. Y. Pop. 2700.

Fulton, post-tp. of Davie co., N. C. Pop. 2320.

Fulton, tp. of Fulton co., O. Pop. 1328.

Fulton, tp. of Lancaster co., Pa. Pop. 1888.

Fulton, post-tp. of Clarendon co., S. C. Pop. 1087.

Fulton, a v. of Washington tp., Ohio co., W. Va. P. 333.

Fulton, post tp. of Rock co., Wis. Pop. 2168.

Fulton (Justin D.), D. D., b. Mar. 1, 1828, at Sherburn, Madison co., N. Y.; graduated at the University of Rochester 1851, and at Rochester Theological Seminary 1853; ordained to the Baptist ministry at St. Louis (where he edited the *Gospel Banner* in 1854; settled in Sandusky, O., 1856; Albany, N. Y., 1859; Boston, Mass., 1863; and Brooklyn, N. Y., 1873. Author of *Roman Catholic Element in American History*, *Rome in America*, *Woman as God Made Her*, *Radicalism*, *The Sabbath*, *Life of Timothy Gilbert*, etc. An energetic and able defender of "evangelical" religion, Baptist principles, temperance, and the rights of man; an equally fearless and outspoken opponent of what are known as "woman's rights." J. H. Gilmore.

Fulton (Robert), b. at Little Britain, Lancaster co., Pa., in 1765, of Scotch-Irish stock; went to Philadelphia when seventeen years old, and practised the art of miniature-painting there and in New York with such pecuniary success that he was soon able to purchase a farm for his mother's support, whereupon he went to London and became a pupil of West; and throughout life he retained his early fondness for art, in which he from time to time made attempts, the fruits of which, in some instances, still exist, and show that Fulton had very considerable power and capacity as an artist. In England he met with the duke of Bridgewater, the father of the English canal system; with Lord Stanhope, an enthusiastic mechanician; and with Watt, the inventor of the steam-engine; and by their direct or indirect influence his attention was turned strongly to mechanical invention, his true field of labor. His machines for marble-sawing, rope-making, flax-spinning, and removing earth from excavations soon after appeared. His *Treatise on the Improvement of Canal Navigation* (1796), and a series of essays on canals, were followed by a British patent for canal improvements, consisting chiefly in the substitution of inclined planes for locks. He resided in Paris 1797–1806, and there brought forward a submarine torpedo-boat for maritime defence, which was successively rejected by the French, the British (1805), and the U. S. governments (1810). In 1803 he undertook the construction of a steamboat on the Seine, having in 1793 addressed a letter upon the subject to Lord Stanhope, himself an experimenter in steam navigation. Fulton (in 1803), in company with Henry Bell, the first successful British steam navigator, visited the Clyde, where Symington's Charlotte Douglas, a steam canal towboat, was then plying. But Fulton's Seine experiment was but partly successful. Aided, however, by Chancellor Livingston, then U. S. minister in France, he purchased (1806) a powerful Boulton and Watt engine and shipped it to New York, where, after careful study of the defects and merits of previous attempts in the same direction, he built and launched (in 1807) the Clermont, his first successful steamboat, which, however, attained a speed of only five miles an hour when going up the North River. His first U. S. patents (1809 and 1811) covered only some points regarding the attachment of the paddle-wheels to the axle of the crank, and throughout life Fulton was involved in lawsuits with parties infringing upon his claims. He constructed many steamboats, ferry-boats, etc., among the most remarkable of which was the U. S. steamer Fulton the First (built 1814), the first war-steamer ever constructed. From mistakes in her model she never attained much speed, and in 1829 was blown up by accident. Fulton d. at New York Feb. 21, 1815. Fulton's great merit was his persistency in the belief that steam navigation was a *desideratum* of American commerce. Millar's successful double boat of 1788 was a plaything; Symington's towboat of 1803 was not adapted to its special purpose of canal service; John Fitch's machinery had fatal errors of construction; and of the many other previous experiments with steam as a motive-power for vessels, all the rest were clear failures. Fulton and Fitch alone, up to that time, labored in this field of experiment with a fixed and serious purpose. C. W. Greene.

Fulton (William S.), b. in Cecil co., Md., June 2, 1795; graduated at Baltimore College in 1813; served as a volunteer in the war of 1812; became the secretary of Gen. Jackson in Tennessee; studied law; was the first Territorial secretary of Arkansas; governor of Arkansas 1835–36; U. S. Senator 1836–44. D. at Rosewood, Ark., Aug. 15, 1844.

Ful'tonville, post-v. of Montgomery co., N. Y., on the S. side of the Mohawk River, 40 miles W. of Albany on the Erie Canal. It has a steam elevator, a steam foundry and machine shop, 4 steam mills, 2 churches, flourishing schools, 2 hotels, several stores, a weekly newspaper, and is connected with Fonda, the county-seat, and the Central R. R. depôt by an iron bridge costing $50,000. Pop. 1117.

T. R. Horton, Ed. "Montgomery Co. Republican."

Ful'via, a Roman lady, daughter of M. Fulvius Bambalio, was the wife of P. Clodius, by whom she had a daughter, Clodia, afterwards wife of Augustus. After the murder of Clodius, she married C. Scribonius Curio, and her

third husband was Mark Antony, whom she loved sincerely, and for whose sake she abandoned the dissolute habits of her earlier life, entering heartily into his ambitious plans, and behaving with great cruelty to his enemies. When her husband was dallying with Cleopatra she created an insurrection for the purpose of recalling him, but was driven from Italy. At Athens she met her husband, who treated her with great harshness, whereupon she retired to Sicyon, and soon after d. of chagrin (B. C. 40), and Antony married Octavia, sister of the future emperor Augustus. Fulvia left two sons by Antony.

Fumiga'tion [Lat. *fumigatio*, from *fumus*, "smoke"], (1) the application of fumes, gas, or vapor to purify clothing, goods, or apartments supposed to be imbued with some infectious or contagious morbific matter. This may be effected by hot air, strong oxidizers, ozone, chlorine, permanganates, vapors of nitric, chlorhydric, sulphurous, or carbolic acids, which destroy the effluvia by decomposing them chemically, and substituting harmless compounds, or by extinguishing cell-life in the cryptogamic and infusorial organisms, which, in some instances at least, constitute the infection. The process of deodorizing by burning fragrant pastilles, coffee, etc., or by vaporizing vinegar or other powerfully odorant substances, simply disguises or overpowers, but does not neutralize, the objectionable effluvia. (2) The act of applying smoke or vapors medicinally. Thus, stramonium, benzoin, the sulphide or oxide of mercury, etc. are used as fumigations in affections of the throat and lungs, and are introduced either by diffusing the vapors through the air to be respired or by means of cigarettes and pipes in which the medicines are "smoked." The introduction of nitrous oxide gas, ether, chloroform, etc., as for anæsthetic purposes, is appropriately termed *inhalation*. SAMUEL ST. JOHN.

Fu'mitory, the *Fumaria officinalis*, a weed of Europe, now naturalized in the U. S., belonging to the order Fumariaceæ. Its name is from the Lat. *fumus*, "smoke," referring to the odor. It is a rather handsome herb, with a strong, disagreeable taste. Its sap abounds in saline matter and a principle called fumarin. Fumaric acid is also reported to be found. This herb is in parts of Europe valued as a tonic, diaphoretic, and aperient, and is esteemed for the treatment of skin diseases. The climbing fumitory of the U. S., called also mountain fringe, is a delicate biennial, the *Adlumia cirrosa* (order Fumariaceæ), which is very fine in cultivation when trained in a shady place upon latticework.

Funchal' [Port., "place of fennel"], the capital of the island of Madeira, situated on its southern coast. It is a handsome place, with a good harbor, and the centre of the wine-trade of the island, and is a bishop's see. Lat. 32° 37' N., lon. 16° 54.5' W. Pop. 18,161.

Funck, or **Func'cius** (JOHN NICHOLAS), a distinguished Latin scholar, b. at Marburg Mar. 29, 1693; appointed in 1730 professor of eloquence and librarian in the academy at Rinteln, at which place he d. Dec. 17, 1777. His chief contribution to classical learning is a history of the Latin language, which he divides into periods corresponding to the different periods of man's life, to each of which a separate treatise is devoted. The titles and dates of publication are—1, *De Origine Latinæ linguæ tractatus* (Giessen, 1720; 2d ed. Marburg, 1735); 2, *De Pueritia Latinæ linguæ* (Marburg, 1720); 3, *De Adolescentia ling. Latinæ* (ib., 1723); 4, *De Virili Ætate ling. Latinæ*, in 2 parts (ib., 1727–30); 5, *De imminenti linguæ Latinæ Senectute* (ib., 1736); 6, *De Vegeta ling. Lat. Senectute* (ib., 1744); 7, *De inerti et decrepita ling. Lat. Senectute* (Lemgo, 1750). Besides these, Funccius published the fragments of the *Laws of the XII. Tables* (Rinteln, 1744), a volume of academic dissertations, and several minor works.

H. DRISLER.

Func'tion [from the Lat. *fungor, functus*, to "perform"]. One quantity is said to be a function of another when it is so connected with it that no change can be made in the latter without producing a corresponding change in the former. (See CALCULUS.) Thus in the equation $y^2+x^2=R^2$, y is a function of x, and x is a function of y. When two varying quantities are connected by an equation, either may be taken as the function, and the other is then called the independent variable. The fact that two varying quantities are so related that one can be regarded as a function of the other may be expressed by the following notation: $y=f(x)$, $x=f'(y)$, $f(x,y)=0$. The first of these expressions indicates that y is some function of x; the second, that x is some function of y; and the third indicates a functional relation between x and y, without specifying which is the function, or which the independent variable. A quantity is a function of two or more variables when it is so connected with them that no change can be made in either of the latter without producing a corresponding change in the former. Thus, in the equation $x^2+y^2+z^2=R^2$, y is a function of x and z; z is a function of x and y; and x is a function of y and z. The fact that a quantity is a function of two or more variables may be expressed by functional equations like the following: $y=f(x,z)$, $z=f(x,y)$, $f(x,y,z)$. The first shows that y is a function of x and z; the second, that z is a function of x and y; and the third shows that x, y, and z are so related that any one may be regarded as a function of the other two.

Geometrical Representation of Functions.—Every function of one variable may be represented by the ordinate of a curve whose abscissa is the corresponding value of the independent variable. For, let $y=f(x)$, and suppose x to have in succession every value from $-\infty$ to $+\infty$; for each value of x there will be one or more values of y, either real or imaginary; each real value of y and the corresponding value of x will be the co-ordinates of a point, and these points, taken together, will constitute a curve whose equation is $y=f(x)$. This curve is called the curve of the function. In like manner, every function of two variables may be regarded as the ordinate of a surface whose abscissas are the corresponding values of their variables. If $z=f(x,y)$, we may assign values at pleasure to x and y, and these, together with the corresponding value of z, will be the co-ordinates of a point of the surface represented by the given equation. If we suppose y to remain constant whilst x assumes every value from $-\infty$ to $+\infty$, the given equation will represent a section of the surface by a plane parallel to the plane xz, and at a distance from it equal to the assumed value of y; if we suppose x to remain constant whilst y varies, the given equation will represent a section of the surface parallel to the plane yz, and at a distance from it equal to the assumed value of x.

Classification of Functions.—Functions are divided into two classes—*algebraic* and *transcendental*. Algebraic functions are those in which the relation between the function and the independent variable may be expressed by means of the ordinary operations of algebra; that is, *addition, subtraction, multiplication, division, raising to powers denoted by constant exponents*, and *extraction of roots indicated by constant indices*. Thus, in the expressions $y^2=2px^3+\sqrt{x}$, $y=x^2-3\sqrt[5]{x}$, y is an algebraic function of x. Transcendental functions are those in which the relation between the function and the independent variable cannot be expressed by the ordinary operations of algebra. Thus, in the expressions $y=\log x$, $y=\sin x$, y is a transcendental function of x. Transcendental functions may be *logarithmic, exponential*, or *trigonometric*. Logarithmic functions are those in which the relation between the function and variable are expressed by means of logarithms, as $y=\log x$; exponential functions are those in which the variable enters an exponent, as $y=e^x$; trigonometric functions are those in which the relation between the function and variable is expressed by means of some trigonometrical element, as $y=\sin x$. Trigonometrical functions are also called circular functions.

Functions are either *explicit* or *implicit;* explicit functions are those in which the value of the function is directly expressed in terms of the variable, as $y=mx+nx^2$; implicit functions are those in which the function is not directly expressed in terms of the variable, as $ay^2+bx^2+c=0$; in this case the value of y can be found by solving the equation which contains it. Implicit functions are sometimes expressed by two or more equations, as $y=f(z)$ and $z=f'(x)$; in this case y is an implicit function of x. Functions are *increasing, decreasing*, or *periodic;* an increasing function is one that increases as the variable increases, as $y=\sqrt{2px}$; a decreasing function is one that decreases as the variable increases, as $y=\frac{a}{x}$; a periodic function is one that increases and decreases alternately as the variable increases, as $y=\sin x$. If the independent variable increases uniformly, equal values of the function recur at equal intervals; thus, in a cycloid of an infinite number of branches, equal ordinates of the ascending or of the descending portion recur at intervals that are separated by the length of the generating circumference. All the trigonometric functions are periodic. The differential of a function is the result obtained by subtracting any state of that function from its consecutive state; hence, the differential of an increasing function is *positive*, and the differential of a decreasing function is *negative*. Functions may be *continuous* or *discontinuous;* a continuous function is one in which the difference between any two consecutive states is less than any assignable quantity, as $y=\sin x$; a discontinuous function is one in which the difference of two consecutive states may be greater than any assignable quantity, as $y=\tan x$. If we suppose x to increase uni-

formly from 0 to ∞ in the equation $y = \sin x$, the value of y will increase continuously till $x = \frac{\pi}{2}$; it will then decrease continuously till $x = \frac{3}{2}\pi$; it will then increase continuously till $x = \frac{5}{2}\pi$, and so on, giving a continuous periodic function; if we suppose x to increase uniformly in the equation $y = \tan x$, the value of y will always increase, but when the value of x passes through the values $\frac{\pi}{2}$, $\frac{3\pi}{2}$, $\frac{5\pi}{2}$, etc., the value of y will change from $+\infty$ to $-\infty$, giving a discontinuous periodic function. The law of continuity is the basis of many of the principles employed in the general theory of numerical equations. The principle of discontinuity accounts for many singular solutions in the higher mathematics.

Interrupted functions are those that are interrupted in value as the variable increases; that is, they are functions in which certain values of the function have no consecutive states. Thus, in the equation $y = ax^2 \pm \sqrt{x \sin^2 x}$, the values of y are real for all positive values of x, and imaginary for all negative values of x, except those that reduce $\sin x$ to 0, that is, for those values of x that are equal to some multiple of π. The function y is therefore interrupted between $x = -\infty$ and $x = 0$, and it is continuous between $x = 0$ and $x = +\infty$. The curve of this function consists of two parts; the part on the left of the origin is made up of a series of disconnected points lying on a parabola whose equation is $y = ax^2$, and whose abscissas are equal to $n\pi$, n being successively equal to $-1, -2, -3$, etc.; the part on the right of the origin is made up of a series of links, such that all chords parallel to the axis of y are bisected by the parabola whose equation is $y = ax^2$. These links touch each other at points on the diametral parabola whose abscissas are equal to $n\pi$, n being successively equal to 1, 2, 3, etc. Functions are *direct* or *inverse*. If two variables are so connected that they vary together, we may regard the *first* as a direct function of the *second;* in which case the *second* is an inverse function of the *first*. Thus, if we regard the *sine* as a direct function of the *arc*, we must regard the *arc* as an inverse function of the *sine*. These relations are expressed by the symbols $y = \sin x$ and $x = \sin^{-1} y$. The latter expression is read *x is the arc whose sine is y*. The following table exhibits the forms to which all elementary functions of one variable may be reduced. They are arranged in pairs, each pair being correlative, so that if one is regarded as direct, the other is its inverse form:

1st pair	$y = x + a$	Sum.
	$x = y - a$	Difference.
2d pair	$y = ax$	Product.
	$x = \frac{y}{a}$	Quotient.
3d pair	$y = x^m$	Algebraic power.
	$x = \sqrt[m]{y}$	Algebraic root.
4th pair	$y = a^x$	Exponential.
	$x = \log y$	Logarithmic.
5th pair	$y = \sin x$	Direct circular.
	$x = \sin^{-1} y$	Inverse circular.

Certain definite integrals, from constant use, are coming to be considered as elementary functions. W. G. PECK.

Func'tus Offic'io [Lat., "having discharged a duty"], a term applied in law to some person whose legal functions in a special instance have been exercised and thereby terminated, or to some instrument which has been put to its appropriate use and has thus spent its force. When an agent has fulfilled all the duties laid upon him, he is *functus officio*. So is a bill of exchange upon which payment has been made, or a warrant which has been used in the arrest of a prisoner. GEORGE CHASE. REV. BY T. W. DWIGHT.

Fundamen'tals [Lat. *fundamentum*, the "foundation"], or **Fundamental Articles of Faith,** those doctrines which are involved in the right of a system to exist—its foundation. It is a relative term, and when a doctrine is asserted to be fundamental a necessary question always is, To *what?* It is also expressive of degrees of necessity, and allows of the questions, In what respect? How far? It is therefore never a defining word till it has been defined. There may be a perfect agreement on the general sense of the word, and a total diversity as to the propriety of its application. Fundamentals are more or less generic as that to which they are related has more or less of the generic in it. If a doctrine be conceded to be fundamental to Christianity, it must be held by every one entitled to the name of Christian. But each body has doctrines fundamental to its system which are not held by the entire Christian Church. Fundamentals have been divided into (1) primary, the explicit knowledge of which is necessary to salvation, and as (*a*) constituent, (*b*) conservative, either as antecedent or consequent; and (2) secondary, implied in the first. Involuntary ignorance of the secondary does not remove the foundation of salvation, but denial of them does. The doctrine of fundamental articles has been most agitated in the earliest and latest efforts to unite the Lutherans and the Reformed. C. P. KRAUTH.

Fundamental Bass, in music, the lowest term of a chord when that chord is in its original or natural form—the root or tonic as contradistinguished from the bass of *inverted* chords.

Fundamental Chord. 1, a chord in its original or normal form, not inverted; 2, a chord not accidental, anomalous, derived, etc., but essential and indispensable; as, *e. g.*, the major and minor triads and the chord of the seventh.

Funds, The Funding System, Sinking Fund. National debts are composed generally of successive loans which have been negotiated at different periods. These may not carry a uniform rate of interest or have the same date of maturity, but the debt as a whole, including all its divisions, is characterized as *the public funds*. The funding of a debt consists in dividing it into parts or shares, which are represented by certificates, and on which interest is paid to the holder. These certificates are known as stock or bonds, indifferently. No way has ever yet been invented by which certain branches of civil service can be carried on without the levying of a tax and the necessary appendage of a public treasury. The trite proverb, "What is everybody's business is nobody's business," contains the precept of municipal administration in contrast with individual direction. There are many branches of social economy which by their nature are beyond the scope and power of private management, as the laying out of high-roads, the supply of wholesome water in cities, lamps, police, and the support of the tribunals of justice. Advancing to matters of national concern, such as the common defence and those improvements of transportation which are the correlatives of natural resources and the common basis of material development, it is manifest that a public treasury and public legislation and administration are the inevitable steps of social improvement, and hence the constitution of public credit, whereof the funding of debt is a necessary consequence. Although national debts have generally originated in the emergencies of war, this fact has no logical connection with their administration, which for the greater part is in the interests of peace. There are no extremes of social necessity which do not carry with them or develop mitigations of a compensating kind. Thus, with all the impressions of the late civil war in the U. S. fresh in the national mind, and many of its calamities yet unrepaired, the burden of the debt is held to be light in contrast with the benefits of a renewed civil constitution, which ensures a higher national life in the future, and a foundation of material prosperity which was impossible under the old laws. The most opposite opinions have prevailed among statesmen and economists concerning the nature of a public debt, of which the principle of funding is the vital element. Some of the old British writers have maintained that "debt and wealth are synonymous"—that "increase of debt is a true increase of riches." Others hold the opposite theory, that "poverty, misery, and the national debt are synonymous terms." The fact that a government bond, representing a certain portion of the national debt, and bearing interest, is convertible into money, or capable of being used like money as a medium of exchange, is the source of the error that it is *de facto* the equivalent of money, and of the plausible deduction that national debt is money. This delusion disappears when we reflect that the property of the country is annually reaped over, and a great harvest of its productions appropriated to the payment of yearly interest on the bond, and finally to the redemption of the principal. It is to be observed, however, that there is no logical connection between the origin of a national debt and the uses to which the bonds based on it are applied. That the documents representing a debt may be used as money, and may be made subservient to the public good by the improvements which are effected by such use, is a simple proposition, and demonstrably true. A nation may advantageously incur debt for the maintenance of its harbors, and thence may follow direct commercial benefits far outreaching the cost. The whole question of funding is therefore a question of discretion on the part of the legislature. Many eminent writers—and among them, Adam Smith—fall into the error of repudiating the whole system of funding, because of the abuses which have been associated with it, and especially the facility of increasing a national debt and oppressing the people by taxes. But, notwithstanding all such abuses, the balance of benefit is on the side of funding, which is no more than to say that national

credit, wisely administered, is a source of wealth and prosperity to a country. There are no examples in history of successful and advanced national development without it. Before the introduction of the funding system into England the financial history of the British government was a history of continuous fraud and dishonesty. Richard I. pawned the revenues of the kingdom to pay the expense of the crusades to the Holy Land; Henry III. pawned the crown jewels and regal ornaments and robes of state to raise money; Richard II. was deposed for extorting £1,100,000 from his subjects on false pretences; the two Edwards, I. and III., and the two Henrys, IV. and VIII., defrauded their creditors of immense sums. In the reign of Elizabeth the people demanded repayment of the money borrowed by her predecessors, and obtained it. At Cromwell's death the debt of the kingdom was £2,474,290, of which the creditors were defrauded by Charles II. on the Restoration, excepting £664,226, on which interest was allowed. This was the beginning of the present debt. William III. introduced the system of funding, which originated with the republics of Venice and Genoa, and it has remained essentially unaltered to the present day. In its usual administration, in the U. S. as well as in England, it is open to question whether it is entirely just towards the creditor. If it be clearly understood beforehand that a government has the right to take advantage of a peculiar state of the market, and to replace any part of its debt at a lower rate of interest, although such a proceeding might partake somewhat of the nature of repudiation, yet, as the creditor is forewarned, no moral default could be charged on the government; but a strict regard for equity would seem to demand that the creditor should have a corresponding right when the market changes back to its former condition. To reduce his income is to deprive the creditor of a part of his capital. The transactions of the British exchequer following the peace of 1815 furnish a striking example of the possibilities of financial administration in emergency. In consequence of the rise of public securities the interest on exchequer bills was reduced (1817) from 5½ to 3½ per cent.; and while only the sum of £3,000,000 was added to the debt, more than £23,000,000 were cancelled. Another operation was to convert 3 per cent. stock into 3½ per cents., whereby the holders of the former were induced to buy into the latter at an advanced price. The result was an increase of £3,000,000 in the debt, while more than £19,000,000 were cancelled (1818). Another measure was the reduction of 5 into 4 per cents. The bank, co-operating with the exchequer, increased its circulation of bills, and lowered the rate of interest from 5 to 4 per cent. By this stroke the sum of £140,250,828 of 5 per cents. was converted into £147,263,328 of 4 per cents., at a yearly saving of £1,222,000 interest and scarcely any increase of the debt. In 1824, 4 per cents. to the amount of £76,806,852 were changed into 3½ per cents., with no change of the capital. Such transactions as these do not heighten our esteem for the rules of administration of national debts. They betray shortsightedness in the managers. The true principles of fiscal policy are such as give permanency and unfaltering confidence in the government, which is the best preparation for emergencies in the future, and of vastly greater consequence in the end than any transient gains by tricks which are more befitting gamblers on the street-corner than the representatives of a great nation.

Sinking Fund.—The first regular plan for the gradual extinction of the national debt of Great Britain was a sinking fund, proposed by the earl of Stanhope, and adopted by Sir Robert Walpole in 1716. The operation of the plan was not encouraging. The payments in liquidation of the debt from 1716 to 1728 amounted to £6,648,000, and the increase of the debt for supplies was about the same. It was found to be much easier to lay hands on the accumulated fund than it was to negotiate new loans, which meant the imposition of new taxes. The plan of holding the fund inviolable for the purpose of liquidation was soon abandoned. In 1733 began the regular practice of resorting to it for the supplies of the year whenever there was a deficiency in the general accounts. In 1792, when the war with France began and new loans became necessary, a sinking fund of 1 per cent. was created on the nominal sum of each loan, which was expected to redeem it in forty-five years. But in the succeeding years loans to the amount of £86,796,375 were contracted without any provisions for their discharge. In fact, it was already apparent that the sinking fund was a delusion and a snare. It was likely to be seized in case of emergency, without the least regard to the end for which it was created. After many experiments and modifications it was finally abandoned in 1828, as a stated part of the financial system, by act of Parliament, which declared that for the future "the amount of the sinking fund be the actual surplus of the revenue over the expenditures." But the same kind of financial tricks already described were continued on one pretence or another. In 1829, debt to the amount of £4,900,000 was created, giving a reduction of £6,000,000; in 1830 the sum of £154,000,000 was added to the debt, and a reduction of capital effected of £168,000,000. This was at the expense of the public creditors. To tell the plain truth, it was nothing less than repudiation. Notwithstanding these facts—which have long been matter of authentic history—the delusion of the sinking fund has been adopted in the U. S., and is pursued with all the seriousness of children who endow their dumb toys with life and understanding. While it is allowed that some advantage may be gained by combining in one sum the remainders of appropriations which would otherwise lie dead and fruitless, and funding them on interest, it is apparent beyond all dispute that the rule adopted by the British Parliament is the true one—viz. that the only actual sinking fund is in the surplus of revenue over expenditures. Everything else for purposes of liquidation is a delusion and a snare.

J. S. GIBBONS.

Fun'dy, Bay of [once called *Fundy Bay*, a corruption of the Fr. *fond de la baie*, the "Head of the Bay," which is a name still given to the upper part of the Bay of Fundy], an arm of the Atlantic extending N. E. between New Brunswick on the N. W. and Nova Scotia on the S. E. Its N. E. extremity divides into two parts—Chignecto Channel, the north-westernmost, itself dividing into Shepody Bay and the Cumberland Basin, the latter reaching to within 13 miles of Northumberland Strait, from which it is intended that a canal shall be cut; the N. E. arm of the bay is composed of Minas Channel and Basin and Cobequid Bay. Spring tides, in parts of the Bay of Fundy, have been known to rise over 70 feet, and come pouring in like an immense *bore*. The funnel-shaped and rapidly narrowing entrance to the bay enables a disproportionately long tidal wave to enter, and as it becomes narrower and shallower the height is necessarily increased. The remarkable tidal peculiarities render navigation dangerous, except to navigators who are familiar with it. Its fisheries are of great importance.

Fü'nen, or **Fuhnen** [Dan. *Fyen*], next to Seeland, the largest of the Danish islands, separated from Seeland by the Great Belt and from Jutland by the Little Belt. Area, 1123 square miles. Pop. 182,816. It is low, but hilly, partly covered with forests, and very fertile. The principal towns are Odense, Svendborg, and Nyborg.

Fu'neral, Funeral Rites [Lat. *funus, funeris*, a "dead body"]. The disposal of the bodies of the departed has in all ages and in nearly all countries excited a profound interest in the living. The two principal modes which are and have been observed are *burial* in the earth or sea, and *cremation*, incineration or burning. Burial has been practised from remote pre-historic times, as is shown not only by the most ancient existing records, but by the examination of cairns and sepulchral mounds in many countries. Burials are either in graves, in which the body (usually either enclosed in a coffin or cist, or among ruder peoples simply wrapped in grave-clothes) is covered directly with the earth, or it is placed in a subterraneous chamber called a vault, tomb, or sepulchre. The *embalming* of dead bodies (see EMBALMING and MUMMY) is a process anciently very prevalent in Egypt and some other countries preparatory to burial. Burial in the sea takes place from ships which are too far from the land to permit interment to take place. The body, placed in a suitable canvas sack, is (very commonly after the reading of the short and impressive burial-service of the Anglican Church) committed to the sea, shot or other suitable weights being attached to the feet. Burial in the earth is usually accompanied by ceremonies prompted at once by affection and by the religious faith and sentiments of the friends of the deceased. Masses and requiems are prescribed in the rituals of some Christian churches; eulogies, elaborate *oraisons funèbres*, or formal sermons are pronounced at or soon after the funerals of distinguished persons; but more commonly in Protestant communities a simple liturgical service, or a still less formal scriptural reading, followed by a few words of sympathy and religious counsel, with a prayer for the living friends, completes the service. Music is not universal at funerals; when used it is either in a minor key and expressive of grief, or of a kind intended to inspire hope and religious faith. A simple bier, or, in the case of public characters of distinction, a more or less imposing catafalque or hearse is employed for the support of the coffin; and funeral cars (also called hearses) are almost uniformly employed in carrying the dead to the grave. The custom of having hired mourners to bewail the dead is at present prevalent chiefly in the East. The *hearse*, in strict language, is the candle-frame used in Roman Catholic ser-

vices for the support of burning tapers. (For an account of places of burial see CEMETERY, by JOHN JAY SMITH.) The dead are almost always buried in the supine position, very commonly with the head toward the E.—a custom which may have a religious significance, but which prevailed to some extent among the aborigines of North America. Some of these peoples, however, like the Kaffirs, buried the dead in the sitting posture—a custom which was once common in the south of Britain, as is shown by the examination of sepulchral mounds referred somewhat doubtfully to a pre-historic age. Recent observers have discovered in North Carolina graves in which the dead were placed very near the surface of the ground, and covered with soft clay, which was afterwards hardened by fire. Many Western aboriginal tribes suspended their dead in trees or placed them upon raised platforms—a practice which may have been designed to keep them from ravenous beasts. Some Indian tribes carry the bones of the dead with them on their migrations; others have the greatest horror of ever speaking of the dead; while among some tribes there prevails a system of ancestral worship which recalls that so prevalent in China, and a solemn dance is held yearly at the burial-place. The Parsees expose their dead until the kites and vultures have removed the soft tissues, when the bones are placed in an ossuary. A very similar practice obtains among some wild South American tribes. In many European monasteries there are ossuaries for the bones of the deceased brothers. Burial is believed to have prevailed quite as extensively in ancient Greece as burning did; and it was undoubtedly far more prevalent in Rome than burning until a comparatively late period of the republic.

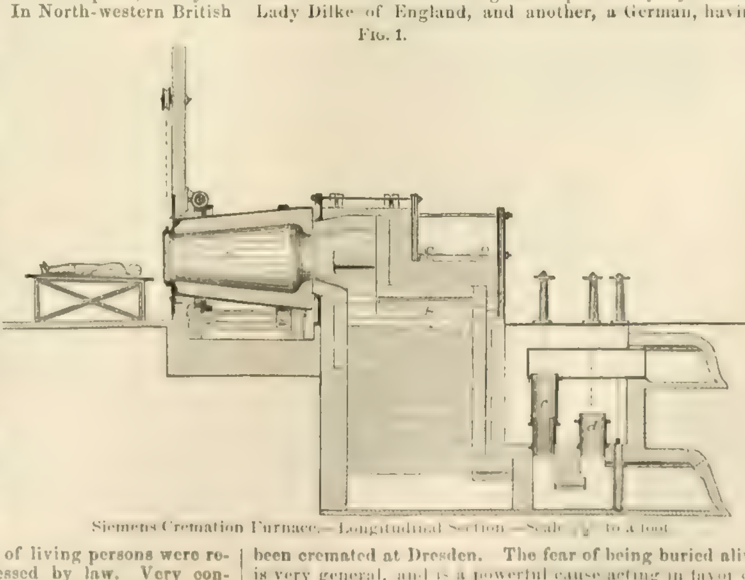
2. *Cremation*, *incremation*, and *incineration* are names given to the practice of burning the dead. This practice certainly prevailed in pre-historic Europe, but probably not in the most remote periods. The cases of incremation narrated in the Old Testament would seem to be exceptional ones (1 Sam. xxxi. 12; Amos vi. 10, etc.). The practice was common in Greece, Rome, Etruria, and other ancient countries, and was finally extinguished by the spread of Christianity, which introduced a belief in a future resurrection, not, indeed, incompatible with the practice of cremation, but in the simple minds of the early believers at least repugnant to their sentiments. The ancient practice was to burn the dead upon a funeral pyre of wood, upon which oil, incense, and spices, and sometimes food and clothing, were placed (a practice reminding us of the custom so prevalent among savages of burying food and weapons with the dead, and of sacrificing horses, dogs, or even slaves, for the service of the departed). Finally, the embers were quenched with wine, and the ashes, placed in a CINERARY URN (which see), were deposited in a sepulchre (*columbarium*) or subterranean cell, or in some cases buried in the earth at the spot where the incremation took place. The use of some kind of cinerary urn for the ashes was to some extent prevalent throughout Western Europe in ante-Roman times, if we can rely upon published estimates as to the date of certain supposed pre-historic remains. At present, the combustion of the dead is frequent, but by no means universal, in Hindostan. In North-western British America there are tribes which practice cremation, and so do some of the tribes of the Shoshone family. Funeral urns are found in ancient North American mounds filled with ashes and half-burned bones. Some California Indians burn their dead, and use the ashes for a sort of paint, with which they besmear themselves in the funeral dance. (See the article on modern cremation below, by S. SEXTON, M. D.)

Besides the two principal modes above indicated, and that of exposure already referred to as prevalent in some countries, there are some other exceptional methods of disposing of the dead. The Fans of West Africa eat their dead, or, as they pretend, exchange their bodies for those of other tribes, which are eaten. In some Pacific islands the sick and aged are buried alive for the sake of economy; in India the burial and burning of living persons were religious ceremonies, now suppressed by law. Very considerable numbers of corpses are thrown into the sacred rivers of India, and it is also customary to take a part of the body from the funeral pile and cast it into the river. In South Africa some tribes drag the bodies of women into some waste place for wild beasts and vultures to devour. The Chinooks and other fish-eating Indians on the lower Columbia River adorned the dead with their finest clothing and ornaments, placed the body in a canoe and allowed it to float out into the sea; and similarly other tribes floated their dead into large lakes and rivers. Many of the Pacific coast Indians not only avoid all reference to the departed by name or by any allusion, but all the property, and even the house, of the deceased are burned; and this burning is the essential part of the funeral ceremony.

C. W. GREENE.

CREMATION.—During the years 1873–74 great efforts were made on the continent of Europe, in England, and in the United States to establish cremation as a means of disposing of human bodies after death wherever it should be desired. This recent movement developed the fact that a great number of people would regard the practice with favor. In London, Paris, New York, Vienna, Berlin, Leipsic, and Dresden the feeling manifested itself in public meetings, organization of societies, and extended discussion in the press. Many experiments were made both with human remains and those of the inferior animals to ascertain the quickest and least objectionable method; for this modern revival of burning, though the practice has prevailed to a greater or less extent through nearly the whole historic period of man, is to be based upon scientific appliances which would attain the object in view quickly and inoffensively. Prof. Brunetti of Padua, Italy, was prominent among the first in the movement. Shortly afterwards Sir Henry Thompson of London wrote an exhaustive article upon the subject, urging its adoption with much force. About the same time public attention was aroused in New York, the idea receiving the approval of many influential and intelligent citizens. Simultaneously in Germany and in Switzerland even more earnestness was shown. Mr. Philip H. Holland of London replied to Sir Henry Thompson at considerable length, but the opposition was much less than might have been expected. This was doubtless due in great part, however, to the general belief that the agitation was purely theoretical, and that there was no immediate prospect of the successful establishment of the practice. Women have been prominent among cremationists, and any general adoption of the system will be largely owing to their advocacy. In England Lady Rose Mary Crawshay, and in New York a lady whose name has not been made public, have written able arguments in its favor. There are two distinct classes of arguments—hygienic and sentimental—in favor of cremation. The sanitarian urges the danger to the living of placing beneath the surface of the earth great numbers of the dead near large cities, to gradually decompose, thus contaminating the water and poisoning the air by the liberated gases, the overloaded soil being able to do its work of disinfection only to a limited extent. In general importance, however, the sentimental influences are greater both for and against burning, and it will be long before it is accepted as a civilized custom. It is a notable fact that it has been inaugurated practically by women, Lady Dilke of England, and another, a German, having been cremated at Dresden. The fear of being buried alive is very general, and is a powerful cause acting in favor of cremation. It simplifies very much the funeral rite, and hence from its economy commends itself to a large class.

FIG. 1.

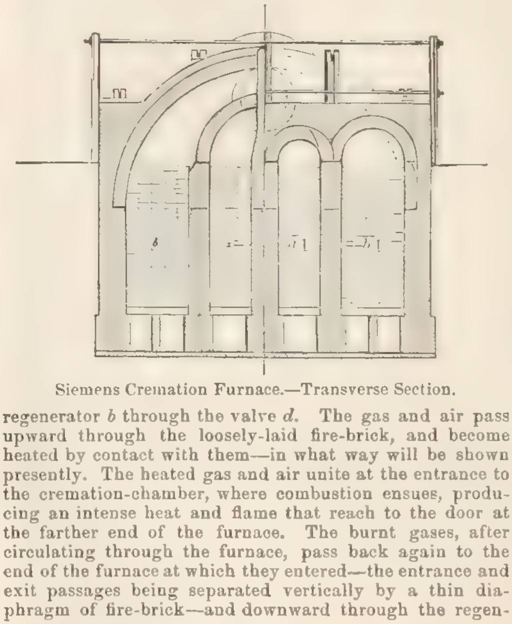


Siemens Cremation Furnace.—Longitudinal Section.—Scale [illegible] to a foot.

The most important objection raised against such total and rapid destruction of the body is medico-legal, as it is claimed that evidences of poisoning and violence would be destroyed. This is met by the statement that necessarily there would be a more careful examination of bodies before burning, and probably a more general detection of crime. Cremation will be for many years after its adoption confined to large towns. The expense necessarily incurred in the erection of furnaces and other apparatus would indicate the probable formation of joint-stock companies to accomplish it. Two societies have been organized in New York City—one among the English, and the other among the German portion of the population—and it is probable that in a few years this rite will be available for those who prefer it. In Dresden, as stated before, a furnace is in operation. The disposal of the ashes is left to the choice of the survivors. They may be placed in the family vaults already built in many of our beautiful cemeteries, or new devices may be adopted as the custom becomes popular.

Cremation Furnace.—The Siemens cremation furnace consists of, first, the furnace A (see Fig. 1), in which the body is placed for cremation; and, secondly, the regenerator B, in which the gas and air used for combustion are heated before entering the cremation-chamber A. The gas for combustion is prepared at a distance from the furnace, and led to it through underground flues (for general description of these furnaces see FURNACE (Siemens iron)). The regenerators (*a*, *a* 1, *b*, *b* 1, Fig. 2) consist of fire-brick chambers filled with fire-brick laid loosely, having regular spaces between them through which the air and gas can pass. The gas is admitted at the bottom of the regenerator *a* through the valve *c*, and the air at the bottom of the

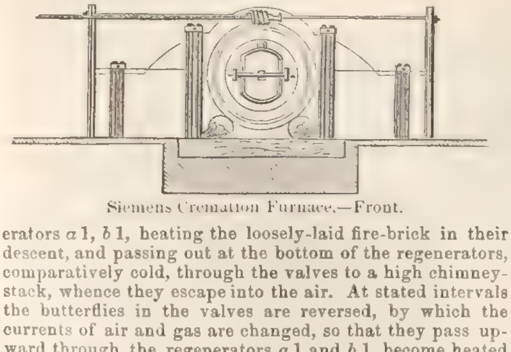
FIG. 2.



Siemens Cremation Furnace.—Transverse Section.

regenerator *b* through the valve *d*. The gas and air pass upward through the loosely-laid fire-brick, and become heated by contact with them—in what way will be shown presently. The heated gas and air unite at the entrance to the cremation-chamber, where combustion ensues, producing an intense heat and flame that reach to the door at the farther end of the furnace. The burnt gases, after circulating through the furnace, pass back again to the end of the furnace at which they entered—the entrance and exit passages being separated vertically by a thin diaphragm of fire-brick—and downward through the regen-

FIG. 3.



Siemens Cremation Furnace.—Front.

erators *a* 1, *b* 1, heating the loosely-laid fire-brick in their descent, and passing out at the bottom of the regenerators, comparatively cold, through the valves to a high chimney-stack, whence they escape into the air. At stated intervals the butterflies in the valves are reversed, by which the currents of air and gas are changed, so that they pass upward through the regenerators *a* 1 and *b* 1, become heated in their passage through them, and after combustion in the furnace pass downward through the regenerators *a* and *b*, which absorb their surplus heat. This reversing the currents is done every half hour. The furnace is raised to a strong heat before the body is introduced, and after the body is in the furnace and the door closed, the amount of gas supplied to the furnace is gradually diminished, as the gases coming from the body are sufficient to support combustion. In this way no foul vapor can escape into the air, every particle being oxidized; and when the process is completed—which takes about half an hour—nothing is left in the furnace but a small quantity of white ash, which is carefully collected and placed at the disposal of the friends. SAMUEL SEXTON.

Fünf'kirchen [Ger. "five churches;" Slavic, *Pecs*, "five"], town of Hungary, in the district of Baranga. Its cathedral is the largest and handsomest church building in Hungary. It has a college and other important educational institutions, and is a bishop's see. Its trade is very active. It has interesting remains of the Roman and Turkish periods, for the Turks held this town 1543–1686. Pop., with suburbs, 24,014.

Fun'gi [plu. of Lat. *fungus*, a "mushroom"]. In botany, the Cryptogamia or flowerless plants include in the higher section ferns, mosses, liverworts, etc.; and in the lower Lichens, Fungi, and Algæ. Sometimes the two first are associated together as Mycetales or Fungales,* their relations being so intimate that no sharp line of separation can be drawn between them, but for the present purpose we shall regard them as distinct. A logical definition of what constitutes a fungus can scarcely be accomplished, but for general purposes it may be sufficient to describe a fungus as a cryptogamic plant of the inferior section, closely related to lichens, mostly epiphytal or hysterophytal (sometimes epizoic), deriving nourishment by means of a mycelium from the substance on which it grows, and never producing the peculiar green bodies (found in lichens) known as gonidia. To this, as well as every other definition hitherto attempted, some exceptions may be taken. The mycelium is at times nearly obsolete, and when growing on inorganic substances it can hardly be assumed that nourishment is derived from the matrix. On the one hand, some Fungi can scarcely be distinguished from lichens, and on the other from Algæ, whilst in the majority of cases they are prominently distinct. H. C. Sorby, F. R. S., has recently shown† that when examined by spectrum analysis this close affinity exists between individuals and small groups of lichens, Fungi, and Algæ, so that not only structurally, but also chromatologically, there is an intimate relation between them. The localities in which these plants are found are as variable as the plants themselves. Some of the larger forms occur in every description of soil, but in most cases arise from decomposed vegetable or animal matter; others affect decaying wood, and others flourish on what would appear to be healthy and vigorous growing trees. Smaller forms occur on decaying organic substances of all kinds; some are parasitic upon and destructive to living plants; a few on living animals, and others submerged in water or developed on such inorganic matrices as naked stones, leaden cisterns, plastered walls, dirty glass, or such eccentric habitats. The conditions which seem most favorable to the development of Fungi are moderate but continuous moisture, a close, damp atmosphere, shady situations, and neither extreme of heat or cold. To this rule, again, there are exceptions, as certain Fungi reach their maturity during winter, and others flourish in profusion in the tropics, but in temperate countries the damp, mild autumnal weather produces the most prolific crops of Fungi. The geographical distribution of Fungi cannot be mapped so satisfactorily as that of the Phænerogamia, inasmuch as they have been less studied or collected by travellers, and there are immense tracts of which the flowering plants are moderately known, but the Cryptogamia are either wholly unknown, or only partially known from a few casual specimens. An attempt has been made by the younger Fries‡ to indicate the features of geographical distribution; but this is necessarily very imperfect and unsatisfactory, even when undertaken by one who had the greatest facilities of any living botanist—through his illustrious father—for the accomplishment of such a sketch. Imperfect as it is, this essay may be perused with profit, as we can only introduce here one or two of the general conclusions arrived at by the author. The fleshy Hymenomycetes, of which the common mushroom (*Agaricus*) may be accepted as the type, flourish most in the colder portion of the temperate zone; the hard Polyporei are tropical, although extending into the temperate zone; whilst *Hexagona* and *Favolus* are intertropical, and do not extend into temperate climes. "When the majority of the species of a genus are of a fleshy consistence, it may

* Rev. M. J. Berkeley, *Introduction to Cryptogamic Botany*, p. 235.
† H. C. Sorby, F. R. S., *Researches in Chromatology*, in *Proceedings of the Royal Society for 1873*.
‡ M. E. P. Fries, in the *Transactions of the Academy of Upsala for 1857*, and *Annales des Sciences Naturelles*, 1861, xv. p. 10.

generally be concluded that that genus belongs to a northern region, even if it should have some representatives in lands which enjoy more sunshine." Most of the Auricularini are cosmopolitan, whilst the Gasteromycetes belong to the warmer division of the temperate and to the tropical zone. The subterranean Fungi are more freely developed in warm climates. Of the more microscopic forms even less is known, but it may be predicated that sphæriaceous Fungi are common both to the temperate and torrid zones, whilst *Mucedines* are almost universal in their distribution, and the coniomycetous Fungi parasitic upon living plants present themselves wherever their host flourishes or an allied species of phænerogamic plant is found. Various conditions of elevation, hydrography, forest, and desert influence or modify these general conclusions.

The relation of Fungi to the human subject is still a matter of controversy, some eminent men contending that many of the "ills that flesh is heir to" may be attributed to minute Fungi, and that many diseases are of fungoid origin; whilst others contend that Fungi are not the cause, but when present are subsequently developed in unhealthy tissues. The minute unicellular bodies which form the basis of much of this controversy are so simple that they cannot satisfactorily be referred to Fungi or Algæ, much less to any definite group of either, and their development has yet to be traced. Whatever may be the result of inquiries in this direction, we do not think it justifiable to assert that minute Fungi have any important or extensive influence in causing disease in the human subject. Much has been written of the associations of fungal spores with cholera, scarlatina, typhoid fevers, measles, diphtheria, etc.,* but the views advocated have not been established, and the theory still remains as much as ever the subject of controversy. In favus and other skin diseases the evidence is strong in favor of fungoid development, but Dr. Tilbury Fox has distinctly intimated his belief that they only exist as accidental products; for he says, "in reference to human parasites, the medical man has little time (and opportunity) to study them in a botanical sense, and regards them with little concern compared with what he considers the more important—viz. the diseases in which they occur; in other words, *as accidental products*."† Too many fatal cases of poisoning by Fungi have occurred to leave any doubt of the deleterious effect of numerous species on the human subject. None of these are better known than the fly agaric (*Amanita muscaria*), which has a wide distribution, is readily distinguished by its brilliant coloring, and everywhere is acknowledged as dangerous. This is but one out of many species that are undoubtedly poisonous, and it may be observed that even species which are known to be wholesome or inert when properly cooked or eaten whilst fresh, may become injurious when kept long enough for their chemical constituents to undergo change or modification. Unfortunately, no concise and definite rules can be laid down whereby poisonous may be distinguished from edible Fungi, except by a botanical knowledge of the species. To aid in this, Mr. Worthington Smith has published in England two large colored sheets of the most common poisonous and esculent species found in that country.‡

In European countries the common mushroom (*Agaricus campestris*) enjoys the widest popularity as an esculent, especially the cultivated varieties. The meadow mushroom (*Agaricus arvensis*) is scarcely inferior, though stronger in flavor, and is preferred by many to the cultivated species. In France the champignon (*Marasmius oreades*) is largely eaten, and in Austria *Agaricus melleus*, which has no admirers in England, finds a constant place in the markets during the summer. Truffles (*Tuber æstivum*, etc.) and morels (*Morchella esculenta*) are favorites not only in Europe, but also in the vales of Cashmere, where two or three species of morels are dried for consumption throughout the year. The great puff ball (*Lycoperdon giganteum*) is increasing in reputation as a breakfast delicacy in Great Britain, whilst *Lactarius deliciosus*, the chantarelle (*Cantharellus cibarius*), and the hedgehog fungus (*Hydnum repandum*) have each their circle of admirers. Numerous other species are also more or less eaten by mycophagists, although they are never found in the public markets. *Boletus edulis* cut in slices and dried may be purchased throughout the year in most of the continental cities. In Tahiti the Jew's ear (*Hirneola auricula Judæ*) is dried in large quantities and exported to China, whilst a species of agaric (*Agaricus subocreatus*) comes into the markets of Singapore, and another dried agaric (*Agaricus fossulatus*) is sent from the Cabul hills into the plains of North-western India. Several species of *Cyttaria* are eaten in the southern parts of South America, and in Australia the *Mylitta australis* is a favorite article of food. In fact, a very long catalogue might be made of the species which are more or less consumed in different parts of the world; but we must rest content with suggesting some of the most important or interesting, referring the reader to more special treatises for further information.§ The cultivation of Fungi for esculent purposes has not hitherto been successful with any other species than the ordinary mushroom. Attempts were made in France for the cultivation of truffles, at first apparently with considerable promise, but ultimately without much satisfaction. There is no good reason to suppose it impossible or improbable that many species might be cultivated if proper care, time, and attention could be devoted to experiments in that direction. Fungi useful to man in medicine or the arts are by no means numerous or of importance. Some species of *Polyporus* have been employed as styptics or beaten till soft and used as amadou. One species in Burmah has a good reputation as an anthelmintic. Some species of *Polysaccum* and *Geaster* are employed medicinally in China. Species of *Elaphomyces* were at one time supposed to possess great virtues, now deemed apocryphal. *Ergot*, developed on rye, wheat, and the germen of various grasses, still maintains its position in the pharmacopœia, but is almost the only fungus now employed (and that sparingly) by the legitimate medical practitioner.

Many very serious diseases in plants are undoubtedly produced by Fungi.‖ First in importance is the potato murrain, which originates in a white mould called *Peronospora infestans*. Another mould of the same genus is destructive to young onions, and another to lettuce, spinach, and other garden produce. The vine disease is occasioned by *Oidium Tuckeri*, and is a great pest in some grape-growing countries. The hop disease is another pest which has its origin in a fungus, *Sphærotheca Castagnei*. Peas are subject to the attacks of *Erysiphe Martii*; cabbages suffer from *Cystopus candidus*, from which turnips are not wholly exempt; and grain-crops have their pests in the red rusts (*Trichobasis rubigo* and *linearis*), in the corn mildew (*Puccinia graminis*), in the smut (*Ustilago segetum*), and in bunt (*Tilletia caries*). Indian corn suffers also from the attacks of *Ustilago maydis*. The seeds of all graminaceous plants are also liable to become ergotized. Plum, pear, apricot, and other fruit trees, as well as roses and other garden flowers, suffer from microscopic Fungi belonging to numerous and diverse genera.

The classification of Fungi must necessarily be noticed here in a concise and cursory manner, and without reference to the modifications proposed by different authors, but in accordance with the method most generally adopted. It may be premised that in all systems the fructification is of primary importance. We assume that there are not less than 20,000 described species, all of which can be arranged in two groups, having reference to the mode in which the fruit is developed. In one group the spores (analogous to the seeds of higher plants) are naked—that is, not enclosed in spore-bearing sacs or capsules—and these are called SPORIFERA. In the other group the spores, generally in definite numbers, are enclosed in rounded or elongated membranous sacs, and these are called SPORIDIIFERA. By general consent, the spores when contained in these membranous sacs, or *asci*, are known as *sporidia*, and when naked are simply known as *spores*. Following this order, we commence with the *Sporifera*, or spore-bearing Fungi, the term *spore* being here applied in the limited sense to which we have alluded. The one common feature which pervades this group is the production of the spores simply and singly upon little short, often nearly obsolete pedicels or sporophores, and *not* enclosed in special sacs or membranous envelopes. In some cases the spores are produced on an exposed surface, or *hymenium*; in others the spore-bearing surface or hymenium is enclosed within a common envelope. In others, again, there is no exposed surface or hymenium, but the spores are produced on the stem or branches of threads, such threads being usually gregarious and forming mouldy patches; whilst, finally, the

* See *Zeitschrift für Parasitenkunde*, edited by Drs. Hallier and Zürn.

† *Skin Diseases of Parasitic Origin*, by W. Tilbury Fox, M. D. (London, 1863), p. 103.

‡ *Mushrooms and Toadstools*, by W. G. Smith (London, 1867).

§ *A Treatise on the Esculent Funguses of England*, by Dr. Badham (London, 1863); Roques, J., *Histoire des champignons comestibles et vénéneux* (Paris, 1841); Fries, E., *Sveriges ätliga och giftiga Svampar* (Stockholm, 1861); Persoon, C. H., *Traité sur les champignons comestibles* (Paris, 1818); Trog, J. G., and Bremer, J., *Die essbaren, verdächtigen und giftigen Schwämme der Schweiz* (Bern, 1844); Vittadini, C., *Funghi mangerecci* (Milan, 1835); Lenz, H. O., *Die nützlichen und schädlichen Schwämme* (Gotha, 1831); Cordier, F. S., *Hist. et Descr. des champignons alimentaires et vénéneux* (Paris, 1836); Barla, J. B., *Les champignons de la Province de Nice* (Nice, 1859); Harzer, C. A. F., *Abbildungen der essbaren, giftigen und verdächtigen Pilze* (Dresden, 1842); Krombholz, J. V., *Die essbaren, schädlichen und verdächtigen Schwämme* (Prague, 1836).

‖ See *Smut, Rust, Mildew, and Mould*, by M. C. Cooke, M. A., with plates, 2d ed. (London, Hardwicke, 1871).

spores may form the principal feature, the pedicels being very rudimentary or nearly obsolete. These four methods of spore-production form the basis of the four subdivisions or families into which the Sporifera are divided, and may be technically stated as follows:

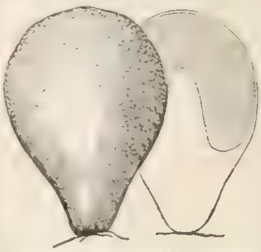
Hymenium present.
- Hymenium (or fruit-bearing surface) free, mostly naked or soon exposed: I. HYMENOMYCETES.
- Hymenium enclosed in a peridium, which is ruptured when mature: II. GASTEROMYCETES.

Hymenium absent.
- Spores naked, mostly terminal, on inconspicuous threads, free or enclosed in a perithecium: III. CONIOMYCETES.
- Spores naked, on conspicuous threads, rarely compacted, small: IV. HYPHOMYCETES.

It will be observed that the names applied to these four families each in turn represents the characteristic feature of the family. In Hymenomycetes the *hymenium* is the prominent feature; in Gasteromycetes the peridium which encloses the hymenium (*gaster*, a "belly") is the chief characteristic; in Coniomycetes the dust-like spores (*konis*, "dust") are the most prominent; and in Hyphomycetes the threads (*hypha*) are the distinguishing characteristic. The Hymenomycetes are regarded by some as the highest development of Fungi. The hymenium or spore-bearing surface is variable in form. In the Agaricini the hymenium is a membranous expansion distributed in folds or gills over the under surface of a pileus or cap; in the Polyporei the hymenium lines the inner cavity of pores or tubes; in the Hydnei the hymenium clothes the surface of prickles or spines; and in the Auricularini the hymenium is spread more or less evenly over the under surface of the pileus, which is often resupinate. In all these the hymenium is normally inferior, whilst in the Clavariei the entire fungus is clavate or branched, and the hymenium covers the entire surface. In the Tremellini the substance is gelatinous, and lobed or somewhat discoid; the hymenium is imperfect and superior, and in many respects this order differs in spore-development from the preceding orders of this family. The common mushroom is a good illustration of the structure which prevails in the Agaricini.* The mycelium consists of slender, branched, rootlike filaments, which penetrate the soil. From this mycelium proceeds an erect stout stem, or stipe, bearing at its apex an expanded cap or hood, the under surface of which is covered by the folds or plates of the hymenium. The spores are quaternary—that is, four spores are produced on the tips of short spicules which crown the apex of the sporophores. The sporophores are distributed over the whole surface of the hymenium, intermixed with cysts or basidia, the true function and relations of which are involved in mystery.† It will be observed that the spores are naked, and when mature fall readily from their slender supports upon the soil beneath. In form they are mostly spherical, ovate, or elliptical, the surface being smooth or warty, colorless or colored, according to the species to which they belong. The difference in color in the spores of the agarics forms the basis of classification in the genus *Agaricus*, in which the species are distributed amongst five sub-genera according to the color of the spores.

Coprinus micaceus (Europe and U. S.), order Agaricini.

The Gasteromycetes differ from the preceding in the hymenium being enclosed in an outer peridium. When fully matured they resemble more or less globose sacs, ruptured above, and filled with a dusty mass of spores and threads. In their early stage the spores are often quaternary, but are soon free.‡ This family may be again divided into two sub-families, in one of which the approach is towards the hymenomycetous type, and the other the coniomycetous. The first sub-family contains (1) the subterraneous species, or Hypogæi, in which the hymenium is persistent, the inner mass not becoming dusty except when decayed; (2) the Phalloidei, in which the hymenium is deliquescent, are terrestrial; and (3) the Nidulariacei, a somewhat aberrant order, in which the spores are compacted into disciform bodies enclosed in an outer peridium. In the other sub-family are contained (1) the Trichogastres, and (2) the Myxogastres; the former are cellular at first, but the hymenium soon dries up into a dusty mass of threads and spores; the later are gelatinous at first, but are soon resolved also to a dusty mass of threads and spores. The Myxogastres are very interesting objects of study, and have been the subject of considerable speculation. At one time Prof. de Bary propounded the belief that they were intimately associated with low forms of animal life, and could not be retained with Fungi, but has since renounced that opinion. The basis of this belief was derived from the study of their gelatinous stage, in which the substance resembles sarcode, and relations with amœboid forms were supposed to exist.



Lycoperdon pyriforme (Europe and U. S.), order Trichogastres.

The third family of sporiferous Fungi is Coniomycetes, in which the hymenium proper is almost obsolete, and the whole plant consists of spore-like bodies, borne on short, often evanescent sporophores, and either seated on a cushion-like stroma or enclosed in a peridium. "This family is distinguished by the vast predominance of the reproductive bodies over the rest of the plant, if not in size, at least in abundance, and from the ease with which in general they fall from the point of attachment; in consequence of which, as the name implies, they have a dusty appearance, and often soil the fingers of those who handle them. In some cases there is a decided perithecium or peridium; in others there is no approach to such an organ, and in very nearly allied productions it may be either present or entirely absent. Many of the genera are doubtless conditions of higher forms."§ In one section of this family the species are found growing on dead or dying plants; in the other, they are parasitic on living plants.

In Sphæronemei there is a more or less distinct perithecium which originates beneath the cuticle of dead or dying plants. The spores are produced in the interior on the tips of slender threads, and when mature are ejected through an apical mouth or by rupture of the perithecium. In Melanconiei the species have similar habitats, but there is no definite perithecium, and the spores usually ooze out in a pasty, black, or colored mass. In the Torulacei the species are entirely superficial, consisting of compound or concatenate spores, produced in patches on the surface of decaying plants, sometimes springing from a decided stroma, and sometimes only from a delicate mycelium.

The section including species parasitic on living plants contains the Æcidiacei, in which there is a distinct cellular peridium, and the Cæomacei and Pucciniæi, in which there are none. The Æcidiacei chiefly affect the leaves of growing plants, and are produced beneath the cuticle, through which they burst, then the peridium ruptures in a stellate manner, the teeth are reflexed, and the chains of spores are exhibited seated in a fringed cup, forming a beautiful object for the microscope. This is the typical form, subject to slight variations. In the Cæomacei the spores are produced in definite or indefinite patches on the green parts of plants, bursting through the cuticle and becoming diffused as a rusty or dingy blackish powder. To this group the red rust and the smut and bunt of corn belong. The spores are mostly globose or nearly so, and the fructification in many genera is very complex.‖ In the Pucciniæi the spores are elongated, septate, and borne on more or less elongated persistent peduncles. In this order the tufts of spores, or *sori*, are definite, sometimes compact, and at others pulverulent. In *Podisoma* the spores are invested in gelatine, resembling in some respects the Tremellini.¶ The late Prof. Œrsted was of opinion that he had demonstrated the relations of *Podisoma* to *Ræstelia*, and it is probable that further observations may confirm the belief that the *Puccinia graminis* of wheat and grasses is another stage of the *Æcidium* of the barberry, although at present we do not consider the fact satisfactorily established.

* See *Anatomy of a Mushroom*, in *Popular Science Review* for 1869, vol. viii. p. 389.

† *Grevillea*, 1873, p. 41; 1872, p. 181.

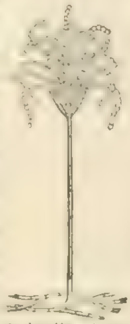
‡ *Sur la fructification des genres Lycoperdon, Phallus*, etc., par Rev. M. J. Berkeley, in *Ann. des Sci. Nat.*, 1839, vol. xii. p. 160; *De la fructification des Scleroderma*, par L. R. et C. Tulasne, in *Annales des Sci. Nat.*, 1842, vol. xvii. p. 1.

§ Berkeley's *Introduction*, p. 315.

‖ Tulasne, L. R. and C., *Memoire sur les Ustilaginées*, in *Ann. des Sci. Nat.*, 1847, vii. p. 12, 73; *Memoire sur les Uredines et les Ustilaginées*, in *Ann. des Sci. Nat.*, 1854, ii. p. 78; *Contributions to the Biology of the Ustilagineæ*, by Dr. A. Fischer von Waldheim, translated for the *Transactions of the New York State Agricultural Society for 1870*; *Microscopic Fungi Parasitic on Living Plants*, by M. C. Cooke, in *Popular Science Review*, 1864, pp. 20, 178, 317, 469.

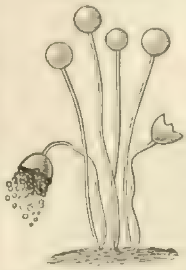
¶ *Notes on Podisoma*, by M. C. Cooke, in *Quekett's Journal*, ii. p. 255.

The fourth family of sporiferous Fungi is Hyphomycetes, in which the naked spores are borne on conspicuous threads. In this family the threads are very prominent, and they constitute the majority of what are popularly known as "moulds." Sometimes, as in Isariacei and Stilbacei, the threads are compacted together into a kind of common stem, but in the remaining orders the threads are free or anastomosing. The two principal orders are the Dematiei or black moulds, and Mucedines or white moulds. In the former the fertile threads are more or less carbonized, and in the latter are almost colorless or faintly colored. Amongst the Mucedines are grouped the moulds so injurious to vegetation, of which the potato-mould (*Peronospora infestans*) may be accepted as the type. And here also the widely diffused, almost ubiquitous, *Aspergillus* and *Penicillium* will be found. The relations of moulds to other Fungi have of late received considerable illustration in the works of Tulasne, De Bary, and others.* A great number of them are probably the conidia of ascomycetous Fungi. The last order is Sepedoniei, in which the threads are hardly distinct from the mycelium, and the spores are profuse, thus approximating more closely than any other of the Hyphomycetes to the Coniomycetes. This cursory glance at the principal groups must suffice for our review of the classification of sporiferous Fungi.



A fertile plume of *Penicillium*, with pencils of spores; magnified 150 diameters.

The Sporidiifera, as we have already intimated, are more complex, inasmuch as the sporidia are produced in definite or indefinite numbers (usually eight or some multiple of eight) in membranous sacs or asci. In one of the families, called Ascomycetes, these asci are formed from the fertile cells of a hymenium, and in the other family of Physomycetes the sporangia or spore-bearing cells are seated on threads (in this respect resembling the moulds or Mucedines), and no definite hymenium is present. The Ascomycetes are second only to Hymenomycetes in number of species, wide distribution, and general interest. In this family there is a cellular hymenium, producing elongated cells, some of which are barren, threadlike, and often branched, mixed with more or less elongated fertile cells, containing usually a definite number (rarely indefinite) of sporidia. This hymenium is sometimes exposed, and sometimes enclosed in a perithecium. In such an extensive family there is necessarily a great modification of form and variety of size. A large proportion are microscopic, whilst some vie with Hymenomycetes in dimensions and utility, truffles and morels being esteemed by connoisseurs as the most delicious of esculent Fungi. In Elvellacei the substance is fleshy, waxy, or tremelloid, and the hymenium is mostly exposed. These are either pileate or discoid, in some cases brightly colored and attractive, and either several inches in diameter or so minute as scarcely to be distinguished by the naked eye. In Tuberacei the hymenium is complicated and enclosed in a peridium. The species are subterranean, in which respect it is analogous to the Hypogæi of gasteromycetous Fungi, but differs in the sporidia being contained in asci. The structure of the Tuberacei is well illustrated in the works of Vittadini, Corda, and Tulasne.† In the Phacidiacei the perithecium is hard or coriaceous, and the hymenium is at length exposed. In Sphæriacei the perithecia are either carbonaceous or membranaceous, sometimes confluent with the stroma, pierced at the apex, and the hymenium is at length diffluent. The stroma is occasionally highly developed, and is clavate, as in *Torrubia*, or clavate, branched, or horn-like, as in *Xylaria*, or broadly effused, as in *Hypoxylon*. The fruit is sometimes very large, multiseptate, and colored. The habitats are also as variable as the plants themselves—dead insects, dung, rotten wood, dead or living leaves, old paper, old rags, matting, nuts, bark, twigs, herbs, lichens, mosses, and even parasitic on other Fungi. In Perisporiacei the perithecia are free, always closed, and mostly membranaceous. The asci become evanescent as the spores approach maturity. Some of the species of Erysiphei are very destructive to plant-life. Many have their perithecia furnished with hooked or branched fulcra, which render them beautiful objects for the microscope.‡ In Onygenei the receptacle is clavate and the asci spring from the threads. The species are developed on animal substances, and remind one of Stilbacei amongst the Sporifera. The Physomycetes are sporidiiferous moulds, in which bladder-shaped sporangia or fertile cells are scattered on threads "which are not compacted so as to form a distinct hymenium." In this family the number of sporidia contained in a single vesicle is indefinite. In Antennariei the threads are felted and moniliform, and the sporangia are irregular. In the Mucorini the threads are free and the sporangia are terminal or lateral. In some species a complex system of fructification has been discovered, two or more threads by conjugation producing a special organ which develops into a fertile sporangium.§



Mucor caninus (a U. S. and European species), showing the bursting of the ripe terminal sporangium.

Morchella esculenta, the common edible morel of Europe and the U. S., order Elvellacei.

Following the same method as that adopted for the *Sporifera*, we append here the characters of the two families composing the *Sporidiifera*, viz.:

Hymenium present. { Asci formed from the cells of a fertile hymenium: V. Ascomycetes.

Hymenium absent. { Fertile cells (sporangia) seated on threads which are not compacted into a hymenium: VI. Physomycetes.

Within the limits of this article it would have occupied too much space to enumerate the orders, sub orders, and genera of Fungi, for which we must refer the reader to some special mycological work.

It will already have become evident that the fructification of Fungi is of very great importance in classification. This is more and more evident as we become acquainted with the variable modes in which the one great end is attained. In some cases we have conidia, spermatia, pycoridia, and ascospores. In some species only conidia are as yet known, and in others only ascospores. In some species conidia are produced on the branches of mucedinous threads and resting spores, enclosed in oogonia, on the mycelium. Some forms of fruit are exceedingly minute and simple, others are large, colored, and complex. Some germinate and reproduce their kind direct, others through a kind of alternation of generations. Polymorphism in Fungi is an interesting, but at the same time a complex study, and much still remains to be discovered of the relations of one form to another.‖

The Messrs. Tulasne have illustrated polymorphism by one common species of *Sphæria* found on pea and bean stems and various herbaceous plants. This species is *Sphæria (Pleospora) herbarum*. The sporidia are eight, contained in elongated membranaceous asci, each being ovate-oblong or elliptical, amber-colored, divided by numerous septa with transverse divisions. These are the ascospores. Another condition of this same plant forms a mould in sooty patches on all kinds of decaying vegetable substances; there is a profuse mycelium from which arise jointed threads, and the conidia are elliptical and ultimately septate. This mould is known as *Cladosporium herbarum*. Another species of mould is sometimes found associated with, or parasitic upon, the *Cladosporium*, which is called *Alternaria tenuis*. It consists of chains of spores resembling inverted jointed clubs, and according to Tulasne is but another condition of *Sphæria herbarum*. Still another phase is to be found in a black mould (*Macrosporium sarcinula*) which grows on decaying gourds. In this form the spores are clavate, with numerous septa, and constricted at the joints. Besides these are bottle

* Tulasne, L. R. and C., *Selecta Fungorum Carpologia*, Paris; De Barry on *Peronospora*, in *Ann. des Sci. Nat.*, 4 ser. xx. p. 5; *Microscopic Moulds*, by M. C. Cooke, in *Journ. Quekett Club*, vol. ii. p. 61; *Polymorphic Fungi*, in *Popular Science Review*, 1871, p. 25.

† Tulasne, L. R. and C., *Fungi Hypogæi*, Paris, 1851; Corda, A., *Icones fungorum hucusque cognitorum*, Prague, 1837–42; Vittadini, C., *Monographia Tuberacearum*, 1831.

‡ Léveillé, J. B., *Organisation etc. d'Erysiphe*, in *Ann. des Sci. Nat.*, 1851, xv. p. 109.

§ *Sexual Reproduction in the Mucorini*, by A. de Bary, translated in *Grevillea*, vol. i. p. 167.

‖ *Polymorphic Fungi*, in *Popular Science Review*, vol. x. p. 25.

shaped cysts containing naked spores capable of germination. Here are five phases or different forms of the same (presumed) fungus. It is probable that in addition to these spermatia may be found or traced to some already known coniomycetous species. This is not an isolated instance, but one out of many which the same authors believe that they have satisfactorily traced. Very many others are with good reason suspected. It is not improbable that the majority of species of *Sphæria* have conidia in the form of moulds (Hyphomycetes) and spermatia produced either in carbonaceous perithecia or spurious conceptacles (Coniomycetes). The section of coniomycetous Fungi including the species parasitic on living plants contains numerous examples of dimorphism or polymorphism; it is rather the rule than the exception. The uniseptate spores of *Puccinia* are preceded by, or associated with, unicellular spores of *Trichobasis*, and these again are in many cases believed to be related to the elegant "cluster-cups" of the genus *Œcidium*, and probably also to the permanently stipitate, unicellular spores of *Uromyces*. In *Phragmidium*, again, the spring spores are a *Lecythea*, and the summer spores of *Melampsora* are *Lecythea*, whilst the final and winter spores are not perfected till the leaves on which the fungus is parasitic have lain on the ground through the greater part of the winter, and become decayed. In *Coleosporium* at different periods of the year spores are produced which differ in character and facility of germination. The relations between *Rœstelia* and *Podisoma* have already been alluded to. In *Tilletia* (bunt) there is an alternation of generations,* the areolate spores on germination producing elongated fusiform bodies, which are the spores of the second generation; these conjugate and produce long elliptical spores of the third generation, which in turn germinate and produce similar spores of the fourth generation. Continually additions are being made to our knowledge of the germination and development of minute Fungi. The Saprolegniæ (if included with Fungi, as they seem to warrant) afford instances of the occurrence of active zoospores, as also do the Peronosporiei and *Cystopus*. Some interesting phenomena are exhibited by certain species to which a passing allusion may be made. In some species of *Boletus*, for instance, when cut and exposed to the light, the surface more or less speedily assumes, by oxidation, a bright blue color. It has been asserted that this coloration is due to aniline or a nearly allied substance. Some species of *Polyporus* (as *Polyporus sulfureus*) exhibit on the surface numerous crystals of oxalate of lime. Certain agarics when wounded exude a milky juice in more or less profusion, which is either white or colored. The odor in some species is very strong; in *Phallus* and *Clathrus* exceedingly disagreeable; in some agarics resembling the odor of bugs; in others, as in *Agaricus odorus* and *Agaricus fragrans*, very agreeable; and in others resembling new meal, whilst in a few the peculiar scent of garlic is unpleasantly perceptible. Still more striking is the luminous property possessed by some exotics, and even under certain conditions by natives of temperate climates, as of the U. S. Humboldt describes the phosphorescent appearance of *Rhizomorpha* when growing in mines. Gardner records a Brazilian species of agaric which gives out at night a bright phosphorescent light, somewhat similar to that emitted by the larger fire-flies, having a pale-greenish hue.† Drummond reported from Swan River the occurrence of agarics growing on tree-stumps which emitted a bright light during the night. Dr. Hooker observed the same kind of thing in the Himalayas, and the phenomenon is a familiar one in the U. S., where it has the rustic names of "fox-fire" and "fire-wood."‡ In the south of Europe *Agaricus olearius* is well known for its luminous properties. Mr. Hugh Low states that he has seen the jungle in Borneo all in a blaze of light, by which he could see to read as he was riding across the island by the jungle-road. Worthington Smith writes of *Polyporus annosus*, found in mines in Wales, being so bright that it could be seen in the dark at a distance of twenty yards. He also alludes to *Polyporus sulfureus* as occasionally luminous in England. A striking example is recorded by Rev. M. J. Berkeley, in which a log of timber 24 feet long had the inside of the bark covered with a white mycelium. This was so luminous that when wrapped in five folds of paper the light penetrated through all the folds on either side as brightly as if the specimen was exposed. Scarcely less remarkable is the peculiar coloring which some species impart to the matrix on which they vegetate. In the case of *Helotium æruginosum*, and one or two closely allied species, the old wood on which the fungus grows is permanently colored of a bright verdigris-green. In other instances, as in that of *Sphæria rubellum* and *Sphæria rhodobapha*, some tint of red is imparted to the matrix. Blackened or carbonized matrices are more common. If space permitted we might allude to the singular forms which some species assume—the stellate puff-balls (*Geaster*), the singular *Ascroë*, the coralline *Clathrus*, many of the minute but beautiful species of the Myxogastres, and the elegant Mucedines. The rapidity of growth; the profusion of spores, and the facility with which they are diffused; the relation of some species to fermentation, and of others, such as *Merulius lacrymans* and *Polyporus destructor*, to decay in timber; and kindred topics might lead us to expand this article to double its present dimensions, but we leave it thus as suggestive rather than exhaustive, hoping that it may be sufficient to induce the reader to seek in special works for such further information as he may desire, and which we have been compelled to exclude. (See FERMENTATION and GERM-THEORY.) M. C. COOKE.

Geaster fornicatus (North American species, reduced: A, section of inner peridium; B, tip of lobe; C, group of spores, magnified.

Funk's Grove, tp. of McLean co., Ill. Pop. 818.

Funks'town, post-v. of Washington co., Md., 92 miles N. W. from Annapolis. Pop. of v. 671; of tp. 1649.

Fur. See FURS AND THE FUR TRADE, by L. P. BROCKETT, A. M., M. D.

Fur'ca, a mountain of Switzerland 8268 feet high, in the canton of Valais, W. of St. Gothard.

Fur'guson's Cove, v. of Mendocino co., Cal. Pop. 40.

Furies. See EUMENIDES.

Fu'rius, the name of many Roman historical characters, mostly of the old patrician gens Furia; but some plebeians and many people of Tusculum bore the name also. The most famous of all was L. Furius, a prætor who overthrew the Gauls in the great battle of Cremona (200 B. C.), and received a triumph.

Furlanet'to (GIUSEPPE), successor in Latin lexicography to Facciolati and Forcellini, was b. in Padua Aug. 30, 1775; was educated at the seminary in Padua; became corrector of the seminary press; professor in the College of Sta. Justina; teacher of church history in the seminary; professor of hermeneutics in the university; and finally director of the seminary. In 1816 he published two fasciculi of additions to the Lexicon of Forcellini, and then undertook a thorough revision of the whole work, which was published in 4 vols. 4to, Padua, 1823–31. D. Nov. 2, 1848. H. DRISLER.

Fur'long [Ang. Sax. *furlang*—*i. e.* the "length of a furrow"], forty rods in linear measure; the eighth of an English or U. S. statute mile, corresponding to the *stadium*, which was the eighth of a Roman mile. There are also several local furlongs, and the word is sometimes used for the name of a square or land measure.

Furlong (HENRY), a Methodist divine, b. at Baltimore, Md., Mar. 21, 1797, entered the ministry of the Methodist Episcopal Church in 1816, and soon became one of the leaders in the Baltimore Conference. He filled important appointments in Virginia, Maryland, and Pennsylvania. In 1860–61 he was chaplain to the Union seamen's bethel at Baltimore. D. Aug. 29, 1874. He was counted among the fathers in Methodism, and enjoyed the fellowship of Bishops McKendree, George, Roberts, Soule, Waugh, and Bascom. J. H. WORMAN.

Fur'man (RICHARD), D. D., b. at Esopus, N. Y., in 1755; removed in childhood to South Carolina with his father, who carefully educated him. When eighteen years old he became a Baptist preacher, attained wide usefulness, and was an eloquent patriot during the war for independence. He became a pastor in Charleston in 1787. D. in 1825. Author of various published discourses.

Fur'nace [Lat. *fornax*]. The use of furnaces for imparting heat under various conditions is common to nearly all the industrial arts, especially to the treatment and utilization of metals and minerals. While special varieties of heating apparatus will be described or referred to in articles on manufactures wherein such apparatus is employed, the general principles of furnaces, and their classification according to the methods of utilizing fuel, are subjects of sufficient individuality and magnitude to warrant a separate essay; and as nearly all important types of furnaces

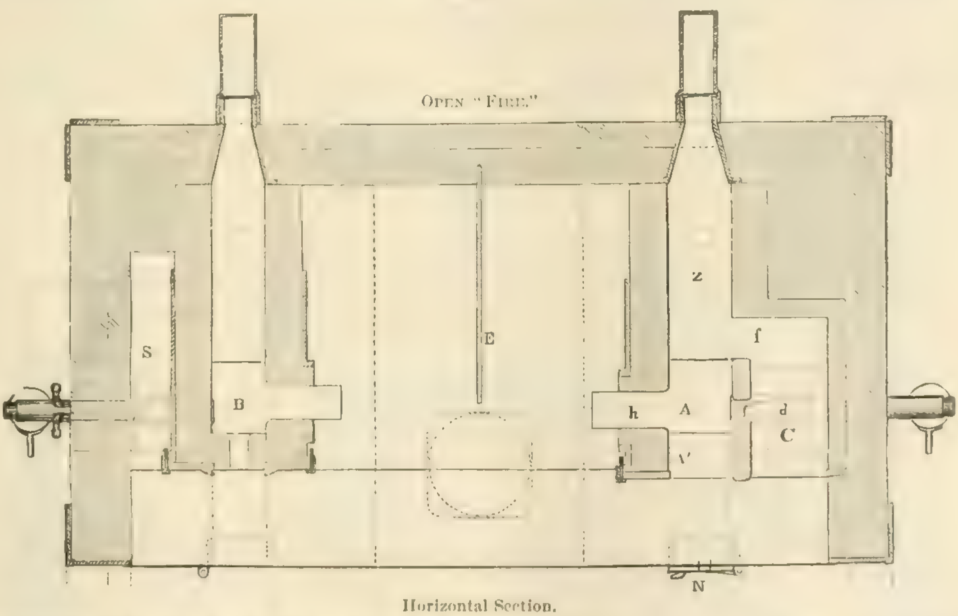
* Cooke on *Bunt Spores*, in *Journ. of Quekett Club*, vol. i. (1869), p. 167.
† *Gardner's Chronicle*, Sept. 21, 1872.
‡ Hooker's *Journal*, 1840, vol. ii. p. 426.

are employed in the iron and steel manufacture, the illustrations will be drawn from this source. Furnaces may be classified as follows: I. According to the methods of applying heat. (1) *Open fires*, in which the material under treatment is heated in the fuel-chamber either in contact with the fuel or with the heat radiated directly from it, or with both. Iron-smelting or blast furnaces are of this class, but as complex chemical processes other than those generating heat take place in them, they are better referred to in a separate article. Furnaces for heating steam-boilers are of this variety, and are considered in the article STEAM ENGINE. The metallurgical furnaces of this class are the cupola for melting iron for castings, etc.; the smith's "fire" in all its forms; the pot-furnace for melting steel in crucibles; also the usual forms of cementing furnaces. In pot and cementing furnaces the vessel that holds the metal, rather than the metal itself, is in direct contact with the fire. All forms of apparatus for heating air for domestic, metallurgical, or manufacturing purposes, by means of conducting walls placed between the heat-imparting medium and the air to be heated, are properly classified as "stoves," and are treated in various articles referring to the warming of buildings, also under the head BLAST FURNACE. The Bessemer converter and the "sponge" or ore-reducing furnace are of this class, and will be treated under STEEL. (2) *Reverberatory furnaces*, in which the material under treatment is heated in a chamber separate from and adjoining the fuel-chamber by means of the hot gaseous products of combustion and by radiation from the heated walls of the chamber. Most of the furnaces used in the wrought-iron and steel manufacture are of this class. The principal varieties are the puddling furnace, the "heating" furnace, the open-hearth or Siemens-Martin steel furnace, and the "air" furnace, which is a reverberatory melting furnace.

II. Furnaces are further classified according to the method of utilizing the fuel: (1) *Coal furnaces*, in which the heat utilized is the *direct* product of the combustion of solid fuel. (2) *Gas furnaces*, in which the fuel enters the furnace in the form of a gas; in metallurgical furnaces this is chiefly carbonic oxide; if bituminous coal, wood, or peat is employed, some hydrocarbons are present. To say that in the coal furnace fuel is used where it is burned, and that in the gas furnace fuel is made into gas in one place and used in another, would not accurately distinguish between the two varieties, because the gas-producer may be a part of the furnace where the heat is utilized, and yet the combustion which produces the carbonic oxide gas may be a distinct chemical process from the combustion which generates the utilized heat. The blast furnace and the cupola are necessarily coal furnaces; the other furnaces enumerated, whether the heat is applied in the chamber where combustion takes place or in an adjoining chamber, may be either coal or gas furnaces.

Description of Furnaces. Of the *open fires*, the smith's fire or forge is the oldest and the most common. It consists, in its simplest form, merely of a pile of coal from one to two feet in diameter, beneath which a blast is forced through a tuyere leading from a hand bellows. Iron or steel bars inserted in the fire may receive a welding heat. In large smith-shops, such as those connected with extensive machine-shops, these fires, sometimes 50 or more in number, are arranged in a suitable building, each with its blast-pipe from a common power blowing-machine, and its water-bosh, anvil, and other appurtenances, and its chimney or a flue leading to a common chimney. The fire is usually placed on a cast-iron table, or rather a shallow tank on legs, at a convenient height. The tuyere is constructed in various ways, many of which are the subjects of patents. A portable smith's forge is usually a light iron stand holding the platform for the fire, and also some form of hand blowing-machine and a water-bosh. The portable forge is chiefly used for heating rivets for ship and boiler work. A

FIG. 1.



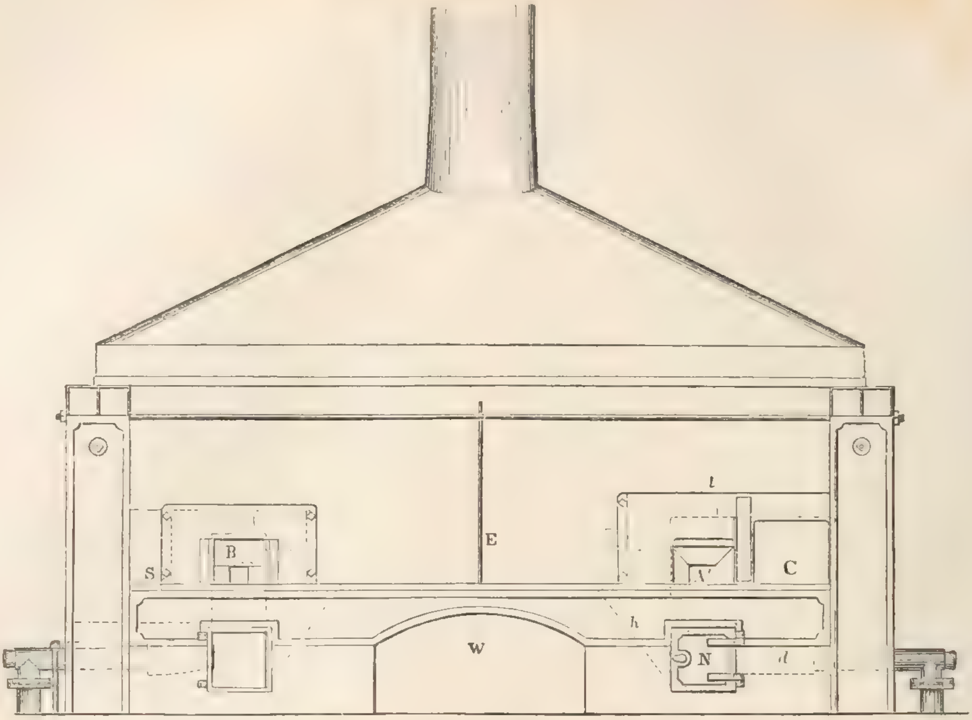
Horizontal Section.

more elaborate form of open fire is shown in horizontal section by Fig. 1, and in front elevation by Fig. 2. It is largely employed in crucible steel works for heating small ingots and bars. The "cold" or cogging fire consists of a pit A, 11 × 16 inches in plan and 2 feet deep, without grate bars, in which the fire is urged by a blast entering the tuyere *d*. The ashes are withdrawn at N, and the ingots are inserted at A', having been previously warmed in the "smoke hole" C, into which flame enters at *f f*. Coal is fed down the incline *h* into the pit A. The extension Z is for the accommodation of long bars. The gaseous products of combustion pass, partly and in a regulated degree, into the general chimney through the holes *l l*, and partly through the mouths and feed holes of the fires. The water bosh is placed under the arch W, and the coke and coal for use lie on the platform above it, being divided by the partition E. The "hot" or welding fire B is a pit 16 × 12 inches in plan, and otherwise similar to the cogging fire. Its tuyere is protected by a water casing. The fuel is coke. S is an iron tray containing welding sand. The fire-pits are built of fire-brick, the most refractory kind being required in the welding fire, where the most exposed parts last but a month. The two fires consume about 15 bushels of coal and 15 bushels of coke in 9 hours to heat and reheat 45 cwt. of steel. Casting the ingot in an iron mould chills its surface, so that sudden heating would "burn" it. It is therefore warmed slowly in the smoke-hole, then heated in the cogging fire, and partially drawn under a power hammer; then it is reheated as often as required in the welding fire.

The earliest smelting furnaces were open fires, not much larger than smiths' forges, and the same crude apparatus is still employed where fuel is plentiful both for smelting ore and for decarburizing crude cast iron.

The reverberatory heating furnace for solid fuel, as employed for heating iron and steel masses of 300 to 2000 pounds weight, is shown in vertical section by Fig. 3. The fire on the grate A is urged by the draft of a high chimney, or usually by a power-fan. The masses to be heated are inserted and withdrawn through the doors J by hand, or by machinery if they are very heavy. The bottom of the furnace is a bed of sand which is compacted by partial

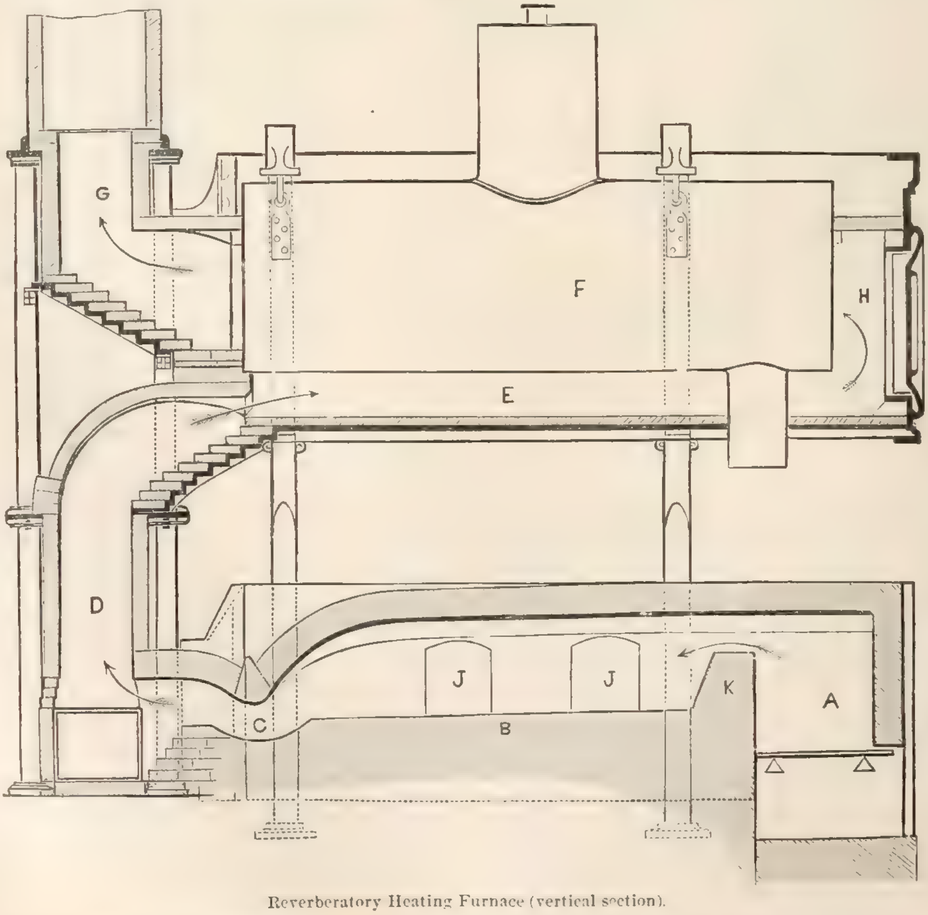
FIG. 2.



Front Elevation.

fusion. The metal is separated from the fuel and shielded from the direct impact of the flame by the bridge K. The flame, passing along under the roof of the furnace, heats the metal below, partly by contact and partly by radiation. The flame-current is "reverberated" by the roof and sides, so as to roll down upon and over the metal. The contracted

FIG. 3



Reverberatory Heating Furnace (vertical section).

throat C tends to check the expansion, and hence to maintain the temperature of the burning gases at this point, although the furnace "works" hotter at the bridge than at the throat. The shape of the roof, the size of the throat, and the height of the bridge are the subjects of endless modifications to suit the nature of the work and also the caprices of the workmen. Cinder that forms from the oxidizing metal and the melting sand bottom when high heats are employed accumulates and is tapped off at C. The furnace is a strongly bound iron shell lined with fire-brick. Upon a bed 10 to 12 feet long, six 7 × 7-inch iron rail piles can be heated to welding in 1½ hours with about 1000 pounds of coal per ton of iron. The engraving also shows one of the various arrangements of boilers for utilizing the waste heat of the furnace. The boiler F and its brick casing are placed over the furnace to save room, and upheld by iron columns. The hot products of combustion pass up the flue D, under the boiler at E, and through the boiler flues into the chimney G. The tubes are accessible for cleaning through the doors H. In mills for rolling iron rails all the steam for driving the engines may be generated by the waste heat from the furnaces. Steel-heating furnaces are worked at a lower temperature, and the boilers over them do not furnish all the required steam.

The reverberatory melting furnace, or "air" furnace for solid fuel, is of similar construction. In the older form (Fig. 4) the flame and any free air it may contain are drawn from the fire-box A along the roof of the furnace, and do not come into very direct contact with the metal lying on the bed B. In the later form (Fig. 5) the flame from A is thrown by the roof directly upon the iron lying at B. This furnace therefore melts faster, but it oxidizes the metal more rapidly. The average air furnace melts 2 tons of pig-iron with a ton of coal. In foreign practice reverberatory melting and heating furnace fires are maintained by the draft of large and high chimneys. The same is true of the reverberatory furnaces almost universally employed in this country for melting iron for cannon and rolls. But in our later foundry and rolling-mill practice fires are maintained more uniformly and with less expense by blast from power blowing-machines, usually rotatory high-speed fans. Iron melted in an air furnace, as compared with that melted by direct contact of fuel in a cupola, escapes contamination by the sulphur and phosphorus in the fuel, and its carbon and silicon may be oxidized to any extent required for castings in the air furnace, thus increasing its strength. The recent practice of melting 5 to 20 per cent. of soft steel scrap, as required, with cast iron in the cupola is found to make equally strong castings for many purposes.

Fig. 4.

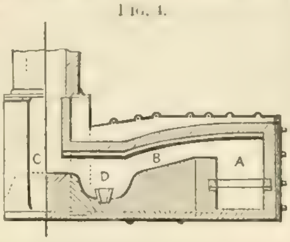
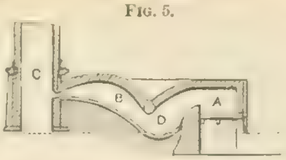
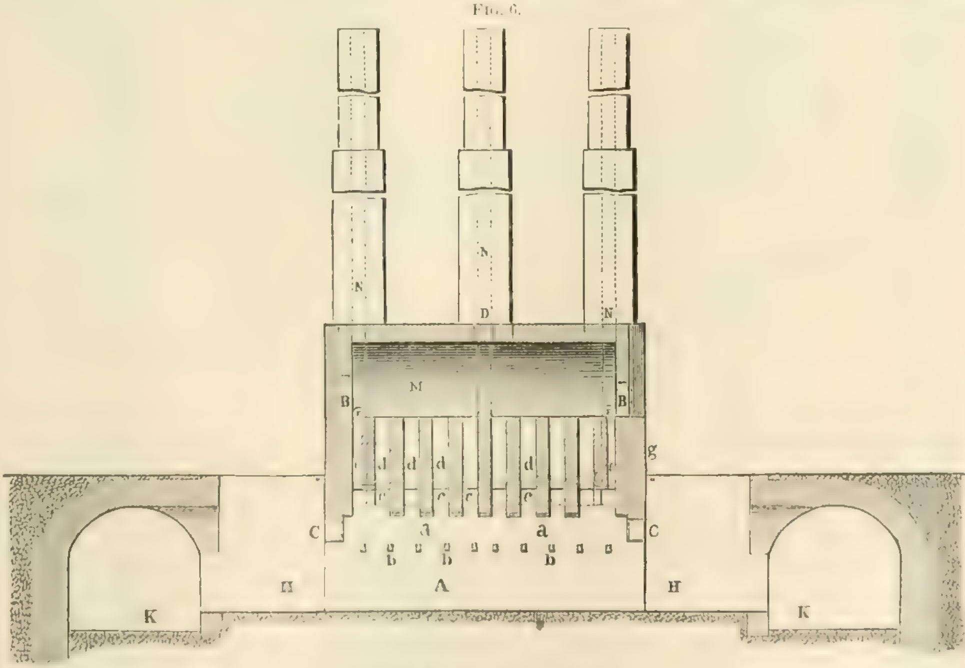


Fig. 5.



The cementing furnace is shown in vertical section by Fig. 6, and in horizontal section by Fig. 7. It is employed for heating wrought iron in contact with carbon to make carburized iron, called "blister steel," which is then rolled into marketable shapes or broken up and melted in crucibles to make cast steel. The same general type of furnace is suitable for annealing metals and for reversing the operation of cementing—viz. heating bars or castings in contact with oxide of iron to withdraw carbon. The furnace consists of two pots or troughs of refractory material (defined in Fig. 7 by the letter G at the four corners of each pot), each about 13 × 4 feet in plan and 4 feet deep, capable of holding 15 tons of iron bars. The pots are surrounded and heated by means of numerous flues *c*, which pass under the bottom and up the sides, and flues *d c*, all of which convey flame from the common fire A to the chamber *m*, whence it is discharged by the chimneys N. The fire-grates lie on the bearing bars *a* (Fig. 6), and form a fireplace about 16 inches wide and 18 feet long. The large doors B B give access to the pots. H H are pits at each end of the furnace for working the fires, and K K are tunnels connecting the pits of a series of furnaces through which fuel is brought and ashes are removed. Layers of charcoal about ½ inch thick and layers of iron bars are laid alternately in the pots (in such manner that no bars shall touch each other) until the pots are full. Then sand and a cover of fire clay is tightly rammed upon each pot, and the doors B B are closed with brick walls, except a sight hole in each. A fire is then built upon the grate at *a*, and a yellow to white heat is maintained on the pots for 6 to 10 days, according to the degree of carburization required. Test bars are from time to time withdrawn at the hole *g* to ascertain the progress of the cementation, and when it is completed the ash-pit doors are closed and the fire is allowed to smoulder and go out. The pots are then opened and the bars are removed. Furnaces for heating retorts in the production of illuminating gas are simpler forms of the above-described apparatus.

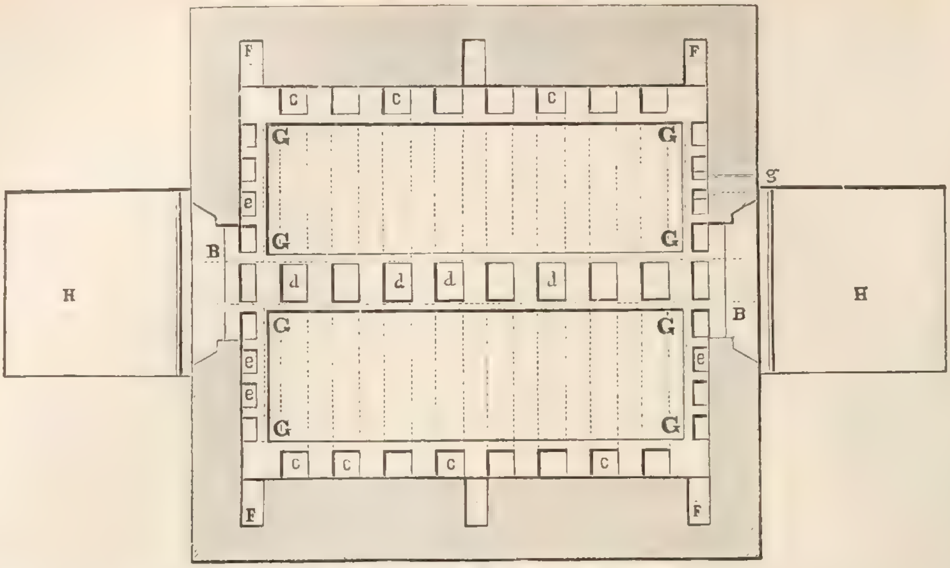
Fig. 6.



Cementing Furnace (vertical section).

The cupola furnace, in a form commonly used for melting iron in foundries, is shown in vertical section by Fig. 8. It consists of a plate-iron shell lined with fire-brick. The internal diameter is ordinarily from 3 to 6 feet. The engravings show a Mackenzie cupola, which is elliptical in cross section in order to shorten the travel of the blast from the tuyere B to the centre of the cupola. The tuyere

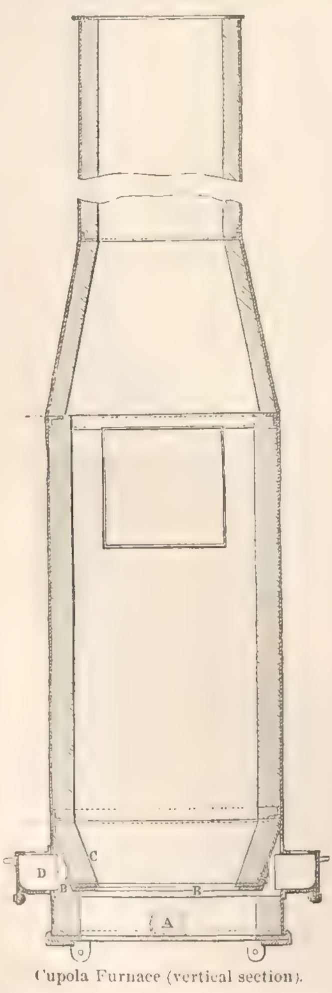
FIG. 7.



Cementing Furnace (horizontal section).

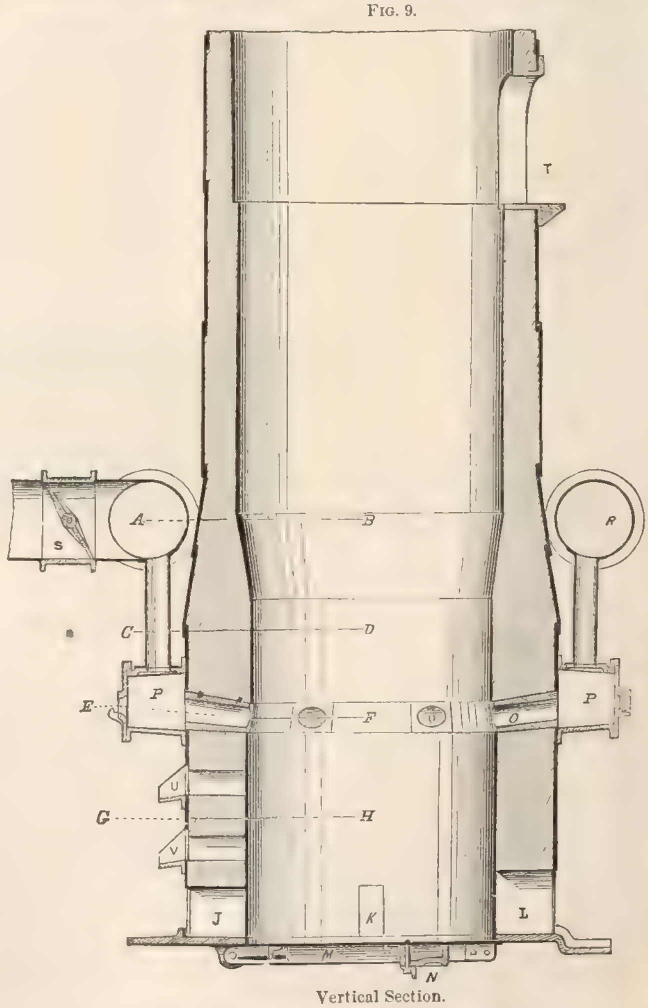
is a slit 1 inch to $1\frac{1}{2}$ inches high, and extending entirely around the furnace. Air is supplied through the wind-boxes D from a high-speed fan or a piston blowing-machine at a pressure of $\frac{3}{4}$ pound to 1 pound, according to the amount and duration of the work. The furnace is narrowed at the melting zone by the boshes C. Iron (either pig or cast scrap) and anthracite coal or coke are charged in alternate layers, and the melted metal accumulates in the hearth below the tuyeres, and is tapped off at A. Bituminous coal, being compacted by the heat and the pressure of superincumbent charges, will not permit free passage of the blast, and is hence an unsuitable fuel for cupolas. From 5 to 10 pounds of iron are melted with a pound of coal, according to the kind and size of furnace. When

FIG. 8.



Cupola Furnace (vertical section).

FIG. 9.

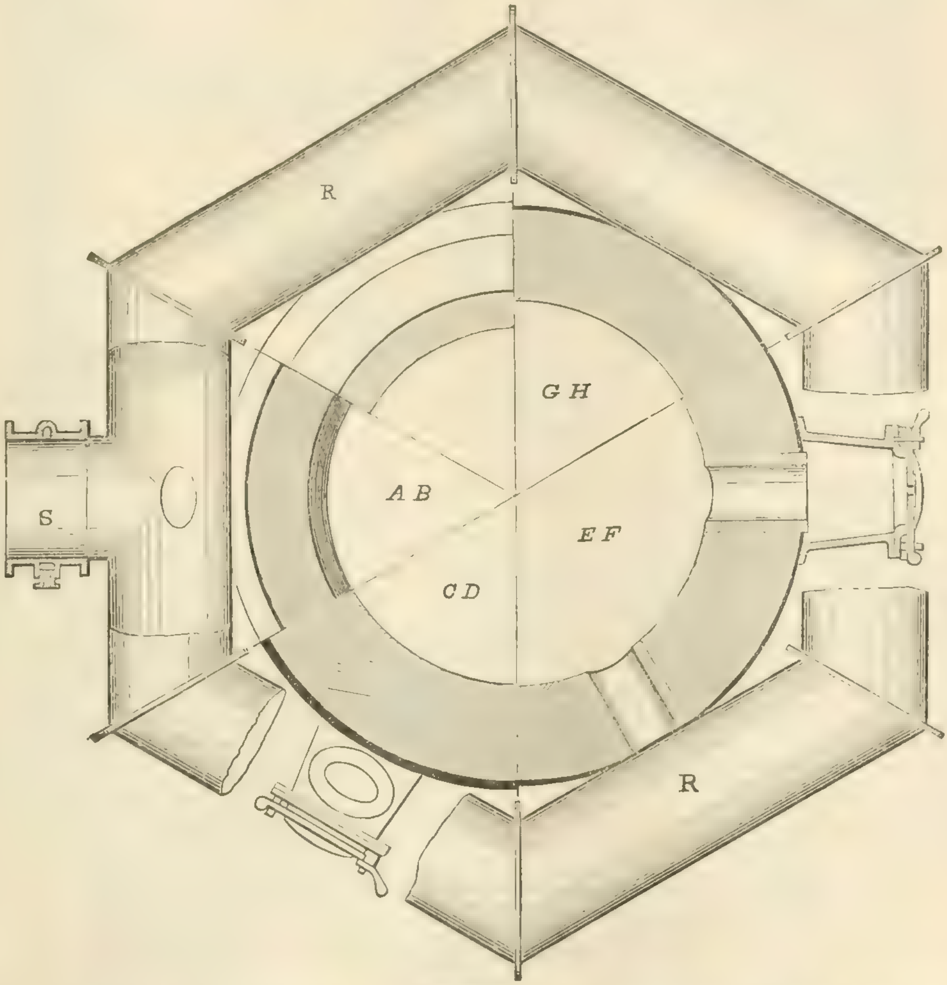


Vertical Section.

the day's melting is over the bottom doors are opened and the sand bottom and the slag and any remaining iron are dropped into the pit below.

For delivering regular quantities of melted iron for many consecutive hours—for instance, 6 tons an hour for a day and a night in a Bessemer steel works—modifications of the cupola are required, as shown in the vertical section Fig. 9 and the cross-section Fig. 10. In the foundry cupola (Fig. 8) the hearth is shallow, so that the bed-charge of coal (which must reach above the tuyeres) may be light; and since the furnace is run but a few hours at a time, this hearth is large enough to contain the slag. If a great quantity of iron is required, large cupolas or a number of cupolas are employed. But when the furnace must melt continuously for many hours, the hearth H (Fig. 9) is enlarged to accommodate a considerable quantity of melted metal and slag, and the tap-holes U V are provided to discharge the slag as it accumulates; otherwise it would rise and clog the tuyeres and form "scaffolds," which are masses of slag and coal that chill upon the walls. The

FIG. 10.



Cross-section.

tuyeres O are cast-iron tubes, generally six in number, with a 5 × 8-inch hole in each, and are so arranged that they can be cleared while in operation by inserting a bar through doors in the wind-boxes P. In a cupola of 5 feet internal diameter the bed-charge of coal, to reach above the tuyeres, is about 2½ tons. Upon this are placed 2½ tons of pig iron and 100 pounds of limestone (to make the cinder fluid); then 600 to 700 pounds of coal, 3½ tons of iron, and 100 pounds of limestone, followed by coal, iron, and limestone in the last-named proportions. The fire is maintained by draft through the holes J K L till the bed-charge is thoroughly alight; these holes are then closed and blast is applied through the tuyeres O. When some 15 tons of iron have been melted and tapped out at L, the slag-hole U is opened. As the hearth fills again with iron the slag floating upon it runs out; and when the iron has risen to U, it is again tapped off at L. The slag-hole now remains open, and the cupola is worked continuously as last described.

The Gas Furnace.—The mere mingling of combustible gas and air is but one element in the production of the great and manageable heats obtained in a gas furnace. The regenerative principle—*i. e.* utilizing the otherwise waste escaping heat to raise the temperature of the entering air and gas—is the subject of those modern improvements which are bringing the gas furnace into almost universal use. There are two systems of regeneration: 1st, the one by means of which Messrs. C. W. and F. Siemens of London have developed the highly perfected and generally used Siemens' furnace. This consists in passing the heated products of combustion, as they leave the furnace, over vast surfaces of brick, upon which they deposit their heat. The entering air and gas are then passed over these hot brick surfaces, and, so to speak, wash off the heat from them and take it up themselves. Meanwhile, the escaping products of composition are heating other brick surfaces, which in their turn yield their heat to the incoming gases. This is the alternating system. The heat in a coal reverberatory furnace probably never exceeds 3500° F.; that produced in a gas furnace by direct combustion is the same, plus the heat returned by the regenerators, and may reach 4500° F., which is the heat at which dissociation commences, and is therefore the maximum attainable by the combustion of the gases employed. 2d. The other form of regenerator is, properly speaking, a stove, in which the outgoing gases pass on one side of thin conducting partitions, while the incoming gases flow along the opposite side, the heat being continuously transmitted through the partitions. This continuous system of regeneration, although employed in a limited or an imperfect manner long prior to Siemens' experiments, and considerably improved by Gorman in the English furnace bearing his name, has recently been raised to the Siemens' standard of excellence by Sellers, and also by Frank, in this country. The gas producer

has also been the subject of many modifications to suit different fuels. The one illustrated in longitudinal section by Fig. 10 A and in cross-section by Fig. 10 B is the form used by Siemens for bituminous coal. It is a strongly bound fire-brick chamber, from 7 to 8 feet square in its largest dimensions and 7 feet deep. Coal charged through

Fig. 10 A.

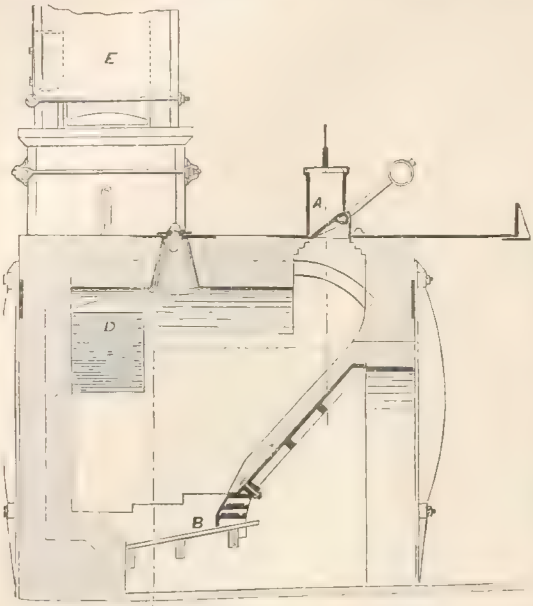
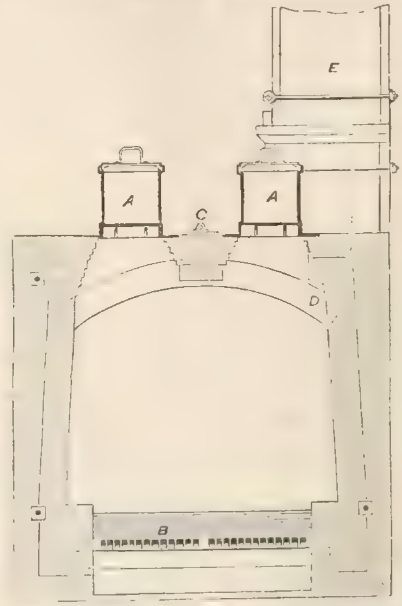


Fig. 10 B.

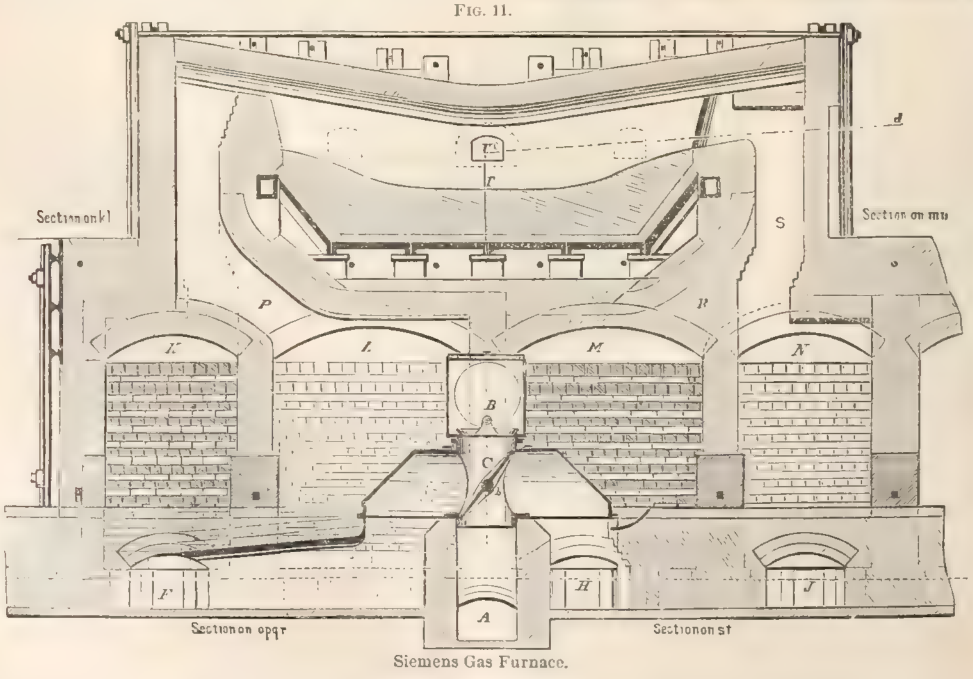


Siemens Gas-Producer.

the gas-tight hopper A is slowly burned on the grate B. The fire is stirred by a bar inserted at the hole C. By means of the flue D the gas enters the gas-stack E, which is also the outlet of three other producers arranged around it. Thence the gas is conducted by brick or iron flues to the furnaces, which may adjoin the producers or be hundreds of feet away. Air for combustion is usually drawn into the grate by means of the furnace chimney, but blast is beginning to be introduced under the grates in order to better control the rate of combustion. Some 2 tons of coal are burned in 24 hours in each producer. The anthracite producer is usually larger and has more grate surface, and jets of steam are employed, chiefly to soften the clinker. The use of water as a means of furnishing combustible gases has not proved advantageous, because their combustion produces no more heat than that abstracted in decomposing the water into these gases. Bituminous coal having been lighted in the producer, the volatile constituents, chiefly hydrocarbons and water, are first evolved. Of the remaining 60 or 70 per cent. of solid carbon, that next the grate is burned to carbonic acid, which, by rising through two or three feet thickness of incandescent carbon, is changed to carbonic oxide. The gases passing to the furnace consist chiefly of carbonic oxide, 25 per cent., hydrocarbons, 10 per cent., and nitrogen, 60 per cent. The producer and gas-flue should contain a slight excess of pressure over the atmosphere to prevent the inflow of air through crevices, and the consequent combustion and waste of gas. Placing the gas-producers below the furnace, or supplying them with air by a fan rather than by the furnace chimney draft, best accomplishes this result. Another means of producing such a plenum is the sheet-iron cooling tube, in which the gas from the stack E (Fig. 10 A) falls towards the furnace, and is thereby cooled from 300° or 400° down to 200° or 250°, thus gaining 15 to 20 per cent. in weight, which urges it forward to the furnace.

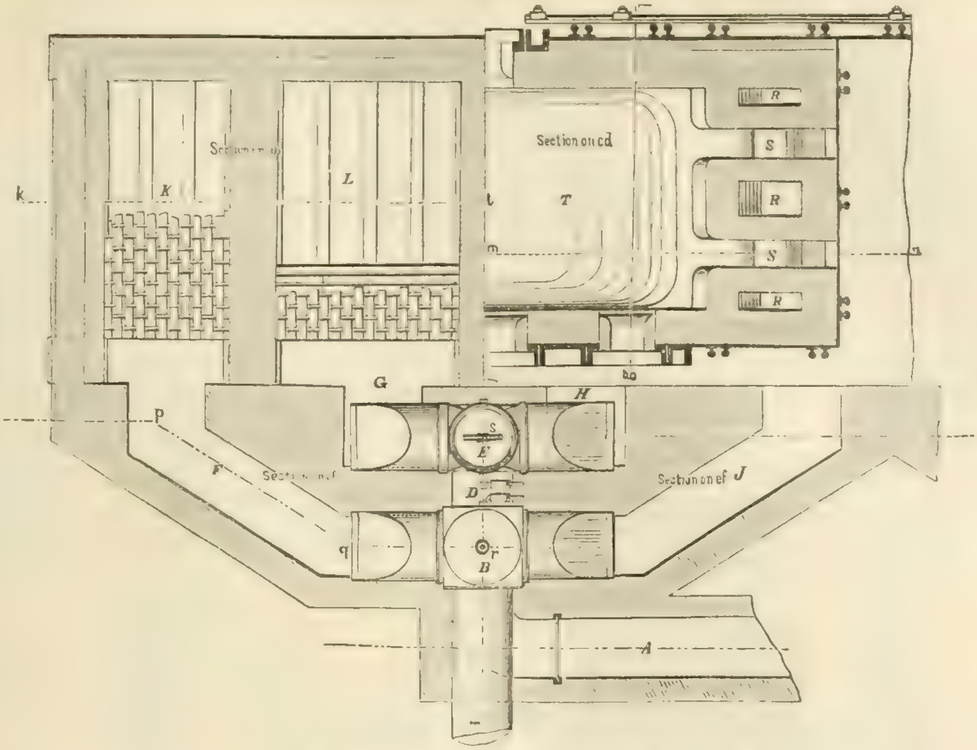
The Siemens Gas Furnace.—The general structure and

Fig. 11.



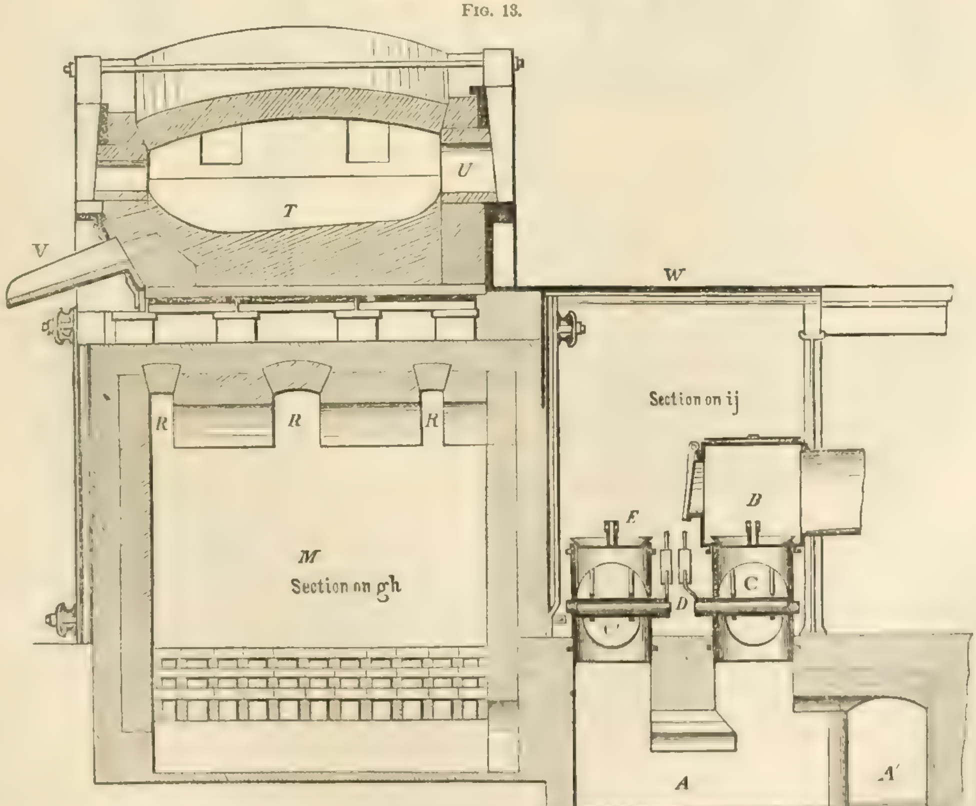
Siemens Gas Furnace.

FIG. 12.



Siemens Gas Furnace (horizontal section).

FIG. 13.

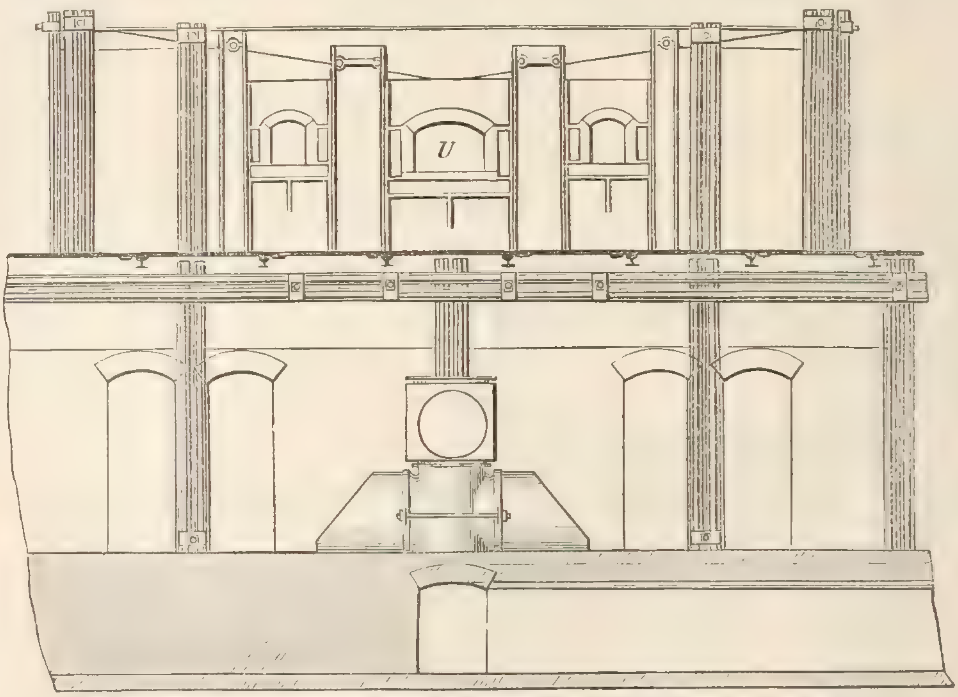


Siemens Gas Furnace (cross-section).

details of this furnace, for both melting and heating, are illustrated by Figs. 11 to 14, which represent a 5 ton open hearth furnace for the manufacture of Martin steel out of cast and wrought iron, as built by Mr. S. T. Wellman for the Otis Iron and Steel Co., Cleveland, O. Above the floor line W (Fig. 13) the furnace is a rectangular iron box about 22 × 10 feet in plan, strengthened with buckstaves, roofed and lined with fire-brick, and furnished with charging doors V, like the ordinary reverberating furnace. The sand-bed or hearth T upon which the materials are melted

rests in a heavy cast-iron basin, beneath which there is free circulation of air to preserve the parts from excessive heat. By means of the spout V the steel is conducted to the casting ladle. Fig. 14 is an exterior view of the charging side of the furnace and of the regenerator below. The regenerator consists of four fire-brick chambers K L M N (Fig. 11; shown in horizontal section at Fig. 12, and in cross-section at Fig. 13), which are filled with a checkerwork of fire-bricks stacked loosely together, so as to present the largest amount of surface to any gas entering the chamber. From each of the end chambers K N two gas-ports S lead up into the furnace (as shown on the right of Fig. 11, and in plan on the right of Fig. 12). From each chamber L M three air-ports P (Fig. 11) and R (Figs. 11 and 12) lead up alongside the gas-ports to a higher point in the furnace, in order to promote a more thorough mixture of air and gas. The ports thus form a sort of vast argand burner at each end of the furnace. The gas, air, and reversing valves and flues are shown in cross-section at Fig. 13, in plan (laid over a horizontal section of the flues) at Fig. 12, and in longitudinal section (laid over a longitudinal section of the regenerators) at Fig. 11. The operation is as follows: Gas from the producers, regulated by the puppet-valve B, passes down through the reversing valve C (Fig. 11), which is so set as to throw it into the flue F and the regenerator K, where it percolates through the mass of red to yellow hot brickwork, and thence passes at an equally high temperature into the furnace. Meanwhile, air, regulated by the valve E, is drawn by the furnace chimney into the reversing valve C′ (Fig. 13), which, being set similarly to C, guides the air through the flue G into the regenerator L where it is also heated red hot, and in this condition it passes up the port P, and meets the red-hot gas at the mouth of the furnace. The combustion is instantaneous, and intense enough, if the gas is not carefully regulated, to melt down the roof of the furnace. The flame is thrown down by the roof upon the bath of metal in the hearth T; thence it passes down the ports R S (Fig. 12) into the two regenerators M N (Fig. 11), which absorb its heat; and thence it escapes through the flues J H under the two reversing valves C C′, and into the chimney-flue A A′. After 20 or 30 minutes, the two left-hand regenerators having been somewhat cooled by the ingoing air and gas, and the two right-hand regenerators having been highly heated by the outgoing products of combustion, the valves C C′ are reversed by means of the handles D, when immediately the currents begin to move in the opposite direction; the gases pass into the furnace at R S and out through the regenerators K L. The chief advantages of the gas furnace over the coal furnace are — 1st, Less than half the coal is required for a given heat; but since the escaping heat of the gas furnace is expended in regenerating gas rather than in raising steam, additional coal must be burned under the boilers, so that the fuel-saving is reduced in rolling-mills to about 25 per cent. 2d, The saving in the oxidation of the iron heated is about 3 per cent.—a greater economy than that in fuel—and is due to the complete command of the chemical character of the flame. The prevention of smoke, the saving of space and labor, and the cleanliness of works are also considerable advantages. It will be observed, by comparing the open hearth with the pot furnace and the puddling furnace hereinafter described, that the use of gas and of regeneration may be adapted to any required shape of furnace and to all varieties of work. In the glass manufacture, for example, they are largely employed. In the gas *heating* furnace the bed is usually made much larger than in the coal reverberatory (Fig. 3), because uniformity of temperature can be much better maintained. The largest practicable coal furnace will heat, for instance, 6 or 7 three-rail steel ingots weighing a ton each; a perfectly manageable gas furnace, 20 × 12 feet on the bed, will hold 15 or 18 such ingots. The continuous regenerator will be described in a following paragraph.

Fig. 14.



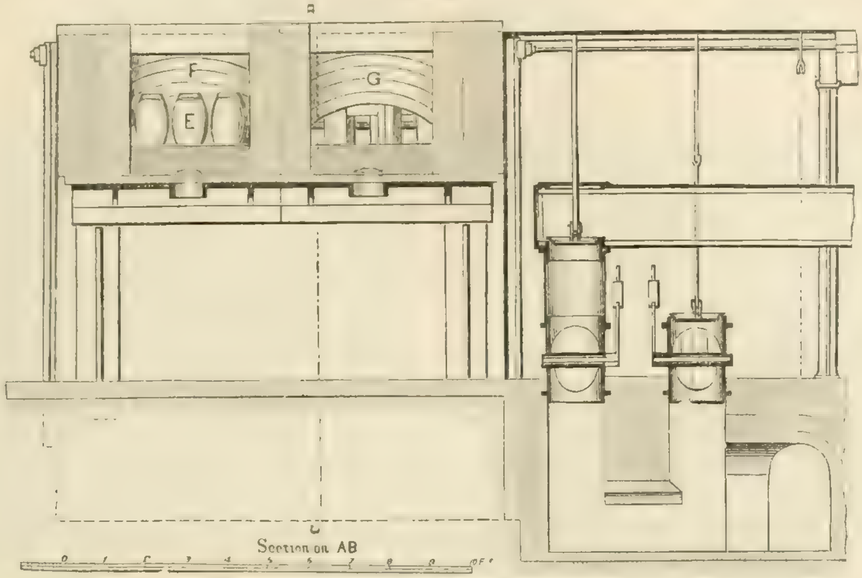
Siemens Gas Furnace (exterior view of the charging side, and of the regenerator below).

The Pot Furnace.—This is a small furnace, worked at a very high temperature, for heating fire-clay or plumbago crucibles or pots in which steel, brass, and other metals are melted. In the manufacture of crucible steel the pots containing the ingredients (chiefly wrought iron or cemented steel, and a little carbon and manganese) are about 15 inches high by 10 inches in diameter. From two to six of them are placed in a "melting-hole," which is a fire-brick furnace just large enough to hold them and the fire in which they are partially buried. The top of the furnace opens, by means of a lid, on the general floor of the building; a grate beneath communicates with a subterranean ash-pit and gangway. The fire in a coal furnace is urged by a powerful blast, and the escaping heat from a long row of melting-holes passes under a common steam-boiler. When the metal is ready to cast, the lid of the furnace is drawn to one side, the pot is lifted out, the cover of the pot is removed, and the metal is poured into a mould. Figs. 15 and 16 are respectively a longitudinal and cross-section of a Siemens gas-pot furnace. The general structure of a melting-hole and the situation of the pots E, whether coal or gas fuel is used, are shown at F G. The structure and operation of the regenerative apparatus will be understood by referring to the foregoing description of the open hearth. Gas and air, entering the hot regenerators I H respectively, mingle and burn as they enter the melting-hole G; thence they pass into and heat the regenerators J K. By means of the reversing valves the currents are changed from time to time, in order to maintain a uniform temperature in the furnace.

The Puddling Furnace.—This is a reverberatory furnace,

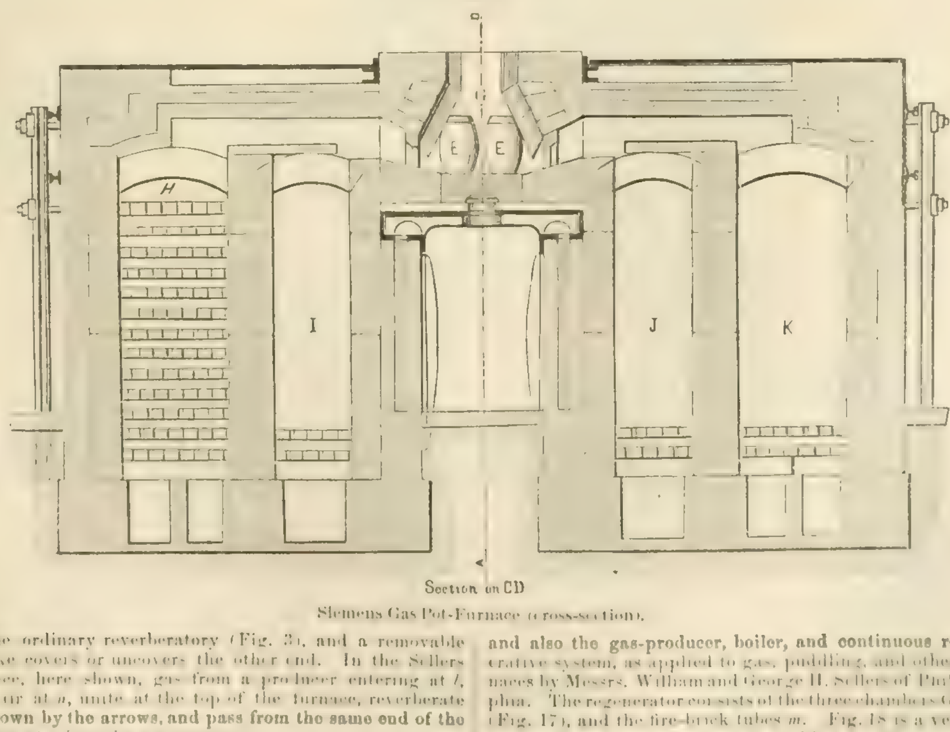
in which crude cast iron is melted and subjected to the oxidizing action of air and of oxide of iron, in order to remove its carbon and silicon, and thus convert it into a pasty mass of malleable iron. Its general construction is like that of the heating furnace (Fig. 3), except that its hearth is formed like that of the open hearth furnace (Figs. 11 to 14). When gas fuel is employed the regenerative system is substantially that shown in the last-named engravings. The single puddling furnace has a door at one side of the hearth, by which the iron is inserted and the "ball" is removed. Through a notch in the door the workman inserts the "rabble" or hooked iron bar by which he stirs the bath and forms the iron into balls. A double furnace has doors on both sides, through which two men work in the same bath. The product of a double furnace is about two tons in ten hours. Many attempts have been made to increase the product of the puddling furnace, and to relieve the severe manual labor of stirring the charge, by mechanical appliances, chiefly by means of the revolving furnace. These contrivances, especially the successful rotary furnace of Danks, will be referred to in the article on the IRON MANUFACTURE. The general features of rotary furnaces are shown in the following engraving (Fig. 18). The wrought-iron chamber B is lined with refractory material, and supported on rollers at W and by a trunnion at Y. It is rotated in either direction as required, and it is also removed from or placed against the gas entrances *p a* by means of a small steam-engine and gearing, not shown in the engraving. The furnace is constantly filled with flame, and the contained fluid iron and slag are stirred either violently or gently by its fast or slow rotation. One end of the Danks furnace is set against a firebox like the firebox

FIG. 15.



Siemens Gas Pot-Furnace (longitudinal section).

FIG. 16.



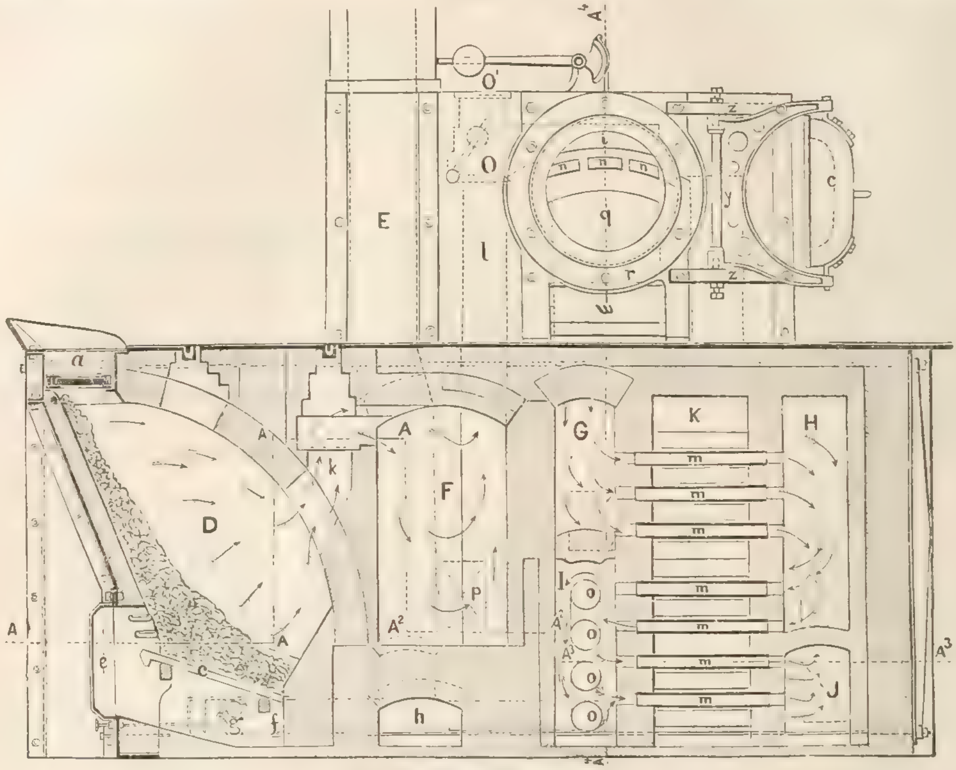
Siemens Gas Pot-Furnace (cross-section).

of the ordinary reverberatory (Fig. 3), and a removable uptake covers or uncovers the other end. In the Sellers furnace, here shown, gas from a producer entering at *l*, and air at *a*, unite at the top of the furnace, reverberate as shown by the arrows, and pass from the same end of the furnace at *g* into the regenerator.

The Continuous Regenerator. Figs. 17 and 18 illustrate generally the rotary puddling furnace as above described, and also the gas-producer, boiler, and continuous regenerative system, as applied to gas, puddling, and other furnaces by Messrs. William and George H. Sellers of Philadelphia. The regenerator consists of the three chambers G K H (Fig. 17), and the fire-brick tubes *m*. Fig. 18 is a vertical section through the chamber G, looking into the ends of the tubes. The products of combustion continually flow out of the furnace at *g* (Fig. 18), into the chamber G;

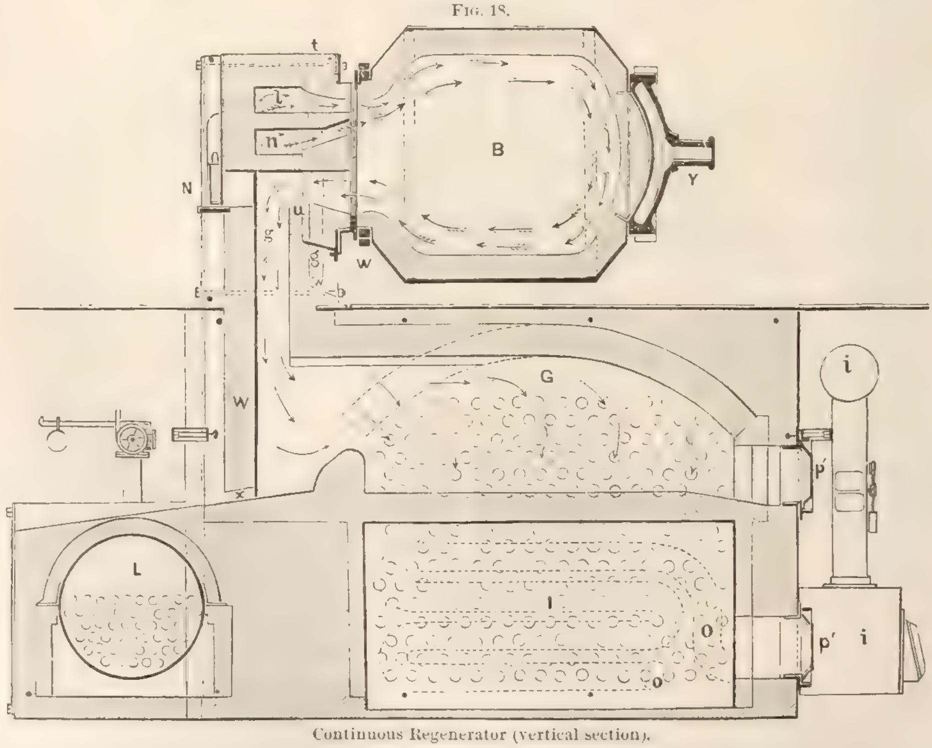
thence through the upper series of tubes to H; thence through the middle series of tubes to I, and thence to the flue J, which conducts them through the boiler L into the chimney E; or they may pass directly to the chimney. Meanwhile, the incoming air for combustion, entering the chamber K at p', continually flows around the tubes, and thence into the furnace at n (Fig. 18). Thus, the escaping heat of the furnace is transmitted through the walls of the tubes to the entering air. An important feature of this system of continuous regeneration is that the air entering the bottom and rising through the chamber K encounters successively hotter tubes, and receives its highest tempera-

Fig. 17.



The Continuous Regenerator.

Fig. 18.



Continuous Regenerator (vertical section).

ture just as it enters the furnace from the escaping gases just as they leave the furnace. For various purposes sufficient heat is obtained by regenerating the air alone, especially when the producer (D, Fig. 17) is close to the furnace, so that the gas loses none of its initial heat in long conduits and cooling-tubes. When a greater temperature is required in the furnace, a part of the escaping heat is applied to the entering gas also by means of a similar re-

generator. The regeneration of either the air or the gas alone is obviously not peculiar to the continuous system. In the apparatus illustrated various improvements are introduced: the escaping gases leave the regenerator at a sufficient temperature to raise steam in the boiler L for operating the rotary puddling furnace: the producer D has a closed ash pit, and air is supplied to it, and also to the regenerator, by means of a fan instead of chimney draft, so that the working may be more nicely regulated; and the gas deposits any dust and ashes that may rise with it in the chamber F before passing into the furnace. An arrangement is also shown for heating the air in the tubes O (a small continuous regenerator) before it enters the producer.

Conclusion.—A treatise on furnaces without descriptions of the different smelting furnaces, and of numerous standard forms of apparatus for applying heat in the various arts, is obviously incomplete: they are all, however, special applications, and as such are described in the treatises on these arts, and they are all modifications of the typical forms herein described. In those arts where fuel is used on the largest scale, such as the manufacture of wrought iron, steel, and glass, and where the highest temperatures are required, the grand improvement of the period, already becoming general, is the use of gaseous fuel, and its regeneration by means of the escaping heat of the furnace. One, at least, of the most important modern manufactures—that of open-hearth steel—is the direct result of the regenerative gas furnace. Heat of sufficient intensity and of suitable chemical character was unattainable by any other known means. The temperature of dissociation having been attained, further improvements would appear to lie in the direction 1st, of economy—less than one-tenth of the theoretical value of fuel is utilized in the best furnaces; 2d, of more enduring refractory materials—fire-bricks are melted at easily attainable heats, and all refractory compounds are soon destroyed by chemical reaction with the ingredients under treatment. ALEX. L. HOLLEY.

Furnace (HEATING). See WARMING.

Fur'nas, county of Nebraska, bounded S. by Kansas. Area, 900 square miles. It is watered by the Republican River, and affords good grazing. Cap. Beaver City.

Furnes [Flemish *Veurne*], town of Belgium, in the province of West Flanders, at the junction of three canals, has a large trade in corn, butter, cheese, and linen. P. 4694.

Furness (HORACE HOWARD). See APPENDIX.

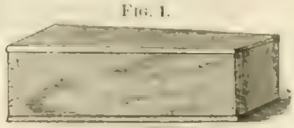
Fur'ness (WILLIAM HENRY), D. D., a clergyman, b. in Boston, Mass., Apr. 20, 1802; a graduate of the Boston Latin School and of Harvard College, 1820; studied theology at Cambridge, and was ordained pastor of the First Congregational Unitarian church in Philadelphia in 1825; there he has since remained. Dr. Furness is widely known as an author: has published a volume of prayers (1850), a volume of sermons (1855); has written devotional poetry of tender feeling; has made numerous translations from the German poets, and has published a volume of prose tales from the German (1856). He has printed many sermons in pamphlet, has contributed articles to the *Christian Examiner*, mostly on his favorite subject, the New Testament Gospels, and was for three years editor of the *Diadem*, an annual published in Philadelphia. But his name will be remembered in connection with the anti-slavery movement, in which he took an intense interest, and on which he frequently and earnestly preached; and with the attempt to recover the character of Jesus by a fresh study of his biographers. His chief literary works were on this theme, the successive volumes being simply attempts at more complete and convincing statement. The first, *Remarks on the Four Gospels*, appeared in 1836; *Jesus and His Biographers*, in 1838; a *History of Jesus*, in 1850; *Thoughts on the Life and Character of Jesus of Nazareth*, in 1859; *The Veil partly Lifted*, 1864; and *Jesus*, in 1871. He also translated from the German, with notes and comments, Dr. Daniel Schenkel's *Characterbild Jesu*, an elaborate essay written as a reply to Renan's work (2 vols., Boston, 1866). (For an estimate of his view of Jesus see the *North Amer. Review* for Oct., 1850.) Dr. Furness is remarkable for a spirit of noble and pure enthusiasm, for earnestness of religious conviction, and for delicacy of literary taste. His fame as a preacher stands very high. In sectarian controversies he has never taken part, nor has he been interested in the extension of the Unitarian faith as a peculiarity, preferring to stand outside of organizations. O. B. FROTHINGHAM.

Furness (WILLIAM HENRY, JR.), son of the above, an artist, b. in Philadelphia May 21, 1828; d. in Cambridge, Mass., Mar. 1, 1867. On leaving school at the age of sixteen, he went into a counting-room, but was there only one year, his passion being for art. His skill in crayon portraits gained him reputation and money; he went to Brooklyn, N. Y., thence soon after to Boston, where a residence of two or three years enabled him to accumulate sufficient means by his pencil to spend more than two years abroad, studying art in Düsseldorf, Munich, Dresden, and Venice. On his return he established himself as a portrait-painter in Philadelphia, married, removed his studio to Boston, and lived in Cambridge. His improvement as an artist was rapid, and at the time of his death he stood in the front rank of his profession. His best work is marked by firmness of drawing, truth of color, fidelity to characteristic traits of feature, and fine feeling of expression. His genius was delicate, his spirit gentle, his taste refined; but earnest study saved him from weakness, and his simple love of truth imparted to his portraits a living charm. He was fortunate in his subjects. Charles Sumner, Lucretia Mott, Dr. Furness, John W. Field, Hamilton Wilde the painter, J. P. Lesley, the daughter of R. W. Emerson, with many persons besides of intellect and character, sat to him. But his best work gave only the promise of what he might have done had he lived. O. B. FROTHINGHAM.

Furni'ture [Fr. *fournir*, to "furnish"]. The furnishing of houses with utensils and ornaments will represent the kind and degree of civilization among any people. With savages, furniture is of a very rude and coarse description, and needs little remark. The furniture of the dwelling of an opulent Persian, Assyrian, or Syrian 2500 years ago (and it has changed but little in the lapse of centuries) may be very briefly described. Entrance was through the centre of the windowless front by a broad, low door—through which the horses or asses also found their way—into the inner court, with its fountains, its garden, and its flowers, from which there was an ascent by a flight of steps to the gallery of the second floor. Opening from this gallery were large rooms, the floors covered with mats, and with broad divans ranged along one side covered with rich shawls, while on the opposite side were closets and chests or coffers richly adorned, or perhaps inlaid with copper, silver, and gold wrought with great skill. In these were kept the costly robes and jewels and the rare and costly perfumes which formed a large item in the wealth of the Oriental nobleman. The dining-room was furnished with a table occupying three sides of a square, with couches on which the guests reclined, placed around the table on the outside of the square. The banquet was likely to be served with dishes of gold and silver, massive and precious, but without forks or spoons. The kitchen utensils were few in number, made of metal, and each one served for several purposes. The cooking was done by an open fire.

The Egyptians, who were for many centuries the most refined and civilized of all the nations of the world, were the earliest to provide abundant furniture for their dwellings, and, with the possible exception of the Phœnicians, the most skilful in its construction. A Theban mummy-case, which from the inscription seems to have been made about 1600 B. C., or almost 3500 years since, now preserved in the Louvre, has its corners very carefully dovetailed, though no other nation made use of this form of joint for many centuries later. These mummy-cases (Fig. 1), often encrusted with ivory or with the precious metals, formed at a very early period a part of the furniture of the dwelling. Egyptian nobles had chairs of great size and beauty, ornamented with carvings and bas-reliefs in wood, ivory, or metal. (Fig. 2.) Their bedsteads were massive and decorated with abundant sculptures in bas-relief, and their mirrors of polished metal were large and adorned with carvings of animal life.

FIG. 1.



Mummy-case in Oak.

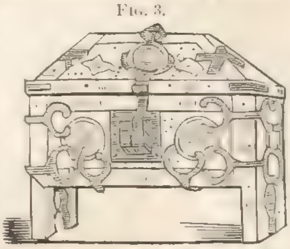
FIG. 2.

Egyptian Throne, or state chair.

The intellectual Greek led too public a life, and was too fully devoted to public displays in art, literature, and philosophy, to give any considerable attention to the decoration of his dwelling. Hence, while all the public edifices, temples, theatres, statues, and paintings of Greece are models of excellence, we have no contemporaneous representations, either in painting, carving, or sculpture, of the interiors of dwellings. We know, indeed, that the Greeks reclined at their meals upon the triclinia or couches around the table, which formed three sides of a hollow square—except the Lacedæmonians, who adhered to the benches

and the sitting posture; that they were also simpler in decoration than the Oriental nations; that their beds and bedsteads in some of the Grecian cities, especially in Corinth and the half-Grecian city of Ephesus, were the most costly and ornamental of all their furniture, calling into exercise the genius of their most eminent sculptors and carvers; and that aside from coffers for their treasures and jewels, closets for their valuable rolls of papyrus or parchment, and wardrobes for their clothing, all much plainer than those of the Orientals, their houses must have been bare of furniture.

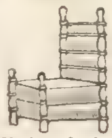
Fig. 3.



Coffer or strong-box of the twelfth century.

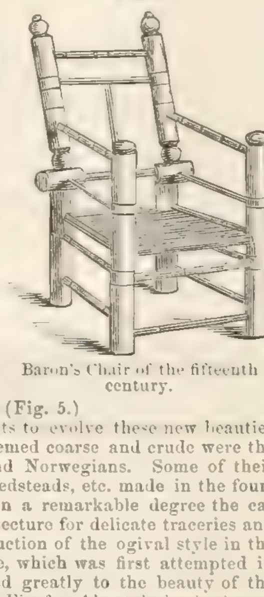
The Roman, with far less artistic taste than the Greek, had a more practical character. In the early history of republican, and even regal Rome, home had its attractions, and such adornments as would enhance these were sought. The couches, chairs, tables, beds, coffers, strong-boxes, libraries, and closets depicted in the paintings on the walls of Pompeiian dwellings, or if of metal preserved there, indicate that great advances had been made in the production of furniture, and that Roman artists had followed Egyptian models in household decoration. As luxury increased, this decoration extended to the smaller and more portable articles of furniture. Many of these were of exquisite workmanship. When the Western empire collapsed, sinking under the inroads of Goth and Hun, all this luxury vanished, and there came in its place the ruder and simpler forms of Gothic art. (Figs. 3 and 4.) The movements which led to the revival of letters and of high art led also, by gradual steps, to the improvement of this Gothic furniture, and demonstrated that in skilful hands even its rude arches, its heavy timbers, and its rough, unhewn beams and rails were capable of being transformed into forms of great beauty and delicacy. (Fig. 5.)

Fig. 4.



Chair of the twelfth century.

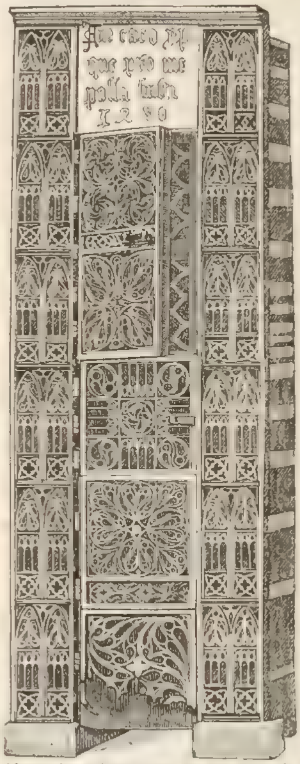
Fig. 5.



Baron's Chair of the fifteenth century.

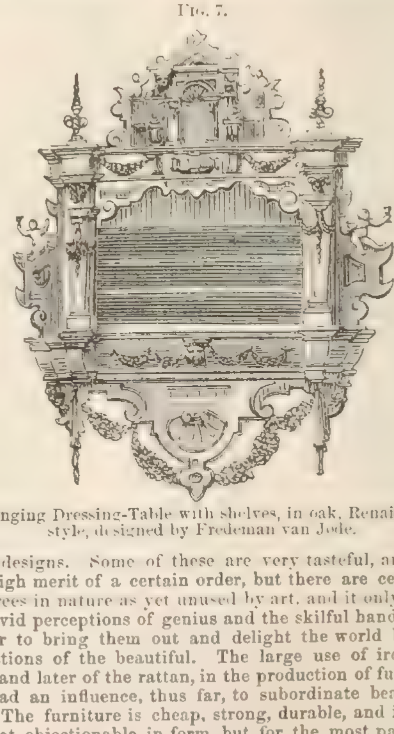
Among the earliest artists to evolve these new beauties from what had hitherto seemed coarse and crude were the Scandinavians—Swedes and Norwegians. Some of their church-stalls, wardrobes, bedsteads, etc. made in the fourteenth century developed in a remarkable degree the capacity of the Gothic architecture for delicate traceries and artistic effect. The introduction of the ogival style in the ornamentation of furniture, which was first attempted in the fifteenth century, added greatly to the beauty of the larger and heavier articles. (Fig. 6.) About the beginning of the sixteenth century the architectural style known as the *Renaissance* began to be applied to the larger articles of household furniture. The Renaissance, though professedly a *revival* of the ancient classic art of Greece and Rome, was really a combination, more or less complete, of the architecture of the luxurious period of the decadence of the Roman empire with the more ornamental styles of the later Gothic. In its application to furniture, however, a better effect was produced than in the development of its bizarre features in large public edifices. The principal artists and architects who were instrumental in introducing the Renaissance style into furniture were the Germans—Gabriel Krammer of Cologne; Jacob Guckeisen and Wendel Dietterlin of Strasburg; Jan Fredeman van Jode (called De Vries or the Frisian), a Dutch designer and engraver; a little later Krispin van Passe, also a Hollander, and the French architect Jacques Androuet, called Ducerceau; and at a later period Undentroh, a German architect. All except the last three belonged wholly to the sixteenth century. The era of Louis XIV. (1643–1715) was, so far as both architectural art and the designing of elegant furniture was concerned, a period of decadence; the style known among architects as the *Rococo* prevailed both in furniture and building; there was great splendor in gilding and bronze, but the designs were not artistic, and there was an incongruous mingling of ancient and modern styles which was almost entirely devoid of character or of the best effect (Fig. 8); and though curiosity-hunters are sometimes in raptures over the barbaric splendors of some of the furniture of the era of *le Grand Monarque*, there is little in it to satisfy a refined and cultivated taste. The latter part of the eighteenth century was marked by a very general return in architecture and the other fine arts to classic models, and these were copied so closely, and with so little regard to the advance which civilization had made in 2000 years, that they preserved all the faults without any considerable portion of the spirit of the classic age. During the present century the various eras of Gothic architecture and the Renaissance period have found their admirers, and the prevalent tendency of the age is rather to the florid or decorated Gothic and the Italian styles of the Renaissance than to the pure classic or the silly and unmeaning vagaries of the rococo style. There have been some indications both in England and the U. S. of an attempt at the creation of a new and distinctly original style of architecture, and of its application to the best qualities of furniture; but it must be confessed that there is far too general a tendency to rest contented with variations and new combinations of the classic, Gothic, and Renaissance designs. Some of these are very tasteful, and possess high merit of a certain order, but there are certainly resources in nature as yet unused by art, and it only needs the vivid perceptions of genius and the skilful hand of the master to bring them out and delight the world by new revelations of the beautiful. The large use of iron and steel, and later of the rattan, in the production of furniture has had an influence, thus far, to subordinate beauty to use. The furniture is cheap, strong, durable, and in general not objectionable in form, but for the most part it is not artistic or beautiful. When we have attained such

Fig. 6.



Closet for missals, etc. of the church of Egebrae, Norway, made in 1480.

Fig. 7.



A Hanging Dressing-Table with shelves, in oak, Renaissance style, designed by Fredeman van Jode.

control over these materials as to make them plastic and readily moulded for use in all their forms, we may be able to unite beauty and usefulness; and then will be the best

FIG. 8.

Easy-Chair of violet ebony, the seat and back covered with Gobelins tapestry (about 1715).

opportunity for the introduction of new conceptions and designs, which in the end shall make the American styles of architecture, whether in building or furniture, as famous as have been the Greek or the Gothic in the past.

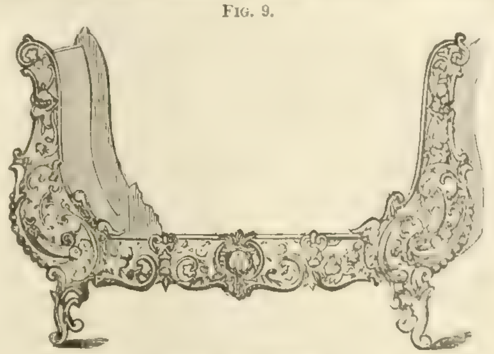
We have thus far said nothing of the furniture produced by the Chinese, Japanese, and other nations of the extreme East. Their cabinets and coffers, their lacquered wares, and their porcelain are certainly very attractive, and in a certain sense beautiful; their inlaid or marqueterie work is admirable, and much of their carving is of great delicacy of finish; but their designs are exceedingly grotesque, their perspective is constantly at fault, and their hinges, locks, and metal-work are mostly worthless. They develop no new designs: their work a thousand years ago was from the same patterns and quite as perfect as now.

In the matter of inlaying, mosaics, and marqueterie the Italians, French, and Hollanders have, in the last three centuries, attained the highest excellence. The Russians are also very skilful in some descriptions of this work. A large table of malachite in various figures and shades inlaid in marble, presented more than twenty years since by the czar Alexander II. to Hon. Thomas H. Seymour, then U. S. minister at St. Petersburg, is one of the finest examples of this kind of work. *Marqueterie* (the term used for inlaying figures with fine wood, ivory, or shells, in distinction from *mosaic*, which is the inlaying with precious stones or metals) is so abundant among the dealers in antique furniture that unless the designs are of special excellence they attract very little attention, and hardly bring any advance of price.

But while artistic furniture delights the eye and gratifies the refined taste, it is not to be forgotten that in the present artificial condition of society, furniture is a necessity, and not a luxury, to the greater part of the civilized world; and while we are entitled to ask that the forms of even the most common articles of furniture should not be rude or uncouth, we can hardly look for any considerable development of artistic excellence in the cheaper grades. Much of the furniture put upon the market has not even the merit of durability; it is cheap, and answers a tolerable purpose so long as it lasts. Made by machinery, often ill fitting in its parts, its defects concealed by glue, putty, paint, and varnish, its merits are few and its deficiencies many. A higher grade of furniture is made by hand, mostly by German, Dutch, or French workmen, and, though not of remarkable elegance, is substantial, durable, and serviceable. Probably more than nine-tenths of the furniture manufactured in the U. S. belongs to these two classes. In the division of labor which is the result of a dense and highly civilized population the production of furniture has been subdivided more, perhaps, than any other branch of mechanical industry. Thus, there are at least a dozen classes of manufacturers of chairs of different patterns—dining, common, cane-seat, easy, upholstered, office, and other chairs. Others make a specialty of sofas, tête-à-têtes, and divans; others of lounges; others, still, of sofa-beds; while yet others make only ottomans. There are eight or ten classes of manufacturers of different styles of tables; one producing only dining-tables, another ironing-tables, another card-tables, another small stands, another library-tables, another carved or inlaid tables; and so on. The manufacture of bedsteads is divided into nearly as many classes, though the best manufacturers have their finest bedsteads manufactured under their own direction; there are numerous manufacturers of what are known as chamber sets, consisting of bedstead, bureau, washstand, commode, small table, and three or four chairs. Some confine themselves to sets coated with an enamel or gilded, and having a very tasteful appearance, though they are not always durable. Others make only maple sets, stained, painted, varnished, or gilded; others make these sets of ash, black walnut, butternut, or a combination of two woods; while the better class are of cherry, mahogany (both now out of fashion), black walnut, or rosewood. Above these in quality come the carved, ornamented, or inlaid sets, which are really artistic and command a high price. The minor articles of household furniture are also very largely distributed among specialists, the best general manufacturers confining themselves to the larger articles. Library furniture — bookcases, tables, cabinets, stands, clocks, etc.—is a specialty by itself, into which very few general manufacturers enter. There is room in this for artistic display, and it is often improved.

The manufacture of iron or steel furniture, or furniture in part of iron or steel, does not to any great extent belong to the class of household goods. (Fig. 9.) The French

FIG. 9.



French Iron Bedstead.

and Germans have, however, made some artistic bedsteads and tables of iron, and our own manufacturers some of the cheaper bedsteads. The willow or wicker furniture and the rattan furniture (the latter owing its introduction almost wholly to the energy and efforts of the late Cyrus Wakefield) are more widely used in dwellings, and are easy and comfortable, though not specially artistic.

The processes of the manufacture of household furniture are briefly these: In the cheaper goods the basis or framework, and sometimes the entire article, is of some of the common woods—pine, bass-wood, white-wood, or soft maple; the frame is usually put together with dovetailed joints and glue, and by the aid of Blanchard's lathe for turning irregular surfaces and the various scroll and endless saws, etc. the desired form is obtained. Where the wood is to be exposed it is now veneered with mahogany, black walnut, or rosewood, sufficient pressure being applied to make the veneer adhere closely and firmly. If only small portions of the wood are to be seen, sometimes the solid black walnut, oak, or ash is used, or the wood, as in bedsteads, tables, etc., is rubbed smooth, stained, grained, treated with acid, or enamelled. If veneer is used, it is pumiced, varnished, pumiced again, and again varnished or rubbed very smooth, oiled, shellacked, or waxed. Ornaments, as handles, scrolls, knobs, or pieces in imitation of carving, are screwed and glued on, and the necessary trimmings—locks, slides, catches, casters, etc.—having been put on and another coating of oil or varnish applied, the article is ready for the market. Very much of this furniture is made in the rough at factories in well-wooded districts, and sent to the large cities to be finished. The table, bureau, and washstand tops are usually cheap marble slabs. Some of the articles, as the lounges, sofas, easy-chairs, tête-à-têtes, etc., are upholstered—that is, the seats are constructed with spiral springs, the lower portion of the coil being firmly sewed to heavy webbing, which is in turn fastened to the bottom of the seat either by nails, slats, or a board; over these springs is a covering of bur-

laps, on which is packed some elastic substance, curled horsehair being the best, but whalebone shavings, tow, bass-wood, or palm-leaf shavings, curled husks, or a compound known as "excelsior," being often used on the cheaper work; the seat is then confined in the form and pattern designed by a covering of heavy unbleached sheeting or drilling drawn tightly over it and nailed. This in turn is covered with haircloth, reps of various colors, woollen or silk brocatelle, broadcloth, morocco, or patent leather. In the number and quality of the springs, in the character of the elastic covering, and in the goods employed for the outside covering, as well as in the way this is attached to the sofa, lounge, or chair, there are abundant opportunities for fraudulent and imperfect work, some of which is difficult of detection. The character and integrity of the manufacturer are the best safeguards against this.

The better grades of furniture are made, except the drawers, those portions of the frames which are covered by upholstery, the slats or spring bottoms of the bedsteads, etc., of the solid woods—black walnut, rosewood, oak, satinwood, curled or birdseye maple, and the like—but often the panels, etc. are veneered with what are called French or veined veneers of the same description of wood, or sometimes of some contrasting wood. This class of furniture is for the most part made by hand, and not by machinery; there is considerable carving of the simpler sort about it, and it is very highly finished. The patterns vary greatly, according to the taste of the manufacturers; some confine themselves to Gothic styles, earlier, mediæval, or later, and more or less florid and flamboyant; some prefer the Renaissance designs, and make these of Florentine, Venetian, Roman, or Dutch styles; some, again, affect the classic styles, though generally those of the decadence period, and a few venture upon the absurd rococo styles. There ought to be—but there is not—a true American style, deriving its inspiration from our forests, our plants, fruits, and flowers, and copying nature as it exists here. There are still higher grades of furniture, on which has been expended the abundant labor of the sculptor and carver's art in bas-reliefs on oak, rosewood, and walnut, but these are rare productions, those who have the wealth and taste to seek for such work generally preferring the antique furniture of the sixteenth, seventeenth, and eighteenth centuries, with its elaborate and artistic carvings. It is becoming somewhat common among our wealthier citizens in the large cities who are building fine residences to summon to their aid "furniture-designers"—a profession which, though well known in Europe, is comparatively new here—and the size, height, location, and outlook from each room being noted, they design for it the appropriate furniture, carpets, curtains, and decorations. These designs are usually worked out by the manufacturer, who employs the designer, and who has a high reputation for artistic work. This method of furnishing a house, while it requires large means for its successful adoption, is undoubtedly a great advance towards high art, and prevents those blunders and incongruities in the artistic arrangement of a home into which persons of wealth and considerable culture, but of defective art-education, are liable to fall.

The extent and importance of the furniture manufacture in the U. S. may be appreciated from the following statistics: In 1850 there were 4242 establishments, employing 22,010 hands, and capital $7,303,358, using raw material to the value of $6,890,546, and producing furniture to the value of $17,663,054. In 1860 the number of manufactories had slightly diminished, there being but 3594 reported, but these employed 27,106 hands and a capital of $13,629,526; paid $8,909,998 in wages, used $8,181,250 worth of raw material, and produced furniture to the value of $26,632,293—an increase of 50 per cent. on the amount for 1850. In 1870, 5981 manufacturers were reported, employing 53,298 persons and a capital of $43,947,913, paying $21,574,531 as wages, using $25,843,170 worth of raw material, and producing furniture to the value of $69,082,684—an increase of over 200 per cent. in ten years, and of 400 per cent. in twenty years. (For much information concerning American furniture we are indebted to Messrs. W. P. Kingman & Co., New York.) L. P. Brockett.

Fur'nius (Caius), a friend of Cicero, who was tribune of the people 50 B. C.; opposed Octavius and favored Mark Antony during the triumvirate, but was pardoned by Augustus; attained consular rank, and in 21 B. C. was prefect of Hither Spain.

Furr, tp. of Stanley co., N. C. Pop. 1044.

Furruckabad', city of British India, the capital of the district of the same name, situated on the Ganges, on the road between Calcutta and Delhi. It is one of the commercial centres of Upper Hindostan. Pop. 60,000.

Furs and the Fur Trade. The use of the skins of wool-bearing and fur-bearing animals as convenient and readily adapted clothing goes back, according to the Sacred Records, to the time of the expulsion of the first pair from Eden. This costume is used among all savage and half-civilized nations in cold climates, and some of those in semi-tropical regions. But apart from the use of these skins of animals as clothing, there grew up, at a very early date, a demand for the finer and more beautiful furs for purposes of ornament and luxury. We find numerous evidences of this both among sacred and profane writers. They were used for the decoration of the tabernacle in the wilderness, the badgers' skins which formed the outermost covering of the sacred edifice being, in the opinion of biblical critics, the skins of the fur-seal (the badger being unknown in Egypt, Arabia, or Palestine), while below this covering was another of rams' skins dyed red (Ex. xxxvi. 19). Costly furs formed a part of the luxurious coverings of couches in the palace of Sardanapalus. Herodotus tells us that the inhabitants of the shores of the Caspian Sea were clad in the rich fur of the seal, and Ælianus and Plutarch both speak of the Pontic mouse (generally supposed to have been the ermine), whose rich fur made warm and beautiful robes, and was used as the covering of couches in the palace of Pharnabazus. The Chinese and Japanese have used furs as articles of luxury for at least 2500 years (the Chinese probably for more than 3000), and the robes of ermine, sable, and fiery-fox furs worn by the nobles of both nations are remarkable for their beauty. The choicest and finest furs (except the sable, which was not known at that time) were very generally worn as articles of luxury by the effeminate Roman aristocracy in the decline of the Roman empire. In the fourth century of our era the furs of the beaver (then known as the Pontic dog), the ermine, the seal, and several species of fox were in great demand. The tribes of Goths, Huns, and Ostrogoths which were migrating in such hosts from the north brought with them the choice furs of the Arctic regions, and during the Middle Ages they became articles of luxury throughout Southern and Central Europe. In the twelfth century the lighter-colored furs were almost universally dyed of a brilliant red color. In the wars with the Saracens the Christian princes imitated their foes in their habits of luxury, and costly furs from the East were used to such an extent that they wellnigh ruined the nations of Europe. Sumptuary decrees were issued about A. D. 1200 by Richard I. of England and Philip II. of France, prohibiting the wearing of these costly furs either by princes or people, but before the close of that century Louis IX. of France appeared in public with a surcoat lined with the skins of 746 ermines. Not long after this the privilege of wearing particular kinds of choice furs was granted to certain noble families in Germany, France, and Italy, but each one was restricted to a single kind of fur, and was permitted to put a figure of the animal producing it in his armorial bearings. Thus, the ermine, the sable, the Hungarian squirrel, the Podolian or fiery fox, and possibly also the beaver and the wolf, came to find a place in the coats-of-arms of some of the highest aristocracy of continental Europe.

For many centuries the Baltic ports were the great dépôts of the fur-trade, the furs being brought thither from Livonia, Sweden, Norway, Northern and North-eastern Russia, and later also from distant Siberian settlements by caravans which deposited them at the great market-towns of Moscow and Nijni-Novgorod. The discovery of the American continent soon changed the current of this traffic, for, though sables and ermines still came only from Russia, Siberia, and Northern Europe, yet the American forests and waters furnished in countless numbers the beaver—then regarded as one of the choicest of furs—the pine and stone martens, the mink, lynx, badger, raccoon, the choicest and most beautiful species of the fox, including the silver, white, cross, blue, and red fox, and the seal and sea-otter, the Virginia opossum, the muskrat, and among larger animals the bison, arctic, grizzly, and black bears, and the large gray wolf. This fur-trade was almost wholly monopolized by three or four great trading companies within 100 or 150 years after the discovery of the continent. The Dutch East India Company was first in the field, and carried on a thriving trade almost exclusively in furs with its trading-posts of New Amsterdam (New York), Beaverwyck (Albany), and one or two points on the Delaware River, as well as at several points on the coast of Maine, from 1609 to about 1684. The French very soon established themselves in the same traffic in Canada and farther N. and W., their chain of forts and trading-houses extending at one time from Hudson's Bay to New Orleans, and nearly all actively engaged in the fur-trade. A class of half-breed *voyageurs* and *coureurs du bois* grew up in this traffic, who were, and are to this day, skilful and successful hunters and trappers, though a more reckless crew of vagabonds could hardly be found. When the British government had by wars and treaties succeeded to the pos-

session of most of this region, the Hudson's Bay Company (chartered in 1660) took possession of these northern hunting-grounds and employed these half-breed voyageurs. For almost 200 years this great company monopolized the traffic in furs. It had indeed a somewhat powerful rival in the North-west Company after about 1790. In 1805 the latter company established trading factories on the Pacific coast, and in 1808, John Jacob Astor established the American Fur Company, with its line of posts across the continent, intending to form a dépôt for furs at the mouth of the Columbia River and ship the furs directly to China and India from that point. He subsequently changed its name to the "Pacific Fur Company," and was on the high road to success when in 1813 his resident partner there treacherously sold out the whole establishment to the North-west Company, on the plea that the British, with whom we were then at war, would have captured it. The Russian-American Fur Company, having its principal trading-post at Sitka in Alaska and subordinate posts on the Yukon, carried on an immense traffic for many years, but in 1867 transferred its property and rights to the U. S. simultaneously with our purchase of Alaska. The trade in furs conducted by citizens of the U. S. has been extensive, but in a greater degree the result of individual enterprise than of the management of gigantic corporations. Mr. Astor, after the treacherous transfer of the Pacific Fur Company to the North-west Company, confined his operations to the region E. of the Rocky Mountains, and with his partner and successor, Mr. Ramsey Crooks, transacted for many years a profitable business in furs. St. Louis was one of the principal dépôts of the fur-trade from 1763 to 1859. The first great establishment there was founded by Laclede, Maxon & Co. in 1763. The brothers Auguste and Pierre Chouteau were connected with it very early, at first as employés, and subsequently as partners, and up to 1808 they employed a large number of trappers and voyageurs, and were very successful. In 1808 the brothers Chouteau and several of their associates formed the Missouri Fur Company, which prospered greatly until 1813 or 1814, when, in consequence of the war with Great Britain, it was dissolved, and several of its members conducted the business independently. In 1827 the Rocky Mountain Fur Company of St. Louis was formed, and sent its trappers to the Pacific coast. The perils of the business were very great—40 men out of every 100 perished in its service—but such was the fascination of this life of adventure that enough were always ready to supply the place of the slain. After some years of successful business this company was dissolved. In 1831, Pierre Chouteau, Jr., who had been brought up in the business with his father and relatives, organized the firm of Pierre Chouteau, Jr., & Co., a name which for the next twenty-five years was familiar to all the trappers and hunters from the Mississippi and the Great Lakes to the Pacific. In 1859 the business was sold to Martin and Francis Bates of St. Louis and New York, who still conduct it, though not on as extensive a scale as formerly. After the consolidation of the North-west Company with the Hudson's Bay Company in 1821, and the expiry of the latter's charter and license in 1859, the fur-trade became more widely diffused in the hands of individuals, and while the aggregate amount collected each year is much greater than it was thirty years ago, the opportunities for acquiring colossal fortunes in it have passed away. Furs are made up now at more than twenty points in the N. and W., and London and Leipsic are becoming the best markets even for American furs, as they have long been for those of Europe, Asia, and South America. In 1870 the Alaska Company, of which Hon. Henry P. Haven of New London, Conn.—long known from his connection with the whale fishery—is a prominent owner and officer, leased from the U. S. the islands of St. Paul and St. George, the largest islands of the Aleutian group, in lat. about 56° 30′ N., about 250 miles N. W. of the coast of Alaska, for the purpose of conducting the trade in catching the sea-otter and fur-seal on those islands. They pay an annual rent of $55,000 for the islands, and a revenue tax of $2.62½ on each fur-seal taken and shipped from the islands, the government requiring that the number taken annually shall not exceed 100,000. It generally ranges from 96,000 to 98,000. These skins are worth from $30 to $45 each, but, taking into the account all the expenses of the business, the margin of profit is not very large.

The furs principally worn in this country are those of the Alaska seal or sea-otter; the fur-seal, of which not over 300,000 are taken annually; the sable, usually called the Russian sable, though the finest specimens come from North-eastern Siberia or Kamtchatka. This animal belongs to the genus *Mustela*, to which our weasel and the pine, stone, and fisher martens, and the mink, as well as the European polecat or fitch marten, also belong. It is a very beautiful animal, about four times the size of the weasel, and its fur is distinguished from all other furs by the hairs turning and lying equally smooth in either direction; this may be tested by blowing it. It is of a rich dark brown, approaching black. Only about 15,000 of these are caught yearly, but they range in value from $20 to $150 per skin, though the very finest rarely reach our market. A fine set of these furs ranges from $800 to $1800. The kolinski or Japanese sable is more plentiful, about 75,000 being caught annually, but is almost wholly taken up in the European, and especially in the English, market, and is hardly known here. The pine marten, or Hudson's Bay sable, is still more abundant, about 200,000 being taken annually; its color is a lustrous brown, and it is sometimes colored and passed off as the Russian sable, but the fraud is easy of detection. It is an excellent fur, but is just now not much in fashion, other furs having taken its place. The stone marten is of inferior quality, and of yellowish-brown color. It is often colored in Europe, where it is much used, but is not now sold here, though twenty-five years ago it was somewhat popular. The fisher marten is a scarce and valuable fur, only about 10,000 being caught annually. It is sold mostly in Europe. The mink is a favorite fur here at the present time, and has been for twelve or fourteen years past. There is a great diversity in its quality. The best specimens are a dark chestnut-brown, approaching to black, and resemble the Russian sable in color and fineness more nearly than any other fur. The greater part are somewhat lighter in color, and the poorest are of a yellowish-brown hue. About 250,000 are taken annually. The ermine, called in England the stoat, is very abundant in the northern portions of America, Europe, and Asia, and about 400,000 are taken yearly. It is pure white in winter, except the tip of its tail, which is jet black; in summer it is yellowish-brown; it does not become so perfectly white in more southern latitudes. Its fur was once prized very highly, and was only allowed to be worn by the highest nobility and on the official robes of judges and magistrates. It is still considered a valuable fur, though somewhat less esteemed than formerly. The skunk (*Mephitis Americanus*), though removed from the genus *Mustela* or marten in which it was formerly placed, belongs to the marten family. It is a well-known and mal-odorous depredator on hens' roosts in the country, and very abundant. Its fur is fine, and that portion of it which is black is very beautiful. For the past twelve or fifteen years it has been growing in favor, and when the black portions are selected and thoroughly deodorized, it makes up very elegantly, and is largely sold under the name of black marten. Probably not less than 200,000 are taken annually. These are the principal furs sold here in the form of collar, boa, and muffs; the seal-skin and sea-otter are also made up in ladies' jackets, gloves, and caps, and in gentlemen's caps, collars, and gloves. These are the only furs which are dyed successfully and retain both their color and gloss. Cheaper fur sets are made of Siberian squirrel, a very pretty slate-colored fur, muskrat, French rabbit or coney, common rabbit, wild-cat, house cat, and occasionally of badger, Virginia opossum, or raccoon. The greater part of the latter skins are, however, exported to Germany and Poland, where they are largely used for trimming overcoats. The muskrat fur is mostly employed in the hat manufacture. About 3,000,000 muskrats are caught annually, and nearly 2,000,000 exported. A cheap imitation of seal-skin is made from this fur by dyeing. The choicer grades of fox furs are used here to some extent for trimming, but very rarely, if at all, for muffs, collars, or tippets. The color of the white fox is only white in winter; in summer he is brown, gray, or bluish, and is then called a cross or pied fox. The choicest of all the Arctic varieties of fox is the silver fox. Its color when in prime fur is a deep glossy bluish black, with a silvery grizzle on the forehead and flanks. One of these skins has been sold for $500 in London. Not more than from 1000 to 2000 of these are caught annually, and not more than 6000 or 7000 of the blue fox, about 10,000 of the cross fox, 60,000 of the white fox, 25,000 of the gray fox, 40,000 of the kit fox, and over 300,000 of the red fox. The greater part of these go to Europe. The skins of the different species of bears, wolves, Canada lynxes, badgers, panthers, and wild-cats, as well as those of the buffalo, are made up into carriage robes, and are in great demand both in Europe and America for this purpose.

Our article will hardly be complete without a brief account of the processes of preparing these furs for wear. As brought to the manufacturers, they have been usually merely stretched and dried by the captors, or possibly a solution of alum has been applied to the flesh side. If not to be manufactured immediately, they are strewn with camphor, protected from dampness, and every few weeks carefully beaten with a stick. When they are to be dressed for making up into muffs, collars, etc., they are placed in tubs with

a quantity of rancid butter, and then trampled by the bare feet of men until the pelt is softened and partially tanned. They are next scraped on the flesh side with a strip of iron to remove portions of the flesh or cellular tissue which have adhered to the skin, and the grease is removed by trampling them again very thoroughly with fine sawdust of mahogany, lignumvitæ, or some other hard wood. They are next beaten many times, and the fur combed out. They are now ready for cutting out and making up into the various patterns of collars, boas, muffs, jackets, caps, gloves, etc. In making up fur goods, some manufacturers cut the skins into very narrow strips, and by carefully matching every scrap, however small, and sewing the whole neatly, they save nearly or quite 40 per cent. in material, and as the seams are all covered the appearance of the new goods is the same to the purchaser as if the articles had been made from nearly entire skins; but when the changing styles of fashion require these costly furs to be made over, the purchaser finds, too late, that he has been defrauded, and that what had presented so beautiful an appearance at first is worthless for all future service. The largest and best houses have steadily opposed this fraudulent system, and the fur-buying public are beginning to learn that though the prices may be slightly greater at first, there is a great advantage in purchasing (especially in costly furs) those which have a permanent value and can be remodelled without serious loss. We are indebted to Frederick Gunther, Esq., of New York for many facts and statistics.

L. P. Brockett.

Fur-Seal, a name given in common to those species of the family Otariidæ, or eared seals, which possess an abundant and dense under-coat of fine fur. Several species, representing two genera, belong to this group, and are all, to a greater or less extent, the objects of eager search. The species of the Alaskan seas is the *Callorhinus ursinus;* the southern species have not been identified with complete certainty, but three species at least are generally recognized—viz. *Arctocephalus Falklandicus*, *A. cinereus*, and *A. antarcticus*. (See Otariidæ.) Theo. Gill.

Fürst (Julius), b. May 12, 1805, at Zerkowo, Prussian Poland, where his father, a learned Israelite, was lecturer of the synagogue, was intended for the rabbinate, and when only twelve years old he was already versed in the Old Testament Scriptures, Jewish tradition, and Hebrew literature. He first learned the German language at the age of thirteen, and three years later he stood at the gates of a gymnasium in Berlin asking for admission to the *secunda* (or second highest class), and in 1825 was ready for the university. For a while he studied at the high school of that place, but, induced by the probability of securing a very prominent position among the people of his native province, he took up the study of Jewish theology at Posen. During his stay there he became alienated from Jewish orthodoxy, and in 1829 finally determined to give up the theological field. He went to Breslau to pursue Oriental and antiquarian studies, and in 1831 to Halle. In 1833 he went to Leipsic to become a journalist, few positions of literary eminence being then open to Jews. But his learning secured him an appointment as lecturer at the university, in which school he labored with great distinction. In 1864 he was made a professor, and enjoyed the same advantages as his Christian colleagues possessed. D. Feb. 9, 1873. His historical, critical, and lexicographical works are numerous, and yet everything he wrote found favor, and all his publications are widely circulated. Particular mention deserve his *Concordantia librorum Sacrorum veteris Testamenti Hebraicæ et Chaldaica* (Leipsic, 1837–40); *Bibliotheca Judaica* (Leipsic, 1849–54, 4 vols. 8vo); *Hebräisches und Chaldäisches Handwörterbuch* (Leipsic, 1857–60), which is fast superseding Gesenius's work, especially in English-speaking countries, for which a translation was made by Dr. Davidson (London, 1865–66; New York, 1867); *Geschichte des Karäerthums* (Leipsic, 1862–65, 2 vols. 8vo). From 1840 to 1851 he also edited *Der Orient*, a paper noted for the value of its contributions. James H. Worman.

Fürst'enwalde, town of Prussia, in the province of Brandenburg, on the Spree. It has considerable linen manufactures. Pop. 8197.

Fürth, town of Bavaria, at the junction of the Rednitz and the Pegnitz. It is the most flourishing manufacturing town of the kingdom. Its articles of brass, bronze, horn, and bone are celebrated. Pop. 24,569.

Furze, or **Gorse,** the *Ulex Europæus*, an interesting Old World shrub of the order Leguminosæ, having numerous solitary golden-yellow flowers of much beauty. It has several varieties, some of which are cultivated in gardens. Furze is grown as a cover to foxes and as sheep-pasture. In Belgium the waste sandy lands yield large crops of furze, which is gathered when green, cut fine in a mill, and fed out to live-stock as a forage-plant.

Fuse. See Fuze, by Gen. H. L. Abbot, U. S. Engineers.

Fusee' [Lat. *fusus*, "spindle"], in the machinery of watches and chronometers, a cone spirally grooved, connected with a chain which may be wound upon the grooved cone. One end of this chain is attached to the base of the fusee, the other to the barrel or box containing the main-spring. The barrel, when the watch is wound up, rotates, being moved by the uncoiling of the main-spring. As the spring uncoils it loses its elastic force, but as a compensation the chain acts upon a longer lever, since, as the fusee rotates, the *point d'appui* of the chain continually approaches the base of the fusee. In this manner the uniform rate of driving force is maintained.

Fu'seli (John Henry), (originally *Füssli*), b. at Zürich, Switzerland, Feb. 7, 1741, was the son of a painter, and became a clergyman in 1761, but a political pamphlet written by him and his friend Lavater led to his expatriation. After this he lived chiefly in England as an artist; studied in Italy 1770–77; had good literary abilities and great knowledge, particularly of the languages; possessed a singularly ungovernable temper and a pungent wit. His paintings are not remarkable for correct drawing, but display a powerful and somewhat fantastic imagination; and similar extravagances occasionally disfigure his literary works (*Lectures on Painting*, *History of Arts*, translation of Lavater's *Aphorisms*, etc.). D. in London Apr. 16, 1825.

Fu'sel Oil, a collective name for a variety of alcohols and compound ethers which are produced during vinous fermentation, and which pass over with the alcohol when fermented liquors are distilled. It is, in fact, to the fusel oil that the different kinds of spirits owe their distinguishing qualities, as when the fusel oil is completely removed from them pure alcohol, more or less dilute, alone remains. Fusel oil varies with the material from which the spirits are prepared: that from the potato consists chiefly of amylic alcohol, with some propylic and butylic alcohol, etc.; that from Indian corn is chiefly amylic alcohol, with compound ethers consisting of the acetate, caprylate, formate, caproate, and œnanthylate of ethyl and amyl. Fusel oil from beet-molasses contains butylic and amylic alcohols, and compound ethers of valerianic, caproic, œnanthylic, caprylic, and pelargonic acids, with ethyl, amyl, etc. The fusel oil from marc brandy contains considerable propylic alcohol, with methylic, ethylic, butylic, amylic, and caproic alcohol. Ethylic or common alcohol is contained in all fusel oil. The following table exhibits the alcohols found in fusel oil, with their boiling-points and specific gravities:

Name	Formula.	Sp. gr.	Boiling-point
Methyl alcohol	CH_3OH.	0.798	66.6° C. = 152° F.
Ethyl "	C_2H_5OH.	0.794	78.4° C. = 173° F.
Propyl "	C_3H_7OH.	0.820	96° C. = 204.8° F.
Butyl "	C_4H_9OH.	0.803	110° C. = 230° F.
Amyl "	$C_5H_{11}OH$.	0.811	132° C. = 275.6° F.
Hexyl "	$C_6H_{13}OH$.		

The following acids have been observed in fusel oils, either free or forming compound ethers with the alcohol radicals methyl, ethyl, etc.:

Formic	$HCHO_2$.	Caproic	$HC_6H_{11}O_2$.
Acetic	$HC_2H_3O_2$.	Œnanthylic	$HC_7H_{13}O_2$.
Propionic	$HC_3H_5O_2$.	Caprylic	$HC_8H_{15}O_2$.
Butyric	$HC_4H_7O_2$.	Pelargonic	$HC_9H_{17}O_2$.
Valerianic	$HC_5H_9O_2$.	Capric or rutic	$HC_{10}H_{19}O_2$.

Amyl alcohol, being in most cases the predominating constituent, is often called fusel oil, even when freed entirely from the other alcohols, etc. It is a colorless liquid, having a peculiar sickening odor which causes coughing. It has a burning taste. Sp. gr. 0.811 at 15° C.; boils at 132° C.; burns with a white smoky flame; freezes at −22° C.; is soluble in alcohol and in ether; nearly insoluble in water. The ordinary amyl alcohol is said by Pasteur to consist of two liquids, having the same composition and vapor density, but differing in optical properties—one rotating the plane of polarized light to the left, while the other is inactive. Some of the compound ethers of amyl derived from this alcohol, as the acetate, butyrate, valerianate, etc., constitute the fruit essences, strawberry, pineapple, banana, apple, pear, etc., now so generally used for flavoring confectionery, syrups, etc.

Defuselation of Alcohol.—As the fusel oil has a higher boiling-point than common alcohol, it distils over with the last portions which come from the still, and in the column still, when the more condensable vapors are liquefied and flow back to the still, the greater part of the fusel oil remains behind. Thus, alcohol nearly free from fusel oil can be obtained. To completely remove it other means must be resorted to. Filtration over fresh wood-charcoal is the process most generally employed. Sometimes the vapor of the alcohol is passed through a chamber filled with charcoal. The following substances have also been recommended: binoxide of manganese for filtration; slaked lime, soda lye, chloride of lime, manganate of soda, milk,

olive oil, and soap. The process of aging or keeping really results in a partial defuselation of spirits; by oxidation the fusel oil is gradually changed, probably to compound ethers, and the flavor and *bouquet* of the spirits are greatly improved. Spirits are not considered suitable for medicinal use till they are two or three years old.

Detection of Fusel Oil. On distilling whisky and other spirits, and diluting the distillate with water, it is often rendered milky by the fusel oil which separates. By allowing spirits to evaporate slowly from the hand, or from a glass which has been rinsed out with it, the peculiar smell of the fusel oil comes out after the ethylic alcohol has evaporated. By mixing ether with the spirits, and then adding water, which causes a layer of ether to separate, the oil may be extracted. On evaporating some of the ethereal layer on a watch-glass the fusel oil is left behind. Nitrate of silver is not a very reliable test, as it is blackened by a great variety of substances. (See FERMENTATION and WHISKY.) C. F. CHANDLER.

Fusibil'ity, the property by which solids become fluid when heated. Most solids are fusible; some, however, undergo decomposition without fusing. The temperature at which solids melt (the melting-point) differs greatly for different substances, but it is always constant for the same substance. The temperature remains constant during the entire period of melting. (See FREEZING MIXTURES.) Many bodies are usually liquid (melted), because the temperature of the air is much above their melting-points. Most solids when heated to their melting-points pass from solids to perfect liquids, but some pass through an intermediate pasty condition (*vitreous fusion*) before they become fluid. This property in glass enables workmen to blow and press it into form, and the forging and welding properties of wrought iron and platinum are due to the same circumstance. The *freezing-point* is the temperature at which the melted body solidifies; it is generally identical with the melting-point. We can, however, often cool a liquid below its melting-point without its solidifying. We may cool water, if we keep it perfectly still, to − 15° C. (+ 5° F.) without its freezing, but if we drop in a grain of sand or agitate it, it at once rises to 0° C. (32° F.) and freezes. A *change of volume* occurs at the moment of melting, usually an expansion, but in the case of water and a few metals it is condensation. The melting-points of bodies are slightly affected by pressure—that of ice being lowered, that of wax being raised. Substances which expand on liquefying have their melting-points raised—those which contract have their melting-points lowered. Mixtures, as of fatty acids, alkaline chlorides, or alkaline carbonates, or of metals (see FUSIBLE METAL), often fuse at temperatures below the melting-points of the simple bodies. FLUXES (which see), partly by their chemical action in reducing compounds to the metallic state, and partly by presenting a readily fusible medium, promote the fusion of metals. The following table of melting-points is taken from Pouillet:

Names.	Centigrade.	Fahrenheit.
Mercury	− 39°	− 38.2°
Ice	0	+ 32
Phosphorus	43	109.4
Spermaceti	49	120.2
Stearine	49-43	120.2-109.4
Potassium	58	136.4
White wax	68	154.4
Stearic acid	70	158.
Sodium	90	194.
Iodine	107	224.6
Sulphur	114	237.2
Tin	230	446.
Bismuth	202	395.6
Lead	320	608.
Zinc	360	680.
Antimony	432	809.6
Silver	1000	1832.
Gold	1250	2282.
White cast iron	1050-1200	1922-2192
Gray " "	1100-1200	2012-2192
Steel	1300-1400	2372-2552
Wrought iron	1500-1600	2732-2912

C. F. CHANDLER.

Fu'sible Cal'culus, in pathology, one of the most common of the forms of urinary calculus. It is often large, brittle, soft, smooth, and whitish. It contains the ammonio-magnesian phosphate, mixed with calcium phosphate and some animal matter, and fuses into a glass without much difficulty before the blowpipe; whence the name.

Fu'sible Met'als, alloys which melt at comparatively low temperatures. It is a curious fact that alloys often melt at temperatures far below the melting-points of their constituents. Bismuth, fusing at 202° C. (395.6° F.), tin, at 230° C. (446° F.), and lead, at 320° C. (608° F.), form alloys which melt in boiling water. Cadmium lowers the melting-point still farther.

FUSIBLE ALLOYS.

Bismuth.	Lead.	Tin.	Cadmium.	Melting-point.
8	5	3	..	100° C. 212° F.
2	1	1	..	93.9° C. 201° F.
5	3	2	..	92.8° C. 199° F.
8	4	2	2	71.1° C. 160° F.

The second alloy of the table is a most remarkable one; when it cools from fusion it expands while still soft, and when used for taking impressions of dies reproduces the finest lines with the greatest accuracy. The last alloy of the table has been used by dentists for filling teeth, being applied in the melted state with little tools like soldering-irons. Plugs of fusible metal, mixed to fuse at certain definite temperatures, have been suggested as safety-valves for steam-boilers. They are found, however, to undergo changes in use which modify their fusibility, making them entirely unreliable. C. F. CHANDLER.

Fusigna'no, town of Northern Italy, in the province of Ravenna, on the Senio. Pop. 5242.

Fus'tian [from *Fostat*, a suburb of Old Cairo, where it was first made], a cotton fabric resembling velvet. In addition to the usual warp and weft, there is an additional weft, which is brought above the surface in loops. When these are cut, the ends rising above the surface produce a short fur, which entirely hides the tissue beneath. This is smoothed by shearing, singeing, and brushing.

Fus'tic [remotely from the Lat. *fustis*, a "stock"], a name applied to several yellow dyewoods. (1) True fustic, tree-fustic, yellow Brazil-wood, old fustic, etc., is the wood of *Morus* (*Broussonetia* or *Maclura*) *tinctoria*, a fine large tree of the order Moraceæ growing in the West Indies and South and Central America. It affords a very permanent and valuable yellow dye, and is largely exported to Europe and the U. S. (2) Bastard fustic, which is believed to be a smaller variety of the same wood, but is inferior in quality. (3) Young fustic, fustet, or Venetian sumach, called also Hungarian or Zante fustic, is the wood of *Rhus Cotinus*, a sumach tree of the Levant, whence it is exported. It makes a brighter yellow than old fustic, but one which is not so permanent. No kind of fustic is of much practical value except when compounded with other dyestuffs. Mixed with other appropriate dyes, fustic is of great value in obtaining green, yellow, orange, brown and drab tints, and even blacks and reds; but it is necessarily excluded from blues, violets, purples, and kindred shades. The fustics are employed for cottons, woollens, and silks.

Futak, town of Hungary, on the Danube. It has considerable trade, and its annual fair is visited by merchants from Turkey and Greece. Pop. 7800.

Futtehpoor', the capital of the district of the same name in British India. The town is of both commercial and military importance. Pop. 16,000.

Fu'ture Es'tate, an estate which is to commence in possession at a future day; an estate in expectancy. Under this general designation are included estates in remainder, reversions, contingent, shifting, and springing uses, and executory devises. In New York an important change has been made by statute in the common-law system of estates, and the term "future estate" has been adopted as a specific technical name for all estates in expectancy except reversions, the various separate titles previously in use having been discarded. A "future estate" is there defined as an "estate limited to commence in possession at a future day, either without the intervention of a precedent estate, or on the determination, by lapse of time or otherwise, of a precedent estate created at the same time." Such future estates are declared to be vested or contingent. "They are vested when there is a person in being who would have an immediate right to the possession of the lands upon the ceasing of the intermediate or precedent estate. They are contingent whilst the person to whom, or the event upon which, they are limited to take effect remains uncertain." (An exposition of the law relative to future estates will be found under the separate titles REMAINDER, REVERSION, USES, EXECUTORY DEVISES, etc.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Fu'ture State, that condition into which human beings enter after death, and which will continue for ever. Nature gives no answer to the question, "If a man die, shall he live again?" Men die, and, so far as we can see, death is an eternal sleep; our senses do not make us acquainted with any *post mortem* life. The body is resolved into its constituent elements, which are indistinguishable from other particles of carbon, hydrogen, oxygen, nitrogen, etc. As to the disembodied spirit, that is not cognizable by our senses, nor in any other way has it manifested its existence, the miracles of Scripture being here, of course, excepted. Yet an existence after death—an immortality, not simply of the species, but of the individual—has been held by all nations in every age of the world. This belief has been generally

restricted to the soul: it has been held in connection with the belief in God, though, like it, the dogma has assumed a thousand absurd and grotesque forms, as in the eschatologies of Egyptians, Chaldees, Persians, Hindoos, Chinese, Greeks, Romans, Scandinavians, Celts, the aborigines of America, and the degraded tribes of Africa and Australasia. All of these nations and peoples have believed in the existence of a supernatural Power and in a future state. The universality of this belief shows that it has its foundation in a divine revelation, or in the innate sentiments of our nature, or in both united. The traditions of the most cultivated nations trace the belief to pre-historic times, and favor the opinion that it originated in divine revelation. But there are certain arguments for the immortality of the soul, involving a future state of retribution, which must always have had great force among every people who have not been sunk into the lowest depths of barbarism. There is an argument drawn from congruity which has always been considered of great weight. Man possesses capacities which are not fully exercised, and desires which are not and cannot be gratified, in the present life; these postulate a future state. The mind is capable of indefinite expansion and development. One stage of advancement prepares for another, and so on *in infinitum;* and as the infinite attributes of God and the boundless immensity of the universe are objective realities to which the immortality of the soul stands subjectively related, the mind of man, which is so adapted to the contemplation of those grand themes, demands an eternity for their exploration. We shrink back from annihilation, nonentity; we love life; we want to live for ever. The instinct is fixed deep and ineradicably in our nature.

> "'Tis immortality deciphers man,
> And opens all the mysteries of his make:
> Without it, half his instincts are a riddle—
> Without it, all his virtues are a dream."

So far as we can discover, "the beasts that perish" have neither capacity nor hope of any future life. They gratify their propensities, propagate their species, and subserve various purposes in the economy of Providence; and that is all. But it is not so with man. As in the fœtus there are rudimentary organs which postulate a higher state of existence than that in the womb, so there are in man undeveloped forces and infinite capacities which foretoken another, a higher, and an eternal state of being. Addison puts the argument with great force into the mouth of Cato when he is reading Plato on the immortality of the soul:

> "It must be so. Plato, thou reason'st well.
> Else whence this pleasing hope, this fond desire,
> This longing after immortality?
> Or whence this secret dread and inward horror
> Of falling into naught? Why shrinks the soul
> Back on herself, and startles at destruction?
> 'Tis the divinity that stirs within us;
> 'Tis Heaven itself that points out an hereafter,
> And intimates eternity to man.
> The soul, secured in her existence, smiles
> At the drawn dagger, and defies its point.
> The stars shall fade away, the sun himself
> Grow dim with age, and nature sink in years,
> But thou shalt flourish in immortal youth,
> Unhurt amidst the war of elements,
> The wreck of matter, and the crash of worlds."

There is an ethical argument of still greater force. The inequality of men's conditions and the imperfection of retributions, divine and human, in the present life, demand a future state. Reason asserts that God must justify his ways to men, the guilty conscience forebodes a coming judgment, and oppressed innocence naturally looks forward to a future state of being for the justice denied in the present. These arguments have great force, though they stop short of demonstration. Some derive an argument for the immortality of the soul from its immateriality and indivisibility; but the most that can be said of this is, that it seems to favor the doctrine in question. But the soul, immaterial and uncompounded as it is, could not live except by the power of God, and the body, material and divisible as it is, by that power may be made immortal. The deductions of reason and the *dicta* of tradition receive confirmation from the clear and authoritative determinations of the Holy Scriptures. That the sacred records were written by divine inspiration, and are therefore of infallible authority, admits of ready and satisfactory proof, but it cannot be adduced in this place. That the doctrine of a future state was an essential element in patriarchal and Mosaic theology is evident. We have, indeed, no detailed account of the faith and worship of the patriarchs, but the translation of Enoch, and the fact that Jehovah called himself the God of Abraham, Isaac, and Jacob centuries after their death—whereas, as Christ argues, "He is not a God of the dead, but of the living, for all live unto him" (Luke xxi. 37, 38)—and the testimony of Paul (Heb. xi.), declare plainly that they did live after their death. The patriarchs considered themselves "strangers and pilgrims on the earth," and "they desired a better country—that is, an heavenly." Without endorsing Warburton's paradox in his *Divine Legation of Moses*, that that lawgiver, unlike all heathen lawgivers, did not inculcate the doctrine of future retribution because the Hebrew theocracy was to be administered by a miraculous dispensation, it may be admitted that it is not set forth as a sanction of the laws of the Jewish commonwealth. But it does not follow from this that the doctrine was not known or inculcated. The contrary is obvious. As Enoch's translation demonstrated a future state to the patriarchs, so the translation of Elijah demonstrated it to the Jews. In the Psalter the felicities of the heavenly state are brought to view as the object of the greatest desire; in Proverbs and Ecclesiastes the retributions of the future state are adduced as the great incentives to virtue; *e. g.* "The wicked is driven away in his wickedness, but the righteous hath hope in his death" (Prov. xiv. 32); "Fear God, and keep his commandments; for this is the whole duty of man"—or, "this concerns all men"—"for God shall bring every work into judgment, with every secret thing, whether it be good, or whether it be evil" (Eccles. xii. 13, 14). The Hebrew word *sheol* (rendered *hades* in the LXX.) may not refer to a place of future punishment, or to the state of the soul after death, but to the grave, or poetically to the abode of the dead, with reference to the body—as Whitby seems to have proved in his dissertation on the subject appended to his notes on Acts ii.—yet as the wicked are represented as separated from the righteous after death, and as the righteous have their eternal home in heaven, the wicked must be excluded from that abode of innocence and bliss. The New Testament is more explicit on these points. In one place (Luke xvi. 23) the term *hades* is used parabolically for the place of torment, the later Jews, after the Greeks, using the word for the abode of the soul, as well as that of the body, after death. Josephus says the Pharisees and Essenes held that the souls of the wicked shall be punished with eternal punishment, and that there is appointed for them an eternal prison; which he calls *hades*. Peter borrows the Greek *tartaros* to designate the place of future punishment (2 Pet. ii. 4). The later Jews also used the term *Gehenna*—from the Heb. *Ge-hinnom*, the Valley of Hinnom, where infants were burnt in honor of Molech—to designate the place of future punishment. It is thus used in Matt. x. 28; Luke xii. 5: "Fear not them which kill the body, but are not able to kill the soul; but rather fear Him which is able to destroy both soul and body in hell"—γεέννη. Other figurative terms are employed to denote the state of future punishment, which is set forth as severe and eternal (Matt. xxv. 46; Rom. ii. 5–11; 2 Thess. i. 6–10, *et al.*). The retributions of the future state will be graduated according to the character and acts of every one—in the punishments of the wicked, as well as in the rewards of the righteous (Luke xii. 47, 48; 2 Cor. v. 10; Gal. vi. 7, 8). What positive punishments will be inflicted over and above the natural consequences of sin, the reproduction of character, and the like, are not clearly revealed. Many of the later Jews, the Fathers of the Church, the Schoolmen, and some modern divines, understand the passages which speak of fire and brimstone in a literal sense; but as chains, worms, etc. cannot be so understood, those texts are to be taken in a metaphorical sense. The New Testament says nothing about the termination of the existence or of the punishment of sinners in the future state, though some of the Fathers and the Restorationists of modern times have maintained that all the damned—wicked angels and wicked men—will be ultimately restored to virtue and happiness. The Romanists hold that those alone will be so restored who die "in venial sin" and remain a while in an intermediate place, which they call "purgatory;" of which, however, nothing is said in the Bible. There is a passage in an apocryphal book of no authority (2 Macc. xii. 39–45) which is cited in favor of purgatory, but it proves too much, as the dead for whom Judas is said to have offered a sin-offering, that they might be delivered from sin, had died "in mortal sin," and all such, according to the Romish standards, are consigned to eternal punishment. The words *aiôn* (used 128 times in the Greek Testament) and *aiônios* (used 71 times), like Heb. *olam*, express the idea of duration extended to the utmost limit predicable of the subject. When applied to God they denote unending existence; and as they are used of the retributions of the future state, there is no reason why they should not be understood in their proper sense. This is confirmed by those numerous and explicit passages which affirm of the righteous that they shall never die—that they shall have a crown of life, an inheritance incorruptible, undefiled, and that fadeth not away—that they shall ever be with the Lord (John vi. 50, 54; viii. 51; xi. 25, 26; 1 Cor. ix. 25; 1 Thess. iv. 17; Jas. i. 12; 1 Pet. i. 4; Rev. ii. 10, *et al.*); and those which affirm of the

wicked who are cast into *gehenna* that their worm dieth not, and the fire is not quenched, and that, dying in their sins, where Christ is they cannot come, but they shall be punished with everlasting destruction from the presence of the Lord and from the glory of His power (Mark ix. 42-48; John viii. 21; 2 Thess. i. 7-10). If there is to be any termination of the varied states of the righteous and of the wicked, or of the existence of either, God has not seen proper to reveal it. The Scriptures say nothing about an intermediate *place*—a region between heaven and hell. They do, however, recognize an intermediate *state*. This is the state of disembodied spirits between death and the resurrection. The souls of the wicked go to hell immediately after they are dismissed from their bodies, but they are not formally judged till the resurrection (Luke xii. 20; xvi. 22, 23; John v. 28, 29; 2 Pet. ii. 4-9; Rev. xx. 11-15; xxii. 10-15). So the souls of the righteous at death go immediately to heaven, where they are happy in the presence of God and the angels, though they will not receive their full reward till the resurrection, when body and soul will be glorified together. This is the teaching of the Old Testament (cf. Gen. v. 24; 2 Kings ii. 11; Isa. lvii. 1, 2). This was the belief of the later Jews; *e. g.* Wisdom of Sol. (iii. 1-4): "But the souls of the righteous are in the hand of God, and there shall no torment touch them. In the sight of the unwise they seemed to die, and their departure is taken for misery, and their going from us to be utter destruction; but they are in peace. For though they be punished in the sight of men, yet is their hope full of immortality." This remarkable passage is an echo of Isa. lvii. 1, 2. They spoke of "paradise," according to the oracle of the Chaldees, as "the glorious country of the soul;" and prayed for the dying, "Let his soul be in paradise." Philo speaks of paradise as "the symbol of a soul leaping for fulness and greatness of joy." The New Testament abounds with passages to the same effect: "The beggar died, and was carried by the angels into Abraham's bosom" (Luke xvi. 22)—a term by which the Jews designated paradise; thus, when Rab. Judah died, they said, "This day he sits in Abraham's bosom." So Christ on the cross promises the penitent robber, "To-day shalt thou be with me in paradise" (Luke xxiii. 43), by which he means heaven, as appears from the other two places in which the word occurs in the New Testament (2 Cor. xii. 1-4; Rev. ii. 7; cf. xxii. 14); in the latter of which it refers to the abode of the righteous after the resurrection, showing that paradise does not differ locally from heaven. Παράδεισος (*paradesa*, Sanscrit, a "place of beauty;" *pardes*, Armenian, a "pleasure garden;" Heb. *pardes*, a "park," as that of the Persian king spoken of in Neh. ii. 8 (cf. Eccles. ii. 5; Cant. iv. 13). The LXX. use this word for the garden of Eden—hence its use in the New Testament—as the earthly paradise was a striking symbol of the heavenly. Some of the Fathers, followed by certain moderns, held that paradise is a different locality from heaven, though, as Tertullian called it, "a place of divine delights," where, as Irenæus says, the righteous see the Saviour as well as in heaven, and as the pseudo-Justin says, "The souls of the righteous go to paradise, and there converse with Christ by vision." Stephen when dying said, "Behold, I see the heavens opened, and the Son of man standing on the right hand of God"—"Lord Jesus, receive my spirit" (Acts vii. 55-60). Paul says, "Whilst we are at home in the body, we are absent from the Lord. We are willing rather to be absent from the body, and to be present with the Lord" (2 Cor. v. 1-9); "For to me to live is Christ, and to die is gain; yet what I shall choose I wot not, for I am in a strait betwixt two, having a desire to depart and to be with Christ, which is far better; nevertheless, to abide in the flesh is more needful for you." (Phil. i. 21-24; cf. 2 Tim. iv. 6-8; Heb. xii. 22-24; Rev. vii. 13-17.)

It thus appears that the disembodied spirits of the righteous are in heaven, happy and holy, and sure of their final reward at the resurrection and general judgment. As the victorious athletes in the ancient Grecian games were all crowned together after all had contended for the prize, so Paul represents all the Christian athletes who are successful in the strife waiting at the goal for their several crowns. They are at rest; they are in the society of angels and saints and Christ, in the presence of God; they are as happy as they can be in a disembodied state, but "mightier joys ordained to know" when they shall receive their glorified bodies. Thus Paul: "For I am now ready to be offered, and the time of my departure is at hand. I have fought a good fight, I have finished my course, I have kept the faith. Henceforth there is laid up for me a crown of righteousness, which the Lord the righteous Judge shall give me at that day; and not to me only, but unto all them also that love His appearing" (2 Tim. iv. 6-8). The day here spoken of is the time of Christ's second advent, when the dead shall be raised, the earth and the works therein shall be burned up, the general judgment shall take place, and the retributions of the eternal world shall be awarded. The eschatology of the Bible is full and clear as to all these points. (Cf. Eccles. xii. 13, 14; Dan. xii. 2, 3; Matt. xiii. 30-50; xvi. 27; xxv. 31-46; Mark ix. 41-48; xvi. 16; Luke xvi. 19-31; John iii. 36; v. 28, 29; viii. 24, 51; xi. 23-26; xiv. 1-3; Acts xvii. 31; xxiv. 15, 25; Rom. ii. 5-16; xiv. 10-12; 2 Cor. v. 9, 10; Gal. vi. 7, 8; 1 Thess. iv. 13-18; 2 Thess. i. 5-10; 2 Tim. iv. 1-8; Heb. vi. 1-12; ix. 27, 28; x. 26-31; xi.; 2 Pet. ii. 4-9; iii.; 2 John 8; Jude; Rev. xx.-xxii.) These passages unequivocally set forth the eschatological points in question, so that the only way to evade their force is to deny their divine authenticity, which is not to be discussed in this place. The doctrine of the resurrection seems to have been almost lost from the traditional systems of the heathen world, but it is clearly inculcated in the Bible. Such passages as Ps. xvi. 8-11; Dan. xii. 2, 3, were understood by the ancient Jews as we understand them. Indeed, the doctrine of the resurrection was held tenaciously by the Jews in every age, except by the Sadducees, who constituted but a small sect. The apocryphal books of Judith (xvi. 17) and 2 Macc. (vii.) are explicit on this subject. Thus, the seven Maccabean martyrs encouraged one another with the assurance, "The King of the world shall raise us up, who have died for His laws, unto everlasting life." Addressing their persecutor, they said, "As for thee, thou shalt have no resurrection to life." Martha expresses the orthodox faith of the Jews when she says of her deceased brother, "I know that he shall rise again in the resurrection at the last day." So Paul, in defending himself from charges brought against him by the Jews, says, "And have hope towards God, as they themselves also allow, that there shall be a resurrection of the dead, both of the just and unjust" (John xi. 24; Acts xxiv. 15). Some of the strongest prejudices against Christianity were occasioned by this doctrine. The Athenians listened attentively to Paul while he discoursed on other points, but when they heard of the resurrection of the dead, they could listen to him no longer, they considered the dogma so absurd (Acts xvii. 32). Philosophers who hoped for the immortality of the soul never dreamed of the resurrection of the body. They did not consider it possible or desirable. They regarded the body as the prison and tomb of the soul, and a great encumbrance, from which they should be relieved for ever at death. Celsus says, "The hope of the resurrection of the flesh is the hope of worms, a filthy, an abominable, and impossible thing, which God neither will nor can effect." Some early Christian heretics for similar reasons denied the resurrection, or explained it away, as some do now, by saying it "is past already" (2 Tim. ii. 17, 18). Some modern sects hold that the resurrection-body is evolved at death, and becomes at once the vehicle of the spirit, thus denying the intermediate state of disembodied spirits, and conflicting with the Scriptures, which set forth the resurrection as taking place "at the last day"—at the second coming of Christ—at the time of the general judgment. The possibility and certainty of the resurrection is argued by Paul from the resurrection of Christ, who is "first fruits of them that slept"—or that shall sleep (that is, die) to the end of time. The model of the resurrection-body is set forth in Luke xx. 27-39; 1 Cor. xv.; Phil. iii. 20, 21, where it is stated that it will not be constituted of gross materials like the present body, but will be free from all animal propensities, infirmities, and everything that would make it other than a suitable vehicle for the glorified and immortal spirit; in short, "the body of our humiliation will be changed, and made like the glorious body of the Saviour." The objection to the possibility of the resurrection is removed when it is shown that the same omnipotence that called it into existence is pledged for its restoration; and the objection to its desirableness, by the character of the body thus raised. It will not be a hindrance, but a help, to the immortal soul. Thus, as the sublime prayer in the burial service of the Church of England expresses it, "We, with all those that are departed in the true faith of Thy holy name, may receive our perfect consummation and bliss, both in body and soul, in Thy eternal and everlasting glory." A small amount of matter will suffice for the resurrection-body, and it can be composed of some of the identical particles which belonged to the body that was laid in the grave, or of elements of the same kind, adapted and adjusted to each individual soul, as in that will consist the proper personality and identity of man. Thus, each will be readily distinguished from all the rest, and no question need be raised as to the recognition of friends in heaven.

> "Eternal form shall still divide
> The eternal soul from all beside,
> And I shall know him when we meet."

The gross and grotesque notions of the resurrection held

by many of the Jews, and by some of the Fathers (*e. g.* Augustine, *City of God*, book xxii.), and endorsed by most of the mediæval Schoolmen, and by not a few modern divines, have no countenance in Scripture, as they are abhorrent to reason, and have done not a little to prejudice men against this doctrine of Christianity. It is not, therefore, "a thing incredible that God should raise the dead." There is a solid foundation for our faith in the resurrection of the dead and the life of the world to come. These tenets are the most powerful incentives to virtue, and they afford the greatest support under the ills of life, and the strongest consolation against the fears of death. (See CALVIN'S *Institutes*, part i. c. 2; part ii. c. 29; TURRETINI, *Opera, Locus Vicesimus*; STANLEY'S *History of Philosophy—Pythagoras and the Chaldaic Philosophy, comprising the Oracles of Zoroaster*; *Catechism of the Council of Trent*, arts. 5, 11, 12 of the Creed; PEARSON *On the Creed*, arts. 11, 12; PLATO'S *Phædo*; CICERO'S *De Senectute*; SALE'S *Koran*; TUCKER'S *Light of Nature*; ARCHDEACON BLACKBURN'S *Historical View of the Controversy concerning an Intermediate State*, *Works*, vol. iii.; ARCHBISHOP WHATELY'S *Scrip. Revelations concerning a Future State*; BISHOP LAW'S *Theory of Religion*; HORSLEY'S *Sermons*, ser. 12, 20, 36, 43; DREW *On the Immateriality and Immortality of the Soul*; WATSON'S *Institutes*, part i. c. 2; part ii. c. 29; DWIGHT'S *Theology*, ser. 163-171; HUDSON'S *Debt and Grace*; LANDIS *On the Immortality of the Soul*; CLARK'S *Israel in Egypt*, pp. 185–230; FISKE'S ESCHENBURG'S *Classical Literature*, ii. 32, 33, 34, and works there cited; MCCLINTOCK AND STRONG'S *Cyclopædia*, art. "Immortality," and works there cited.) T. O. SUMMERS.

Fuze, a device whereby an explosion may be effected at a safe distance from its destructive action. The charge may be in motion or be stationary, and a short, or a long, or an indefinite time may be desirable between the act of the operator and its effect. Hence numerous and widely different contrivances are employed. For projectiles, including shells, case-shot, carcasses, explosive bullets, and grenades, fuzes are classified as time, percussion, concussion, and combination fuzes, but confusion often exists in the use of these terms. Time fuzes consist of cases of paper, wood, or metal containing the ingredients of gunpowder, varied to suit the required rate of burning. Being selected or cut to the proper length, they are inserted in the fuze-hole of the projectile, where, being ignited by the flame of discharge or by a match, they communicate fire to the enclosed bursting charge at the desired point of the trajectory. To this class belong most fuzes used with smooth-bore ammunition, such as the Bormann and its numerous modifications, the mortar, and the sea-coast fuze. Percussion fuzes are designed to cause an explosion only after the projectile strikes the object. As this is difficult to effect unless a particular point is brought into contact, the class is practically restricted to use with rifled arms, or with grenades, like Ketchum's, provided with some guiding device. One of the simplest forms consists of an ordinary percussion cap upon a gun-cone, placed within a plug at the point of the projectile; a small priming communicates the explosion to the interior. The cone may be fixed, or, as in the Parrott, Schenkl, and Absterdam fuze, be attached to a movable plunger. In the former case a thin exterior covering is crushed by the impact, and the cap is thus exploded; in the latter case the same result follows from the inertia of the plunger, which, when the projectile is suddenly stopped, brings the cap into violent contact with the thick exterior cover. For incendiary shells the Tice fuze, belonging to this class, was found to be serviceable in the late war in the U. S. It contained a small vial of fulminate, which the shock of discharge left, by an ingenious contrivance, unprotected among some loose shot. They caused an explosion at the first impact, however slight. If the percussion cap is made to ignite a time fuze, the explosion may readily be delayed; but it is hardly possible in any way to render the action so instantaneous as to prevent the projectile from burying itself before the fragments can be scattered by the bursting charge. In breaching a masonry wall or penetrating an iron-plated ship this delay is advantageous, since it adds the force of the explosion to the original impact, and thus shatters and enlarges the crater, or carries destructive fragments of the plate and backing into the vessel. Indeed, it has been found well in the latter case to dispense with fuzes entirely, and to place the bursting charge in a flannel bag, in order to retard the explosion which is produced by the sudden shock. For use against troops or earthworks, however, the unavoidable delay is for obvious reasons objectionable. Experiment has shown that a projectile imbeds itself in an old earthen parapet fully three-fourths of its maximum penetration before explosion, and that at this depth the effect of the shells of field and ordinary siege guns is nearly or quite harmless. Concussion fuzes are employed to obviate a difficulty peculiar to rifled guns—viz. that the length of the projectile, and, in many varieties, its expanding base, cuts off the flame of discharge from a time fuze, and thus prevents its ignition. In them the shock in the bore of the piece is utilized to ignite a time fuze of proper length for the range required. To this class belongs the "McEvoy attachment," consisting of a hollow wooden cylinder fitted to the projecting end of an ordinary time fuze; within is a gun-primer loaded with lead, which, ignited by inertia at the discharge, fires the fuze. A better application of the same idea is displayed in the Sawyer fuze. Many other inventions, some mechanical and some depending on the use of fulminates, have appeared, but the supposed superiority of the next class has often caused it to be preferred. For one purpose, however, the concussion fuze is especially adapted. It may be desirable—as, for instance, in shelling a working-party with a view to interrupting its labor—to have mortar-shells fall in its vicinity liable to explode at any time within an hour. The McEvoy-Beardslee fuze is designed to meet this case. A small vial of sulphuric acid is placed in a plug containing chlorate of potassa and sugar, but separated from it by several thicknesses of slowly absorbing paper. The shock breaks the vial, and, after a time, depending upon the number of thicknesses of paper, the acid soaks through to the powder, detonates it by contact, and thus ignites the bursting charge. The combination fuze consists of a time or concussion fuze, with some additional device by which explosion at once results when the projectile strikes. One of the simplest fuzes of this class is the Splingard, which consists of a time fuze containing in its axis a long hollow cone of plaster of Paris open at the bottom. Weakened by the burning away of the supporting composition, this cone breaks, and admits the flame at once to the interior at any impact occurring before the expiration of the time for which it was prepared. To this class belong the Schenkl fuze used in the U. S. during the late war, the most elaborate form of the English Armstrong fuze, and many others.

When the explosive is stationary, as in ordinary or military mining—including torpedoes planted for the defence of a river or harbor—quite different fuzes are necessary; which may be classed as time, contact, or electrical. The first class ordinarily consists of trains of quick-match, ignited by slow-match cut to a sufficient length to allow the operator to escape to a safe distance before the explosion. Various kinds of match are employed. Thus, the Bickford fuze (gunpowder priming) burns from $2\frac{4}{10}$ to 4 feet per minute, the Ord fuze (gun-cotton priming) about 15 feet per second, and the Gomez fuze (fulminate priming) about 300 feet per second. The old powder-hose burned very rapidly, and was therefore usually ignited by a piece of port-fire which consumed at a rate of about 1 inch per minute. For military purposes, except in cases of necessity, these trains have been quite superseded by electricity; but the Gomez fuze, which is violently explosive, may sometimes be advantageously employed to spread combustion rapidly through large masses of gunpowder, such, for example, as the load of a fireship set adrift against a bridge or fleet. The primary ignition may be effected by clockwork so arranged as to release a trigger after the desired lapse of time. Contact fuzes for the torpedo service are analogous to percussion fuzes for the artillery, and many devices are employed. A projecting lever may be so arranged that upon contact with a vessel it shall set free a trigger, and thus explode a common gun cap. A similar plan has been used with drifting torpedoes designed to float freely with the current, coupled in twos by a rope. When the latter is fouled upon the anchor-chains the torpedoes are brought alongside, and held there by the tide, which is thus enabled to act upon a wheel armed with vanes like a windmill. The revolutions, transmitted to a screw axle, soon release a trigger, and thus cause a blow to be delivered upon a pin resting on a gun cap. A sensitive fulminating priming, protected by a thin copper or lead cap so placed as to be crushed by the blow of the ship, is another form of this fuze. Still another consists of a bottle of sulphuric acid imbedded in a mixture of chlorate of potassa and sugar; the ship, by striking a projecting pin, breaks the bottle and thus ignites the torpedo. Ordinary cannon primers may be so arranged as to explode in a similar manner. Many of these devices are equally applicable to small mines buried in the ground in front of fortifications, to be fired by men or horses charging over them. The great objection to the whole class is that they debar a route to friends as well as to foes. Electrical fuzes, being perfectly under the control of the operator, obviate this difficulty. Many varieties, adapted to the different forms of electrical action, have been invented. The oldest contrivance, and that still most employed, is based upon the property possessed by a voltaic current of heating any poor conductor introduced into its circuit. A very thin

wire of platinum, German silver, or iron, from a quarter to half an inch in length, is soldered so as to form a bridge between two stout parallel copper wires imbedded in a plug of wood, gutta percha, India rubber, or other non conducting material. The free ends of these wires being attached to the leading wires from a powerful voltaic or magneto-electric battery, the passage of the current reddens the bridge and thus explodes a priming packed around it. The chief advantage possessed by these over other electrical fuzes is, that they admit of easy and accurate testing by the passage of a current through them too feeble to dangerously heat the bridge. As the electrical resistance of the latter is usually less than an ohm, giving a current-strength requisite for ignition of from one-half to three farads per second, this condition is easily fulfilled. Various primings, such as gunpowder, gun cotton, fulminating mercury, compounds of chlorate of potassa, etc., may be employed around the bridge; and for the detonation of gun-cotton or any of the nitro-glycerine explosives a copper cap may advantageously be added, charged with about fifteen grains of some violent fulminate sure to be ignited by the priming. Similar in principle to the foregoing is the Beardslee fuze, which is adapted to an alternating magneto-electric current possessing a comparatively high electro-motive force, although less than that from a frictional machine. The stout wires are connected by a very short plumbago line drawn with a soft lead pencil upon the end of the wooden plug. The priming is good rifle powder. The electrical resistance of these fuzes is variable, ranging between 500 and 3000 ohms, and their testing, although possible, is not satisfactory. The Von Ebner fuze, used in the Austrian torpedo service, is adapted to the extra current from a large primary coil, which, with an electro-motive force rather less than that of most magneto-electric machines, may be made to possess enormous quantity. The fuze bridge at first consisted of a plumbago line primed with fulminating mercury and a mixture of sulphuret of antimony and chlorate of potassa, but at present only the latter mixture is employed. To fire any considerable number of such fuzes as the foregoing it is necessary to make use of a derived circuit, and hence the explosion, although nearly, is not absolutely simultaneous. This is a serious objection in blasting with the modern detonating compounds. To overcome it, fuzes adapted to electricity of high tension, such as condensed frictional or secondary currents, have been prepared. They are made by replacing the bridge with a layer of some chemical compound which is so strongly polarized by the passage of the spark as to induce explosion. Such primings are the following, some of which, however, are sufficiently conducting to allow the use of magneto-electric, and even voltaic, currents. The Slatham compound is subsulphide of copper; that of Abel is 45 parts of subsulphide of copper, 10 parts of subphosphide of copper, and 15 parts of chlorate of potassa; that of Dowse is fulminating copper; that of other parties (including Mr. Abel in his submarine fuzes) fulminating mercury, with a greater or less proportion of some conducting substance, like graphite or powdered metal, added for conductivity. Of all this class, the fulminating copper priming makes the most sensitive fuze. It may easily be so prepared as to explode in a dry atmosphere when the exposed ends of the wires are brushed with a feather, or when an ebonite comb is passed through the hair of a person grasping one wire terminal, the other being insulated in the air. One hundred blast holes may be fired simultaneously with such fuzes, connected in straight circuit, when a good ebonite frictional machine with a suitable condenser is employed; but it is needless to add that their use is criminally dangerous. Safe fuzes, which will fire from twenty to thirty charges in this manner, are in the market; and in the U. S. this method of blasting is employed nearly to the exclusion of all others where many simultaneous discharges are necessary. H. L. Abbot.

Fuzelier (Louis), b. in Paris in 1672; was a most prolific writer of plays, mostly comedies and lyric tragedies of small merit, but with occasional very clever passages. His best piece was *Momus Fabuliste*, a one act play. Nearly all his long list of plays are very lively productions, with an easy style of versification which won him much popularity; but all are now forgotten. Fuzelier was (1744–52) conductor of *Le Mercure*, in which he published many articles. D. at Paris Sept. 19, 1752. Fuzelier was a zealous collaborator with Lesage in the work of supplying light plays for the second class theatres, but many of his pieces were acted at the Théâtre Français.

Füzes Gyarmat, town of Hungary, 50 miles N. of Békés. It is situated among marshes abounding in herons, turtles, and crabs. Pop. 5735.

Fy'ens, or **Fie'nus** (Thomas), b. at Antwerp, in the Low Countries, Mar. 28, 1567; studied medicine with great success at Leyden and in Italy, whose schools then abounded with famous instructors; became in 1593 professor of medicine at Louvain, and soon had a European reputation for skill; was for a time court physician to the duke of Bavaria, and afterwards first physician to the archduke Albert at Brussels. Author of some very curious medical works, of which *De Cauteriis* (1598), and *De præcipuis artis chirurgicæ controversiis* (1649) are the most noteworthy. At present his works have only an historic value. D. Mar. 15, 1631.—His father, John Fienus (d. 1584), was a famous physician, author of a singular work, *De Flatibus*.

Fyfe (Robert Alexander), D. D., b. Oct. 20, 1816, in the parish of St. Andrew's, province of Quebec; graduated at Madison University and Newton Theological Institution 1842; pastor of Baptist churches in Perth, Ont., Warren, R. I., Milwaukee, and Toronto. In 1860 appointed principal of the Canadian Literary Institute at Woodstock, Ont., a position which he still holds.

Fyne, de (Passchier), b. Jan. 31, 1588, at Leyden, in the Netherlands; became a Reformed minister and joined the Remonstrant or Arminian party; was silenced by the Calvinists, but continued to preach with great zeal and courage; was subjected to sharp persecutions, but was finally allowed to assume (1638) a pastorate at Haarlem, where he d. in 1661. Of his existing writings, his account of the Collegiants or Rhynsburgers is highly valued.

Fyrouz' I., an Arsacide king of Persia (the name is also spelled Feroze and Firouze), usually identified with the Pacorus of the Greek and Latin writers, called also Arsaces XXIV. as king of Parthia; reigned 83–103 A. D. The name *Fyrouz* signifies "victorious."

Fyrouz II., a Sassanide monarch of Persia (the Perosis of Byzantine writers), reigned 458–484 A. D. He succeeded his younger brother, Hormuz, whom he overthrew by the aid of the White Huns and put to death. A dreadful famine marked the first part of his reign, and the king became involved in wars with the White Huns, who finally defeated him with great slaughter, Fyrouz and twenty-nine of his sons being among the slain. The accounts of historians regarding many points of his reign are conflicting, for some celebrate his valor, benevolence, and virtue, while others regard him as a tyrant and a coward. He is named Fyrouz the Brave by some writers, and by others, Fyrouz the Bad.

Fyrouz III., titular king of Persia, son of Yezdejerd III., the last Sassanide monarch. Expelled by the Mohammedans from Persia, he fled to the domains of the Chinese emperor Kao-Tsoung (Tait-Song), by whom he was recognized, and who by fruitless negotiations strove to restore him to the throne. He is the *Pilouse* of Chinese historians, and seems to have been a Chinese viceroy in Bokhara. D. 679. His son, Ninus, was the last Sassanide who bore the royal title.

Fy'rouz (or **Feroze**) **Shah I.** (Rokn-ed-Deen, the "support of the Faith"), a Mohammedan king of Delhi who succeeded his father, Altamsh, in 1236, having previously been governor of Lahore. He was a vicious prince, and was deposed by the sultana Rezia, his sister, in 1236.—Fyrouz Shah II. (Jelal-ed-Deen, "glory of the Faith") reigned at Delhi 1289–96; was an Afghan usurper who succeeded the last Gouride sovereign, and who is chiefly memorable for his cruelties; was murdered by his nephew and successor, Allah-ed-Deen, in 1296.—Fyrouz Shah III., king of Delhi, b. 1296; succeeded Mohammed III. in 1351; abdicated 1386, and d. 1388. His reign was memorable for its tranquillity and the material prosperity of the kingdom. He founded in 1354 a city now called Ferozepoor (which see), formerly Fyrouzabad, and began the construction of the great canal system now known by his name. (See Feroze Shah, Canal of.)

Fyt, or **Feydt** (Jan), a Flemish painter, b. at Antwerp in 1609. As a painter of animals he was excelled by no Flemish artist except perhaps Snyders. His dogs, and especially his greyhounds, are regarded as the best ever painted. His birds and furred animals rank also with those of the first masters; but his best pictures are those of dead game. His management of light and shade is effective, but his drawing is not always perfect. He etched a number of valuable plates after his own works. He excelled also in flower and fruit pieces, and in representations of vases, bas-reliefs, and marble works. His coloring is true, his touch bold, vigorous, and effective, and his brush excellent. D. 1671.

Fyzâbâd', town of British India, in the province of Oude, on the right bank of the Ghoggra. The government had its seat here until 1775, when it moved to Lucknow. The population of Fyzâbâd is estimated at 100,000, but the town is now falling into decay.

G.

G is a consonant, and the seventh letter in most modern European languages. In English it has (1) a hard sound, which is that of the mute *k*, *plus* a vocalization; and (2) before *e*, *i*, and *y* it has the soft sound of *j*. (3) When it follows *n*, the two usually stand for the nasal sound of *ng*, especially at the end of a word. In the midst of a word the *g* following *n* sometimes retains the *j* sound, as in *manger*; sometimes the *g* not only unites in the nasal *ng* sound, but it has a secondary hard *g* sound, as in *anger*; again, *ng*, even in the midst of a word, may have its appropriate nasal sound without qualification, as in *hanger*. In chemistry G stands for glucinum.

G, in music, the fifth degree in the ascending scale of C, major or minor, being the dominant in that scale. *Gamut G* is the note on the lowest line of the bass stave, a seventh below F on the clef line. *Double G* is one octave lower than gamut G, on the space below three ledger lines. *G dur* is the German for G major, and G *moll* for G minor. *Gis*, in German, is G sharp. G *in alt*, the first note in alt, situated one octave above the treble clef line. G *in altissimo*, a note one octave higher than G in alt, or a fifteenth above the treble clef line. Its place, as the first note in altissimo, is on the fourth ledger line above the stave.

Ga'bii, an ancient Latin city which stood 12 miles E. of Rome, on the banks of a small lake in a volcanic crater, from which flows the stream called Osa, and not far from the Lake Regillus, now drained. In early Roman days it was an important town. Cicero, Horace, and Juvenal allude to its decay, but it afterwards revived and became a bishop's see, but is now deserted. It anciently had quarries of a valuable volcanic stone, and gave name to the Gabine cincture. (See CINCTURE.)

Gabin'ius (AULUS) became tribune at Rome in 66 B. C.; brought forward and carried the law which gave Pompey the supreme command against the pirates; served under Pompey 64–63, and gained immense wealth; was prætor in 61; consul in 58; proconsul in Syria and Judæa 57; restored Ptolemy Auletes in 55; was exiled for corruption 54–49. D. about 47 B. C. Gabinius was a man of corrupt and abandoned character.

Ga'bion [It. *gabbia*, a "cage," from Lat. *cavus*, "hollow"], in military operations, a hollow cylinder of sticks set in a circle and wattled together, somewhat in the manner of a basket. It is of various dimensions, and is designed to be set on end and filled with earth or sticks. Gabions are proof against ordinary musket-balls, and are useful in repairing breaches and in constructing field-works, etc.

Ga'ble, that part of the outer wall of a building which lies between the slopes of the roof and above the upper line of the side walls, called in classic architecture the *pediment*. The bounding lines of the gable were in the richer forms of the Gothic treated with great freedom and decorated with profusion of ornament, and were frequently broken by corbie-steps and other diversities. Small gables are called gablets, and are introduced into the decoration of many Gothic exteriors.

Ga'blenz, von (LUDWIG KARL WILHELM), BARON, Austrian general, a son of the Saxon lieutenant-general Gablenz, b. at Jena July 19, 1814, and educated at the military academy of Dresden. He served first in the Saxon horse-guard, but in 1833 entered the Austrian service, and became, after six years, a captain of horse. He was a handsome and elegant man, with a winning address, and was often employed in honorary service. During the long period of peace he travelled much, even in the interior of Africa. In 1848 he fought in Italy under Radetzky with great distinction, and was made a major of the staff. He next became chief of staff to Count Schlick; distinguished himself especially at Kaschau; obtained the Maria Theresa cross, and was promoted to be colonel. Soon after he was employed in diplomatic negotiations. In 1853 was appointed director of the bureau of statistics in Vienna; in 1859 distinguished himself in the disastrous battle of Solferino, and by his defence of Caoriana covered the retreat of the centre. In 1863 he was made a lieutenant-marshal, and in 1864 received the command of the 6th army corps, which, together with a Prussian corps, and with the Prussian field-marshal Wrangel as commander-in-chief, was sent against the Danes in Sleswick-Holstein. As governor of Holstein he made a very favorable impression by his liberality. In 1866 he commanded the 10th army corps, and at Trautenau on June 28 he gained the only advantage which the Austrians could boast of in that disastrous war. He also took part in the battle of Sadowa, and was sent to the Prussian head-quarters to negotiate after the battle. When the war was over he retired, and was chosen member for life of the Austrian Upper House, in which he belonged to the liberal party. In 1867 he entered once more into service, and became commandant of Croatia and Sclavonia; in 1868 was made a general of horse, and in 1869 general in command of Hungary. Nov. 28, 1871, he retired. Becoming implicated in stock speculations which proved unfortunate, he shot himself in Zürich Jan. 28, 1874. A. NIEMANN.

Ga'blonz, town of Bohemia, on the Neisse, the centre of a manufacturing district where more than 6000 men are employed in the fabrication of ornamental glassware.

Gaboon', a river in Western Africa, falls into the Atlantic near the equator. In 1845 the French planted a colony here on account of the ivory with which the vicinity abounds; the colony was broken up in 1871, but has since been re-established. The Gaboon colony has several interesting missions, Roman Catholic and Protestant.

Ga'briel [Heb., "mighty one of God"], the name of the heavenly being who communicated prophetic tidings to Daniel, and foretold in later times the birth of Jesus Christ and of St. John the Baptist. Gabriel in Jewish, Christian, and Mohammedan traditions is reckoned as one of the great archangels.

Gabriel Channel, between Tierra del Fuego and Dawson's Island, is 25 miles in length, and in breadth varies from half a mile to three times that distance. On the S. there is a great glacier between Mounts Sarmiento and Buckland. The shores are abrupt masses of slaty rock, and the channel is subject to violent whirlwinds.

Gabriel, St., Orders of (Roman Catholic), (1) a congregation of lay conventual brethren (*conviventes*) and of non-conventual gentlemen (*confluentes*) at Bologna. They are engaged in the work of instruction. (2) The "Brothers of St. Gabriel" in France were founded in 1835 by the abbé Deshayes. They are engaged in instructing the young, especially in rural places, chiefly in matters of doctrine.

Gabriel's Creek, tp. of Madison co., N. C. P. 1372.

Gad [Heb., "fortune" or "troop"], seventh son of Jacob by Zilpah, and founder of the Israelitish tribe of Gad, which, after the conquest of Canaan under Joshua, settled E. of the Jordan, N. of Reuben, and S. of the half-tribe of Manasseh; but we subsequently find the Gadites far to the N., E., and S. of their prescribed limits. They were a warlike, nomadic people, and disappear after the time of Tiglath-Pileser IV., who carried them into captivity 740 B. C.—GAD, the "king's seer," a prophet who was a personal follower of David, wrote a book of the acts of David, which is not extant, and of which we have no account except in 1 Chron. xxix. 29.

Gad'ara [not to be mistaken for GERASA, which see], a stronghold of Trans-Jordanic Palestine, on a hill just S. of the Hieromax, about 8 miles S. E. of Lake Tiberias. It is first mentioned by Polybius (*Hist.*, v. 71), who relates its capture by Antiochus the Great (218 B. C.), and speaks of it as "the strongest of all the cities in that part of the country." Its ruins, called by the Arabs *Um Keis*, occupy a space about two miles in circumference. The ancient pavement of the principal street is described by Porter as almost perfect. There are hot baths on the bank of the river near by. The present inhabitants occupy old tombs in the limestome rock. R. D. HITCHCOCK.

Gade (NIELS WILHELM), b. Feb. 22, 1817, at Copenhagen; received a musical education, and in 1841 the musical society gave him a prize for his first overture, *Echo of Ossian*. His first symphony, in C minor, attracted still greater attention, and on the invitation of Mendelssohn he went in 1843 to Leipsic, where, with a few interruptions, he resided till 1848 as director of the concerts of the Gewandhaus. On his return to Copenhagen, in 1848, he became director of the musical society, and developed a great activity as a composer. His compositions comprise nearly all the different forms of his art, but he has been most successful in a kind of dramatic composition with solo, chorus, and orchestra, the most celebrated of which are *Comala*, *The Elf-King's Daughter*, and *The Crusaders*; he has written only one opera, *Mariotta*. His earlier overtures and sym-

phonies unfold a most original picture of the Northern character, and the above-mentioned dramatic compositions, of a later date, contain many exceedingly interesting and even brilliant descriptions. He is stronger than Mendelssohn, but his form is less perfect; he is clearer than Schumann, but he has not his wealth of ideas.

Gad-Fly. See Horse-Fly.

Gad'idæ [from *Gadus*, one of the genera], a family of fishes of the series Teleostomi, sub-class Teleostei, order Teleocephali, and sub-order Anacanthini. It includes the cod, haddock, hake, etc. The old family Gadidæ is in the Smithsonian arrangement divided into four: Bregmacerotidæ, Ranicepitidæ, Gadidæ, Merlucciidæ. See Appendix.

Gadjatch, town of Russia, in the government of Poltava, stands at the confluence of the Khoral and Psiol. Tobacco is extensively cultivated in its vicinity. P. 6874.

Gads'den, county of Florida, bordering on Georgia. Area, 330 square miles. The surface is undulating, the soil productive. Tobacco, rice, corn, fruit, and cotton are raised. The county is well timbered, and is traversed by the Jacksonville Pensacola and Mobile R. R. The navigable Appalachicola River flows along the W. border. Cap. Quincy. Pop. 9802.

Gadsden, post-v. and tp., cap. of Etowah co., Ala., 120 miles N. E. of Montgomery, on the line of the East Alabama and Cincinnati R. R., 52 miles W. by S. of Rome, Ga., on the N. bank of the Coosa River, at the southern terminus of Lookout Mountain, in the midst of the Coosa coal-fields and iron deposit. It has 8 steam-mills engaged in cutting yellow-pine lumber, inexhaustible forests of which lie along the Coosa; 4 churches, 5 schools, and 1 newspaper. Pop. of tp. 2203. W. M. Meeks, Ed. "Times."

Gadsden (Christopher), an American statesman and distinguished patriot, lieutenant-governor of South Carolina, b. in Charleston, S. C., in 1724; educated in England, returning to Charleston in 1741; engaged in a mercantile business, in which he was largely successful. In 1765 he was appointed a delegate to the Congress which met at New York in October to petition against the Stamp Act; was also chosen member of Congress in 1774; he was among the earliest advocates of republican principles and American independence; colonel and brigadier-general of South Carolina vols. in 1775, and engaged in the siege of Charleston in 1776; during the siege of Charleston, while lieutenant-governor in 1780, he, with five of the council, remained within the lines of the city; several months after the capitulation he was arrested by order of Lord Cornwallis and transported to St. Augustine, where a parole was offered him, which he refused, and remained in close confinement for forty-two weeks. In 1782 he was chosen governor of South Carolina, but declined the office, continuing, however, his exertions for the good of his country, both in the assembly and council. D. Aug. 28, 1805.

Gadsden (Christopher Edwards), D. D., b. at Charleston, S. C., Nov. 25, 1785, a grandson of Christopher Gadsden; graduated at Yale 1804; became a deacon in the Protestant Episcopal Church 1807; a presbyter 1810; held rectorships in Berkeley and in Charleston, S. C.; was consecrated bishop of South Carolina 1840; was editor of the *Gospel Messenger*. D. at Charleston, S. C., June 24, 1852. Founder of the Protestant Episcopal Society, and a devoted friend to the colored race, for whom he labored much.

Gadsden (James), an American statesman and soldier, b. at Charleston, S. C., May 15, 1788; graduated from Yale College 1806, and engaged in commercial business in Charleston until 1812, when he was appointed second lieutenant of engineers U. S. army; served during the war with Great Britain (1812-15); as aide-de-camp to Gen. Jackson 1816, with whom he served in Florida; promoted to be captain 1818, and appointed colonel and inspector-general U. S. army 1820, but was not confirmed by the Senate; member of the legislative council of Florida Territory (1824), and commissioner to treat for the removal of Seminole Indians to Southern Florida; U. S. minister to Mexico 1853, and negotiated the purchase of Arizona, which purchase is known by his name. D. at Charleston, S. C., Dec. 26, 1858. G. C. Simmons.

Gads'den Pur'chase, a name given to that part of Arizona and of New Mexico which lies S. of the river Gila. This region was purchased from Mexico for the U. S. by Gen. James Gadsden by convention dated Dec. 30, 1853, the U. S. paying $10,000,000, and Mexico giving up a large amount, stated at from $15,000,000 to $30,000,000, in claims for Indian depredations. The sale was very unpopular in Mexico, where it was a principal cause of Santa Anna's banishment as a traitor 1855. Area of Purchase, 45,535 square miles.

Gad'wall, or **Gray Duck** (*Chaulelasmus streperus*), a wild duck of Asia, Europe, America, and North Africa. It is very quick, and hard to shoot, but is highly prized for the table. It inhabits both fresh and saline marshes, and is a bird of passage.

Gael'ic Language and Literature. The term Gaelic (from *Gadhel*, "wanderers," a common name of the Irish and Highland Scotch, and not from the word *Gallus*, a "Gaul") or Gadhelic, in a wide but appropriate sense, is synonymous with the Erse or north-western group of Celtic tongues, including the Irish, the Manx, and the Highland Scotch. Indeed, the three may be regarded as dialects, or rather groups of dialects, of the same mother-tongue. But the name is more commonly limited to the Celtic language spoken in some of the islands and in parts of the Highlands of Scotland. It is also prevalent in Cape Breton and in some other British colonial possessions. The Gaelic differs from the Irish in its vocabulary, retaining words which the Irish has dropped, and dropping words which the Irish has retained; and in both words have changed their primitive meanings; new idioms have arisen in each, and new grammatical forms; and each has numerous peculiarities of pronunciation, the Irish retaining more of the characters of the ancient tongue. The use of Gaelic is fast diminishing.

The Gaelic literature is much less extensive and important than the Irish. The most famous work in the language is the so-called Ossianic poems, of which Macpherson professed to give the world a translation. It is now generally conceded that though Macpherson gave them form and connection, he freely used old materials, both traditional and manuscript; that his work is in parts of great antiquity, and that some of his materials may fairly be considered Ossianic. But Ossian (or Oisin) was himself an Irishman, contemporary with Saint Patrick, and there are very considerable Ossianic remains which are strictly Irish. Most of the extant literature is either poetical, traditional, or religious, and the last-mentioned is of the Protestant period. Gaelic versions of the Bible have been published in 1690, 1767–87, and 1826, besides several incomplete versions. Some of the published Gaelic literature is quite recent, and Canada has at least one Gaelic poet, Mr. Evan McColl of Kingston, Ont. (See Armstrong's and the Highland Society's Dictionaries, 1825, 1828; Stewart's *Grammar*, 1801; *Bibliotheca Scoto-Celtica*, by John Reid, Glasgow, 1832.)

Gae'ta [Lat. *Cajeta;* see Virgil, *Æn.* vii. 1], a strongly fortified sea-coast town of Southern Italy, in the province of Caserta, about 40 miles N. W. of Naples; lat. 41° 30′ N., lon. 13° 40′ E. It was an ancient Greek colony, is most picturesquely situated on a steep promontory overlooking the Bay of Gaeta, was a favorite resort of the Roman aristocracy—Cicero, Augustus, Tiberius, Faustina, and many others had luxurious villas here—and monuments of this period still exist, as the tomb of Lucius Munatius Plancus, the reputed founder of Lyons, and that of Sempronius Atratinus. The famous duodecagonal column or tower, inscribed with the Greek and Latin names of the winds, is now a ruin. Gaeta has the honor of being the first among the Italian towns to form, after the downfall of the Roman power, an independent communal government, such as gave birth to the great republics of Genoa, Venice, and Florence. This little commonwealth was a republic in the time of Charlemagne; coined money and was ruled by its own dukes or doges until 1230. It sustained many noteworthy sieges during the Middle Ages, and has drawn to itself the interest of the present century as the retreat of Pius IX. in 1848–49, and as the last, and indeed only, stronghold that made a spirited resistance in defence of the ex-king of Naples. It was during this siege that rifled cannon were first used as battering-guns on a large scale. The citadel surrendered to Gen. Cialdini on Feb. 13, 1861, after three months' defence. The population of the town in 1871–73 was about 5000, chiefly occupied in the coasting-trade and in fisheries.

Gætu'lia is the ancient name for the western part of the desert of Sahara. It was situated S. of Mauritania and Numidia, and inhabited by the Gætulians, who are supposed to have been the aboriginal Berbers, and to be represented in our time by the Tuaricks. The Gætulians first came in contact with the Romans during the war with Jugurtha, in whose army they served as light cavalry. They were subdued by Lentulus, who from his victory over them received the surname of *Gætulicus*.

Gaff, in a sailing vessel, is the spar to which is bent the upper edge or head of a fore-and-aft sail. Gaff is also the lever, often hooked or barbed, with which fishermen handle large fishes; also the artificial spur of steel or other metal worn by game-cocks in matches.

Gage, county of Nebraska, bordering on Kansas. Area, 864 square miles. The soil is good, especially along the streams. The pasturage is excellent. Grain is the staple product. The southern part of the county is occupied by the Otoe reservation. Cap. Beatrice. Pop. 3,559.

Gage (Frances Dana), b. at Marietta, O., Oct. 12, 1808, daughter of a Mr. Joseph Barker and wife of J. L. Gage; became early distinguished as a temperance orator and an agitator upon slavery and woman's rights; removed in 1853 to St. Louis, where she suffered much from her peculiar opinions and acts; became an editor in Ohio; served without pay in the care of sick and wounded soldiers 1861–65, and also instructed the freedmen. Disabled in 1867 by ill-health, she ceased her active and very useful labors. Author of a volume of clever *Poems*, *Elsie Magoon*, a tale, and of the widely known and admirable pieces for the young signed "Aunt Fanny."

Gage (Thomas), the last governor of Massachusetts appointed by the king, and commander-in-chief of the British force in America, b. in England, a son of Viscount Gage; was appointed governor of Montreal in 1760, and on the departure of Gen. Amherst succeeded him as commander-in-chief of the British forces in America. Being considered the most suitable person to execute the tyrannical laws of Parliament intended to subdue the rebellious spirit manifested in Massachusetts, he was appointed governor in that province, and arrived in Boston May 17, 1774. Several regiments soon followed him, the repair of fortifications on Boston Neck was begun, the powder in Charlestown arsenal was seized, and detachments sent out to Salem and Concord to take possession of stores, which led to the battle of Lexington. In May, 1775, the provincial congress of Massachusetts declared Gen. Gage unworthy of obedience, and the exercise of his functions was henceforth confined to Boston. In June he issued a proclamation offering pardon to all rebels excepting Samuel Adams and John Hancock, and established martial law. The battle of Bunker Hill occurred a few days later, after which Gage was relieved by Sir William Howe, and returned to England the following October, where he d. Apr. 2, 1787. Geo. C. Simmons.

Gagetown, post-v., cap. of Queen's co., New Brunswick, on the W. bank of the river St. John, 30 miles below Fredericton, with which it is connected by daily steamboats in the season of navigation. Pop. of v. about 300; of sub-district, 1282.

Gail (Jean Baptiste), a learned Hellenist, was b. at Paris in 1755; appointed assistant to Vauvilliers in the chair of Greek in the College of France 1791; became titular professor 1792; curator of the Greek and Latin MSS. in the Imperial Library and member of the Institute of France in 1809. He aided greatly in restoring the study of Greek in France, and published a large number of works illustrating the classic Greek authors, but his writings are not held in high estimation. His principal works are—*Theocritus*, with translation, 1792; *Anacreon*, 1793; *Homer*, 1801, 7 vols.; *Xenophon*, 1797–1815, 10 vols. 4to; *Thucydides*, 1807, 10 vols. 8vo; and a collection of philological essays and memoirs entitled *Le Philologue*, 24 vols. 8vo. D. 1829. H. Drisler.

Gail (Jean François), son of the preceding, was b. in Paris in 1795; was for a time assistant to his father in the College of France. Published in 1821 *On the Nature of the Bacchus-Worship in Greece;* in 1825 an edition of the *Periplus* of Scylax; an edition of the *Geographi Græci Minores*, of which 3 vols. appeared 1826–31; and, in conjunction with Longueville, a translation of Matthiæ's Greek grammar, 4 vols. D. 1845. H. Drisler.

Gaillac, town of France, in the department of Tarn, the centre of a rich wine-district. Pop. 7834.

Gaillard (Edwin), M. D., b. in Pineville, St. Stephen's parish, Charleston district, S. C., Mar. 13, 1796; graduated in New York 1819; was prominent in his district as physician and surgeon. D. Oct. 11, 1834, from the effects of a large and laborious practice, at the early age of thirty-seven. He was the father of the distinguished professor, editor, etc., now of Louisville, Ky., of this name. Paul F. Eve.

Gaillard (Edwin Samuel), A. M., M. D., LL.D., b. in Charleston district, S. C., Jan. 16, 1827. Took his literary degree 1845 at Columbia, S. C.; received first honors in South Carolina Medical College 1854; went to Europe 1860; returning thence, settled in New York City. In June of that year he was awarded the "Fiske Fund Prize" for his essay on ozone. During the war of 1861–65 he filled every position in the Confederate army from assistant surgeon of a regiment to that of medical director of army and inspector of hospitals. He established the *Richmond and Louisville Medical Journal* 1866; was elected professor in the Medical College of Virginia 1867; and received the prize for an essay on diphtheria 1867. Removed to Louisville, Ky., with his journal, by the unanimous request of the Medical Society of that State, 1868, and is now professor of the principles and practice of medicine in the Louisville Medical College. In 1873 the University of North Carolina conferred upon him the title of LL.D. When it is known that Dr. Gaillard lost his right hand at the battle of Seven Pines, near Richmond, Va., 1862, and now edits the largest and most successful monthly medical journal in the U. S., and has just commenced another, called the *American Medical Weekly*, none can deny him energy of the first order. His great capacity for labor has placed him in the front rank of his profession. Paul F. Eve.

Gaillard (John), b. in St. Stephen's, S. C., was U. S. Senator 1804–26, and often acting president of the Senate. D. at Washington, D. C., Feb. 26, 1826.

Gaillard (Peter Cordes), M. D., son of Peter G. Gaillard, b. Aug. 29, 1815; succeeded Dr. S. H. Dickson in 1858 as professor of medicine in South Carolina Medical College; was also assistant editor of the Charleston *Medical Journal* and president of the South Carolina Medical Society; was distinguished for attention to hygiene and sanitary science; believed that yellow fever was imported, and in a modified way contagious; and to the last was wholly devoted to his duties as an instructor and physician. D. Jan. 14, 1859. Paul F. Eve.

Gaillardet (Théodore Frédéric), an author and dramatic writer, b. in Paris in 1805, was at first known through the celebrated drama *La Tour du Nesle*, performed in Paris for the first time in 1832, and the authorship of which he claimed against Alexandre Dumas *père*. After this he came to New York, and founded the Franco-American paper *Le Courrier des États-Unis*, of which he is still the Paris correspondent. He is the author of the *Mémoires du Chevalier d'Eon* and of the *Professions de foi et considérations sur le système Républicain des États-Unis*. Félix Aucaigne.

Gaines, tp. of Genesee co., Mich., on the Detroit and Milwaukee R. R. Pop. 1316.

Gaines, tp. of Kent co., Mich. Pop. 1205.

Gaines, post-v. and tp. of Orleans co., N. Y., on the Erie Canal. Pop. of v. 250; of tp. 2196.

Gaines, post-tp. of Tioga co., Pa. Pop. 440.

Gaines (Edmund Pendleton), an American general, b. in Culpeper co., Va., Mar. 20, 1777; appointed second lieutenant 6th U. S. Infantry Jan., 1799, and first lieutenant Feb., 1802; U. S. collector of the port of Mobile, Ala., 1805; captain 1807; major and lieutenant-colonel 1812; colonel 1813; appointed adjutant-general (rank of colonel) 1813, and brigadier-general U. S. A. 1814; for gallant conduct in the defence of Fort Erie, Aug., 1814, where he was severely wounded, he was brevetted major-general, and received the thanks of Congress and a gold medal; similar testimonials were made to him by the States of Virginia, Tennessee, and New York. In 1816 he was appointed one of the commissioners to run the boundary with Creek Indians; engaged against Creek and Seminole Indians in command of Southern military district, when transferred to command of Western division; wounded by Seminole Indians in Florida 1836. D. at New Orleans June 6, 1849.

Gaines (John P.), an American soldier and legislator, b. in Kentucky; served in the war with Mexico as major in the Kentucky Volunteer Cavalry; captured at Incarnacion Jan., 1847; volunteer aide to Gen. Scott, and distinguished at Molino del Rey; M. C. from Kentucky 1847–49; governor of Oregon Territory 1850–53. D. in Oregon 1858. G. C. Simmons.

Gaines (Myra Clark), wife of Gen. E. P. Gaines and daughter of Daniel Clark, a citizen of New Orleans of Irish birth, who (according to testimony brought out by the famous lawsuit in which the daughter was long involved) in 1803 privately married Zulime des Granges, a Frenchwoman, the reputed wife of one Des Granges, who, it is alleged, had a wife living at the time of his marriage to Zulime. Myra, the second child of Mr. Clark by this woman, was b. in New Orleans in 1805, and was educated principally in Philadelphia, where she lived as Myra Davis, Clark and Zulime having separated, and the latter having married a third time. Clark d. in 1813, and the daughter in 1832 was married to W. W. Whitney, then a resident of New York. Shortly afterwards Mr. Whitney and his wife received notice from Mr. Davis, with whom Myra had been brought up, information of the fact that she was the legitimate daughter of Clark, and that not long before his death he had by will given his large estate entirely to her. After Mr. Whitney's death his widow married Gen. Gaines in 1839. The missing will was never produced, but its previous existence was sustained (1856) by the testimony of persons, some of whom professed to have seen it, and others to have heard Clark acknowledge its existence and his daughter's legitimacy. To prove her legitimacy was now necessary, since by the laws of Louisiana the child of an adulterous union could not inherit even by will of the parent. The U. S. Supreme Court finally decided this

point in her favor, after many years of litigation in the State and U. S. courts. She next (1866–67) successfully maintained an action in equity before the U. S. Supreme Court to recover her property, most of which was in New Orleans, and had been disposed of according to a will by which in 1811 Clark had devised his estate to his mother. In 1874, Mrs. Gaines had already recovered possession of several million dollars' worth of this property, and many minor suits for the recovery of the remainder were going on. The total value of the property before the war was some $50,000,000.

Gainesboro', tp. of Independence co., Ark. P. 618.

Gainesboro', post-tp. of Frederick co., Va. P. 2422.

Gainesboro, post-v., cap. of Jackson co., Tenn., on the Upper Cumberland River, 80 miles N. E. of Nashville. It has a newspaper, a Masonic hall, the lower part of which is used for a school-house, 2 hotels, and a number of stores and shops. Pop. about 300. WM. W. BAKER,

ED. AND PUB. "JACKSON COUNTY NEWS."

Gaines's Mill. The wound received by Gen. Johnston at the battle of Fair Oaks proving severe, Gen. R. E. Lee shortly after succeeded him in chief command of the Confederate army. Following out the plan of his predecessor, which now met with less opposition, of concentrating an army about Richmond of sufficient strength to bear down upon that portion of the enemy upon the N. side of the river, crushing it or destroying its communications with the York River, Lee by the latter part of June, 1862, found himself at the head of an effective army of not far from 100,000 men, drawn from along the coast and throughout Virginia; including the corps of Jackson, 25,000 strong, which, under cover of an ostentatious movement of troops from Richmond, designed to convey the idea that Jackson was being reinforced in the Shenandoah Valley, had been withdrawn therefrom with such rapidity and secresy that neither McClellan nor the Union commanders in the Valley were fully aware of Jackson's movement until he reached Fredericshall about June 22 or 23. Meantime, McClellan had been considerably reinforced, the rolls of his army on June 26 showing a total of 156,318, with 115,102 "present for duty." Eleven bridges had been constructed across the Chickahominy, seven of them available for all service. The bulk of the army had been transferred to the right (S.) bank of the river, where its position had been strengthened by intrenchments; leaving Porter's corps, numbering 27,000, alone remaining on the left (N.) bank (June 24). During all this time McClellan had been in constant communication with Washington, continuing his demands for reinforcements, and reporting his daily expectation of advancing to attack the enemy. On the 24th he reported his bridges and intrenchments complete, and ordered an advance of the picket-line on the left, preparatory to a general forward movement, which he appears to have determined upon for the next day; the advance of this day being, he says, "to ascertain the nature of the ground and to place Heintzelman and Sumner in position to support the attack intended to be made by Franklin on the 26th and 27th." At 5 P. M. he telegraphed, "The affair is over, and we have gained our point fully;" but at 6.15 P. M. he sent another despatch to the effect that Beauregard had arrived at Richmond in strong force; that Jackson's advance was at Hanover Court-house; that the Confederate army now numbered 200,000 men; and that he should probably be attacked to-morrow (26th). Foreshadowing a disaster, he expressed his determination to "die with his army," and sought to throw the responsibility off his shoulders and place it "where it belongs." In truth, the whole force of Jackson had reached Hanover Court-house, but Beauregard was not, and had not been, near Richmond, being, in fact, in Alabama; while the Confederate army at the highest estimation not only did not exceed his own, but, on the contrary, he was at all times slightly superior in force. The long-contemplated attack, however, was destined to remain unaccomplished by McClellan, for Lee, having now completed his preparations, himself struck the first blow on the afternoon of the 26th. (See MECHANICSVILLE.) Being now fully aware of the presence of Jackson, and correctly interpreting the nature of Lee's plan to be the laying hold of his communications, and still over-estimating the enemy's strength, McClellan determined on the night of the 26th to transfer his base to the James River—a change he had, indeed, contemplated for some time, and one which he had been free to make at any time since the destruction of the iron-clad Merrimack in May, and which was moreover his obvious base of approach to Richmond, for by it alone could the co-operation of the navy be secured; but, with his natural hesitancy where an alternative presented itself, he delayed doing from choice what he now felt compelled to do. The quartermaster at the White House was ordered to run the trains, loaded with provisions and ammunition, to the last moment, to load the wagons to their utmost with subsistence and send to Savage Station, destroying what could not be removed, and to throw all the supplies up the James River and establish dépôts there as soon as possible. This was accomplished, but only by the destruction of vast quantities of stores. The position of Porter's corps on Beaver Dam Creek being too far in advance to attempt to retain, it was withdrawn at 2 A. M. (27th) to a position stretching around the bridges and within supporting distance of the main army. The greater part of the trains and heavy guns were removed to the right bank during the night. Fearing that the immediate withdrawal of Porter's corps to the right bank would expose its rear to danger, and to gain time to make arrangements for the proposed change of base, McClellan determined to resist Jackson with this corps in its new position. This position was well selected on a range of heights between Cold Harbor and the Chickahominy. The new position was about the arc of a circle, covering the approaches to the bridges which connected the right wing with the troops on the opposite side of the river. Morell's division held the left of the line in a strip of woods on the left bank of the Gaines's Mill stream, resting its left flank on the descent to the Chickahominy, which was swept by the artillery on both sides of the river; the right of the line was held by Sykes's division, partly in woods and partly in open ground, reaching toward the rear of Cold Harbor. Each brigade had in reserve two of its own regiments. McCall's division was formed in second line. The cavalry, under Gen. P. St. George Cooke, was posted behind a hill in rear, to aid in watching the left flank and defending the slope to the river. The withdrawal of the Union army had been quickly discovered by the Confederates, who were soon in pursuit, a slight encounter taking place about noon at Gaines's Mill; but it was 2 P. M. before the division of A. P. Hill, which had been awaiting the arrival of Jackson, advanced alone to the attack in the direction of Cold Harbor, but was firmly met by Sykes's division and repulsed with heavy loss; to relieve Hill, Lee ordered Longstreet to make a feint on the Union left, but upon examination that officer, deeming a feint to be useless, determined upon an attack in force. Jackson, however, arriving on the Union right while dispositions to this end were being made, while D. H. Hill had made considerable advance in this direction, a general attack was now made along the whole line. By 3 P. M. the engagement became so severe that the entire second line and reserves were moved forward to sustain the first against repeated and desperate assaults along the entire Union front. Porter had already sent back for reinforcements, but owing to delays it was not till 3.30 P. M. that Slocum's division, which had been held in readiness, reached the field, increasing Porter's strength to about 35,000, now contending against double that number. So severely was Porter's line pressed that he was compelled to divide Slocum's division, and send parts of it, even single regiments, to the points most threatened. At 5 P. M. Porter reported his situation as critical, and French's and Meagher's brigades were sent to his support. On the right the division of Sykes, with Griffin's brigade, reinforced by Bartlett's brigade of Slocum's division, held its ground firmly, repulsing all attacks; on the left a stubborn resistance had also been made, but its lines were finally broken. This of itself need not have caused disaster, for at this juncture Porter called into action all his artillery, under cover of which he was withdrawing his men and effectively checking the enemy's advance, when Gen. Cooke, with the cavalry, attempted to charge the right flank of the Confederates on the left, as yet still within the woods. This charge was met by a withering fire, under which the horses, becoming unmanageable, wheeled about and dashed up the crest among the gunners, leading them to suppose the charge was being made by the enemy; and being without support, the batteries were hastily withdrawn, overrunning the retreating infantry, and causing the utmost disorder. An impetuous charge now made by the Confederates carried the crest, capturing 14 guns and driving the Union left to the Chickahominy; the key-point of the line being thus carried, the right, which up to this time had held its ground against Ewell's and D. H. Hill's divisions, was compelled to retreat, adding to the general confusion. At this critical moment the brigades of French and Meagher arrived upon the field, and, pushing through the stragglers, advanced rapidly to the front; encouraged by their presence, the retreating troops were rallied behind these fresh brigades, and advanced ready to meet another attack. But it was now dark, and though the reinforcement was slight indeed, yet the severe handling received by the Confederates, added to the knowledge of the arrival of fresh troops to the enemy, prevented Lee from following up his advantage. During the night the Union army was withdrawn to the right bank.

the rear guard of regulars crossing at 6 A. M. (28th), destroying the bridge behind them. During all this day McClellan had remained with the bulk of his army upon the S. side of the Chickahominy, confronted by but 25,000 Confederates, who, under Magruder, taking advantage of the nature of the ground, had kept up a great show and noisy demonstration, first at one point, then at another, deceiving McClellan and his division commanders, who believed they were confronted by a superior force, and their lines were maintained in readiness to resist an attack during the entire time that the disastrous action was occurring on the opposite bank; which, as may be supposed, the Confederate commander was careful to avoid, no serious fighting occurring on this side of the river. As has been seen, only one division and two brigades were sent to Porter's assistance, and of these only the division seasonably; so that it happened that Porter with 35,000 men was contending against a force double his own in numbers, while 25,000 men on the S. side held in check a force more than double this number. "Had Porter been withdrawn on the night of the 26th, our army would have been *concentrated* on the right bank, while two corps at least of the enemy's force were on the *left* bank. Whatever course we then took, whether to strike at Richmond and the portion of the enemy on the right bank, or move at once for the James, we would have had a concentrated army, and a fair chance of a brilliant result in the first place; and in the second, if we accomplished nothing, we would have been in the same case on the morning of the 27th as we were on that of the 28th, *minus* a lost battle and a compulsory retreat; or had the fortified lines (thrown up *expressly* for the object) been held by 20,000 men, as they could have been, we could have fought on the other side with 80,000 men instead of 27,000; or, finally, had the lines been abandoned with our hold on the right bank of the Chickahominy, we might have fought and crushed the enemy on the left bank, reopened our communications, and then returned and taken Richmond. As it was, the enemy fought with his *whole force* (except enough left before our lines to keep up an appearance), and we fought with 27,000 men, losing the battle and 9000 men. By this defeat we were driven from our position and our advance of conquest turned into a retreat for safety." (BARNARD, *Report on Peninsular Campaign.*) Says Gen. Magruder, commanding the Confederate forces on the right bank of the Chickahominy: "I considered the situation of our army as extremely critical and perilous. The larger part of it was on the opposite side of the Chickahominy, the bridges had all been destroyed, but one was rebuilt, and there were but 25,000 men between his (McClellan's) army of 100,000 men and Richmond. Had McClellan massed his whole force in column, and advanced it against any point of our line of battle, . . . its momentum would have ensured him success and the occupation of our works about Richmond; and consequently the city might have been his reward." The battle of June 27 was fought on the same ground where occurred the battle of Cold Harbor (June 3, 1864), but is familiarly known as the battle of Gaines's Mill; Lee calls it the battle of the Chickahominy. No official report of the aggregate loss on either side was made, but from the reports of division commanders the Union loss is estimated at upwards of 6000 (of which 2000 were taken prisoners) and 22 guns; the Confederate loss exceeded 9000 in killed and wounded.

Gainestown, post-tp. of Clarke co., Ala. Pop. 2409.

Gainesville, post-v. and tp. of Sumter co., Ala., on the right bank of the Tombigbee. It is the N. E. terminus of a branch of the Mobile and Ohio R. R., and has one national bank and an active trade. Pop. of tp. 3916.

Gainesville, post-v., cap. of Greene co., Ark., 73 miles N. by W. of Memphis.

Gainesville, post-v., cap. of Alachua co., Fla., on the Florida R. R., 98 miles S. W. of Fernandina. It has a large trade, a productive soil, and a fine climate. There are 3 academies, and 1 weekly newspaper. The surrounding scenery is fine.

Gainesville, post-v., cap. of Hall co., Ga., 53 miles N. E. of Atlanta, the capital of the State, on the Atlanta and Richmond Air-line R. R. It has 2 banks, 2 newspapers, 4 churches, a college, car-shops, machine-shops, mills, 4 hotels, and 60 stores. It is situated on the summit of the Chattahoochee ridge, that divides the waters of the Atlantic and Gulf. It has a number of fine springs—chalybeate, limestone, and freestone—and is therefore a very popular health-resort. Pop. 472. M. VAN ESTES, ED. "EAGLE."

Gainesville, post-v. of Hancock co., Miss. Pop. 71.

Gainesville, post-v., cap. of Ozark co., Mo.

Gainesville, post-v. and tp. of Wyoming co., N. Y., contains a female seminary and has manufactures of cheese, furniture, etc. Building-stone is quarried in the township. Pop. of v. 114; of tp. 1612.

Gainesville, post-v., cap. of Cooke co., Tex., 8 miles S. of Red River. It has a bank, a printing-office, 3 hotels, 2 institutions of learning, Masonic, Odd Fellows, and Good Templars lodges, 2 churches, fair-grounds, 2 mills, saddle and furniture factories, and 3 railroads chartered and to connect here. Principal business, farming and stock-raising. It has 2 weekly papers.

CHAS. M. BAILEY, ED. "GAZETTE."

Gainesville, post-tp. of Prince William co., Va., on the Washington City and Great Southern R. R. Pop. 1908.

Gains'borough, town of England, Lincolnshire, on the Trent. It has large manufactures of linseed oil, and carries on an important transit trade between the interior and the North Sea. Pop. 8724.

Gainsborough (THOMAS), an English painter of landscapes and portraits, b. in Sudbury, Suffolk, 1727; d. in London Aug. 2, 1788. He was an artist from childhood, for he sketched at ten and painted at twelve. Gravelot and Hayman were his instructors. When only sixteen years of age he painted landscapes and portraits in Hatton Garden. Marriage with a young lady of moderate fortune made him comparatively independent, and for several years he lived at Ipswich and Bath, painting portraits with rapidly increasing success. Returning to London in 1774, he gained reputation by portraits of the royal family and eminent people. They are done with a free hand, sketchily, with little color, but are faithful as likenesses and effective as pictures. The portraits of Mrs. Sheridan, Mrs. Siddons, and Mrs. Graham are among his best. Gainsborough's fame, however, rests on his landscapes, which, though not, strictly speaking, original in style, had a character of their own for simplicity of theme and treatment, subdued tone of color, and idyllic charm of feeling. He was a friend and rival of Sir Joshua Reynolds, was one of the original Academicians, and was, except for a short interval, a regular contributor from 1768 till 1784. He left 56 paintings and 148 drawings, which are much prized by connoisseurs. His favorite pictures are well presented in engravings. O. B. FROTHINGHAM.

Gais'ford (THOMAS), one of the most distinguished English classical scholars, was b. at Ifort, Wilts, Dec. 22, 1779; educated at Christ Church, Oxford; took orders in the Church, but devoted himself to classical learning; appointed professor of the Greek language in the University of Oxford in 1811, and dean of Christ Church in 1831. He was also one of the curators of the Bodleian Library and a delegate of the University Press. The letters of Wyttenbach show that Gaisford was regarded, after the death of Porson, as the best representative of English scholarship, and he was often consulted in regard to the MS. treasures in England. His literary activity was very great, and began early. His principal works are *Hephæstionis Enchiridion de Metris* (1810; reprinted in Leipsic, 1832); *Poetæ Græci Minores* (1814–20, 4 vols.; reprinted Leipsic, 1823, in 5 vols.); *Stobæi Florilegium* (1822, 4 vols.; reprinted Leipsic, 1823, 4 vols.); *Sophoclis Tragœdiæ* (2 vols., 1826; reprinted Leipsic, 1827, 8 vols.); *Herodoti Historiæ* (1824, 4 vols.; 3d ed., 1849; reprinted Leipsic, 1824); *Suidæ Lexicon* (folio, 3 vols., 1834); *Parœmiographi Græci* (1836); *Scriptores Latini rei Metricæ* (1837); *Eusebii Demonstratio Evangelica* (3 vols., 1852); *Etymologicum Magnum* (folio, 1848). He was elected a corresponding member of the Institute of France, and member of other learned societies. D. June 2, 1855. H. DRISLER.

Gaissin, town of Russia, in the government of Podolia, on the Soba. Pop. 7218.

Ga'ius, or **Ca'ius,** a famous Roman jurist of whose personal history little is known. He certainly wrote during the reigns of Hadrian and the Antonines. It is conceived from his style that he was only a teacher and writer upon the law, and not a practical jurisconsult. He was the author of numerous works upon the Roman law, of which the most important was the *Institutes.* This work was freely used in compiling Justinian's *Institutes,* and was the basis of the *Lex Romana Wisigothorum,* but was supposed to be lost. In 1816, Niebuhr discovered a palimpsest at Verona, which was afterwards found to contain, almost entire, the long-lost *Institutes* of Gaius. The palimpsest was afterwards deciphered, in spite of great difficulties, by Göschen and Bethmann-Hollweg, and the text was published first in 1821, again, much improved, in 1824, and in still better form in 1842. Other editions are those of 1829 and 1841, and the London text of 1869. There are at least three English and three French translations.

Galac'tine, a gelatine-yielding substance, said to occur in milk. (*J. Pharm.* [3], xxv. 423.)

Galactom'eter [Gr. γάλα, γάλακτος, "milk," and μετρον, "measure"], otherwise called **Lactom'eter,** an instrument for determining whether milk has been watered or

not. In some cases it is a mere hydrometer or specific-gravity glass—in other cases a graduated test-tube, the richness of the milk being judged by the percentage of cream which appears after standing. (See MILK.)

Gala'go, a genus of lemurs, of which some four species are found in various parts of Africa. They are handsome, active, harmless creatures, living on fruit, acacia-gum, insects, and small birds and animals.

Galam Gum. See GUM.

Galan'gal, a stimulant, aromatic drug, derived chiefly from the *Alpinia officinarum*, of the order Zingiberaceæ, a native of Southern China. It resembles ginger, and is used for the same purposes, but is seldom seen in the U. S. *Greater Galangal*, a substitute for the true, is the root-stock of *Alpinia Galanga* of Java.

Galanthus. See SNOW DROP.

Gala'pagos Islands ("Tortoise Islands"), a group of thirteen small islands of volcanic origin in the Pacific, on the equator, and between lon. 89° and 92° W. The Ecuadorians planted in 1832 a penal colony here, which still exists. The islands, which now belong to Ecuador, are noticeable on account of the land-turtles (*Testudo nigra*) of large size which are found here in great numbers. The flora and fauna of the group are peculiar and highly interesting.

Gal'ashiels, town of Scotland, is situated on both sides of the Gala, partly in Selkirkshire and partly in Roxburghshire. It has large woollen manufactures. Pop. 9678.

Gal'ata, suburb of CONSTANTINOPLE (which see).

Gala'tia, or **Gallogræ'cia,** was a country in Asia Minor, situated between Paphlagonia, Pontus, Cappadocia, Lycaonia, Phrygia, and Bithynia, and inhabited by a colony of Gauls, who in the third century B. C. had invaded Greece, crossed the Hellespont, and subdued Troas, and who in 230 were compelled by Attalus I., king of Pergamus, to settle here. They formed a state with a democratic government, which in the days of Pompey was transformed into a monarchy, but shortly after they were conquered by the Romans, and their country was made a Roman province. In the fourth century Jerome says that the Galatians still spoke the same dialect as that spoken about Treves. The apostle Paul visited them twice, and addressed to them one of his earliest Epistles.

Galatia, post tp. of Saline co., Ill. Pop. 1319.

Gala'tians, Epistle of St. Paul to the, was written from Ephesus in 55 or 56 to the disciples in Galatia, where Paul himself had founded churches. The occasion of the Epistle was the interference of certain persons who sought to impose Jewish laws on Paul's converts. He is led into a discussion of the relations of Christianity to Judaism, and his treatment of this question shows more of the influence of his rabbinical education than any other of his writings. This is, next to the Romans, the most important of his Epistles.

Galati'na, town of Southern Italy, in the province of Lecce, about 12 miles N. W. from Otranto. It claims to have been an early Greek settlement, and the name would seem to imply this, but there is no other evidence on the subject. The neighborhood is highly fertile, and the town itself contains several well-sustained charitable institutions and some handsome churches; among the latter, Santa Caterina, founded by a prince of Taranto ransomed from Turkish slavery by the inhabitants of Galatina. P. 10,334.

Galato'ne, town of the province of Terra di Otranto, Italy, 6 miles N. W. of Gallipoli. Pop. 4877; with surroundings, 5878.

Ga'latz, or **Galacz,** city of Moldavia, on the left bank of the Danube, which here is navigable for vessels of 300 tons. It is the great centre of trade between Vienna and Constantinople, exporting grain, wine, wool, and timber, and importing cloth, cotton, and silk goods, iron-ware, leather, and tobacco. The largest part of the old city consists of wooden huts; in the new city, however, are many handsome houses of stone. English and German merchants have begun to settle here, but in the main the trade is carried on by Greeks. Pop. 36,107.

Gal'axy [Gr. γαλαξίας, from γάλα, "milk"], or **Milky Way,** a circle of nebulous or cloud-like light spanning the entire heavens, with the appearance of which every one is familiar. One of the ancient philosophers is said to have conjectured that it was really formed of stars too small to be singly visible to the naked eye. This conjecture was strengthened by Galileo, who, scanning that part of the heavens with his telescope, found minute stars in great numbers; and it was entirely confirmed by his successors, especially by Herschel, in whose telescopes the cloudiness seemed to be entirely resolved into stars. The number of the smallest telescopic stars in the Galaxy is now known to be greater than in all the rest of the heavens, so that this cloudy girdle really forms the most important part of the visible universe. The problem of the structure of the Galaxy is therefore almost the same with that of the structure of the universe, and is still far from being satisfactorily solved. The most celebrated theory on the subject is that of Herschel, who considered that the aggregation of the stars in this belt was caused by the stellar system stretching out immensely farther in this direction than in others. In this theory the figure of the universe is that of a flat round disk, near the centre of which our sun is placed; and the reason so many more stars are seen in the Galaxy than elsewhere is simply the much greater space which the telescope looks through when pointed so as to look edgeways through the disk. This theory has been shown by Mr. Proctor to be extremely improbable. If the universe were so constituted, the density of the Milky Way would be nearly uniform, and it would shade off at the edges very gradually and uniformly. But a careful examination with the naked eye is sufficient to show that the object in question is composed principally of separate clusters or clouds of irregular form, between many of which comparatively dark spaces are seen, while in many other places there are spots of comparatively great brilliancy. Now, on Herschel's theory, or any other theory of uniform density of stars, these dark spaces could only arise from long holes and rifts extending through the Galaxy in the direction of the earth, and the brighter portions would have to be considered as long projections extending out from the direction of our sun. Indeed, one of these rifts, which in the summer and autumn may be seen in the southern portion of the Galaxy, is so striking that Herschel had to suppose an immense cleft in the stellar system to account for it. Now, the existence of long, narrow openings, all pointing to our sun, is so improbable that we may consider Herschel's views entirely untenable. The true constitution of the Galaxy is still one of the unsolved problems of astronomy. Probably it is a vast irregular ring of star-clusters, near the centre of which our sun is situated. But no certain data exist for fixing the position of this ring among the other stars, and our means of measuring the distances of the stars are too imperfect to enable us to collect such data. The solution of the problem must therefore be left to future generations. S. NEWCOMB.

Gal'ba (SERVIUS SULPICIUS), a Roman emperor, b. Dec. 24, B. C. 3, near Terracina; was adopted by his step-mother, a relation of the wife of Augustus; was prætor 20 A. D.; consul in 33; commanded in Gaul 39–41, defeating the Germans with severe loss; commanded with reputation in Africa 45–46, and attained great honors at Rome; held command in Spain 61–68; was then saluted emperor by his men, and went to Rome, where he succeeded Nero in 68, but his avarice and cruelty rendered him unpopular, and he was murdered by the prætorians Jan. 15, 69 A. D. Galba was the first emperor not of the Augustan family. He was succeeded by Otho.

Gal'banum [Gr. χαλβάνη; Lat. *galbanum*], one of the fetid gums; a gum-resin brought from the Levant, India, and Persia. It is the concrete juice of some unascertained umbelliferous plant, probably a *Ferula*. It is antispasmodic, expectorant, and stimulant, and is used as an ingredient of plasters. Therapeutically, it is regarded as intermediate between ammoniac and assafœtida.

Gale, Sweet Gale, or **Dutch Myrtle,** the *Myrica Gale*, a fragrant European and North American shrub, growing in cold, wet lands. It abounds in an essential oil. It has been used in medicine against the itch, and will keep away moths and other insect vermin. Hence the Scotch Highlanders make beds of the twigs, which are also sometimes an ingredient in home-brewed beer.

Gale, tp. of Trempealeau co., Wis. Pop. 1450.

Ga'len, tp. of Wayne co., N. Y., on the New York Central R. R., contains the village of CLYDE (which see) and other villages. Pop. 5706.

Galen, the Anglicized name of CLAUDIUS GALENUS, an illustrious physician of antiquity, b. at Pergamus, in Mysia, in 130 A. D. After eleven years of study with the most eminent medical teachers of Pergamus, Smyrna, Corinth, and Alexandria, he became physician to the gladiatorial school of his native town. When thirty-three years old he went to Rome, and remained four years, winning great applause by his skill as a practitioner and success as a teacher. He returned to Pergamus, but was soon afterward summoned by Marcus Aurelius and Verus, the emperors, to attend them at Aquileia; went thence to Rome again and became physician to the family of Marcus Aurelius. He afterwards returned to Pergamus, but probably visited Rome for the third (perhaps the fourth) time in his old age. The time and place of his death are not known with certainty. Suidas says that he died when seventy years old (about 200 A. D.), but Abulfaragius states that he died

in Sicily when eighty-eight years of age, and there are good reasons for believing that this may be correct. Galen was a man of great learning, but exceedingly vain of his attainments and skill, and speaks, probably with good reason, in terms of contempt of the medical men of his time, particularly of those at Rome. He found the medical profession divided into several sects and parties, but after his time there was but one, the Galenic; and for 1300 years his was by far the highest authority in the profession. Yet when tried by the standard of modern science, Galen's theories and practice are often childish and worse than useless, and he seems to have accomplished many of his cures by means of the unbounded faith which the people had in him, and which he had in himself, as a wonder-worker. He was a laborious dissector of animals, and practised surgery at Pergamus, but not at Rome. He wrote a vast number of treatises upon philosophy, logic, and medical subjects. Eighty-three genuine and many more spurious and doubtful medical works of Galen's are extant, besides numerous fragments, and large numbers are lost. Perhaps the most famous work was the *Ars Medica*, but his best treatises are those upon diagnosis and semeiology. The best edition of Galen is that by Kühn (20 vols., Leipsic, 1821-33). CHARLES W. GREENE.

Gale'na, the sulphide of lead, consisting of lead 86.6, sulphur 13.4, and the ore from which metallic lead is almost exclusively obtained. It crystallizes in cubes, has a blue-gray color and a highly metallic lustre, like that of freshly-cut metallic lead. Galena shows great diversity of physical characters. When distinctly crystallized it affords almost all the modifications of the cubic system, and when massive varies from a coarsely crystalline or laminated structure with large and brilliant cleavage surfaces to fine granular or fibrous. Galena generally, perhaps always, contains silver, sometimes in such quantity as to become a rich silver ore, and the diversity of physical characters which it exhibits has been supposed to be indicative of the percentage of silver in it, the fine-grained ore being thought to be the most argentiferous. No reliance can, however, be placed on this character, as the coarsely crystalline galena is sometimes very rich in silver—as that from the Chamberlain mine in Arkansas—while granular and fine-grained ore, like much of that from Ellenville, N. Y., and Lubeck, Me., may be nearly barren. Galena is a conspicuous element in many mineral veins, and is largely worked as an ore for lead or for the silver it holds. In Cornwall it is associated with tin; in the Hartz Mountains and in Transylvania the silver ore is chiefly argentiferous galena. The proportion of silver in galena varies from a few grains to 1000 ounces to the ton. In the U. S. galena is of very frequent occurrence in the veins contained in the crystalline rocks of the Alleghany belt of New England, the Adirondacks, and Canada. It is also found in the Silurian rocks of the Shawangunk Mountains, Rossie, N. Y., and Lexington, Ky., where it occurs in fissure-veins, and in the lead-regions of the Upper Mississippi and Southern Missouri, where it fills or lines crevices called *gash-veins* in the Galena and Lower Magnesian limestones—representatives of the Trenton and Calciferous groups of New York. Galena is met with throughout the silver-mining districts of Colorado, Utah, and Nevada, where it is generally rich in silver. Though not constantly present in the silver ores of this region, it is so abundant as to afford important aid in the process by which the silver is obtained from the ore.

Galena is frequently found in the ancient mounds of the Western States, and it is evident that the mound-builders attached some value to it; but no proof has yet been gathered that they smelted it or made any use of metallic lead. Probably they employed it for ornament, as they did the mica which they brought from North Carolina, and much of the copper they mined on Lake Superior. Some, and perhaps all, of the galena of the mound-builders came from Lexington, Ky., where they worked a large vein which contains much of it. J. S. NEWBERRY.

Gale'na, city, cap. of Jo Daviess co., Ill., on the Galena (or Fevre) River, 5 miles from its junction with the Mississippi, and on the main line of the Illinois Central R. R., 7 miles from Dunleith, 180 miles W. N. W. of Chicago, and 445 miles by water above St. Louis. It is built on bluffs on either side of the river, which is ordinarily navigable by steamboats. The town is named for the mines of lead-sulphide (galena) which abound in this vicinity. There are 72 lead-producing townships in Wisconsin and Illinois, for which Galena is the business-centre. These townships cover a million acres of land, mostly very fertile. The town is very picturesque by reason of the high and broken character of its site, is well built, and has abundant water-power, 2 national banks, a large pork-packing interest, manufactures of woollens, furniture, castings, lumber, flour, etc.; a heavy trade by rail and river in lead, grain, flour, pork, provisions, and lumber, of which the latter is an important article of receipt, while the others are largely shipped hence. Galena is the seat of the North-western German-English Normal School, has 12 churches, 4 weekly, 1 tri-weekly, and 1 daily newspaper, a handsome stone custom-house, and a fine high school, a good system of public instruction, 5 Roman Catholic schools, and a convent of Dominican nuns, who instruct 450 pupils. Pop. 7019.

Galena, tp. of La Porte co., Ind. Pop. 867.

Galena, post-v. of Kent co., Md. Pop. 307.

Galena, post-v., cap. of Stone co., Mo., on James River. Pop. 27.

Galeopithecus. See FLYING LEMUR and INSECTIVORA.

Gale'rius, or **Maxim'ian II.** (GALERIUS VALERIUS MAXIMIANUS, called also ARMENTARIUS), was a Dacian peasant, who served with such distinction in the Roman army that Diocletian gave him his daughter in marriage, and in 292 A. D. declared him Cæsar and Jovius. The failure of his expedition (297) against the Persians brought him into disgrace, but his second campaign won him great glory. He was the prime mover in the Diocletian persecution, for he always regarded the Christians with deep aversion. In 305 he became Augustus, jointly with Constantius Chlorus; in 307 the revolt of Maxentius robbed him of Italy and Africa, Gaul and Britain having been already lost to Constantine, but he still reigned in the East, and distinguished himself by important works of internal improvement. D. 311 A. D.

Gales (JOSEPH), b. 1760 in England; became a bookseller, printer, and publisher of the Sheffield *Register;* but his liberal principles involved him in troubles with the public officers, and in 1793 he sold his business to his assistant, James Montgomery, went to Philadelphia, edited the *Independent Gazetteer*, and, for the first time, published shorthand reports of the congressional debates. In 1799 he went to Raleigh, N. C., where he long edited the *Register.* D. at Raleigh Aug. 24, 1841.

Gales (JOSEPH), son of the foregoing, b. at Eckington, England, Apr. 10, 1786; studied at the University of North Carolina; learned printing in Philadelphia; went in 1807 to Washington, D. C., and was employed as assistant editor of the *National Intelligencer*, of which in 1810 he became sole proprietor; but in 1812 his brother-in-law, W. W. Seaton, became his partner. D. July 21, 1860, having maintained 53 years his connection with this journal.

Galesburg, city and tp., cap. of Knox co., Ill., 163 miles S. W. of Chicago, on the Chicago Burlington and Quincy R. R., at the point where the line from Chicago to Quincy crosses that from Peoria to Burlington, Ia. The railroad has extensive works here. There are also 2 iron-foundries and machine-shops, and manufactories of corn-planters, stalk-cutters, cultivators, and carriages and wagons. Knox College and Female Seminary and Lombard University are located here; the city also has a very comprehensive and well-conducted system of public schools, and a free library. There are two national and 1 savings bank, 2 good hotels, 15 churches, and several lodges of Masons and Odd Fellows. It has 1 daily and 3 weekly newspapers. Pop. of city, 10,158; of tp., exclusive of city, 878.
S. W. GRUBB, ED. "REPUBLICAN REGISTER."

Galesburg, post-v. of Kalamazoo co., Mich., on the Michigan Central R. R., 9 miles E. of Kalamazoo. Pop. 140.

Galesville, post-v., cap. of Trempealeau co., Wis., 7 miles from the Mississippi on Beaver Creek, and 22 miles N. of La Crosse. It has a university, a graded school, a court-house, a newspaper, a flouring-mill, a cheese-factory, a stove-factory, barrel manufactory, steam saw-mill, and stores, 2 churches, 2 hotels, and an unlimited water-power. Pop. 1068. G. S. LUCE, ED. "JOURNAL AND RECORD."

Galia'ni (FERDINANDO), b. at Chieti, Southern Italy, Dec. 2, 1728; devoted himself with great success to the study of archæology, letters, history, and political and commercial science; visited England; published in 1750 his great work, *Della Moneta;* entered the Franciscan order; became councillor to the Neapolitan board of trade 1769; its secretary, 1770; finance minister, 1782. D. at Naples Oct. 30, 1787.

Galic'ia, a province of Austria, consisting of the old territories of Galicia, Lodomeria, Auschwitz, Zator, and Cracow, and now divided into two governmental districts, Lemberg and Cracow. It is bounded S. by Hungary, from which it is separated by the Carpathians; E. and N. by Russia and Poland, towards which it has no natural boundaries, except in some places where the Dniester and the Vistula make the line of demarcation. The surface is a terrace, through which the Carpathian Mountains gradually sink into the great East European plain. The soil is fertile, but the climate is cold—long winters with deep

snow and short hot summers. Grain, flax, hemp, and hops are grown, but the grape will not ripen. Fine horses and excellent cattle are reared, and the forests are peopled with deer and wolves. Of minerals, iron and rock salt abound; the latter especially is of great importance. Galicia has an area of 29,941 square miles, with 5,145,129 inhabitants, Polish and Ruthenian Slavi, with the general character of the Polish society. There is a class of nobles, who have warlike passions, a romantic temper, and elegant manners; and there is a peasantry, rude, filthy, ignorant, and intemperate. But there is no middle class, no manufacturers, no merchants, except the Jews, who live in abject and miserable condition, despised and ill-treated both by the peasantry and the nobility. In this unfortunate structure of society lay the possibility of the division of Poland: and since Galicia (in 1772) came to Austria it has made great advances in the track of modern civilization, in spite of the rebellions which have convulsed it, and whose general character has been the murder of the nobility by the peasantry. The Ruthenians are mostly Roman Catholics of the Ruthenian rite; the Poles, Roman Catholics of the Latin rite; their number is about equal.

Galicia, the name of an old province of Spain, comprises the north-western part of the Peninsula, bounded S. by Portugal and N. and W. by the Atlantic, was in 1833 divided into four provinces, Corunna, Lugo, Orense, and Pontevedra. The surface is mountainous, traversed by several ranges of the Cantabrian Mountains, which reach the Atlantic in lofty and rugged promontories (Cape Ortegal and Finisterre), between which the estuaries of the rivers form the best and safest harbors in Europe (Ferrol and Corunna). The soil is fertile, the climate mild and moist; the ground partly covered with dense forests, affording also fine pasturage and arable lands. The inhabitants, numbering in 1867, 1,937,792, are a vigorous but not very intelligent race, which, however, on account of its industry and plain practical sense, forms one of the most honorable parts of the Spanish nation. Thousands of them emigrate each year to Portugal or to the other provinces of Spain, where they live for some years as workmen, and when they have saved a little money they return home. They are known as Gallegos.

Ga'lien, post-tp. of Berrien co., Mich., on the Michigan Central R. R. Pop. 856.

Gal'ilee [Heb. גָּלִיל, *Galil*, "a wheel" or "circle"], a name applied originally to the twenty towns round about Kedesh-Naphtali, given by Solomon to Hiram in return for services rendered in building the Temple at Jerusalem; but in the Roman period it was the name of the northernmost of the three great provinces of Western Palestine, including the ancient territories of Issachar, Zebulon, Asher, and Naphtali. Lower Galilee appears to have begun with the southern boundary of Esdraelon, and to have extended some 8 or 10 miles N. of Nazareth. All N. of that was called Upper Galilee. The whole province is supposed to have had an area of 2000 square miles. In the time of Christ it was the most densely peopled and thrifty portion of Palestine. According to Josephus, it contained 240 towns (*Autobiography*, 545), and was noted both for the fertility of its soil and the bravery of its inhabitants (*Jewish War*, 3, 3, 2). The population of the whole province, but especially the northern part of it, was largely heathen. This was so in the time of the Maccabees (1 Macc. v. 17–23). Strabo (b. 54 B. C.) says the province was "inhabited generally by mixed tribes of Egyptians, Arabians, and Phœnicians." (*Geog.* xvi. 2, 34.) In Isa. ix. 1, and Matt. iv. 15, it is called "Galilee of the Gentiles." The few Jews who lived there were far less bigoted than their brethren in Judæa. Hence, the greater part of Christ's life was spent in Galilee, and most of his disciples were Galileans. (For an elaborate argument in support of the position that the population of Galilee in the time of Christ was *not* mainly heathen, see the *Bibliotheca Sacra* for Jan. and for Apr., 1874.)

R. D. Hitchcock.

Galilee, in certain ancient churches, the entrance-chapel or porch, usually at the W. end of the church, or, in other cases, a portion of the church whose floor was depressed one step below the rest, and beyond this portion women were not allowed to pass. In the galilee monks assembled to receive visits from their female relatives, for it was considered less sacred than the rest of the church.

Galilee, Sea of. See Gennesaret, Lake of.

Galilee, a v. and tp. of Great Beaver Island in Lake Michigan, belonging to Manitou co., Mich. It is a Mormon settlement. Pop. 203.

Galile'i (Galileo), commonly called **Galile'o,** b. at Pisa Feb. 14, 1564. His father was a musician. In his boyhood Galileo studied the classics, invented small machines, became an accomplished musical performer, and showed great taste for painting, wherein he endeavored to detect the same law of harmony which he had learned from mathematics. His father wished him to study medicine, but his own inclination was for mathematical pursuits. The propositions of Euclid were taught him by Ostilio Ricci of Fermo, then master to the pages of the grand duke. At the age of twenty Galileo was already a distinguished geometrician. It was at this age that he noticed the swinging of a lamp in a church, and, observing that the oscillations were of equal duration, he inferred that this principle might be used to measure time exactly; but it was not until fifty years after, or about 1633, that he applied this observation to the construction of a clock. Galileo was also the inventor of the microscope, of the thermometer, the proportional compass, and of a telescope with a magnifying power of thirty. This last he presented to the Venetian senate, and was handsomely recompensed for it. By telescopic observations Galileo first discovered the mountainous character of the moon; he also detected the phases of the planet Venus, the satellites of Jupiter, the rings or ring of Saturn, the rotation of the sun and its corruptibility inferred from the spots upon its disk. As is usual with discoverers, many of his inventions were disputed by inferior geniuses; among them, the Milanese Baldassarre Capra asserted priority in the contrivance of the proportional compass, but failed to prove his claim, and his pamphlet was adjudged libellous. But great as was Galileo in astronomy, he was still greater as the founder of the experimental philosophy, as a physicist, and as a mechanician. He was the first to formulate the principle of *virtual velocities*. In 1630 was published at Leyden his book entitled *I discorsi e dimostrazioni matematiche intorno a due nuove scienze*—a work that attracted little notice at the time, but which Lagrange, in his *Mécanique Analytique,* considers as Galileo's most substantial title to scientific glory. In his treatise *Delle cose che stanno nell' acqua* he maintained and proved the so-called *hydrostatic paradox*, declaring that the form of bodies did not affect their power of flotation. Having discovered the isochronism of the pendulum, Galileo endeavored to use it for the purpose of measuring the pulsations of the arteries. In an essay, now lost, entitled *De visu et coloribus,* he established the profound truth of the laws of *consonance and dissonance*, or of the unity and variety of colors; a fact which daily observation and the history of language continue to confirm—language being only a modification of colors and of sounds. He also wrote a treatise on fortification; he maintained that longitude might be determined by the satellites of Jupiter. The sphericity of the earth had already been affirmed by the ancients, and also its motion as a body suspended and revolving in space. Eusebius of Cæsarea had stated the belief of Philotas, that the earth moved and revolved around a central fire in an oblique circle (for the precursors of Galileo see the learned and impartial memorial presented in 1873 to the Royal Institute of Science and Letters in Lombardy by the distinguished Piedmontese astronomer, Prof. Giovanni Schiaparelli). But what is most remarkable of all is the precision with which the antipodes and the attraction of the earth are spoken of as early as 1304 by the preacher Giordano da Rivalta, who said, "Whosoever might be beneath the earth on the other side of the world below would have his feet planted against our feet, and his soles would be opposite our soles. Thou wilt say: How, then, can he stand downward? and I reply to thee: To him who is below it will appear as if he were above, and as if he were standing erect as thou art. And if he should be raised up in the air—that is, drawn downward in respect to us—he would fall back again towards the earth, just as one here would fall from a tower. It will therefore everywhere seem to a man that the sky is infinite over his head, and, in fact, so it is—neither more nor less." Niccolò da Cusa, Domenico Maria Novara of Ferrara, Celio Calcagnini, and Copernicus successively prepared the way for the convictions and the demonstrations of Galileo concerning the revolution of the earth. He was, then, in this respect, not so much a new discoverer as a bold, earnest, and able expounder of a system which, in spite of the hostility of churchmen—it is known that even Luther and Melanchthon wrote against the Copernican system as contrary to the authority of the Bible—was destined to triumph through the clearness of evidence made accessible after Galileo's time to the people, whose good sense was prompt to accept the conclusions. His teachings, however, encountered enemies and opposition in his own day, but the first to excite persecution were the men of science themselves, who were unwilling to be suddenly convicted of ignorance, to confess their mistakes, and to be sent back to school. It was these very men who forced Galileo to fly from Pisa and seek the protection of Salviati when he had ventured to contradict, by experiments made from the top of the Leaning Tower, the theorem of Aris-

totle which declared that *the velocity of the motion of falling bodies is in proportion to their weight.* Salviati not only received him well, but recommended him to the Venetian Sagredo, who secured him the appointment of professor in the University of Padua. At Pisa, Galileo had received but 60 *scudi* annually; at Padua, he had at first double that sum, and afterwards, in 1610, 1000 florins, which was a very large salary for that period, there being required of him only thirty hours of instruction during the year, or, to speak more precisely, sixty half hours.

At Padua, Galileo enjoyed great liberty, and his real troubles only began some years later, when, not satisfied with teaching science, he ventured to declare "that in Scripture there were propositions which were false in the literal sense of the words; that even in matters of solemn dogma the forms of expression were sometimes inexact, out of regard to the incapacity of the popular comprehension; and that in all natural questions philosophical argument should have more weight than mere scriptural declaration." This was certainly very bold. Cardinal Baronius answered with much moderation, "that the Scriptures were given to teach men how to rise to heaven, not how the heavens were made." The court of Rome did not choose to show the same forbearance, and, being under pressure of evil influences, perhaps could not do so. Galileo was denounced, and summoned to appear before the Sacred Congregation of the Index to receive an admonition. He obeyed the summons; the inquisitors solemnly declared the Copernican theory of the revolution of the earth false and contrary to Holy Scripture, and condemned in the most absolute terms the propositions in regard to the central position of the sun, with the earth revolving round it. The report, though untrue, that Galileo had been included by name in this condemnation, soon spread through Tuscany, and he procured from Cardinal Bellarmin a certificate to the contrary. This certificate declared that the decision of the pope and the Congregation against the Copernican system had simply been communicated to Galileo. Though now free to leave Rome, the great astronomer continued to press, in safe quarters, his overwhelming arguments in favor of the rejected system, until recalled to Florence by the prudent friendship of the grand duke. Urban VIII., who, when only Cardinal Barberini, had greatly admired Galileo, and had declared himself of his opinion, being now pope, accepted the dedication of the *Saggiatore*, and exhorted Galileo to come again to Rome, where he was extremely well received in 1624. At this time he was occupied with the solar spots, as also with the tides, and he even returned again to discuss the subject of the earth's motion, notwithstanding the papal prohibition, at the same time, however, praying the grand duke "to consider it as mere poetry or as a dream: nevertheless, as the poets sometimes set a value upon their fancies, so I likewise have a certain esteem for this my novelty."

In 1632, Galileo published at Florence his celebrated *Dialogo sopra i due massimi sistemi del mondo, tolemaico e copernicano* (republished 1874 at Leghorn by Francesco Vigo). Urban VIII. was made to believe that the ignorant Simplicio was intended for him, and as there is no wound so deep as that of injured vanity, the pope now left the Congregation of the Index to do as they liked, on the ground that Galileo had violated the orders he had received. He was therefore summoned once more to Rome, and once more he obeyed the summons. Touching this trial much has been written to accuse, and much to defend, or at least to excuse, the Roman court. It has been asserted that Galileo did not retract until he had been subjected to torture, and that in uttering his retractation he added in a low tone, *E pur si muove* ("Still, it does move"). As to the latter tradition, it is of little consequence whether the protest was audible or suppressed by fear of the stake, but the question as to whether this great man was actually put to the rack cannot fail to be of the greatest interest. It is quite certain that at the time many persons believed Galileo had been literally tortured. It is also most certain that the Romish Church has done her utmost to keep secret the proceedings in the trial of Galileo, and the records exhibit certain *lacunæ* that may well have their significance. At any rate, though it may be doubtful whether Galileo was put to actual physical torture at Rome during his trial, it is most certain that he was threatened with it, and that he was exposed to cruel moral torture, while no menaces were spared to make him quail before his judges. On June 22, 1633, Galileo, at the age of seventy years, on his knees and clad only in a shirt of sackcloth, was forced to pronounce, in the presence of his judges and a large assembly of prelates, a most humiliating formula of abjuration. (See *Parchappe*, ch. viii. On the subject of the trial of Galileo, see the documents published by Silvestro Gherardi in the *Rivista Europea*, 1870, with the arguments which accompany them; also Prof. Govi's interesting pamphlet, Turin, 1872.) Galileo was at first sentenced to imprisonment at the good pleasure of the papal government, but he was afterwards allowed to retire under surveillance to his villa of Arcetri, on the Florentine hills, where he continued his work and his observations until he lost his sight. In this villa was inaugurated in 1873 the new astronomical observatory. Traditions of the blind Galileo are still preserved in that vicinity. A few years since Prof. Arcangeli, finding himself near the tower of Galileo in Arcetri, asked a peasant who Galileo was, and received for answer a strong expression of surprise that he should not know who that arch-magician was, who, being blind, divined the stars! Galileo died at the age of seventy eight, on Jan. 9, 1642—the year of the birth of Isaac Newton—and was buried in the church of Santa Croce at Florence. For fuller information concerning Galileo, see NELLI, *Vita di Galileo*; CANTU, *Illustri Italiani*; *Galilei*, par le docteur PARCHAPPE; *Galileo e l'Inquisizione*, di MONSIGNOR MARINI (Rome, 1850); PHILARÈTE CHASLES, *Galileo Galilei*; LIBRI, *Histoire de la vie et des œuvres de Galilei*; and the splendid collection in 4to of the *Opere edite ed inediti di Galileo Galilei*, published at Florence by Eugenio Alberi at the expense of the grand duke. In 1864, on the occasion of a centennial celebration of the birth of Galileo by the University of Pisa, a discourse was published by Prof. Silvestro Centofanti, and a comparison between Galileo and Bacon, as founders of the experimental philosophy, by Prof. Pasquale Villari. ANGELO DE GUBERNATIS.

Gal'ingale, a name applied popularly to various plants, especially to certain sedges of the genus *Cyperus*, and more particularly to *Cyperus longus*, a bulbous sedge of Europe. Its bulbs have been employed in medicine, but are now more used by perfumers, who extract from them a substance having a fragrance like that of violets. Other species yield perfumes, especially in tropical lands.

Ga'lion, city of Crawford co., O., 64 miles N. of Columbus, on the Cleveland Columbus Cincinnati and Indianapolis R. R., at the junction of the Indianapolis division with the main line, and on the Atlantic and Great Western R. R. It has the shops of the railroads, 2 foundries, a large mill, 2 national banks, 2 newspapers, 2 hotels, 11 churches, a fine union school building, and a building association, and is rapidly growing. Railroad interests constitute the leading business. Pop. 3523.

ROWE & CONROD, EDS. "REVIEW."

Galipea. See ANGOSTURA BARK.

Gal'ipot [Fr.], the concrete turpentine which collects upon pine trees in the S. of France; called also *barras;* it is an article of commerce, and after melting and straining enters into some pharmaceutical compounds in European practice. (See TURPENTINE.)

Gall (FRANZ JOSEPH), M. D., b. at Tiefenbronn, in Baden, Mar. 9, 1758, of Italian descent on the father's side; studied at Baden, Bruchsal, Strasburg, and Vienna, where in 1785 he took his medical degree. From childhood he had noticed and extensively compared the differences in the shapes of men's heads, believing that these differences would afford the best index to the mental and moral characters of persons examined. In 1796 he began to lecture at Vienna upon his new theory, since widely known as the "science of phrenology" (see PHRENOLOGY); but the announcement drew upon him much censure, ridicule, and opposition, and in 1805 the Austrian government interdicted his lectures. In 1807 he repaired to Paris with his apostle Spurzheim; he became a practitioner of medicine, and in 1819 a citizen of France. D. near Paris Aug. 22, 1828. His principal works are *Philosophisch-Medicinische Untersuchungen* (1791), *Recherches sur le Système Nerveux* (1808), *Anatomie et Physiologie du Système Nerveux* (1810–19), and *Sur l'origine des qualités morales et de facultés intellectuelles* (1822–25).

Gal'lagher (WILLIAM D.), b. at Philadelphia Aug., 1808, the son of an Irish patriot and exile; removed in 1816 to Cincinnati; was apprenticed to a printer 1821; was for many years a journalist of Cincinnati; also edited journals in Xenia, O., and Louisville, Ky.; was employed in clerkships at Washington, D. C., 1850–53. Author of *Erato* (3 vols., 1835–37, poems), and another original volume (1846), besides a compilation of poems (1841), etc. He also prepared a *Social and Statistical View of the Mississippi Valley*, and accomplished much in developing a taste for literature in the West. In 1853 he became a farmer near Louisville, Ky., and was later employed in the treasury department at Washington. He has written much upon agricultural subjects.

Gallait (LOUIS), historical painter, b. at Tournay (Belgium) in 1810. His studies were pursued in Antwerp, but chiefly in Paris; his first pictures were exhibited in Brus-

sels, and soon gained for him fame; but he has been a more frequent contributor since 1855 to the French exhibitions. His great subjects are taken from the history of the Low Countries: *The Duke of Alba in the Netherlands, The Last Moments of Egmont, The Last Honors paid to Egmont and Horn, The Abdication of Charles V.* But he has painted other scenes, partly historical and partly imaginative: *The Death of Palestrina, Job and his Friends, Montaigne visiting Tasso, Baldwin crowned Emperor of Constantinople, The Temptation of St. Anthony*, etc. His paintings are of large size and full of action. M. Gallait is a member of the Royal Academy of Belgium, an honorary member of the Royal Academy of London, and a foreign associate of the Paris Academy of Fine Arts, in the place rendered vacant by the death of Overbeck. He obtained a medal in 1835 and the decoration of the Legion of Honor in 1841. He is a resident of Brussels. O. B. FROTHINGHAM.

Gal'land's Grove, tp. of Shelby co., Ia. Pop. 692.

Gal'la Ox, a breed of domestic cattle found in Abyssinia. Like most of the cattle of India, it has a hump upon the shoulders, but it is chiefly remarkable for its monstrous horns, which, considering the small dimensions of the animal, far exceed in relative size the horns of any other breed. This breed is apparently in every way inferior to the ordinary cattle of Europe and the U. S.

Gallara'te, town in the province of Milan, noted for its commercial and industrial activity. It is situated at the junction of the railways leading from Lake Maggiore and Lake Lugano to Milan, from which city it is about 25 miles distant. The first spinning-jennies ever used in Italy were introduced here by the family Ponti—a family to whose enlightened liberality this town is otherwise largely indebted. It contains many fine buildings, and great care and expense has been bestowed on a new cemetery, which is much praised. Pop. 7596.

Gal'las, a powerful native race of Eastern Africa, who have for years been gradually encroaching upon the Abyssinians proper. They seem to have originated far to the S. of Abyssinia. They are divided into many tribes, are partly Mohammedan, while the majority are pagans. They are remarkable for their bravery and savage character. They are dark brown, with frizzled hair.

Gal'latin, county of Southern Illinois, bounded on the E. by the Wabash and the Ohio rivers. Area, 310 square miles. It is fertile and well timbered. Tobacco and grain are staple products. Coal is mined, and salt-springs are found here. It is intersected by the Springfield and Illinois South-eastern R. R. Cap. Shawneetown. P. 11,134.

Gallatin, county of Kentucky, separated from Indiana by the Ohio River. Area, 150 square miles. The soil is productive, the surface undulating and well timbered. Tobacco and grain are staple products. The county is traversed by the Louisville and Cincinnati R. R. Cap. Warsaw. Pop. 5074.

Gallatin, county of Montana, bordering on Wyoming. Area, 6200 square miles. It was in 1870 the foremost agricultural county in the Territory. Grain, live-stock, and dairy products are the staples. The county is traversed by the Yellowstone and numerous other streams. Much of it needs irrigation, and timber is rather scanty. A part of the county is in the Crow reservation. Gold and lignitic coal are abundant. Cap. Bozeman. Pop. 1578.

Gallatin, post-v., cap. of Daviess co., Mo., at the junction of the Chicago Rock Island and Pacific R. R. and the St. Louis Kansas City and Northern R. R., on Grand River. It has 2 banks, 13 stores, 2 newspapers, 2 hotels, a fine graded public school, and 4 churches. Pop. about 1500. J. T. DAY, ED. "NORTH MISSOURIAN."

Gallatin, tp. of Clay co., Mo. Pop. 2211.

Gallatin, tp. of Columbia co., N. Y. Pop. 1116.

Gallatin, post-v., cap. of Sumner co., Tenn., 26 miles from Nashville, on the Louisville Nashville and Great Southern R. R., and 3 miles from the Cumberland River. It has a large cotton factory, a wool-factory, a national bank, a deposit bank, 2 large flouring-mills, a carriage-factory, an iron-foundry, a manufactory of agricultural implements, planing-mills, 2 newspapers, 7 churches, 4 hotels, and the usual number of stores, shops, etc. Pop. 2123.

T. BOYERS & CO., EDS. "EXAMINER."

Gallatin (ALBERT), LL.D., one of the most distinguished statesmen of America, b. at Geneva, Switzerland, of an ancient patrician family Jan. 29, 1761, and was the son of Jean de Gallatin by Sophia Albertina Rolaz du Rosey, his wife. His maternal grandfather was Albert Rolaz, Seigneur du Rosey, of Pays, now canton of Vaud in Switzerland. His ancestor, Jean de Gallatin, secretary to the duke of Savoy, removed from Bresse, now department of Ain in France, to Geneva, of which he became a citizen in 1510, and although he was created a viscount palatine (*vice-comes*) by Pope Leo X. (1522), he embraced the Reformation, and was one of the magistrates of the city in 1535, when Geneva became an independent republic. His wife was Perronnette d'Entremont, nearly related to Jacqueline d'Entremont, wife of the illustrious Admiral Coligny. Albert Gallatin was left an orphan in his infancy, and was educated under the care of a distinguished lady, a friend and relation of his mother. He graduated in 1779 at the University of Geneva, and being deeply imbued with the bold and liberal spirit of the times, he declined offers of honorable and advantageous employment under one of the sovereigns of Germany, and in opposition to the wishes of his family emigrated to the U. S. He landed at Boston July 14, 1780, and soon after his arrival proceeded to Maine, where he served as a volunteer under Col. Allen, made advances to the government for the support of the American troops, and in Nov., 1780, was placed in command of a small fort at Passamaquoddy, defended by a body of militia, volunteers, and Indians. In 1783 he was professor of the French language at Harvard University, and the following year, having received his patrimony from Europe, he purchased large tracts of land in Western Virginia, with a view of forming an extensive settlement; he was, however, prevented by the Indians; in 1786 purchased a farm on the banks of the Monongahela, in Fayette co., Pa.; in 1789 was elected a member of the convention to amend the constitution of Pennsylvania, and united himself with the Republican party; in 1790 was elected to the house of representatives of Pennsylvania, and continued to be re-elected till he took his seat in Congress; in 1793 was elected a Senator of the U. S., but his eligibility was contested on the ground of his not having been a sufficient length of time a citizen, and he lost his seat by a strict party vote. It was on this occasion that the doors of the Senate were, for the first time, thrown open to the public. The same year married in New York City a daughter of Com. James Nicholson. There was one service rendered by Mr. Gallatin at this time which he always looked upon as most important in its consequences and most honorable to himself—the head he personally made against what is commonly called "The Whisky Insurrection." In 1794, Mr. Gallatin returned to Fayette co. In Oct., 1794, was again elected, by the concurring votes of *all parties*, to the legislature, and on the same day was elected member of Congress for the adjacent district of Washington and Allegheny counties, in which he did not reside. In Dec., 1795, he took his seat in Congress, and continued there during three terms, and had been re-elected for a fourth term when, on the accession of Mr. Jefferson to the Presidency in 1801, he was appointed secretary of the treasury. Although Mr. Gallatin spoke on every important subject of debate that arose, he paid particular attention to the financial concerns of the country. It was on his motion that the committee of ways and means was first organized; and he explained his views in *A Sketch of Finances*, published in 1796, and in *Views of Public Debt, etc.*, published in 1800. The Congressional career of Mr. Gallatin was one of a splendor rarely surpassed.

In 1809, Mr. Madison offered him the state department, but he declined it, and remained at the head of the treasury department until 1813, a period of twelve years. While at the head of the treasury he exercised a great influence with the other departments and in the general administration of the government, especially in regard to its avowed policy of retrenchment and financial reform. On the offer of the Russian mediation in 1813, Mr. Gallatin proceeded to St. Petersburg as envoy extraordinary of the U. S., without, however, resigning the office of secretary of the treasury, it being his intention to resume the duties of that arduous and difficult office if he was not successful in negotiating an honorable peace. Previous to his departure he drew up a number of bills that were necessary to carrying into effect the system of taxation that he had recommended to Congress in his annual report and in a letter addressed by him in reply to one from the committee of ways and means; these bills were reported by the committee on Jan. 26, 1812, and were finally passed by Congress at their special session held on May 24, 1813, in the form in which they had been recommended by Mr. Gallatin and reported by the committee. Great Britain having refused the mediation of Russia, she agreed to treat directly with the U. S. Gottenburg was first selected for carrying on the negotiations, but Mr. Gallatin having arranged with Lord Castlereagh that they should be transferred to Ghent, he proceeded there in 1814, and in conjunction with his distinguished associates negotiated and signed the treaty of peace. In 1815 he went to London, where, with Messrs. Adams and Clay, he negotiated and signed a commercial convention between the two countries. In 1816, Mr. Madison was desirous that he should resume the place of secre-

tary of the treasury, but he declined, and went out to France as minister of the U. S., where he remained until 1823. He was twice deputed on extraordinary missions—in 1817 to the Netherlands, and in 1818 to England. He would not accept of a seat in the cabinet at Washington on his return in 1823. In 1824, when nominated for Vice-President of the U. S. by the Republican members of Congress, he declined the nomination. He also declined the Panama mission tendered to him by President Adams. He received the thanks of the government of the new republic of Greece for his efforts in their behalf. In 1826 he was appointed envoy extraordinary to England, returned to the U. S. in Dec., 1827, and resided in the city of New York; and, with the exception of the preparation of the argument to be laid before the king of the Netherlands on behalf of the U. S. in reference to the north-eastern boundary, which occupied him for the first two years, he held no public office. In 1830 he was chosen president of the council of the University of the City of New York. An early disciple of the school of Adam Smith, he was always strongly in favor of free trade, and assisted at the free-trade convention held at Philadelphia in 1831. The preparation of the memorial to Congress on behalf of said convention was committed to him. The same year (1831) he became president of the National Bank, which position he resigned in 1839, when he was succeeded by his eldest son, James Gallatin. He had been for several years, and was at the time of his death (Aug. 12, 1849), president of the New York Historical Society, and also president of the American Ethnological Society, organized under his auspices.

Besides his numerous writings on the currency and other subjects connected with finance, and his official papers, he published some elaborate works on the Indian languages, etc. In 1840 his essay on the north-eastern boundary appeared, which, together with his essay on the map of Mr. Jay, read before the New York Historical Society, displayed great research. In 1846 appeared his remarkable and unanswerable letters on the Oregon controversy. His beautiful essays on the Mexican war are still fresh in the recollection of all. They were addressed to the interests as well as the moral obligations of nations. He was from principle a sincere lover of peace; he had been opposed to the war of 1812, which had been forced on Mr. Madison's administration; and the last years of his political life in the diplomatic service of the country were employed in promoting that object. His last intellectual effort was a treatise on the languages and civilization of the Southern and Western tribes of Indians. His reputation extended from America throughout Europe. He left the impress of his great mind on the age in which he lived, and went to the grave universally honored. His career was alike honorable to the country of his birth and to that of his adoption. (*Proceedings of the New York Historical Society*, Oct., 1849.) ALBERT H. GALLATIN.

Gallatin City, a v. of Gallatin co., Mont. Pop. 53.

Gallatin, Mount, a mountain some 10,000 feet high, near the N. W. corner of Wyoming, and in the National Park. Near its base rise the Gallatin River and the E. fork of the Madison.

Gallatin River, one of the head streams of the Missouri, rises in Montana, near the National Park. Its general course is northward through one of the most beautiful, healthful, and fertile parts of Montana. Length, 125 miles.

Gallaudet (EDWARD MINER), PH. D., LL.D., a son of Dr. T. H. Gallaudet, was b. in Hartford, Conn., Feb. 5, 1837; taught in the Hartford Asylum in 1856, and in 1857 took a prominent part in organizing the Columbia institution for the deaf and dumb. In 1864 he took the preliminary measures for founding the National Deaf-Mute College at Washington, of which he became president, acting also as professor of moral and political science. In 1868 he published a report of his observations in the deaf-mute schools of Europe. He is also author of other reports on deaf-mute education.

Gallaudet (THOMAS), D. D., son of Dr. T. H. Gallaudet, b. at Hartford, Conn., June 3, 1822; educated at Trinity College of that city, and graduated in 1842; was 1843–58 a professor in the New York institution for deaf mutes; took orders in the Protestant Episcopal Church 1850; became rector of St. Ann's church, New York City, in 1852, and instituted in it regular services for deaf mutes and their friends; general manager of the Church Mission to deaf mutes Oct., 1872; pastor of the sisterhood of the Good Shepherd at St. Barnabas House, Apr., 1869; chaplain of the Midnight Mission, Nov., 1871; has done much to promote the instruction of deaf mutes elsewhere, and has written largely upon the subject.

Gallaudet (THOMAS HOPKINS), LL.D., b. in Philadelphia Dec. 10, 1787, of Huguenot descent; graduated at Yale in 1805; was tutor there 1808–10; studied 1811–14 at Andover Theological Seminary; studied law also; visited Europe 1814–15 in the interest of the Hartford institution for deaf mutes, which he started, and to the superintendency of which he had been appointed; returned in 1816, accompanied by Laurent Clerc; was in charge of the asylum 1817–30, and afterwards remained a director; was chaplain of the insane retreat at Hartford 1838–51; author of *Sixteen Discourses* (London, 1818), *Bible Stories for the Young* (1838), *The Child's Book of the Soul*, *Youth's Book of Natural Theology* (1852); helped prepare a small English dictionary; wrote valuable articles for *Annals of the Deaf and Dumb*, etc. D. at Hartford, Conn., Sept. 9, 1851. (See his *Life*, by H. HUMPHREY, 1858; H. BARNARD, *Tribute to Gallaudet*; DR. SPRAGUE, *Annals of the American Pulpit*.)

Gal'lauher, tp. of Clinton co., Pa. Pop. 252.

Gall-Bladder, a pear-shaped membranous sac, the reservoir for the bile, situated in a fossa on the inferior surface of the right lobe of the liver. It is about four inches long, and one in width at its broadest part, and in its natural undistended condition holds about an ounce. The gall-bladder consists of three coats—an external, derived from the serous membrane which lines the abdominal cavity; a middle coat, composed of muscular and fibrous tissue; and an internal mucous coat. A thick viscid mucus is secreted by the last-mentioned coat which sometimes plugs up the common bile-duct, thus giving rise to jaundice. The gall-bladder receives the bile secreted by the liver through the hepatic and cystic ducts. It discharges its contents through the common bile-duct into the upper portion of the small intestine. Besides being greatly distended with bile in consequence of obstructed ductus communis, the cavity of the gall-bladder may be almost entirely obliterated in consequence of obstruction in the cystic ducts. It also frequently contains biliary calculi. Many plant-eating mammals and some birds are without a gall-bladder; and there are a few mammals which have two. EDWARD J. BERMINGHAM.

Gal'le, or **Pon'to Gal'lo,** town of Ceylon, on the southern coast of the island, is fortified, well built, and has a good harbor. Its trade, however, is insignificant, compared with the fertility of the surrounding districts and the commercial advantages of its position. P., with surroundings, 27,873.

Gal'le (JOHANN GOTTFRIED), PH. D., b. at Pabsthaus, Germany, June 9, 1812; studied at Wittenberg and Berlin, and became astronomical assistant in the Berlin Observatory, under Encke; discovered three comets 1839–40; and in 1846, following the directions sent him by Leverrier, on the evening of the very day when he received those directions he found the planet Neptune. In 1851 he became professor of astronomy at Breslau; twice received the Lalande prize; author of numerous papers and some treatises on climatology and astronomy.

Gal'leass, a sort of galley formerly built in Spain and Italy. There were enormous towering structures at either end. As many as 300 galley-slaves were employed in rowing one of these vessels. They were much larger than the galleys, and (unlike them) had guns in broadside.

Gal'leon, a name given to a class of large ships formerly built in Spain. Some galleons were used in war, and had sometimes four gun-decks. Others were employed as treasure-ships in bringing the precious metals from America to Spain. They were large, clumsy structures, and were the easy prey of pirates and hostile navies. Their bulwarks were three or four feet thick.

Gal'lery [Fr. *galerie*, originally a hall for festivity], in architecture, may designate any long, narrow passage. Latterly, it generally designates a permanent platform or floor elevated above a part of the general floor of an apartment, and running along one or more sides of a room. Galleries may be let into the wall or supported on pillars. There may be two or more galleries, one above another. This is usually the case in theatres and opera-houses. On shipboard there is sometimes a gallery extending outward from the stern and quarters of a ship. In fortification a gallery is a long covered passage, either through earthwork or masonry, or underground. The term is also applied to a hall for the exhibition of works of art.

Gal'ley [Fr. *galée*, *galère*], a form of ship which is the direct offspring of the *navis* of the ancients. The Phœnician, Carthaginian, Greek, and Roman vessels, if of considerable size, were galleys. The name is properly given to a class of vessels formerly much used in the Mediterranean, and even now scarcely obsolete. They were long, narrow ships, which were propelled partly by sails, but chiefly by oars. They were used both in war and commerce. The oars were in one or more banks or tiers, and were often worked by convicts (as in France and other countries) or by slaves. The swift piratical galleys of Barbary were rowed by Christian slaves. In such cases

the rowers were chained to their oars. Several varieties of open boats are known as galleys.

GALLEY, in printing, is the tray of wood or metal in which the compositor deposits the types from the composing-stick as often as the latter is filled.

Gal'lia, commonly anglicized as **Gaul,** the name given by the Romans to the regions inhabited by Celts in Italy and what is now France. Celtic Italy was called Cisalpine Gaul, and that part N. of the Po was called Transpadane Gaul; while what is now France was Transalpine Gaul, Gallia Ulterior; also Gallia Comata, or "long haired Gaul," from the length of the people's hair. Gallia Braccata, "breeched Gaul" (from the use of breeches as clothing), was also called Gallia Narbonensis, and was a strip along the Mediterranean coast of France.

CISALPINE GAUL, in a general way, may be defined as having had the Rubicon as its south-eastern and the Trebia as its south-western landmark. Traces of a Celtic language exist in the names of places still farther S., and Celts must early have had a strong foothold in Italy; and the native Celtic population was often reinforced by immigrant tribes from Transalpine Gaul, but the population certainly contained a larger Italian or non Celtic element as far back as history goes. The Roman power gradually trenched upon Cisalpine Gaul, and it finally received a special form of government under the Romans.

TRANSALPINE GAUL, the Gallia of Cæsar, was divided in his time into Aquitania, which lay S. W. of the Garonne, whose people were probably of Basque race; Gallia Proper, or the region of the Celtæ or Galli, extending from the Garonne to the Saône and Marne; and Gallia Belgica, bounded E. by the Rhine. But there were certainly Germanic tribes on the left of the Rhine, as well as many Celts in the heart of Germany at this time. It has been conceived that the Belgæ were Gauls (Celts) of the Cymric branch, but the point has never been established; and it is certain that a large Germanic element existed there. Julius Cæsar and his successors adopted, with a large degree of success, the policy of Romanizing Gaul, and in later times, chiefly under Frankish influence, it became to some extent Germanized, and most of its distinctively Celtic traits disappeared. (See CELTS.)

Gallia, county of Ohio, separated from West Virginia by the Ohio River, its eastern boundary. Area, 420 square miles. Its surface is hilly, but it is fertile, producing cattle, grain, and wool abundantly. Coal and iron ore are found. Cap. Gallipolis. Pop. 25,545.

Gal'liard [Fr. *Gaillard;* It. *Romanesca*], a gay and lively dance of a kind now unfashionable or obsolete or nearly so, except among European peasants. Also the music for such a dance, which was smooth and melodious and in very quick time.

Gallia'te, town in the province of Novara, Italy, and near the city of Novara, possessing silk and cotton manufactories. The vicinity is considered very salubrious, and is much frequented in the summer for hunting and fishing, as well as for health. Pop. 7018.

Gal'lic Ac'id ($C_7H_6O_5 = H_3C_7H_3O_5$), discovered by Scheele, occurs in most astringent parts of plants, associated with tannic acid, as gall-nuts, sumach, divi-divi, green and black tea, sandal-wood, walnuts, etc. It may be extracted from infusions containing at the same time tannic acid by first precipitating that acid by gelatine, evaporating the filtrate to dryness, extracting with alcohol, and dissolving the gallic acid from the residue, obtained on evaporating the alcohol, in boiling water, which on cooling deposits crystals of gallic acid. It is purified by recrystallization and treatment with animal charcoal. Gallic acid is usually obtained by the fermentation of gall-nuts. The powdered gall-nuts are exposed to the air for a month or six weeks in a moist state, at a temperature of 20° to 25° C. (68° to 77° F.). The ferment appears to be the *Penicillium glaucum* and the *Aspergillus niger*. The mass becomes covered with these plants (mould), and the surface is frequently cleansed by removing this mould. When the fermentation is completed, the moist mass is pressed, and the residue is boiled with water to extract the gallic acid, which deposits in crystals as the solution cools. By redissolving in 8 parts of boiling water, and treating the solution with animal charcoal, the coloring matters are removed. By this fermentation the tannic acid of the nut-galls, which is a glucoside (see GLUCOSIDES), assimilates the elements of water and yields gallic acid and glucose:

$$\underset{\text{Tannic acid}}{C_{27}H_{22}O_{17}} + 4H_2O = \underset{\text{Gallic acid}}{3C_7H_6O_5} + \underset{\text{Glucose}}{C_6H_{12}O_6}.$$

By the action of acids or alkalies the tannic acid is decomposed in the same manner. Tannic acid is rapidly converted into gallic acid by boiling in dilute sulphuric acid. The gallic acid crystallizes in long silky needles or in triclinic prisms, which are inodorous and have an astringent taste. They dissolve in 100 parts of cold and in 3 parts of boiling water. The solution reddens litmus. They are very soluble in alcohol, less so in ether, and soluble in glycerine to the extent of 40 grains in a fluid ounce. Heated to 210° C. (410° F.), gallic acid is converted into pyrogallic acid and carbon dioxide:

$$\underset{\text{Gallic acid}}{C_7H_6O_5} = \underset{\text{Pyrogallic acid}}{C_6H_6O_3} + CO_2.$$

If exposed to the air, the aqueous solution of gallic acid, especially if alkalies are present, disengages carbon dioxide and deposits a black substance. Boiled with potassa, it is changed to black tanno-melanic acid. Warmed with concentrated sulphuric acid, it is changed to rufigallic acid. Gallic acid reduces gold and silver salts to the metallic state. It does not precipitate gelatine, which distinguishes it from tannic acid. With ferric salts (sesqui-salts) it produces a deep bluish-black color. Gallic acid expels carbonic acid from its salts, and being tribasic it forms three classes of salts, according as one, two, or three atoms of hydrogen are replaced by metallic radicals. There are also basic and acid salts. Hlasiwetz (*J. pr. Chem.* ci. 115) claims that this acid is quadribasic. Gallic acid is employed in photography, but is not as useful as pyrogallic acid as a developer. It is the agent most frequently employed to reduce silver in hair-dyes. The most effective dyes consist of two fluids, to be applied successively: first, an ammoniacal solution of nitrate of silver; second, an alcoholic solution of gallic acid. In medicine, gallic acid is used as an astringent, especially for internal use, as tannic acid, though more powerful, is rendered insoluble by gelatine. It is used to check hæmorrhages from the chest and uterus; is used in pyrosis and for night-sweats of phthisis. For external use it is inferior to tannic acid.

C. F. CHANDLER.

Gal'licanism, the name generally applied to a movement within the Roman Catholic Church in France which wishes to vindicate the national position of the French Church against the encroachments of the papal court. The question is one of constitution and administration only, not of doctrines and dogmas; and the liberty which is desired is not a schism or the establishment of an independent Gallican Church, but simply a limitation of the papal authority in favor of the episcopal. From the very beginning the Gallican Church occupied a more independent position with respect to the pope than, for instance, the Church of Italy, and in the thirteenth century this independence became more distinctly defined. The Pragmatic Sanction of Louis IX. (1269) forbade the pope to levy money from the French clergy without the consent of the king, and placed the clergy under the authority of the royal courts in all civil cases. Certain decrees of the Councils of Constance (1414–18) and Bâle (1431–49) were condemned in Rome, but adopted in France by the assembly of the estates at Bourges (1438); and by the Pragmatic Sanction of Charles VII. these decrees, which placed the general council above the pope, forbade the pope to lay a tax on the appointment of bishops and prelates, and abolished the annates, were incorporated in the constitution of the Gallican Church. Nor was this Pragmatic Sanction a dead letter. In 1455 the bishop of Nantes appealed from a royal ordinance to the papal court, but the Parliament of Paris interfered, and declared that the bishop had violated the privileges of the Church and the laws of the nation. It was abolished, however, in 1516, by a concordat between Francis I. and Leo X.; Francis hoped to be invested with the fief of Naples, and his chancellor to be made a cardinal. But the Parliament and the university protested, and the decrees of the Council of Trent (1545–63), which defined the episcopal authority as derived from the pope, and not from Christ, were not adopted in France. The French people still clung to the Pragmatic Sanction of Bourges, and considered it as the constitution of the French Church, though it had been formally abolished. During the government of Richelieu and Mazarin the Church of France was drawn closer to Rome, but early in the reign of Louis XIV. its independence was once more asserted. The king had made the appointments to all the subordinate ecclesiastical offices in a diocese during a vacancy occurring in the episcopacy. The pope disputed this right, and now followed the "Declaration of the Clergy of France," drawn up by Bossuet, and sent to the pope in 1682. It maintained that in temporal matters the pope had no authority over the king, and that even in spiritual matters his judgment was not "irreformable;" his directions must agree with the decrees of the general councils and with such rules and customs as are generally adopted by the Gallican Church. In Rome the "Declaration" was publicly burnt, and Louis XIV. made some explanations and formal concessions, but in reality the position taken by the "Declaration" was maintained.

During the Revolution the constitution of the French

(or, as its Latin name is, the Gallican) Church was entirely broken up. The estates and revenues of the clergy were seized and confiscated, the schools and seminaries for their education destroyed, and the Church itself abolished. Most of the bishops fled and lived in exile. But in 1801, Napoleon opened negotiations with the pope concerning the re-establishment of the Roman Catholic Church in France, and in 1810 the Declaration of 1682 was promulgated as the fundamental law of the re-established Church. The pope refused to consecrate the bishops whom the emperor had appointed, but Napoleon took the pope prisoner and compelled him by the concordat of Fontainebleau (1813) to submit. As soon, however, as the pope reached Rome he declared the concordat null and void, and when the Bourbons returned to the French throne, and with them the exiled bishops, a new concordat was concluded (in 1817) by which the liberties of the Gallican Church were considerably restricted. The activity which the Jesuits began to develop, and the fanatical reaction which became more and more apparent in literature, especially through the writings of Joseph de Maistre, made the French people at last uneasy, and in 1824 and 1826 it was necessary for all bishops and teachers to declare publicly that they adhered firmly to the Declaration of 1682. But of late the question of Gallicanism, of the relation between the Gallican Church and the pope, has lost some of its interest, and has been merged into that of liberalism and ultramontanism—a question not of constitution and administration only, but also of doctrines and dogmas. The Vatican Council of 1870 gave the death-blow to Gallicanism and liberal Catholicism. Bishop Dupanloup of Orléans was the last distinguished Gallican; he first voted against papal infallibility, but afterwards submitted to the Council. CLEMENS PETERSEN.

Gallie'nus (PUBLIUS LICINIUS VALERIANUS EGNATIUS), son and successor of Valerian, was raised to the purple by his father in 253, and in 260 became sole emperor. His reign was greatly disturbed by the invasions of Germans, Franks, Goths, Sarmatians, Persians, and others, a dire pestilence decimated the people, and the so-called thirty tyrants created anarchy throughout the empire. Gallienus seems to have been a weak and sensual though personally brave man. He was killed by his own soldiers at the siege of Milan, 268 A. D.

Gallinaceous Birds. See RASORES.

Gall-Insects are usually defined as those which deposit their eggs in the tissues of plants, and as being confined to two of the seven Orders of true insects. They may be more correctly defined as insects which live within abnormal growths or excrescences produced on different parts of plants, either by the action of the indweller or by that of its parent; the animal in the one case being the architect of its own dwelling; in the other, born within its already constructed abode. These swellings exhaust more or less the parts of the plant on which they occur, and are sometimes so numerous as to destroy the entire plant. Many different families of insects are represented by gall-producers, and they occur in all the Orders except the two lowest—viz. the Straight-wing insects (Orthoptera) and the Nerve-wing insects (Neuroptera). Yet the gall-making habit is by no means common to all the other genera of the family, nor even to all the other species of the genus where it occurs; for the very same genus which contains species which make galls often—and, indeed, quite generally—contains other species that possess no such faculty. Gall-insects are preyed upon by a number of parasitic species which manage to reach them in their hidden recesses; and their galls are appropriated by a number of guest-insects or Inquilines. These do not properly come within the present scope; and those persons who wish to learn more about them will do well to consult the writings of Osten Sacken, Walsh, and Bassett in the *Proceedings* of the Philadelphia Entomological Society. The clearest idea of the different gall-insects, their characteristics and habits, will be conveyed by briefly considering them by Orders, and by mentioning a few species in each family which make the more common or conspicuous galls.

Order Hymenoptera, or Clear-wing Flies.—By far the greater number of gall-insects belong to the order Hymenoptera, or Clear-wing flies, and the family Cynipidæ, or gall-flies proper, is essentially a gall-inhabiting one. It comprises two divisions or sub-families, the Cynipidæ Psenides, or true gall-makers; and the Cynipidæ Inquilinæ, or guest gall-flies, which last do not construct galls of their own, but sponge upon the gall-substance produced by others. We have to deal, in this connection, principally with the first division. The typical genus, *Cynips*, has a curved ovipositor, which is more or less hidden within a valve in repose. Most of the oak-galls are produced by species of this genus. With the ovipositor just mentioned the female pierces the plant-tissues, and therein consigns an egg, together with a small quantity of a peculiar poisonous fluid. Under the influence of this fluid the gall rapidly

Fly belonging to the genus *Cynips*, the principal genus of Hymenopterous, gall-making insects. Hair-lines indicating natural size.

develops, and is generally fully formed before the egg hatches. The egg is whitish in color and soft. It invariably swells more or less by endosmosis of the surrounding juices, and the outer pellicle is so delicate that no shell is left in hatching; but the larva, or young gall-insect, seems rather to be gradually transformed from the egg. This larva is also whitish, very soft, and has an inconspicuous head and no legs. The body is more or less cylindrical, tapering to both ends, but more especially behind, and lies in a curved position within the cell. As the larva grows the gall-substance around its cell hardens into a cream or buff colored shell, which frequently separates entirely from its surroundings. This may perhaps be in part explained by the absorption of digested matter, as no fæces are found in the cavity, and if excreted and absorbed they would naturally cause increased hardening, and lessen the influence of the plant immediately around the cavity. Most insects, once out of the egg, go through somewhat sudden changes or transformations, especially from the larva to the pupa, and from the pupa to the imago or perfect state. But the chitinous integument of these gall-flies is so delicate that the larval molts are not traceable in any exuviæ left within the cell; while the change from the larva to the pupa, and from this to the perfect state, is comparatively slow, and partakes rather of the character of continued and uninterrupted development. The fly, once perfected, remains for a considerable time within its cell, but finally eats its way out of its prison.

One of the most interesting biological features of these gall-flies is the fact that two entirely different galls, produced on the same tree at different seasons of the year, may be made by insects specifically related. Thus, there is a large woolly gall, the deformation of a bud, which grows on our black oaks in spring, and which produces in summer a common gall-fly (*C. q. operator*, O. S.) which is bisexual. The female oviposits between the acorn and cupule of the previous year's setting, and the result is a pip-like gall (*Q. operatola*, Riley MS.) embedded in that position, and generally about half exposed. These fall with the acorn to the ground, and the second spring succeeding give forth flies which are all females, and which produce the woolly galls of spring. In the light of this dimorphism and this alternation of generations, the fact, long recognized, that certain galls produce nothing but females, becomes explicable; and there can be little doubt that all species known only in the female sex exist also in the bisexual form, though the gall producing this last may present an entirely different appearance to that producing the former. *Cynips q. spongifica* O. S., produces the well-known American oak-apple, a large, round, drab-colored swelling, filled with brownish spongy matter, and formed on the leaves of the Black oak (*Q. tinctoria*). Those formed in spring produce both sexes, while those formed in late summer—the progeny, no doubt, of the former—produce only females, which have been described as a distinct species (*C. q. aciculata*, O. S.), but which Walsh proved to be specifically related to the former. *Cynips q. inanis* O. S., produces the Bastard oak-apple, which is found on the leaves of the Red oak (*Q. rubra*), and differs from the preceding in being smaller, and in the more brittle central chamber being connected with the outer rind by radiating filaments. *Cynips q. prunus* Walsh, produces the Oak plum-gall, a large red-brown growth from the cupule of acorns of the Black and Red oaks. It is remarkable for remaining two, or even three, years in the gall before issuing. *Cynips q. ficus* Fitch, causes a number of compressed, fig-like swellings on the twigs of the White oak. *Cynips q. hirta* Bassett, is wingless, and forms pea-like galls, with a granulated surface, on the leaves of the Chestnut oak (*Q. montana*). An undescribed species forms a gall extending by a long peduncle from the margin of the leaf of the Yellow oak (*Q. coccinea*). *Cynips q. saltatorius* Edwards, covers the leaves of the different white oaks

with minute, seed-like galls, inserted, each in a pocket, on the under side. When mature the galls fall to the ground,

Bastard Oak-apple (formed by *Cynips q. inanis* O. S.), found on the Red oak, and showing the radiating fibres which support the central chamber. Color, drab.

and there keep up a constant jumping or bounding movement. The ground covered with these animated galls presents a curious spectacle, and few persons at first comprehend that the motion is imparted by the sudden jerking of the larva within, very much as a "skipper" would send a rounded body bounding if confined within one that scarcely admitted of the maggot's full expansion. *Cynips gallæ-tinctoriæ* (Geoff.) produces the gall-nut of commerce on *Quercus infectoria*, while *Cynips insana* West. produces on the same oak, in the country bordering the Dead Sea, the "mad apples" which Moore describes as

> "Dead Sea fruits that tempt the eye,
> But turn to ashes on the lips."

As *Cynips* proper works particularly on the oak, so *Rhodites* works on the Rose, and *Diastrophus* on the Raspberry and Blackberry. *Rhodites rosæ* (Linn.), common to Europe and America, forms a polythalamous, mossy gall on the twigs of the Rose, known as the *bedeguar* of the rose. *Rhodites bicolor* Harr., makes a cluster of pretty, round, and prickly galls on the leaf-stalk of the same plant: *R. radicum*, a large brown, irregular, polythalamous gall on the roots; and *R. ignota* O. S., a gall, resembling somewhat a beet-seed, on the leaf stalk of the same. *Diastrophus nebulosus* O. S., makes a large, irregular, red-brown, polythalamous swelling on blackberry canes; and *D. cuscutæformis* O. S., forms a collection of one-celled galls of the same color, and more or less thickly covered with spinous fibres, on the same plant. *Antistrophus*, *Tribalia*, and *Ibalia* are genera of limited extent, the first containing (so far as yet described) but one species (*Antistrophus l. pisum*, Walsh and Riley), which makes a pea-like gall quite common on the stems of *Lygodesmia juncea*, growing on the plains of Colorado; the second also containing one species (*Tribalia batatarum*, Walsh), which forms a gall on the tuber of the potato; and the habits of the third being unknown.

Prickly Rose-gall (formed by *Rhodites bicolor* Harr.), growing on the leaf-stalk of the rose. Colors, green and rosy.

The next most extensive family of gall-making insects in this order is that of the Saw-flies (Tenthredinidæ). These flies are generally of larger size than the true gall-flies, and only comparatively few of the species of a few genera in the family (which is a very extensive one) possess the gall-making habit. The females are characterized by having a saw like ovipositor, by the aid of which they insert their eggs in the tissues of plants, mostly of the willow (*Salix*) family. These eggs are also accompanied with a peculiar poison, which causes the gall to fully form, in most cases, before the young larva hatches. The larvæ—called "false caterpillars"—are at once distinguished from those of other gall making insects by the large head, but more especially by having twenty legs (six true and fourteen false or pro-legs). *Nematus salicis-pomum* Walsh, forms, on the leaf of the Heart leaved willow, the Willow apple gall, a beautiful growth, resembling a miniature apple, but perfectly tasteless. *Euura s. ovum* Walsh, forms the Willow egg gall, a round or oval swelling, from one-third to one half inch long, growing from the side of the twig of the same

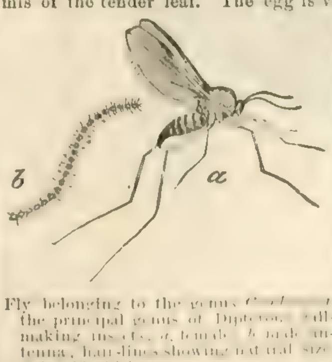
Willow Apple-gall (formed by *Nematus salicis-pomum* Walsh), growing on the leaves of the Heart-leaved Willow (*Salix cordata*): *a*, *a*, galls; *b*, larva enlarged; *c*, gall cut open. Colors, pale-green and rosy.

species of willow. *Euura s. gemma* Walsh, causes a curious and premature enlargement of the bud of the Humble willow (*Salix humilis*), from which the larva issues when mature and enters the ground. *Euura s. nodus* Walsh, causes elongate swellings of the stem of the Long-leaved willow (*S. longifolia*).

Saw-fly, belonging to the genus *Nematus*, the hair-lines showing natural size.

There is but one other Hymenopterous family—viz. the Chalcididæ—which furnishes gall-insects, and the gall making habit in it is very exceptional, being confined to the genus *Isosoma*, while the other genera of the family are parasitic. *Isosoma hordei* (Harr.) is the well-known Joint-worm which does so much damage to wheat, rye, and barley by producing woody enlargements of the stalk just above the first or second knot.

Order Diptera, or Two wing Flies.—The gall-making insects of this Order belong mainly to two families—the Cecidomyiidæ and the Trypetidæ. The first contains by far the larger number of gall-making species, popularly known as gall-gnats or gall-midges. They are all of small size, and generally of obscure color, mostly black, and they look not unlike small mosquitoes. Many of the species so closely resemble each other that they are far more easily distinguished by the galls they produce than by any characters which the mature flies present. The female has a telescopic ovipositor, with which she is enabled to thrust her eggs into the soft parts of plants, such as the bud or the epidermis of the tender leaf. The egg is very small, soft, elongate, and usually deep orange or reddish. It is also accompanied by some secretion which acts on the plant and causes the gall to form before the larva hatches. These larvæ are legless, mostly cylindrical, and taper to each end, but they are easily distinguished from the larvæ of the true gall flies: 1st, by being more elongate and narrow; 2d, by being (with a few exceptions, in which they are white) of an orange color, varying to blood red; 3d, by having a very small, pointed, and retractile head; 4th, by a very characteristic horny, usually forked, process called the "breast bone." This process lies under the skin on the anterior joints of the body near the head, and is either Y shaped, "clove shaped," or oar shaped. In other



Fly belonging to the genus *Cecidomyia*, the principal genus of Dipterous gall-making insects; *a*, female; *b*, male antenna; hair-lines showing natural size. Color, blackish.

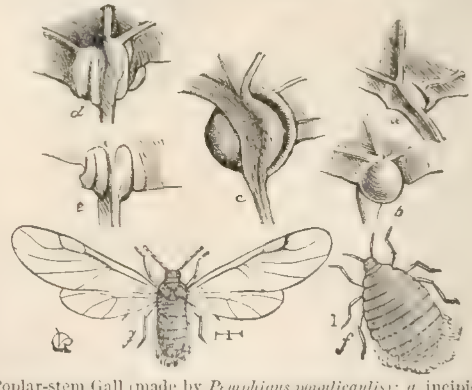
case, the tips of the prongs—which are either two or three in number, and can be exserted upon the retraction of the head and anterior joint—are always armed with sharp points, which no doubt serve to lacerate the walls of the gall, and thus assist the insect in obtaining its food, as well as in making a passage-way for the future exit of the perfect insect. The gall-gnat larvæ either quit their galls and enter the ground to transform, or remain in them and spin a very delicate cocoon, like goldbeaters' skin, for the same purpose. In either case, the pupa, which usually is furnished with a pair of little horns on the head, works its way to the surface, in order that the perfect gnat may escape; whereas in the other two gall-making families we have considered the flies perfect within their respective galls, and either eat their own way out or pass through a passage-way partly prepared by the larva. *Cecidomyia salicis-strobiloides* O. S., forms the Pine-cone willow-gall, a deformation not unlike a pine cone, and quite common on the tips of the twigs of the Heart-leaved willow. *C. s. brassicoides* Walsh, forms the Cabbage-sprout willow-gall, a series of deformations not unlike cabbage-sprouts, along the leaves of the Long-leaved willow (*Salix longifolia*). The grapevine apple-gall (*Vitis pomum*, Walsh and Riley) is a polythalamous gall found on the Grapevine, and made by a yet unknown gall gnat. In external appearance this gall so resembles a hickory-nut or a small apple that it has been looked upon by those not versed in entomology and vegetable physiology as a vegetable monstrosity produced by hybridization with those plants. Yet a glance at its internal structure, which shows a number of elongate cells, each occupied by an orange larva, at once reveals its nature. The Grapevine filbert-gall (*Vitis caryloides*, Walsh and Riley) is also formed by a yet unknown gall-gnat, and frequently presents the appearance of a bunch of filbert or hazel nuts, it being a collection of single galls springing from a common point, and each gall being one-celled. The grapevine trumpet-gall (*Vitis viticola*, O. S.) is a pointed, trumpet-shaped gall of a beautiful crimson color, growing numerously from the upper surface of the leaf of the Grapevine. *Cecidomyia solidaginis* (O. S.) produces a common gall in the shape of curled and dwarfed leaves at the tips of the Golden-rod (*Solidago*). The Dogwood tube-gall (*Corni-tuba*, Riley MS.) is a blunt-ended and tube-like growth quite commonly found on the under side of the leaf of the Dogwood (*Cornus*), and formed by a yet undescribed gall-gnat. *Cecidomyia q. pillulæ* (Walsh) forms pill-like galls of a blood-brown color, quite common on the leaves of the black group of oaks. *Lasioptera vitis* (O. S.) makes tomato-like swellings on the tender parts of the Grapevine.

Pine-cone Willow-gall (formed by *Cecidomyia salicis-strobiloides* O. S.), growing on the tips of twigs of the Heart-leaved Willow (*Salix cordata*). Color, glaucous green.

The Dogwood Tube-gall, growing on the leaf of the Dogwood: *b*, a section of one of the tubes, enlarged, showing the larva at the bottom; *c*, larva, greatly enlarged, showing "breast-bone."

The second family of Diptera containing gall-makers is the Trypetidæ, but few of the species, however, having the habit. These flies have something of the form and size of the common house-fly, but are much more brightly colored, the wings being transparent and marked with various-shaped cloudings. The larva is white and maggot-like, and contracts when full grown to a brownish, coarctate pupa within the gall. The fly escapes by continued fretting and moistening of a small space in its prison-wall, the face being temporarily very much swollen into a sponge-like mass for this purpose, and the gall-substance having generally become sufficiently soft by exposure to the weather to permit this kind of exit. The female has a boring ovipositor, by which she can force her eggs into the tips of herbaceous plants. *Trypeta solidaginis* (Fitch) forms the globular pithy swellings so commonly seen in winter, when the leaves have dropped, on the stem of Golden rod (*Solidago*). *T. Diana* (O. S.) forms somewhat similar galls (*Artimisiæ indurata*, Riley) on the Sage-bush (*Artimisia tridentata*) of the Western plains.

Order Hemiptera, or Bugs.—The American gall-making insects of this Order, so far as known, belong solely to the Homopterous division, or Whole-wing bugs, and are confined to two families—viz. the Plant-lice (Aphidæ) and Flea-lice (Psyllidæ). With the insects of all the Orders so far considered (where the insects undergo complete metamorphosis—*i. e.* the larva differs entirely from the imago in appearance), the gall is produced by the action of an irritating poisonous secretion inserted into the plant-tissue by the parent. With those now under consideration (in which the larva is born much more nearly in the image of the parent), the gall is also formed under the influence of a poisonous irritation, but this irritation is conveyed by the newly-hatched insect, principally by the insertion of its proboscis, very much as the common bed-bug causes irritation and swelling of human flesh by the insertion of its beak. In the Plant-lice the original architect of the gall breeds and dies within it, but her numerous young either issue as soon as born and found new galls, or else remain with their parent till full grown, when they also issue from their gall and scatter. In either case, the gall—which in most instances is never securely closed—gapes or cracks open to allow their exit. *Pemphigus vagabundus* Walsh, forms a large, irregular growth, like the cockscomb flower (*Celosia*) on Cottonwood. When found in early summer, it is green and shiny, and contains the single wingless architect. By fall it becomes dry and dark, and is crowded with winged lice, which are all females. These leave the gall, and in all probability lay eggs from which hatch bisexual young, the females of which form the spring mother gall-lice. *P. populicaulis* Fitch, makes a rose-tinted swelling at the juncture of the leaf and leafstalk of the same tree. *P. ulmi-fusus* (W. and R.) makes a large spindle-shaped gall on the leaves of the Red elm. *Byrsocrypta rhois* (Fitch) produces the Sumach gall, a large, hollow, reddish swelling on the leaf-stem of the Smooth and Staghorn sumachs, and has life-habits similar to *Pemphigus*. *B. ulmicola* (Fitch) makes a compressed gall like a cockscomb on the upper side of the leaves of the White elm. *Phylloxera* forms galls, mostly on the Hickory, sixteen distinct galls made by insects of this genus on Hickory in the U. S. being known to the writer. *P. vastatrix* Planchon, the notorious Grapevine Phylloxera, makes wrinkled pouch-like galls on the under side of the leaves of some vines. The mother-louse fills her gall with eggs, and the young hatching therefrom escape and found new galls, and become parthenogenetic mothers; this virginal reproduction continuing for several genera-



Poplar-stem Gall (made by *Pemphigus populicaulis*): *a*, incipient gall on the under side of the leaf; *b*, same on upper side; *c*, fully-formed gall, showing slit from which the insects escape; *d*, *e*, double galls, one each side of midrib; *f*, wingless female; *g*, winged female, showing pterogostic characters of the genus.

tions, until, with the fall of the leaf, the last generation creeps on to the roots. The Flea-lice form galls of various

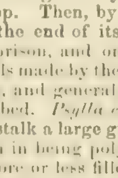
Insect belonging to the genus *Psylla*: hair-lines natural size.

shapes and sizes on the stems and leaves of Hackberry (*Celtis*). In life habits they differ from all the other gall insects, and agree with their nearest relatives, the plant-lice, only in being the architect of their own galls. The

Hackberry Mamma-gall (made by *Psylla celtidis-mamma*): *a*, leaf with galls, natural size; *b*, section of gall enlarged, showing insect within; *c*, pupa, greatly enlarged, showing spines at tip of body, by which the gall is perforated for escape.

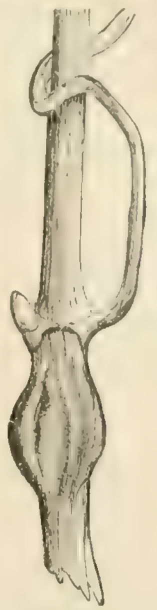
egg—glued in spring to tender leaf or twig—soon hatches, and under the irritation caused by the young *Psylla*, the gall soon imbeds it. Within this gall the insect dwells till it has acquired the pupa state, which is generally by the time the leaves begin to turn and drop. Then, by means of certain horny spines or thorns at the end of its body, this pupa works its way out of its prison, and once out soon gives forth the perfect fly. The galls made by these flea-lice are usually quite hard and woody, and generally one-celled. Most of them are yet undescribed. *Psylla celtidis-grandis* (Riley MS.) makes on the leafstalk a large grayish-yellow swelling, which is an exception in being polythalamous. The few cells it contains are more or less filled with a white flocculent matter secreted by the insect.

Order Coleoptera, or Beetles.—The gall making insects of this Order in the U. S. belong to two families—viz. the Curculionidæ, or Snout-beetles, and the Buprestidæ, or Buprestians. In each family the habit is confined to a single genus, so far as now known; though, if we consider the gall making beetles of other countries, the genera might be multiplied, especially in the gall-making Curculionidæ or gall-weevils, and even two families (Sagridæ and Lamiadæ) added. The insects issue through a passage way partly prepared beforehand by the larva. *Baridius Sesostris* Le C., forms the Grapevine wound gall, a simple woody swelling of the tender cane with a fissure on one side. The beetle doubtless inserts her egg in a hole first made with her snout, and the gall is due perhaps more to this action than to that of the larva which hatches from the egg, and which is a whitish, cylindrical, wrinkled, legless grub, with a brown head. Among the Buprestians *Agrilus ruficollis* (Fabr.) makes the Raspberry gouty gall, a woody swelling of young



Baridius Sesostris Le Conte, a gall-weevil: the hair-line showing natural size. Color, shiny yellowish-brown.

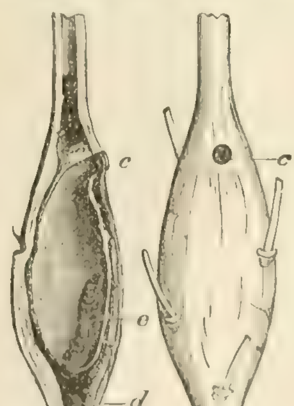
raspberry canes, with numerous longitudinal slits. The beetle is one-fourth inch long, of a metallic green color, with a bright coppery thorax. The larva is quite elongate and thread like, with a large flattened head, and two small horns at the end of the body. Several are generally found in the same swelling, and it is probably to their action alone that the gall is due.



Grapevine Wound-gall (formed by *Baridius Sesostris* Le Conte), and occurring on grape-canes. Colors, green and rosy.

Order Lepidoptera, or Scaly-wing Insects.—The gall making habit obtains in but few of the insects of this Order, and these are confined to the Heterocerous division, or Moths, and almost entirely to a few genera in the family Tineidæ. The insects issue from the gall through a neatly contrived doorway. *Gelechia gallæ-solidaginis* Riley, forms elongate, hollow swellings on the stems of the Golden-rod. The parent moth deposits an egg on the stem of the young plant, and the young larva eats its way into the stem through a minute hole which subsequently closes up. This larva, like the gall-making saw-fly larvæ, has legs, but is readily distinguished from these last by its smaller head and by having but ten instead of fourteen pro-legs. When mature, it lines its gall with silk, eats a passage-way at the upper end, and stops up the hole with a little plug of liquid silk, so fitted that the moth in issuing can easily push it away from within, though it cannot well be pushed inward from without. After completing this doorway the larva retires to the bottom of its chamber, casts its skin, and becomes a brown chrysalis, from which, in due time, the moth bursts. *Walshia amorphella* Clem.,

Solidago Gall-moth (*Gelechia gallæ-solidaginis*), with wings expanded, and with wings folded.



Solidago Moth-gall (formed by *Gelechia gallæ-solidaginis* Riley), on the stems of Golden-rod: *a*, section; *b*, entire gall; *c*, *c*, the door through which the insect escapes; *e*, larva; *d*, excrement.

forms a somewhat similar, but more solid and woody swelling on the stems of the False indigo (*Amorpha fruticosa*).

Acarina, or Gall Mites.—These minute animals are not, strictly speaking, true insects, but belong to the class of

Arachnida (Spiders, etc.), which are distinguished from true insects by having, among other characters, eight instead of six true legs. Yet, as some systematists include them under the general term Insecta, they may come under the popular designation of "gall-insects." The more perfect galls produced by mites are pocket-shaped, and the mites which produce them belong mostly to the genus *Phytoptus*, which contains species of elongate form and possessing but six legs, in which respect they depart from the normal character of their class, and approach more nearly the true insects. None of these gall-inhabiting mites have yet been

Mite-gall, on leaf of Wild Cherry.

described in America. The Plum-leaf purse-gall (*Pruni crumena*, Walsh), which abounds on the upper side of the leaves of the wild plum, is made by an undescribed *Phytoptus;* and a similar but larger growth, made by a species of the same genus, is common on the leaves of the wild cherry. C. V. Riley.

Gal'linule (*Gallinula*), a genus of wading birds, including the moor-hen of Europe (*G. chlororopus*) and the Florida gallinule (*G. galeata*), besides various tropical species. *Porphyrio* (of which the best known species is *P. martinica* of the U. S. and tropical America—the purple gallinule) and other kindred genera contain birds called gallinules, all together constituting a sub-family (Gallinulinæ) of the family Rallidæ or rails.

Gal'lio, proconsul of Achaia (Acts xviii. 12), was probably Lucius Junius Annæanus Gallio, elder brother of Seneca the philosopher, adopted as a son by Junius Gallio, a celebrated rhetorician; but some suppose that the last-mentioned Gallio was the proconsul. The younger Gallio, according to Eusebius, committed suicide in 65 A. D. Several ancient writers speak highly of his character.

Galliot', a Dutch brigantine, broad, strong, and flat-bottomed, and having a gaff mainsail. The name was once given to a small galley.

Gallip'oli, a small, well-fortified maritime town of Italy, in the province of Lecce. It is situated on a high rock, formerly a promontory, but now entirely surrounded by the waters of the Ionian Sea, and only connected with the mainland by a fine bridge of twelve arches. The port (or rather *road*), accessible only on the E. side, is commanded by a strong castle. The town is supplied with good water, brought from the inland hills by an aqueduct which terminates in a superb fountain. This is an ante-Christian work, and the fountain is adorned with fine busts and bas-reliefs, and bears many Latin inscriptions. During the Middle Ages, Gallipoli sustained several romantic sieges. In 1429 the Turkish corsairs surprised the town and carried many of its inhabitants into slavery. In 1809 it was attacked by an English flotilla, which was vigorously repulsed. Gallipoli is at present a thriving commercial town, exports olive oil (which is stored in great tanks cut in the solid rock), and has some manufactories. The steam line from Naples to Ancona touches regularly here, and but for the insecurity of the harbor it might soon become an important place. It is a bishop's see. Pop. 9951.

Gallipoli [Gr. Καλλίπολις], city of European Turkey, in the province of Roumili, at the N. E. end of the Dardanelles, and about 110 miles W. S. W. of Constantinople. It is miserably built, but has two good harbors, large manufactories of earthenware and morocco leather, and carries on a very extensive trade. In its bazaars meet merchants of all nations, all tongues, all styles of dress, and during daytime the long alleys, stocked with all kinds of costly produce, present an extremely lively scene. Gallipoli was the first European town that fell into the hands of the Turks in 1357, nearly a century before the fall of Constantinople. It is the key to Constantinople and the Black Sea, and was occupied by the allied armies of England and France in 1854. It has a Greek bishop. Its population, which in 1810 was 15,000, and in 1815 was 80,000, is now about 20,000. Revised by R. D. Hitchcock.

Gal'lipolis', city and tp., cap. of Gallia co., O., on the Ohio River, about equidistant from Pittsburg and Cincinnati, with which cities it has regular packet-line connections. It is above the highest water-mark, and is the southern terminus of the Gallipolis McArthur and Columbus R. R. It has a national and private bank, 2 large woollen mills, furniture-factories, foundries, planing-mills, 9 churches, an academy, a high-school, 16 other public schools, and 3 weekly newspapers. Pop. of city, 3711; of tp. 868.

Wm. Nash, Ed. "Gallipolis Journal."

Gal'lipot, a glazed earthenware jar, such as is used by druggists for holding cerates, extracts, salves, and other similar preparations.

Gallisonnière, de la (Augustin Félix Elisabeth **Barrin**), Count, b. at Anjou, France, 1742; served under his uncle, the governor-general De la Gallisonnière (see below), in the marine service in Canada; entered the army, serving against Hanover; was made *maréchal de camp* 1788, and grand-seneschal of the sword for Anjou 1789, by virtue of which office he was president of the nobles in the states-general in that year. He was chosen to preside over the assembled Three Estates at the beginning of the Revolution, and was premier deputy of the nobles in the Constituent Assembly. Some time after he became an *emigré* and fought against the revolutionists, but in 1801 returned, and was in public life under Napoleon. When the Bourbons returned he was made lieutenant-general, but retired from public life in 1815. D. Mar. 2, 1828. He wrote much upon the public affairs of his time.

Gallisonnière, de la (Roland Michel **Barrin**), Marquis, b. at Rochefort, France, Nov. 11, 1693, son of a distinguished general of the Knights of Malta; entered the French navy 1710; while having the rank of a captain was (1745–49) governor-general of Canada, where he displayed great energy in naval construction, and in establishing a line of forts between Canada and Louisiana. The Indians at first despised him for his small stature, but soon learned to love him and respect his abilities. His administration was marked by troubles with the English in Nova Scotia and the Ohio Valley. Gallisonnière next was chief of the bureau of maps and charts, with the rank of *chef d'escadre.* He performed much excellent scientific work in this position. In 1756 he defeated Byng off Minorca (for which defeat Byng was afterwards executed), but the fatigue and excitement of this action were too severe for Gallisonnière's health. He was obliged to give up the command, and d. soon after at Nemours, Oct. 26, 1756. He was very fond of botanical science; was deformed and of feeble health, but of very active mind.

Gallit'zin, post-v. and tp. of Cambria co., Pa., on the Pennsylvania R. R., 12 miles W. of Altoona. It has mines of bituminous coal. Pop. 977.

Gallitzin, a Russian princely house whose origin is Lithuanian, the prince Gedemin, the ancestor of the Jagellon princes, being also ancestor of the Gallitzins. The name comes from *Golitza* ("leather gauntlet"), a surname of Mikhail Ivanovitch Bulgak, one of the ancestors of the family, distinguished as the wearer of gloves of this kind. Ivan the Terrible in the sixteenth century made one of the family a boyar, and since that time there have been many diplomatists, generals, and politicians among the princes of this house.—Prince Dmitri (1735–1803), father of the missionary Gallitzin, was a diplomatist, and author of several scientific works.—His wife, Amalie von Schmettau (b. at Berlin Aug. 28, 1748; d. near Münster Aug. 24, 1806), abandoned the society of her infidel husband, became a Roman Catholic, and was as distinguished for piety and literary talents as she had previously been for social talents and personal beauty. She occupied herself in religious and philosophical controversies, and attained a wide influence among the aristocratic families of Germany; an influence which was greatly forwarded by the stirring events of the latter part of her life.—Prince Emmanuel (1804–53) was an active writer upon science and literary subjects, and an amateur musical composer and oil-painter.

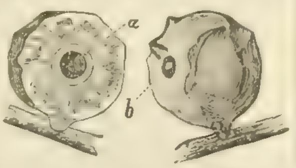
Gallitzin (Demetrius Augustine), Prince, a son of the Russian ambassador at Paris, Prince Gallitzin, and of the Princess Amalie von Schmettau, was b. at The Hague Dec. 22, 1770. His father was a free-thinker, but in 1787 the young man followed his mother's example and became a Roman Catholic. He was an officer of the Russian guard, and served for a time as a staff officer in the Austrian force in Brabant, but in 1792 was dismissed, came to America, became a Sulpitian, studied theology at Baltimore, and in 1795 took priest's orders. He officiated at Conewango, Pa., and other places in the Middle Atlantic States. In 1798 he founded the Roman Catholic town of Loretto, Cambria co., Pa., expending a large fortune in the work. He bore the name of "Father Smith," and labored with the greatest zeal and self-denial. In 1809 he resumed his original name. He wrote *Defence of Catholic Principles* (1816), *Appeal to the Protestant Public* (1818), *On the Scriptures*, and other works. D. at Loretto, Pa., May 6, 1840.

His life has been written by T. Heyden, by H. Lemke (German), and by Sara M. Brownson (1875).

Gallitzin (ELIZABETH), a cousin of Prince Gallitzin, b. in 1796, became a Roman Catholic, and at Rome joined the Society of the Sacred Heart. In 1840 she came to the U. S.; founded a school of the Sacred Heart in New York City, an institution at McSherrystown, Adams co., Pa., and a mission and convent, now at St. Mary's, Pottawattomie co., Kan. D. in St. James parish, La., Dec. 8, 1843.

Gal'livant's Ferry, tp. of Horry co., S. C. Pop. 1089.

Gall-Nuts are hard, woody, spherical swellings, of an olive-gray or bluish and more or less wrinkled exterior and yellowish-brown interior, formed by *Cynips gallæ-tinctoriæ* (Geoff.) on the twigs of a species of oak (*Quercus infectoria*) common throughout Syria and Asia Minor. They are collected by the poor, and exported from Smyrna, Aleppo, and other parts of the Levant, as well as from the East Indies, to all portions of the civilized world, and used for tanning and dyeing purposes, but more especially in the manufacture of the best writing-inks. They have no odor, but taste somewhat bitter, and are powerfully astringent. They give the following analysis: Tannic acid, 65; gallic acid, 2; ellagic and luteo-gallic acids, 2; brown extractive substance, 2.5; gum, 2.5; starch, 2; sugar, 1.3; chlorophyl and volatile oil, 0.7; woody fibre, 10.5; water, 11.15—total 100. They produce black dyes when mixed with solutions of sulphate of iron. In the manufacture of ink they are bruised and exhausted by three successive boilings, each time with a reduced quantity of water; and while the solution is warm a certain proportion of sulphate of iron and gum-arabic, also in warm solution, is added, and the whole allowed to remain for some time till all sediment is deposited. Gall-nuts are principally brought to America from Smyrna and Trieste, and they are so common near Aleppo that they are sometimes called Aleppo galls. Those gathered before the fly issues are known in commerce as "blue galls," and are most esteemed. The second gathering, or "white galls," from which the fly has escaped, are of inferior quality. Notwithstanding the recent discoveries in chemistry and the art of dyeing, these galls are still an important article of commerce; which fact attests their value as a cheap and efficient dye. C. V. RILEY.



Gall-nuts: *a*, section, showing central chamber; *b*, hole from which the fly has issued.

Gal'lon [Fr. *galon*, a "grocer's box"], the standard unit of liquid capacity in the U. S. and of liquid and dry capacity in Great Britain. The capacity of the gallon has been very variable. It will facilitate the understanding of its changes to bear in mind that this measure was originally designed to be a measure not of bulk, but of weight. To carry out to its full extent the notion on which it was founded would have required that every commodity measurable in bulk should have had its own gallon, each holding the same weight, but the bulks varying inversely as the specific gravities. As this would have led to endless complication, early usage led to the adoption of two different gallons only, related to each other in capacity in the inverse ratio of the specific gravities of corn (wheat) and wine (the wine of Gascony, at that time a British province, being taken as the standard); these being supposed to represent the average of the two classes of exchangeable commodities, wet and dry. The ratio here spoken of was assumed to be that of 143 to 175. In British legislation the earliest definition of the gallon is found in an act of the 9th of Henry III. (1225), being the first act contained in the published statutes at large, which is a repetition of the Magna Charta of 1215. Ch. 25 of this act declares that "one measure of wine shall be through our realm, and one measure of ale, and one measure of corn, that is to say the *quarter* of London." The quarter of London is here spoken of as a measure, existing and known, but its capacity is not distinctly set forth until the fifty-first year of the same king (1266), when it was declared by statute that "an English [silver] penny, called a sterling, round and without any clipping, shall weigh thirty-two wheat corns in the midst of the ear, and twenty pence do make an ounce, and twelve ounces one pound, and eight pounds do make a gallon of wine, and eight gallons of wine do make a London bushel, which is the eighth part of a quarter." Instead of the uncertain standard of thirty-two wheat-corns, it was natural that an arbitrary but fixed weight, representing the probable average weight of such wheat-corns, should come in time to be recognized; and this weight is shown by Secretary John Quincy Adams (*Report to the H. of R.*, Feb. 22, 1820) to have been equivalent to 22½ grains troy. An ounce was therefore 450 grains troy, a pound 5400 grains, and eight pounds, or the weight of one gallon of wine, 43,200 grains. As the weight of Gascon wine (taken as the standard) was held to be 250 grains to the cubic inch, this gallon of wine, by a computation founded on the definition above, could not have contained more than 172.80 cubic inches; and the wheat-gallon, or vessel containing the same weight of wheat, 211.44 cubic inches. Mr. Adams, however, finds that, by "the treatise of weights and measures of 1304," it appears that in actual usage, except for moneys and medicines, the pound contained fifteen ounces, and not twelve; so that the number of grains troy in a commercial pound was 6750, and in eight such pounds, or a wine-gallon, 54,000. This, divided by 250, gives 216 cubic inches, which is the eighth part of a cubic foot. Such was the capacity of the earliest wine-gallon known in England; and this would give 264¼ cubic inches for the corresponding wheat-gallon, and 2114⅔ cubic inches for that of the bushel. A statute of Henry VI., however, of 1423, revived certain ordinances "of old time;"—ordinances which, not being embraced in the statutes at large, must antedate the Great Charter—according to which a different value of the gallon was derived from the mode of calculating tonnage. A ton of water was the weight of thirty-two cubic feet, and the eighth part of a cubic foot, or 216 cubic inches, was a gallon of water. Hence, the wine-gallon measure, being enlarged so as to hold the same weight of wine, became 217.6 cubic inches, requiring the wheat-gallon to be correspondingly modified, so that this became 266.17 cubic inches. But another rather inconsistent provision of this same statute required the hogshead to be of the capacity of eight cubic feet, but to hold only 63 gallons of wine; whence the wine-gallon was made 219.43 cubic inches, the wheat-gallon 268.53, and the bushel 2148.24; which last measure, as we shall see, was afterwards called the Winchester bushel.

The want of public standards in England was for some centuries a source of great confusion. Henry VII. attempted to supply this want, and an act of the twelfth year of his reign (1496) provided that a new standard gallon-measure should be constructed, and should remain in the king's treasury for ever. According to this act, the gallon-measure was to hold eight pounds of *wheat* (not wine) of twelve *troy* ounces each; that is, each ounce was to contain twenty pennyweights, and each pennyweight *twenty-four* grains, instead of twenty-two and a half, as earlier. This gallon had the capacity of 224 cubic inches; and being, by the terms of its definition, a wheat-gallon, it implied a wine-gallon of 183 cubic inches and a bushel of 1792 cubic inches. The statute seems to have been ignorantly prepared, and the two measures last named were so far below those in actual use that the corresponding standards were never constructed. But the gallon of 224 cubic inches, though made as a wheat-gallon, was afterwards interpreted (perhaps in some sort to compensate the blunder) as a wine-gallon, and another wheat-gallon was calculated from it, which ought to have been 274 cubic inches, but actually was 278, and from this was constructed a standard bushel of 2224 cubic inches, which, with the standard gallon-measure of 224 cubic inches, was deposited in the king's treasury, and both these remained in existence till 1834, when they were destroyed by fire.

The introduction of troy weight, however, into this act led to a modification of the old gallon of Henry III. in a manner not intended or anticipated. As, when the pennyweight was 22½ grains, the old sterling or Tower pound, which was the pound of commerce, contained 6750 grains, so when the pennyweight became 24 grains, the pound was assumed to contain, for this purpose at least, 7200 grains, and the gallon (eight pounds) 57,600 grains, giving a capacity of 230.4 cubic inches, which, for greater simplicity, was put in round numbers at 231. Such was the origin of the gallon which is at present standard in the U. S. The account given of this matter by Mr. Adams in his report above referred to is confused, unintelligible, and erroneous. Furthermore, the wheat-gallon of Henry III., being increased in like manner as the wine-gallon, became 282 cubic inches; a measure used in England for ale and beer down to Jan. 1, 1826, and in the U. S. somewhat later. A statute of 23 Henry VIII. (c. 4) sanctioned this gallon and its corresponding bushel of 2256 cubic inches. In the reign of Elizabeth a quarrel between the excise-officers and the dealers in herring led to the enactment of a statute (13 Eliz., 1570) that "32 gallons wine-measure, which is *about* 28 gallons by old standard, shall be the lawful assize of herring barrels, any old statute to the contrary notwithstanding." The "old standard" was the wheat-gallon of Henry III., which, as seen above, had the capacity of 264¼ cubic inches. Inasmuch as 231 × 32 = 264 × 28 = 7392,

it will be seen that this statute gives implicitly the legislative sanction to the wine-gallon of 231 cubic inches, which had grown out of a misinterpretation of the statute of 1496. In 1688 a new controversy arose as to the capacity of the lawful gallon, and the commissioners of excise addressed to the lords of the treasury a memorial on the subject, who in turn referred the question to Sir Thomas Powis, attorney-general. This officer, after a careful examination of the statutes, and particularly of the statute of 1496 just mentioned, reported that he "*did not know how 231 cubical inches came to be taken up,*" but that nevertheless he "did not think it safe to depart from *the usage;*" showing that the wine-gallon of 231 cubic inches was now well established by common law, if not by statute. In the thirteenth year of William III. (1701) the Winchester bushel was declared by statute to be the standard for the measure of grain. Winchester was a royal residence from the time of Alfred to that of Charles II. In some respects it was more favored by these monarchs than even London. Alfred held here his *wittena-gemote*, or great state council, and under Athelstane there were six mints in this city, when London had but three. Henry III. built here a noble palace, of which the great hall still stands; and here Charles II. began another yet more splendid, which he did not live to finish. Here also Henry VIII. received the great German emperor Charles V. But what gives to Winchester its interest in connection with the subject of weights and measures is the fact that here were held annually four great fairs, one of which, beginning on Sept. 12, lasted for sixteen days, and was in early times the largest in England. Apparently, the bushel derived (1423) from the hogshead of 8 cubic feet and 63 gallons became the standard in these great markets, and hence acquired the name it bears at present. The Winchester bushel, therefore, properly contained 2148.24 cubic inches, and the Winchester gallon 268.53 cubic inches; but the standard bushel-measure constructed in the time of Henry VII. to represent this bushel was found by trial in 1696 to hold only 2145.6 cubic inches. What was the degree of accuracy of the measures in actual use under this name cannot now be known; but in 1700 the old difficulty between excise-officers and dealers broke out anew, and led to protracted and fruitless litigation; the consequences of which appear in two legislative acts—viz. 1st, the statute of William III. just mentioned, which not only established the Winchester bushel as the standard, but explicitly defined its capacity; and 2d, a statute of 5th Anne (1706), which in like manner established and fixed the wine-gallon. In both cases the definitions were given in terms of the linear dimensions of the vessels representing the measure. Thus, the bushel was to be of the capacity of a cylinder 18½ inches in diameter and 8 inches deep; and the wine-gallon, the capacity of a similar vessel 7 inches in diameter and 6 inches deep; to which last definition the act added the words, "or any vessel containing 231 cubic inches and no more." This added clause conflicts slightly with the definition preceding, which would give for the gallon 230.91 cubic inches; but it is this clause which has ever since practically determined the capacity of the wine-gallon. The Winchester bushel, as computed according to the terms of the statute, contains 2150.4252 cubic inches, and the Winchester gallon, 268.8 cubic inches. This statute, nevertheless, did not effectually control usage; and even acts of Parliament as late as 31st and 45th George III. (1791 and 1805) recognize departures from it, requiring inspectors of corn returns to make comparison between the Winchester bushel and the bushel "commonly used," and to cause a statement of such comparison to be conspicuously exhibited. The acts of 1805, moreover, expressly mention 272¼ inches as the contents of the Winchester gallon, which is, of course, a gross legislative error. In 1818 a royal commission was appointed to inquire into the actual condition of British metrology, and to recommend measures for its reformation. As the result of their labors a bill was introduced into Parliament which, with slight modifications, became a law June 17, 1824, and was put into operation Jan. 1, 1826; which fixed the capacity of the gallon by requiring that it should be such as to contain 10 pounds avoirdupois, or "70,000 grains troy, of distilled water at the temperature of 62° F., weighed by brass weights under the barometric pressure of thirty inches," and stating at the same time the capacity thus determined to be 277$\frac{274}{1000}$ cubic inches. This is the value of the *imperial* gallon; and since its introduction this is the only legal gallon in Great Britain for wet or for dry measure. The bushel derived from this holds 80 pounds of water under similar conditions, and contains 2218$\frac{1907}{10000}$ cubic inches.

In the U. S. no system of weights and measures has been established by act of Congress. Our gallon, bushel, foot, yard, pound avoirdupois, and pound troy have been inherited from Great Britain. For purposes of coinage, only, the pound troy at the Mint in Philadelphia, copied from the British standard pound troy, has been made also the standard here. The control over the subject which is now practically exercised by the secretary of the treasury was originally assumed by Mr. Secretary McLane in 1832 as being the legitimate prerogative of that department. A resolution of the Senate of the U. S. of May 1, 1830, having ordered an examination to be made of the weights and measures in use in the several custom-houses, and these having been reported to be discordant, and some of them largely so, Mr. McLane, in communicating this result to the president of the Senate, added, "It is believed, however, that this department has full authority to correct the evil, by causing uniform and accurate weights and measures and authentic standards to be supplied to all the custom-houses." Mr. McLane accordingly proceeded to construct such standards, the superintendency of the construction being committed to Mr. F. R. Hassler, chief of the Coast Survey, by whom the previous examination and report had been made. This report, dated Jan. 27, 1832, stated the "legal capacity" of the gallon to be 231 cubic inches, and that of the bushel—the Winchester bushel being assumed to be legal—2150.42 cubic inches; but he placed the temperature of comparison at 39.83° F. (meaning the temperature of maximum density of water, which is more nearly 39.1° F.), and proposed (as he afterwards practised) the adjustment of these measures by making the gallon to contain 58,372$\frac{1754}{10000}$ grains of distilled water of this density, and the bushel 543,391$\frac{89}{100}$ grains. The British standard temperature of comparison being 62° F., it follows that the so-called Winchester bushel of the U. S. and the Winchester bushel of Great Britain, when compared at any common temperature, differ in capacity by more than a cubic inch and a half, the first-mentioned being the larger. Congress has since given a legal sanction to the proceedings of the treasury department above described, by the passage of a joint resolution (approved June 14, 1836) directing that a complete set of all the weights and measures adopted as standards be delivered to the governor of each State of the U. S. Occasional and partial attempts were made during the colonial period and after the Revolution, up to about 1820, to regulate measures of capacity by provincial or State legislation. (For an account of these the reader may consult the report of Mr. Adams, above referred to.) They were limited in general to a legislative sanction of the wine-gallon of 231 cubic inches, and of the Winchester bushel, or rather of the Winchester half-bushel of 1075$\frac{2}{10}$ cubic inches. In 1829 an act was passed by the legislature of the State of New York to regulate measures of capacity, by which the gallon was made a measure capable of containing 8 pounds of distilled water at maximum density, or 221$\frac{5112}{10000}$ cubic inches, being neither in simple relation (as it seems to be) with the imperial gallon, nor in harmony with the gallon of 231 cubic inches in common use. In the revision of the statutes in 1851 this act was repealed, and the measures fixed as above described by the treasury department of the U. S. were adopted as standards in this State. F. A. P. BARNARD.

Gallotan′nic Acid ($C_{27}H_{22}O_{17} = H_3C_{27}H_{19}O_{17}$), the variety of tannic acid or tannin which is found in the gall-nuts of *Quercus infectoria* and other species of the oak, in sumac, and in Chinese gall-nuts. It differs from caffe-tannic, catechu-tannic, morin-tannic, querci-tannic, and quino-tannic acids in certain important properties, although it resembles them in possessing a slight acid reaction, a rough astringent taste, coloring ferric salts blue-black or green, precipitating albumen and gelatine, and converting animal membranes into leather. (See TANNIC ACID.)

C. F. CHANDLER.

Gal′loupe's Island, in the outer harbor of Boston, Mass., was a military rendezvous during the late civil war. Pop. 39.

Gal′loway, tp. of Christian co., Mo. Pop. 480.

Galloway, tp. of Atlantic co., N. J. Pop. 2860.

Galloway (JOSEPH), LL.D., b. in Maryland, became a wealthy lawyer of Philadelphia; entered the Continental Congress in 1774, and was at first a warm patriot, but after the Declaration of Independence became a Tory, and in 1778 went to England; wrote a number of books and pamphlets upon American affairs, and some religious publications. D. in England Aug. 29, 1803.

Gal′lows, the structure by means of which capital punishment by hanging is inflicted. The culprit stands upon a platform, or drop, beneath a crossbar elevated upon two upright supports. A rope or halter hangs from the crossbar, and a noose at its end is placed upon the criminal's neck. He is hanged by the falling of the drop, or in some cases is drawn up from the platform by a heavy weight at the other end of the rope.

Galls. In the language of naturalists "galls" are abnormal growths or excrescences produced on growing or

living plants by one or more insects or closely allied mites, which develop and are nourished therein. These deformations are found on all parts of plants, and present a great variety of form, color, and texture—from the simple pouch-like bulging of the leaf to the most perfect and complicated structure. Many of them resemble familiar fruits, flowers, and vegetables, while a few, like fruits, are eaten by man. Take, in illustration, those occurring on the oaks. The bud may prematurely develop into a bunch of lanceolate leaves or become aborted into an acorn-like chamber. The tender leaf of spring, and even the blossoms, are beset with several green, and mostly globular, gall growths. The more mature leaves furnish an infinite variety, from two-hundredths of an inch to over two inches in diameter, either globular, pedunculated, conical, cup-shaped, or clavate, and with a surface either smooth, reticulate, wrinkled, downy, woolly, or prickly. The fruit is deformed by large globular excrescences growing from the cupule; by hard cells within the cupule, and set in cavities with fimbriated mouths; by pip-like bodies between the acorn and cupule; or, finally, by stony chambers or indurations in the meat itself, without external indication. A multitude of different gall growths affect stem, twig, and branch; while the trunk, and even the roots, are not exempt. The internal structure of galls is as varied as the external, but there is invariably a cell, within which the insect is nursed and nourished. This cell, in most succulent galls, is merely a cavity of various form in the general tissue; but it more often takes on the character of an oval chamber more woody than the surrounding substance, and which, though lying generally secure in said substance, is not unfrequently suspended to the general envelope by radiating fibres, in the same way that the hub is connected by spokes to the felly of a wheel; while more rarely it is entirely separated from its envelope and rolls around loosely therein. Galls are, in every case, the result of the combined action of an animal and vegetable organism, and would necessarily cease to exist if either of the organisms which jointly co-operate to produce them were swept out of existence. They have always interested the curious, and for a long time puzzled the philosopher, while to the uninformed of to-day they are, as they were universally in the days of Dioscorides, ascribed to spontaneous generation or to some freak of the plant bearing them. The diversity of form and character, and the constancy with which these characters are perpetuated according to the species, are remarkable when we consider the close resemblance in form and size which the gall-makers themselves present. Galls are technically separated into two groups—viz. the "monothalamous," or one-celled galls, each nourishing a single individual; and the "polythalamous," or many-celled, nourishing many individuals under a common envelope. Galls are produced either by the action of a peculiar poisonous fluid injected with the egg by the mother gall-insect, so that the young larva finds its habitation already prepared; or by the mechanical irritation (aided, most likely, by some similarly poisonous property) of the young larva, which is then the architect of its own house. In the former case the egg is generally inserted by the parent in the plant-tissues; in the latter, it is generally attached to the surface. The secretory organs of the plant are influenced by this poison very much in the same way that the human secretory system is influenced in producing the smallpox pustule when we insert vaccine matter into a child's arm. Galls, in a general sense, partake not only of the chemical character of the plant juices, but of the consistency of the part upon which they are found. Thus, the nut-galls of commerce and most of the galls occurring on oaks partake of the bitter and astringent nature of these plants; yet some produced on the succulent parts of the same tree are pleasantly sub-acid. Few families of phænerogamous plants are free from these growths, but none have thus far been found on Fungi or on Mosses. The term "galls" is sometimes applied to those animal swellings produced by Dipterous larvæ, mostly belonging to the genus *Œstrus*, or by mites dwelling in or under the skin of birds and mammals. It is also applied to some of the swellings on trees and shrubs produced by the growth of cryptogamic parasitic plants. It should not be applied, as it sometimes is, to those plant-swellings and nodosities which are caused by the punctures of insects which always dwell exposed thereon, the difference between a gall and a mere swelling being that the architect of the former is hidden from view, and of the latter always exposed. C. V. RILEY.

A "monothalamous" gall:—Being the American Oak-apple (formed by *Cynips q. spongifica* O. S. found on the Black Oak, and showing (*a*) the central cell in which the larva develops, and (*b*) the hole through which the fly issues. Colors, drab inside; yellowish-brown outside.

A "polythalamous" gall:—Being the Wool-sower gall (formed by *Cynips q. seminator*, Harris): *a*, showing a section; *b*, one of the pip-like kernels, showing woolly wing and the hole through which the fly escaped. Colors, light buff and rosy.

Gall Stones. See CALCULUS.

Gal'lup (JOSEPH ADAM), M. D., b. at Stonington, Conn., Mar. 30, 1769; took his medical degree at Dartmouth College 1798; practised at Hartland, Bethel, and Woodstock, Vt.; was president and professor in the medical school at Castleton, Vt., 1820–23; lecturer in the State University, and one of the founders and first professors in the medical school at Woodstock, Vt. Author of several professional works, of which the most important was *On the Institutes of Medicine* (2 vols., 1839). D. at Woodstock, Vt., Oct. 12, 1849.

Gallup'pi (PASQUALE), a Neapolitan philosopher, b. at Tropea, in Calabria, in 1770; d. at Naples in 1846. In 1819 he published the first two of his six volumes entitled *Saggio filosofico sulla Critica della Conoscenza*. In 1821 appeared his widely-known and often reprinted *Elementi della Filosofia ad uso dei giovinetti*. His greatest work, *Lettere sulle vicende della Filosofia relativamente ai principii delle Conoscenze Umane da Cartesio fino a Kant inclusivamente*, was published at Messina in 1827. In 1831 he was appointed professor of logic and of metaphysics in the University of Naples, and the year following he published the two first volumes of his *Filosofia della Volontà*, the two last appearing in 1839, and other smaller works in the mean time. Being elected a member of the Institute of France, he wrote for it two memoirs—one on transcendental idealism and absolute rationalism; the other, on the theodicy of the ancient philosophers. The last years of the life of Galluppi were embittered by poverty and by physical suffering.

Gal'lus (C. AQUILLIUS), a Roman eques, distinguished as a jurist, pupil of the pontifex Q. Scævola, was prætor B. C. 66, along with Cicero. His life was devoted to the elucidation and application of the principles of law, and his opinions and edicts are quoted or referred to by Cicero and in the *Digest*. Gallus presided at the trial when Cicero delivered his oration *Pro P. Quintio*. A glowing eulogium is passed on the upright character and judicial eminence of Gallus by Cicero in his oration in defence of A. Cæcina. Besides the slight notices above mentioned, nothing of the productions of Gallus has been preserved. H. DRISLER.

Gallus (C. CORNELIUS), the friend of Virgil, distinguished as a poet and soldier, was b. at Forum Julii B. C. 66. At the age of twenty his poetical abilities had attracted attention, and at the time of Cæsar's death (B. C. 44) he had attained sufficient distinction to make his adherence to Octavianus desirable. He commanded a division of the army against Antony at the battle of Actium, and soon after was sent to Egypt, of which he was made governor after its reduction to a Roman province. His conduct while in this office was made the subject of complaint to Augustus, who removed him from his position. The exact nature of his offence is not known. The senate instituted an investigation, and condemned him to exile with loss of his estates, upon which he put an end to his life (B. C. 26). Gallus composed four books of elegies, in which he sung the praises of Lycoris, and translated into Latin the poems of Euphorion of Chalcis. His poetry was greatly admired by his contemporaries, and is praised by Virgil and Ovid. All his writings have perished, though certain epigrams in the Latin *Anthology* pass under his name. The life of Gallus has been made the basis of a treatise on the manners and customs of the Romans in the time of Augustus, by W. A. Becker, translated by Rev. F. Metcalfe, London, 1853. (See BÄHR, *Gesch. d. Röm. Lit.*, [illegible]; C. C. C. VOLKER, *[illegible]*, 2 parts, Bonn, 1840, and [illegible] 1844.) H. DRISLER.

Gal'ly Rock, tp. of Pope co., Ark. Pop. 1163.

Gally Rock, tp. of Yell co., Ark. Pop. 687.

Galt, post-v. of North Dumfries tp., Waterloo co., Ont., Canada, on Grand River and the Guelph branch of the Great Western Railway, 14 miles from Guelph. It has two

weekly papers, several branch banks, large manufactures, and abundant water power. Pop. of sub-district, 3827.

Galt (Sir Alexander Tilloch), K. C. M. G., son of John Galt, b. at Chelsea, England, Sept. 6, 1817; entered the service of the British and American Land Company 1833; was its manager 1844–56; went into the Canadian Parliament 1849; finance minister 1858–62, 1864–66, under Cartier; was a principal founder of the railway-system of Canada; received his title in 1869; long a member of the Canadian Parliament from Sherbrooke, Quebec.

Galt (John), b. in Irvine, Ayrshire, Scotland, May 2, 1779; was employed for a time in mercantile pursuits; studied law, and afterwards spent three years in travelling in the Levant and Southern Europe, and after his return to London assisted his father-in-law, Dr. Alexander Tilloch (1759–1825), in the management of the *Star*, a newspaper. He afterwards produced a large number of dramas, novels, and other writings of unequal merit, many of them highly successful and marked by great originality. Among his best works are *The Ayrshire Legatees* (1820–21), *The Annals of the Parish*, *Laurie Todd*, *Life of Byron*, and an *Autobiography*. From 1826 to 1829 he was in Canada, where he acted as agent for the Canada Company, and founded the town of Guelph, Ont. D. at Greenock Apr. 11, 1839. Mr. Galt was for a long time utterly helpless before his death, having received no less than fourteen strokes of paralysis.

Galt (Patrick Henry), an American officer, b. in Virginia; entered the army as third lieutenant of artillery in 1814; was adjutant at the Military Academy in 1821, and aide-de-camp to Maj.-Gen. Scott 1822–29; distinguished in the battle of Wahoo Swamp, Fla., Nov. 21, 1836, and in the Mexican war, where he commanded his regiment, with rank of major; brevetted lieutenant-colonel for gallantry at Contreras and Churubusco. D. at Philadelphia Jan. 9, 1851.

Gal'ton (Francis), F. R. S., a cousin of Charles R. Darwin, was b. at Duddeston, Warwickshire, England, in 1824; was educated at King's College, London, and Trinity College, Cambridge; travelled extensively in Africa; entered the British civil service in the board of trade: and is (1874) connected with the meteorological office. Besides books of travel, etc., he has written *Meteorographica*, 1863; *The Art of Travel*, 1867; *Hereditary Genius*, 1869.

Galu'sha (Jonas), a Revolutionary soldier, b. about 1751, was a judge of the Vermont supreme court 1795–97 and 1800–06; governor of Vermont 1809–13 and 1815–20. D. at Shaftesbury, Vt., Oct. 8, 1834.

Gal'va, city and tp. of Henry co., Ill., situated at the junction of the Chicago Burlington and Quincy R. R. and Keithsburg branch of the same; the Peoria and Rock Island R. R. also crosses the C. B. and Q. at this place. It is 141 miles W. by S. from Chicago and 45 miles from Rock Island, in a rich agricultural and coal region, on one of the highest points of the dividing ridge between the Mississippi and Illinois river-basins. It has 2 large public school-buildings, costing about $20,000, 8 church edifices, a large number of business-houses, 2 hotels, 1 national bank, and 1 newspaper. Nearly the whole business part of the place was destroyed by fire in Nov., 1872. It is, however, rapidly recovering from the effects, and already many new business-houses are up, and more projected. Pop. of city, 2160; of tp. 3096.

F. T. Ward, Ed. "The Galva Journal."

Galva'ni (Alvisio or Luigi), the discoverer of dynamic electricity, was b. at Bologna Sept. 9, 1737, and was in youth strongly inclined to enter the priesthood, but was deterred by his friends, and in 1762 graduated M. D. at Bologna; became a lecturer upon anatomy there, and gave special attention to comparative anatomy; made important observations upon osteology and the kidneys and ear of birds, and in 1786 was led to the discovery of electric currents by the accidental contact of the dissected legs of a frog with a scalpel, which provoked muscular contractions. In 1797 the death of his wife, the loss of his lectureship (for political reasons), and other misfortunes led to a chronic illness, of which he d. at Bologna Dec. 4, 1798.

Gal'vanism. (For a brief account of the general principles of this science as they are known at the present day, see under the article on Electricity, *Dynamical Electricity*, § 47.) It may not be amiss to mention in this place that the early investigator, Luigi Galvani (who was b. in 1737, and d. in 1798, and who gave his name to this important subject), actually concerned himself only with that department of it known now as "animal electricity," and died in the belief that all the phenomena he had observed resulted from electricity present in animal tissues. (See Electricity, § 77.) His theory was opposed by Volta, who has contested the honor of giving his name to this subject (which is often described as voltaic electricity), who maintained that the contact of dissimilar substances was the source of the energy displayed in this class of actions.

What we may call the present or chemical theory of dynamic electricity was first enunciated by Fabrioni so early as 1792. This theory was elucidated and extended by many others, among whom we may notice especially Davy and Faraday, and may now be regarded as the well-established theory of the voltaic pile or galvanic battery. It must not, however, be overlooked that a minute amount of excitement is believed to result from the mere contact of dissimilar bodies, though this, of course, can be no source of available energy, and is rather a subject of metaphysical than of practical interest in any discussion of electric phenomena.

Henry Morton.

Gal'vanized Iron (an incorrect name) is sheet or other iron coated with zinc by dipping it into a bath of melted amalgam of zinc and mercury, containing a little sodium. The iron is first cleansed with sulphuric acid, and is then washed and scoured. Before galvanizing it is usually dusted with sal-ammoniac powder. The process was invented by C. F. Mallet in France, and improved by H. W. Crawfurd of England in 1837. It is a very useful treatment for iron roofs, telegraph wire, ships' bolts, etc., the zinc acting as a paint. Sometimes, before tin-plating, sheet iron is covered with a film of zinc, which makes the tin-plating more permanent. The name galvanized iron might properly be given to sheet iron coated with tin by an electro-plating process, which has been successfully tried. This material is sometimes afterwards dipped in a zinc bath, with beautiful results, but the process is an expensive one.

Galvanom'eter, an instrument for measuring dynamic electricity, is of various forms, the more important of which are described in the article Electricity (which see), by Prof. Henry Morton, Ph. D.

Galvan'oplasty (syn. *Electro-metallurgy*), the art of working in metals by the aid of electricity. The metals most readily separated from their solutions by electricity, and most useful when deposited, are copper, silver, gold, and nickel. The process is resorted to (1) for reproducing seals, coins, medallions, wood-cuts, engravings in metal, busts, bas-reliefs, etc.; (2) for coating base metals with silver, gold, nickel, or platinum; (3) for etching copper-plates for the engraver. (See Electrotype, Gilding, Nickel Plating, Photography, and Silver Plating.)

C. F. Chandler.

Gal'veston, county of Texas, bordering on the Gulf of Mexico. Area, 680 square miles, of which almost half is water. The soil is generally light, but live-stock, sea-island cotton, and garden products are raised. The county is traversed by the Galveston Houston and Henderson R. R. Most of the population is in Galveston, the capital. Pop. 15,290.

Galveston, post-v. of Cass co., Ind., on the Pittsburg Cincinnati and St. Louis R. R. (Indianapolis and Chicago division), 16 miles S. E. of Logansport. It has two weekly newspapers. Pop. 390.

Galveston, city, cap. of Galveston co., Tex., the principal seaport of the State, on Galveston Island, between Galveston Bay and the Gulf of Mexico. It is connected by railroads with all parts of the State to which railroads extend, and by regular lines of steamships with Liverpool, New York, New Orleans, and the ports of Western Texas as far as the Mexican boundary, and sail-vessels engage largely in direct trade with Great Britain and the continent of Europe, in the coffee-trade with Rio Janeiro, in the West India and Mexican trade, also in that with Northern U. S. ports. The exports of cotton for the year ending Sept. 1, 1872, were 333,502 bales, and the receipts from Sept. 1, 1873, to Feb. 10, 1874, were 272,776 bales, an increase of 40,023 bales over the same time in the previous year. The exports during the same commercial year, besides cotton, included 4000 bags of wool, 470,000 hides, 50,000 beeves, and large quantities of peltries, bones, horns, pecan-nuts, beeswax, hair, etc. The custom-house value of exports was $35,334,747; of imports, $298,811,831, including 42,500 bags of coffee, and 44,614 emigrants arrived at this port in the same year. There are 4 cotton-presses, with warehouses and yards occupying upwards of 40 acres of ground, and storing more than 100,000 bales of cotton. There are between 9 and 10 miles of street-railway, 2 libraries (1 numbering 9000 volumes), 15 churches, 31 schools, a Roman Catholic university, a medical school, an orphanage, 1 savings and 2 national banks, 2 iron-foundries, railroad-shops, machine-shops, gas-works, etc., 2 hospitals, 2 daily and 4 weekly newspapers. No epidemic disease has visited the city since 1867, and the usual health is remarkably good, the climate delightful. Oranges and other tropical fruits grow in the open air, and vegetable gardens flourish all the year. Galveston is the see of a Roman Catholic bishop. Pop. 13,818.

Editor "News."

Gal'vez, de (BERNARDO), COUNT, b. at Malaga, Spain, in 1756, was the son of the viceroy of Mexico, and nephew of Don José de Galvez, a high grandee of the Spanish court. In 1776 young Galvez became colonel of the Louisiana regiment, and was governor of Louisiana 1777–83. He captured Baton Rouge, Pass Manchac, Natchez, Mobile, and Pensacola from the British, and was made lieutenant-general, count, and captain-general of Louisiana and Florida. In 1784 he became captain-general of Cuba, and in the same year succeeded his father as viceroy of Mexico. He built the palace of Chapultepec. D. in Mexico Nov. 30, 1786.

Gal'way, county of Ireland, in the province of Connaught. Its western part along the Atlantic is wild and mountainous; the eastern part is flat. Good breeds of cattle and sheep are reared here. The fisheries are considerable, but agriculture is neglected. Area, 2447 square miles. Cap. Galway. Pop. 248,257.

Galway, town of Ireland, the capital of the county of Galway. It is situated on Galway Bay, at the mouth of the Corrib, and has a considerable retail trade, thriving fisheries, and some manufactures and commerce. It is the terminus of the Midland Great Western Railway, is the seat of one of the queen's colleges for Ireland, and has a Roman Catholic bishop. The town, with its suburbs, is virtually a county within itself. Pop. 13,184; with suburbs, 19,843.

Galway, post-v. and tp. of Saratoga co., N. Y., has a seminary and 3 churches. Pop. of tp. 2174.

Galway Bay is an inlet of the Atlantic, 20 miles long and from 18 to 8 miles broad, on the western coast of Ireland, protected from the swell of the ocean by the Arran Isles, and affording many advantages for the construction of a harbor of refuge.

Ga'ma or **Grama Grass** [said to be from *Gama*, one of the Maldive Islands, or from M. Gama, a gentleman of Mexico who first cultivated it], the *Tripsacum dactyloides*, a very large grass of North and tropical America, cultivated to a considerable extent as a forage-plant in the warm regions of both continents. The name is given in the Far West to various species of buffalo-grass (chiefly *Bouteloua*), which furnish good pasturage for stock.

Gama, da (VASCO), count of Vidigueira, was b. at Sines, in Portugal, in 1450; became a skilled mariner and a gentleman of the king's household, and in 1497 was despatched in command of the royal squadron to the East Indies by way of the Cape of Good Hope, lately discovered by Diaz. The Indian Ocean was then unexplored. Gama coasted the eastern shores of Africa, and visited India, returning to Lisbon in 1499. Cabral's expedition and the discovery of Brazil followed. Gama made his second voyage, with 20 ships, in 1502–03, and became involved in hostilities with the towns of the Malabar coast, which he punished severely. In 1499 he had received the title of admiral of the Indies. In 1524 he was sent out as viceroy. D. at Cochin, India, Dec. 25, 1524.

Gam'ala, a strong fortress and town of Palestine, besieged in vain by Agrippa, but taken by Vespasian after a brave resistance, when the survivors, 9000 in number, perished. It probably was at *El Hossn*, a steep hill opposite Tiberias, and on the E. side of the Sea of Galilee.

Gama'liel THE ELDER, a famous Jewish doctor and Pharisee, instructor of St. Paul. D. about 50 A. D. Tradition says he became a Christian, but the Jewish writings, in which his learning, justice, and wisdom are commemorated, do not allude to this conversion.—GAMALIEL THE YOUNGER, grandson of the above (b. about 50 A. D., d. about 116), was also a famous rabbi, president of the school at Jamnia, and strove to blend Platonism with Judaism.

Gambetta (LÉON), lawyer and politician, b. at Cahors of Genoese parents, Oct. 30, 1838, looks more like an Italian than a Frenchman, and is one-eyed. He was an obscure lawyer until 1868, when he pleaded in a political case which made him known to the masses. In 1869 he was therefore elected deputy to the Corps Législatif as representative of radicalism. On Sept. 4, 1870, Gambetta became a member of the revolutionary government. During the siege of Paris he left the city, and vainly attempted, from Tours, and afterwards from Bordeaux, to arrest the German invasion. In 1871 he was returned member to the Versailles National Assembly, abandoned the cause of his former friends of the Commune, and supported M. Thiers, after whose fall Gambetta tried to become again the leader of the Left of the Assembly. Pres. of Chamber of Deputies, 1879. FELIX AUCAIGNE.

Gam'bia, a deep and powerful river which traverses the region of Western Africa known as Senegambia. It falls into the Atlantic at Bathurst, in lat. 13° 28′ N., lon. 16° 35′ W.

Gambia, a British settlement at the mouth of the river Gambia. Bathurst, on the island of St. Mary, is the principal station, and has a considerable export trade in gold-dust, ivory, wax, hides, and horn. The settlement has a population of 14,190, of which only 56 are Europeans.

Gam'bier, post-v. of Knox co., O., on the Cleveland Mt. Vernon and Columbus R. R., 9 miles E. of Mt. Vernon. It is the seat of KENYON COLLEGE (which see). Pop. 581.

Gambier Islands, a group of islands of coral formation in the Pacific Ocean, in lat. 23° 8′ S., lon. 134° 55′ W.; under the protectorate of France. Vessels going from Chili to Tahiti visit them to take in fresh water. Pop. 1500.

Gambier (JAMES), BARON, G. C. B., b. in the Bahamas of Huguenot stock, Oct. 13, 1756; entered the British navy; served with distinction against the American Revolutionists and the French; rear-admiral 1795; vice-admiral 1799; admiral 1805; bombarded Copenhagen, and was made a baron 1707; was one of the commissioners who drew up the Treaty of Ghent 1814. D. at Iver, England, Apr. 19, 1833. His title is now extinct.

Gam'bir, or **Gam'beer** (*Terra Japonica*), a variety of catechu. It is the solid astringent extract obtained by infusing the leaves and shoots of the *Nauclea* (*Uncaria*) *Gambir* in warm water, and evaporating the solution to dryness. The best gambir is made at Riouw, in the isle of Brittany, in the Eastern Archipelago. It is principally exported from Singapore, in brown masses covered with matting. Its fracture is even and dull. It dissolves almost completely in boiling water, and its solution gives precipitates with glue and with sulphuric acid. Its peculiar properties, which make it useful in tanning leather, are due to tannic acid, which is called catechu-tannic acid, as it differs from gallo-tannic acid in giving a grayish-green precipitate with ferric salts, while the latter gives a bluish-black precipitate, and in giving no precipitate with tartar emetic. (See TANNIC ACID.) C. F. CHANDLER.

Gambling, or **Gaming.** See DICE, PLAYING-CARDS, LOTTERY, and SPORT.

Gamb'ling-Hou'ses. It is humiliating to reflect that while the Mohammedan religion has always successfully repressed gambling, Christianity has witnessed its worst excesses. The most degrading form which this vice has assumed is that by which houses are dedicated to it. From the days of St. Louis, whose brother was an extravagant gambler, to those of Du Guesclin, who was not less insanely given to this degrading vice, we find in France men who were famed for honor and bravery rendered contemptible by this low form of avarice. In the reign of Charles VI. the Hôtel de Nesle in Paris was a noted gaming-house for the nobility, and there is an old poem which describes the infamous deeds of this mansion. (*The Gaming-Table*, by ANDREW STEINMETZ, vol. i.) From Louis XI. to Henry IV. gambling steadily progressed, until under this last monarch, who set the example by the most extravagant play, *académies de jeu*, or gambling-houses, were established everywhere in Paris in the teeth of the most stringent laws. During the reign of Louis XIII. 47 gaming-houses at Paris, which had been licensed, and from which several magistrates drew a perquisite of half a sovereign a day, were suppressed. Mazarin, under Louis XIV., developed gaming, and made the palace a mere gambling-house, as appears from the letters of Madame de Sévigné. When the play of *hoca* was prohibited in Paris under penalty of death, it was freely played at court. Gaming-houses were first licensed in Paris in 1775. Fouché received £128,000 for permitting them, and in these "hells" this minister of police employed 120,000 spies, who were also *croupiers*. It is to be remarked that in all countries a decline in public honesty and private decency has been in exact ratio to the spread of gambling; and this has increased as gaming-houses have existed. In such places cheating becomes a science, and the houses colleges of deceit. Loaded dice have been dug up in Pompeii, and the Egyptians knew how to throw a sure six; but it is in the great gaming-houses of modern times that a thousand means of systematically plundering the public are deliberately invented and practised. Under John Law, the gambler, all France became in one sense a "hell," and it was at this time that houses of play received this most appropriate name. Under the empire gambling became in reality "Napoleonic," and the Palace Royal, Frascati's, and other magnificent *enfers* witnessed the nightly ruin of families and fortunes. In 1836, by the motion of J. B. Delessert, all gambling-houses were closed on Jan. 1, 1838. Many have read the celebrated sketch, *The Last Night at Frascati's*. At present gambling in Paris is secret and illegal. It is chiefly conducted at houses where *lorettes* dine. After dinner the doors are closed, and cards, roulette, etc. are introduced. The great gambling-houses of Germany, now suppressed, were at Baden, Homburg, and Wiesbaden, to which may be added Spa and Aix-la-Cha-

pelle. These towns combined every attraction, and to the mineral springs which first made them places of resort were added walks, drives, gardens, balls, reading-rooms, and public music. The principal game at the public tables was trente-et-quarante ("30 and 40"), commonly called rouge-et-noir, and the second roulette. No skill was required to play at these; the coin laid on the red or black side of the table was either lost or returned double, or else on certain numbers, which appeared to give an even chance to the player, or to increase the profit with the risk in due ratio, as certain cards or the dropping of a ball on a certain number decided. But once in about fifteen times a certain "tie," or *zero*, gave all on the table to the bank; and on this tie the company supported the place, paid dividends, and paid immense sums to the government. At Spa the annual profit was £40,000. In 1872 all these moral pest-houses were put an end to. At present that at Monaco is the only one left, and there may be still beheld the spectacle of a prince so degraded as to live by vice, and to whom the *odor lucri* is indifferent. C. G. LELAND.

Gamboge, or **Camboge** [named from *Cambodia*, where it is obtained], the dried juice from the trunk of a tree growing in Cambodia and Siam, lately determined to be the *Garcinia morella*, variety *pedicellata*, order Clusiaceæ. Gamboge is a brittle resinous substance, odorless, but of acrid taste, orange-yellow in mass, and a splendid pure yellow in powder. It consists essentially of a gum and resin, without volatile oil. The resin, known as *gambogic acid*, forms on the average about 80 per cent. of good gamboge, and is the ingredient that yields the color and the medicinal power. Gamboge is imported from Canton and Calcutta in cylindrical rolls called pipe gamboge, and, though of inferior quality, in irregular masses called cake or lump gamboge. Medicinally, gamboge is a powerful irritating cathartic, producing watery discharges, and in full dose nausea and vomiting as well. From its harshness it is not used alone, but generally as an ingredient of the compound cathartic pill of the Pharmacopœia. In the arts gamboge is used as a pigment. It readily diffuses in water, forming a yellow emulsion. It is employed also to stain wood in imitation of box, to stain marble yellow, and the resin dissolved in alcohol is an ingredient of the gold-colored lacquer used for brass work. EDWARD CURTIS.

Game-Laws, laws regulating the killing and taking of game. Under the English common law all game was regarded as the property of the king, and heavy penalties were imposed upon those who encroached upon the royal prerogative by engaging in the hunting of such animals. To kill a deer, it is stated, was considered almost as heinous an offence as to kill a man. But the severity of the punishment was relaxed in favor of offenders belonging to the nobility or the higher classes of society; so that, by force of custom, they came to enjoy a peculiar privilege and exemption. But at an early period the laws concerning the taking of game were defined by statute. The statute now in force has abolished all distinction of class in regard to the nature of the liability incurred by violating the law, and requires all persons desiring to hunt game, either upon their own land or that of another, to take out a yearly certificate by which permission is conceded. If the land belongs to some third person, his consent that a certificate may issue must be obtained. Poaching is punished with great severity. No person is authorized to sell game without procuring a license conferring the power. Minute and stringent regulations are established determining the times of the year when game may be taken by those possessing the privilege. The policy of the English legislation is to confine the right to kill game to the aristocratic and landholding classes; and the laws prohibiting interference with their privileges are consequently made very rigid and strictly enforced. In the U. S. the right to kill game is enjoyed equally by all citizens, and the only common-law restriction against its exercise arises from the necessity of avoiding the commission of a trespass upon the lands of other persons. But statutory provisions have been adopted in a large number of the States prohibiting the act of taking certain valuable kinds of game except at certain seasons of the year. (For details the statutes of each State must be consulted.) GEORGE CHASE. REVISED BY T. W. DWIGHT.

Games, Ancient. See GRECIAN GAMES, by PROF. H. I. SCHMIDT, S. T. D.

Ga'ming, in law. Gaming consists in the playing of games of hazard for money or some article of pecuniary value. At common law this was not recognized as a criminal offence, and was only made punishable when it had been employed as a means for the commission of fraud. Thus, cheating by the use of false dice or deceptive cards subjected the defrauder to indictment, and he was punished by fine and imprisonment. Public gaming-houses also were deemed common nuisances, and might be suppressed. But in all cases where the persons engaging in gaming were the victims of no imposition, acted of their own free consent, and the play was fairly conducted, not only was the act not deemed sufficiently reprehensible to deserve legal punishment, but the courts would lend their aid to enable the winner of money to recover it from the loser. But the pernicious influence of gaming upon social morals, and the aversion which it is apt to create in its votaries to the pursuit of ordinary methods of money-making, as well as the great opportunities which are afforded for deluding and defrauding the inexperienced and the young, have led to the enactment of statutes both in England and (without doubt) in all the States of the Union, making the practice unlawful and imposing penalties upon those engaging in it, or providing means for its repression. In England provision is made for the institution of summary proceedings to convict and punish the proprietors of gaming-houses, and it is declared that all contracts by way of gaming or wagering shall be void, and that no suit shall be brought to recover the money won. Bills and notes given for money won at play are void on account of the illegal consideration. In New York all wagers or bets upon any gaming or upon any uncertain event are pronounced unlawful, and all contracts for the payment of money when the question of chance is determined are void. If any money or property be deposited with a stakeholder to await the result of a game or wager, the depositor, whether he lose or not, may bring suit against the stakeholder or winner (if he receive it) to recover it. If, moreover, any person shall at any one time or sitting win any sum of money or value, he may be compelled to forfeit five times the value of the money or articles so won, to be recovered by the overseers of the poor. An habitual gambler has been adjudged to be an "improvident person," under a statute which makes "improvidence" a disqualification to hold the office of executor or administrator. In Massachusetts obtaining money by gambling is declared larceny. The provisions against gaming in the other States are of substantially the same purport, though they are not generally of such great stringency as in New York. In a number of the States it is the rule that if money put up as a stake be once paid to the winner, the loser cannot recover it.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Ga'ming-Hou'ses, houses kept for the purpose of enticing people to gamble for money or other articles of value. At common law these may be suppressed as public nuisances, on account of their tendency to produce public disorder by the assembling of many persons, or to promote cheating and other corrupt practices. It is necessary in order to sustain an indictment that the house be used commonly for gaming purposes. Such a use upon a single occasion would not be sufficient. There is no need that the house be open to the entire public; it will suffice if it be used by a class of persons. If the proprietor be merely a temporary occupant, he is liable to the same extent as if he were the owner of the premises. In a number of States statutes have been passed regulating or prohibiting the keeping of gaming-houses. In New York any person keeping a room or building for gambling purposes, or leasing it with knowledge that it is to be used in such a manner, may on conviction be subjected to a fine of not less than fifty nor more than five hundred dollars; and if any one shall inveigle another into a gambling-house, he may be held responsible for the money or property lost by the person so invited. (See GAMING.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Gam'marus [Lat. for "lobster;" Gr. κάμμαρος], a genus of sessile-eyed crustaceans of the order Amphipoda and family Gammaridæ. The genus includes the fresh-water shrimp (*Gammarus pulex* of Europe, *Gammarus minus* of the U. S.), common under stones, and some marine species.

Gam'mell (WILLIAM), LL.D., an American teacher and author, b. in Medfield, Mass., Feb. 10, 1812; graduated at Brown University 1831; tutor in that university in 1832, and subsequently professor of rhetoric and English literature till 1850, when he was transferred to the chair of history and political economy, which he continued to fill till 1864. He is the author of a *Life of Roger Williams* and of a *Life of Gov. Samuel Ward*, both of which were published in Sparks's *American Biography*: a *History of American Baptist Missions*, published in 1850, and of several discourses and essays, historical, biographical, and literary. He has also been a frequent contributor to the press in reviews, magazines, and newspapers. J. H. GILMORE.

Gam'ut, in music, the name commonly given to the series of notes forming the diatonic scale. The first attempt to adjust in a scientific manner the elements of the diatonic scale is usually ascribed to Guido d'Arezzo, a Benedictine monk of the tenth century. He had diligently

studied music, such as it then was, and by practice in his monastery became so sensible of the needless difficulties imposed upon learners for want of a clear and scientific arrangement of the various tones that he undertook the remodelling of the whole musical system. He commenced by altering the Greek *tetrachord* to a *hexachord*, adding one note below the lowest then in use. To this new or supplementary note he gave the name of *gamma*, from the third letter of the Greek alphabet. He had also been much impressed with the recurrence of certain syllables in the following verse of a hymn to St. John, then in frequent use:

"*Ut* queant laxis *Re*sonare fibris,
*Mi*ra gestorum *Fa*muli tuorum,
*Sol*ve pollute *La*bii reatum,
Sancte Joannes."

To the six notes of the hexachord he therefore appropriated these syllables—viz. Ut, Re, Mi, Fa, Sol, La, and by a combination of the word *gamma* and the syllable *ut*, the scale thus formed (*Si*, for the seventh grade, being added afterwards) acquired the name of the *gamm-ut*, or *gamut*. The scale as thus regulated by Guido appears to have embraced two octaves and a sixth in its range—*i. e.* the original gamut, its repetition in the octave, and six notes of a further series. WILLIAM STAUNTON.

Gananoque, flourishing v. of Leeds co., Ont., Canada, near the Grand Trunk Railway, and on the St. Lawrence, opposite the Thousand Islands. It has extensive manufactures, a great water-power, and is a place of summer resort. Pop. of sub-district, 2020.

Gan'dia, town of Spain, in the province of Valencia, on the Alcoy. It is, with respect to its situation, one of the most beautiful towns in Spain. Pop. 6479.

Gan'do, the name of a kingdom of Upper Soudan, Western Africa, is situated on both sides of the Niger, and is inhabited by a people of the Foolah race. On account of the fertility of the soil and the character of the inhabitants, this kingdom, in connection with Sokota, seems destined to be the centre of Mohammedan civilization in Western and Middle Africa. At present, however, the country suffers much from a bad administration. It has a capital of the same name.

Ganga. See SAND GROUSE.

Gan'ges [Gr. Γαγγης: Hind. *Gangâ*], the principal river of Hindostan, and (as well on account of its magnitude and physical character, exhibiting the most striking phenomena and working according to the most complex natural laws, as on account of its intimate connection with the civilization of the country, its religion, and its business) the most interesting river on our globe—more interesting even than the Nile. Its sources are in the Himalayas, its mouth in the Bay of Bengal. Its entire length is about 1500 miles; its general direction, first S. E., and then E. It begins its upper course, under the name of Bhagirathi, in lat. 30° 54' N. and lon. 79° 7' E., at an elevation of 13,800 feet, in the Himalaya Mountains, where, according to the celebrated old Sanscrit epos, *Ramayana*—which in many places is simply an allegorical description of the Ganges and its influence on human life—it became entangled in the hair of Siva on its descent from heaven to earth. It issues from under an immense bed of snow, piled up between three peaks from the height of 13,800 feet to 22,000 feet; rushes out from the Himalaya in wild torrents; joins the Alakananda, a river larger than itself; receives the name of Ganges; and, having descended more than 12,000 feet during a course of 160 miles, it enters at Hurdwar, at an elevation of 1024 feet, the plain of Hindostan, and begins its middle course. From Hurdwar to Seebgungi, where the lower course of the Ganges (the Delta) begins, the distance is nearly 1100 miles. At Hurdwar the Ganges becomes navigable—above Cawnpore only for river-craft and passenger steamers, but below Allahabad for large vessels. In spite of the frequent shoals which it forms at one season and removes the next, thus altering its banks from year to year, the middle channel of its bed is everywhere practicable for large vessels after its confluence with the Jumna. Below Allahabad it receives from the left the waters of the Goomty, Ghoggra, Gunduck, and Koose, and from the right those of the Tous, Kurumnassa, and Sone; and passing by the large cities of Benares, Patna, Bahar, and Moorshedabad on its way to Calcutta, it forms a most splendid highway of communication and traffic through one of the most fertile and most thickly peopled regions on the earth. The Delta of the Ganges begins at a distance of 200 miles from the sea, and forms a perfect wilderness of creeks and rivers, some of which are salt, and all of which are subject to tidal influences. The northern arms unite with the waters of the Brahmapootra; the southernmost, the Hoogly, opens the widest and deepest passage to the Bay of Bengal. According to the poet, this delta was formed by Siva squeezing the water from his hairs and letting it run out between his fingers; but according to the naturalist, it was formed, as all other deltas were formed, by the mud which the river carries along with it, and which, in the case of the Ganges, is of an amount so immense that its annual average has been computed at 534,600,000 tons. This large tract of low, flat, alluvial land is yearly inundated by the Ganges from the beginning of May to the beginning of November. In the middle of August only the houses built on mounds and the tops of the trees are seen; the whole landscape is one sheet of water, where large vessels and small boats, steamships and rafts, swarm and float along. In November, when the waters have subsided, acres of land have been carried away, and in other places acres of land have been formed. The river is worshipped by the natives as the goddess "Ganga." Not only are pilgrimages made to particular places on its shores, where ablutions are performed, the dying exposed, and the dead thrown in, but the whole Hindoo mythology is interwoven with symbols and pictures referring to it.

Ganges, post-tp. of Allegan co., Mich., on Lake Michigan. Pop. 1255.

Gan'gi, town of Sicily, in the province of Palermo. Pop. 10,535.

Gan'glion [Gr. γάγγλιον]. In very general terms, a ganglion is an accumulation of gray nervous matter or cineritious substance. More exactly, a ganglion, wherever found, consists of nerve-cells and nerve-fibres mingled in various proportions, and bearing relations (not fully known) to one another, of blood-vessels, and of a framework of connective tissue. The term (plu. *ganglia*) is also applied to parts of the gray matter of the brain and spinal cord, having more or less definite shapes and boundaries, and being the seat of certain functions; the optic thalami and corpora striata in the brain are ganglia. Ganglia answering to the specific definition given above are found attached to the posterior roots of the spinal nerves (and some cranial), upon the terminal branches of many nerves, and in greatest abundance and of greatest size in the so-called sympathetic nervous system. (See GANGLIONIC NERVOUS SYSTEM.) A ganglion may be round or flat, or of any shape (semilunar ganglion), and may be of microscopic size, or as large as a finger-nail. In the Invertebrata the nervous system is wholly made up of such ganglia united by nervous trunks (bundles of nerves). The exact functions of ganglia are not well known. In general terms, they have, or may have, all the attributes of a nerve-centre —*i. e.* be the standing-point of motor impulses and the reception-point of sensory impressions. Many reflex actions are wholly under the control of ganglia. E. C. SEGUIN.

Gang'lionic Ner'vous Sys'tem. The ganglionic or sympathetic nervous system is an appendage of the cerebro-spinal system, existing in a rudimentary condition in nearly all Vertebrata, and attaining its most complete development in man. It consists of ganglia placed in front of the vertebral column, on either side of it, from the base of the skull to the coccyx, or lowest bone of the spine. These ganglia are united by vertical nervous cords, which form the chains of the sympathetic. There are four pairs of ganglia in the head, three in the neck, twelve in the dorsal region, four in the lumbar, five in the sacral region, and one ganglion upon the coccyx. This single ganglion is the point of union of the two chains. From these ganglia nerves proceed in two directions: (1) to the spinal nerves and thence to the spinal cord; and (2) to various organs and to other ganglia near organs. These ganglia, of large size and great importance, are placed upon or near to the heart, lungs, stomach, liver, kidneys, intestines, uterus, bladder, etc. These ganglia are nearly all symmetrically placed on either side of the median line, and, together with intricate networks of nerve-fibres coming to and going from them, constitute what are called plexuses. Thus, we have cardiac plexuses, solar plexus, hypogastric plexus, etc. Some of the nerves connecting the vertebral chain of ganglia with the visceral ganglia are so important as to be designated by special names. The cardiac nerves extend from the cervical ganglia to the cardiac plexuses; the splanchnic nerves connect the dorsal ganglia with the semilunar ganglia, which lie behind the stomach and go to form the great solar plexus. All the ganglia referred to above are visible to the naked eye, but there are innumerable microscopic ganglia in the sympathetic; they are found between the muscular fibres and under the mucous membrane of various organs.

The functions of the ganglionic nervous system are motor, sensory, and nutritive; and are only imperfectly known. (1) The following are the chief movements which are controlled by the sympathetic: In the head certain movements of the iris (ophthalmic ganglion), of muscles of the internal ear (otic ganglion), of muscles of the soft palate (spheno-palatine ganglion); in the chest, the cardiac contractions

by the cervical ganglia and cardiac plexuses: in the abdomen, the peristaltic movements of the stomach and intestines, the evacuative movements of the bladder and uterus. The most striking peculiarity of this motor energy is that it is wholly withdrawn from the influence of volition—that it is manifested in an automatic, necessary way. It is also to be remembered that this motor energy is in part derived from the spinal cord by means of the fibres connecting the two systems. Motor energy is also shown in the range of the ganglionic nervous system in the movements of blood-vessels, arteries chiefly; and this so-called vaso-motor function is worthy of separate study. The anatomical basis of this function lies in this, that blood-vessels possess a muscular coat, and receive numerous filaments from sympathetic ganglia; some of the larger vessels even bear plexuses. Experimentation shows that if the ganglia or nerves supplying blood-vessels be removed or severed, the vessels relax and remain dilated; while, on the other hand, if these nervous elements be irritated (as by electricity), the vessels diminish in size by contraction of their muscular coats. In the parts supplied by vessels whose nerves have been cut we observe redness, increased heat, and greater activity of nutrition. This law, that the ganglionic nervous system controls vascular contractility, was enunciated by the distinguished American physiologist Brown-Séquard. It has since been shown that this function of the sympathetic nervous system is in great part borrowed from the spinal cord, the same effects being produced by section of ganglionic nerves and certain parts of the spinal axis; the chief vaso-motor centre for the body being in the medulla oblongata. The intimate connection between the two systems is shown in many normal and pathological actions. The cardiac movements, for example, occur under the immediate influence of ganglia of the sympathetic, but these movements are made faster or slower, or rendered irregular, by nervous excitations coming from the brain or spinal cord; physical and psychic pain may arrest the heart's action; certain emotions cause palpitation; others may cause intermittent cardiac contractions. The peristaltic movements of the stomach and the processes of secretion in its glands are produced by reflex actions, taking place chiefly within the circuit of the great sympathetic; yet active mental exertion or an emotion may arrest these actions, producing acute indigestion; and, *vice versâ*, an intense irritation of the stomach may cause many cerebral symptoms—headache, vertigo, mental depression. An emotion may produce jaundice, an evidence of disturbance of the secretory function of the liver by a cerebral influence. The various intestinal functions are done by the agency of ganglia and nerves of the abdominal sympathetic; but we find that irritation of the intestines (worms, undigested food) may set up violent actions of the spinal cord (convulsions in infants) or cerebral depression (melancholia in the adult); and the action of cold upon the skin of the body is a well-known cause of increased peristaltic action and secretion in the bowel (diarrhœa). Turning now to purely local vascular movements, it is a matter of common observation that we blush or turn pale in consequence of unexpressed mental states (emotions). The above facts justify the following generalizations: (1) that while many local movements (muscular and vascular) and secretions are under the immediate control of ganglia of the sympathetic system, the relations existing between this and the cerebro-spinal are most intimate, and that actions of a reflex order are constantly taking place, involving the activity of both systems, an impression made upon terminal cerebro-spinal nerves being capable of producing actions in organs supplied by ganglionic nerves, and an irritation of terminal nerves of the sympathetic being capable of setting up actions in the brain and spinal cord, and in parts supplied by nerves issuing from them. (2) The sensations arising in the ganglionic nervous system are usually vague and dull: in perfect health there are no visceral sensations. When excessively excited, however, the ganglia and nerves of this system are capable of evolving most intense pain (colic, passage of calculi, angina pectoris). (3) As regards the relations of the ganglionic nervous system to nutrition, properly speaking—*i. e.* intimate tissue-changes independent of vascular modification—we know little or nothing. The theory which would make the ganglionic nervous system the seat of the emotions has little in its favor; all that can be said is, that many emotions are expressed in part by actions (vaso-motor and secretory) produced by the activity of this system, the cerebro-spinal system having been the starting-point of the activity. E. C. SEGUIN.

Gang Mills, lumber-manufacturing v. of Trenton tp., Oneida co., N. Y. Pop. 104.

Gangrene [Gr. γάγγραινα], the death, or partial death, of an organ or any portion of the body. Debility from any cause, and especially from old age, is the great predisposing agency. Among the exciting causes may be mentioned mechanical injuries and obstruction either to the ingress of arterial blood to, or egress of venous blood from, a part. The immediate cause of the death of a part is always the complete cessation of the capillary circulation in it. A distinction is generally made into *wet* and *dry* gangrene, according to the condition of the part affected. Another division is into *constitutional* and *local*. Gangrene usually begins with a diminution in the sensation and temperature of the part, the cuticle becomes detached, and a serous fluid is found beneath it. The limb crackles under the finger, owing to the presence of gases which are evolved by the decomposing tissues. These symptoms increase until all sensation is lost, and the part becomes colored greenish-black by the sulphuretted hydrogen set free during the process. The treatment must necessarily vary according to the cause. The system should be supported, and inflammation, if present, allayed. If there be any chance of saving the part, the temperature should be kept up by warm fomentations. EDWARD J. BERMINGHAM.

Gangue [Fr.], in mineralogy and mining, the mineral substance which surrounds an ore or a mineral, lying within the same vein, but not blended with the substance it encloses.

Ga'nier, tp. of Kankakee co., Ill. Pop. 1582.

Gan'jam, district of the province of Madras, British India. It lies along the Bay of Bengal, between lat. 18° 13' and 19° 52' N. Its area is 6400 square miles; pop. 926,930. It produces rice, maize, sugar, oil, and different dyestuffs. The principal town is Rosikoila.

Gannat, town of France, in the department of Allier, has a large trade in wine and corn. Pop. 5599.

Gan'net, a name applied to the sea-birds of the genus *Sula*. The Atlantic coasts of the U. S. have two species—the common gannet (*Sula bassana*), called solan goose in England, and the booby gannet (*Sula fiber*) of the Southern States. The former is extensively taken on northern coasts for its feathers and down. The eggs are also gathered, and the young birds are eaten. One of the principal guano birds of the southern hemisphere is a gannet (*Sula variegata*).

Gan'nett (EZRA STILES), D. D., an American Unitarian clergyman, b. in Cambridge, Mass., May 4, 1801; d. near Boston Aug. 28, 1871. A student at Phillips Academy, Andover, a graduate of Harvard College in the class of 1820, and of the Cambridge Divinity School three years later, he passed at once into the ministry as colleague pastor with Dr. W. E. Channing, being ordained in Federal Street church, Boston, June 20, 1824. In that charge he remained till his death. His great activities were wholly devoted to his ministry; he was an ardent preacher, a keen theologian and controversialist, an impassioned writer and speaker on religious and ethical themes, and a consecrated pastor. His published discourses were numerous. He founded *The Scripture Interpreter*, edited for some years *The Monthly Miscellany*, and was joint editor with Dr. Alvan Lamson 1844–49 of *The Christian Examiner*. As a leader of his denomination he was known in England as well as at home. Its benevolent operations he had deeply at heart; and though both in theology and politics he was conservative, his passion for righteousness was felt in almost every movement of social philanthropy that was active in his generation. O. B. FROTHINGHAM.

Gano (Rev. STEPHEN), M. D., Baptist clergyman, b. in New York Dec. 25, 1762; was a surgeon in the Continental army, and having been ordained to the ministry Aug. 2, 1786, from 1792 to Aug. 18, 1828, when he d., was pastor of the First Baptist church at Providence, R. I.

Ganoids. See FISH, by PROF. T. GILL, M. D., PH. D., M. N. A. S., and FOSSIL FISHES, by PROF. J. S. NEWBERRY, M. D., LL.D., M. N. A. S.

Gansevoort (PETER), b. at Albany, N. Y., July 17, 1749; appointed major 2d New York regiment 1775, and accompanied the army of Montgomery in its invasion of Canada; lieutenant-colonel 1776, and commanded Fort George; the following year, while in command of Fort Stanwix, he successfully withstood a siege of nearly three weeks against the British and Indian forces under St. Leger, by which he prevented the latter from co-operating with Burgoyne; for which service the thanks of Congress were tendered him. In 1781 the State of New York appointed him brigadier-general, and in 1809 he was appointed in the U. S. army with the same rank. D. July 2, 1812.

Gan'son (JOHN), b. in Le Roy, Genesee co., N. Y., Jan. 1, 1818; graduated at Harvard College in 1839; studied law, was admitted to the bar, and removed to Buffalo soon after, and reached the first place at the bar in Erie co. In 1862 he was elected to the State senate, and on the expiration of his term was elected to Congress, serving from 1863 to 1865. In 1864 was elected a delegate to the Chicago convention which nominated McClellan for the Presidency.

After serving out his term in Congress, he retired from political life and devoted himself to his profession, in which he attained eminent success and an ample fortune. In 1873 he was induced to accept the nomination for the State senate, and was elected by a large majority, serving, as before, on the judiciary committee. In politics he was a Democrat of the conservative school, always discharging his duties in accordance with his personal convictions, and not governed by mere party ties. D. at Buffalo, N. Y., Sept. 28, 1874.

Gantt, tp. of Greenville co., S. C. Pop. 841.

Gantt (LEVI), b. in the District of Columbia 1817; graduated at the U. S. Military Academy July, 1841, and entered the army as brevet second lieutenant of infantry; promoted to be second lieutenant 1842, and first lieutenant 1847; served in the Florida war (1841–42), and in the war with Mexico (1846–47), being engaged in the battle of Monterey, siege of Vera Cruz, battles of Cerro Gordo, Contreras, Churubusco, Molino del Rey, and Chapultepec: in the last-named battle, while bravely leading a storming-party, he was killed Sept. 13, 1847.

Gan'ymede [Γανυμήδης], in Greek mythology, the beautiful son of Tros and Calirrhoë, stolen by Zeus, who sent his eagle, or came in the shape of an eagle, and took Ganymede to Olympus, where he became the cup-bearer of the gods. His myth is, however, variously stated.

Gap, a poorly built but beautifully situated town of France, in the department of Hautes-Alpes. It is a bishop's see. Pop. 8219.

Gap, tp. of Montgomery co., Ark. Pop. 528.

Gap Civil, post-v., cap. of Alleghany co., N. C., in a fine valley, 38 miles S. W. of Wytheville, Va. Pop. of tp. 958.

Gapes, a disease of fowls and other birds, caused by the presence of trematode worms (*Fasciola trachealis*) in the windpipe. The number of worms present is sometimes so great as to choke the bird. More commonly they cause inflammation and difficulty of breathing. A feather moistened with spirits of turpentine may be thrust into the windpipe, and turned about till the worms are removed. Similar organisms have been found in the air-passages of mammals, but their presence is not easily detected, nor is there any effective treatment.

Garaman'tes, the ancient name of a people of the great desert of Sahara. They were not negroes, and had a town called Garama (now *Germa*). They were warlike nomades, and were engaged in the caravan-trade across the desert, and their descendants probably still exist under other names.

Garanceux, a product of the action of sulphuric acid on waste madder. (See MADDER.)

Gar'ancin, a preparation of madder, obtained by first exhausting the pulverized madder with water, treating it with sulphuric acid at 100° C. (212° F.), and again washing. For most purposes garancin is preferred to madder; it produces more brilliant colors, requires less after-treatment, and leaves the whites clearer. (See MADDER and CALICO PRINTING.) C. F. CHANDLER.

Garci'a (MANUEL DE POPULO VICENTE), father of Mmes. Malibran and Viardot, was b. at Seville, Spain, Jan. 21, 1775; was a fine tenor singer, an able instructor, and a writer of operas, of which *The Caliph of Bagdad* is the best. D. in Paris June 9, 1839.—His son MANUEL, b. 1805, in Madrid, attained a world-wide fame as a teacher of vocal music, chiefly in Paris and London. Author of works on musical instruction.

Garcila'so de la Ve'ga, "the Spanish Petrarch," b. 1503 at Toledo, was an officer in Charles V.'s army, and d. at Nice of a wound in 1536. His poems (*Obras*, 1553) are few, but of high excellence.

Garcilaso de la Vega, b. at Cuzco, Peru, 1530, was the son of the Spanish governor of Cuzco by a Peruvian princess of the Inca blood; served as a soldier in Europe, but is chiefly remembered for his *Commentaries*, a valuable narrative of Peruvian history before and during the war of conquest. D. in Spain about 1615.

Gard, department of France, bordering on the Rhône and the Mediterranean, and watered by the Rhône and its affluents, the Gard and the Ceze. From the Cevennes, which occupy its north-western part, the country slopes down towards, and become marshy along, the Mediterranean. Wine, olives, and silk are the main productions; coal is found. Area, 2291 square miles. Pop. 429,747.

Gar'da, Lago di (the ancient *Lacus Benacus*), the largest and one of the most beautiful lakes of Northern Italy, stretches nearly from N. to S. on the boundary between the Lombardian and Venetian territories. It is 33 miles long, 10 miles broad, receives several small streams from the Alps, and sends its waters through the Mincio to the Po. It is very rich in fish. On account of its fine climate and the beauty of its scenery its shores are lined with elegant villas.

Garda'ia, town of Algeria, in the Sahara, in lat. 32° 28' N. and lon. 4° 38' E. It is situated in an oasis watered by artesian wells 900 feet deep. It is fortified, and forms one of the principal stations on the caravan-route from the Mediterranean to the interior of Africa.

Gardele'gen, town of Prussia, in the province of Saxony, on the Milde. Pop. 6266.

Gar'den, tp. of Buchanan co., Va. Pop. 1015.

Garden (ALEXANDER), M. D., F. R. S., was b. in 1728 in Scotland; graduated at Aberdeen in 1748; was a student under Dr. John Gregory; settled in 1752 at Charleston, S. C., where he acquired much wealth. He was an able botanist and zoologist, and in 1773 was chosen to the Royal Society. In 1783 he went to England, being a loyalist, and his property was confiscated, but afterwards given to his son. He became vice-president of the Royal Society, and died in London April 15, 1791. Linnæus named the beautiful genus *Gardenia* in his honor.

Garden (Major ALEXANDER), a son of Dr. Alexander Garden, was b. at Charleston, S. C., Dec. 4, 1757; was educated at Westminster and the University of Glasgow; returned to South Carolina in 1780, and joined the Revolutionary army, serving under John Laurens, Greene, and Henry Lee. His father's confiscated property was given him after the war. His *Anecdotes of the Revolutionary War* (1822–28) is a valuable source of historical information. D. at Charleston, S. C., Feb. 29, 1829.

Garde Nationale. See NATIONAL GUARD.

Gar'den Cit'y, post-v. and tp. of Blue Earth co., Minn. Pop. of v. 368; of tp. 1391.

Garden City, Queens co., N. Y., lies N. of, and immediately adjoining, the town of Hempstead, 15 miles from New York, and accessible by the Long Island, Central, and South Side (L. I.) R. Rs. It comprises about 10,000 acres of very level meadows, formerly known as Hempstead Plains. The plot was a few years ago purchased by Alexander T. Stewart, Esq., who holds the entire property in fee. At this time of writing (Feb., 1875) there are on the premises about 75 finished houses of several grades of cost, renting from \$150 to \$800, the latter rental securing a house with gas and the modern improvements, spacious grounds, with stables and outbuildings. Many new dwellings are in course of construction. On the premises is a large hotel, with basement and mansard roof, furnished throughout in the best manner, and kept in a style equal to first-class city hotels. A park of about 20 acres, handsomely laid out and kept in the best order, surrounds the hotel. The hotel has accommodations for 100 guests. The streets and avenues of Garden City are wide, partly lighted with gas, and planted with ornamental shade trees. The whole property is supplied with abundance of pure water, and the neighborhood is healthy. Schools and churches are conveniently located near the premises.

Gar'den Grove, post-v. and tp. of Decatur co., Ia., 150 miles W. from the Mississippi River and on a branch of the Burlington and Mo. River R. R. It has a good steam flouring-mill, a fine new school-house and excellent schools, 2 churches, 2 hotels, 3 wagon-shops, 2 harness-shops, 3 blacksmith-shops, 2 restaurants, a drug store, and three general stores. It has 1 weekly newspaper. Pop. of tp. 859. W. J. WIGHTMAN, ED. "DECATUR CO. LEADER."

Garde'nia [named in honor of Dr. Alexander Garden of Edinburgh and Charleston, S. C. (1728–91)], a genus of plants of the order Rubiaceæ, including some of the most beautiful and fragrant shrubs and trees known. Among them, the *Gardenia grandiflora* and other species of China yield a valuable yellow dye; and the *Gardenia campanulata* of Chittagong is used in medicine. Many species are cultivated in green-houses. Some of these are called cape jasmine, and came originally from Eastern Asia and South Africa. Excellent timber and resins are produced by various species.

Gardening. See HORTICULTURE and LANDSCAPE GARDENING.

Garden Plain, tp. and post-v. of Whitesides co., Ill. The township is on the Mississippi River, and the village is 3 miles S. of Fulton, on the Mendota and Clinton division of the Chicago Burlington and Quincy R. R. Pop. of tp. 1091.

Garden Prairie, post-v. of Boone co., Ill., in Bonus tp., on the Galena division of the Chicago and North-western R. R., 21 miles E. of Rockford.

Garden Valley, a v. of Austin tp., Lander co., Nev. Pop. 28.

Garden Valley, tp. of Jackson co., Wis. Pop. 678.

Gar'diner, city and tp. of Kennebec co., Me., on the Kennebec River, 41 miles from its mouth, and on the Maine Central R. R. It is divided by the Cobbossee River, which here empties into the Kennebec, forming in its passage through the city a very valuable water-power. The Cobbossee is spanned by 8 dams within one mile from its mouth, with a total fall of 133 feet above low tide. It contains 9 saw-mills driven by water and 1 by steam, 3 large paper-mills, 3 manufactories of sash, blinds, and doors, one large gutter-factory (steam), 2 furniture manufactories, 1 small tannery, one leather-belting manufactory, 1 large brick grist-mill, 1 bran, flouring, and grist-mill, 1 woollen factory, 2 iron-foundries, 5 machine-shops, 1 fancy box manufactory, 1 manufactory of broom-handles, bed-slats, etc., 1 gas-factory, 1 axle-factory, 1 spring-factory, 2 brick manufactories, a pottery, 5 carriage, and other smaller manufactories. Opposite, in Pittston, is one of the most complete steam-mills in the State. Gardiner has 2 newspapers, 11 churches, 3 national and 1 savings bank, 2 public libraries, and a provident association. It is the head-quarters of the ice-business on the Kennebec, which is one of the greatest industries of the city. Pop. of tp. 4497. H. K. MORRELL, ED. "HOME JOURNAL."

Gardiner, post-tp. of Ulster co., N. Y., on the Wallkill Valley R. R., 81 miles N. of Jersey City. It has manufactures of leather and lumber. Pop. of tp. 1991.

Gardiner (GEORGE W.), b. in the District of Columbia; graduated at the U. S. Military Academy, and entered the army as third lieutenant of artillery in 1814, promoted to be first lieutenant 1818, and captain 1832; served in the war with Great Britain 1812–15; in garrison duty mostly 1815–35. In the Florida war he was engaged in Dade's battle with the Seminole Indians, Dec. 28, 1835, where the whole command save three fell without attempting to retreat. A beautiful monument was erected at West Point to Dade and his command.

Gardiner (JOHN), son of Dr. Sylvester Gardiner (1707–86), b. at Boston, Mass., 1731; studied law in the Inner Temple, and was called to the bar in England, and practised in London and in Wales; was one of the counsel for Wilkes in 1764; became in 1766 attorney-general of St. Kitt's, West Indies; removed after the Revolution to Boston, Mass., and in 1786 to Pownalboro', Me. (then Massachusetts); was in the Massachusetts legislature 1789–93; procured the abolition of the laws of primogeniture in Massachusetts, the prohibition of special pleading, and the repeal of the anti-theatrical laws. He was one of the leaders of the original Unitarian movement in Boston 1787. Was drowned off Cape Ann Oct. 15, 1793. He was a man of great learning, wit, and eloquence, and a zealous republican.

Gardiner (JOHN SYLVESTER JOHN), D. D., son of John Gardiner (1731–93), b. at Haverfordwest, Wales, June, 1765; was educated by John Lovell of Boston, a famous teacher, and for six years was a pupil of Dr. Parr in England; was ordained in 1787 by Bishop Provoost, and was in charge of the Episcopal parish of St. Helena, S. C., 1787–91; assistant minister (1792–1805) and rector after 1805 of Trinity church, Boston, Mass.; was distinguished for eloquence and literary taste. D. at Harrowgate, England, July 29, 1830.

Gardiner (STEPHEN), D. D., LL.D., b. at Bury St. Edmunds, England, 1483; was educated at Cambridge, and became master of Trinity Hall; became Wolsey's secretary, and in 1528 was sent by Henry VIII. to Rome to further his application for divorce; became secretary of state 1529; bishop of Winchester 1531; ambassador to France 1533; chancellor of Cambridge University 1540; opposed, as far as he dared, the Reformation; came into great power on Cromwell's fall; married the king to Catharine Parr 1543; envoy to Flanders 1545; was imprisoned during Edward VI.'s reign; restored to his bishopric by Queen Mary and made lord chancellor 1553. D. in London Nov. 12, 1555. He was a severe persecutor of Protestantism, an able and ambitious public officer, and a man of extraordinary learning. Gardiner's principal writings are *De vera obedientia* (London, 4to, 1534–35; translated by M. Wood, 1553); *A Necessary Doctrine of a Christian Man*, 1543; *Sacrament of the Aulter*, 1551, and various tracts on religious and literary subjects. Ascham defends Gardiner, who was his benefactor.

Gardiner (SYLVESTER), M. D., b. at Kingston, R. I., 1707; studied medicine in Paris and London; became a practitioner of Boston, Mass., and also medical instructor and drug-merchant; acquired wealth; founded (1760) the present city of Gardiner, Me., and colonized it with Germans; was one of the founders of King's chapel, Boston; prepared and published a prayer-book; established a church and library at Gardiner; was a loyalist in the Revolution; went to England in 1776, where his family became allied by marriage with the nobility. He returned to America in 1785, and d. at Newport, R. I., Aug. 8, 1786. Some 100,000 acres of his lands were confiscated, but his heirs regained possession, and the property in Maine was entailed to his grandson, Robert Hallowell, who took the name of Gardiner.

Gardiner's (or **Gardner's**) **Island,** an island lying E. of Long Island, belongs to East Hampton tp., Suffolk co., N. Y. Area, 3300 acres. It is chiefly devoted to pasturage. It was colonized by the English in 1639. Here (in 1699) Capt. Kidd buried his treasures, which were afterwards dug up. Its N. point, in lat. 41° 8′ 18″ N., lon. 72° 8′ 13″ W., has a lighthouse.

Gard'ner, post-v. of Greenfield tp., Grundy co., Ill., on the Chicago and Alton R. R., 27 miles N. E. of Pontiac. Pop. 940.

Gardner, tp. of Sangamon co., Ill., is traversed by the Springfield and Illinois South-eastern R. R., and lies W. of Springfield. Pop. 1270.

Gardner, post-v. and tp. of Johnson co., Kan., on the Kansas City branch of the Leavenworth Lawrence and Galveston R. R., 30 miles S. W. of Kansas City. Pop. of tp. 944.

Gardner, post-v. and tp. of Worcester co., Mass., at the junction of the Vermont and Massachusetts and the Worcester Gardner and Winchendon R. Rs., and about 26 miles from Worcester, the county-seat. It is the chief seat of the chair manufacturing interests in this county. It contains 14 cane and wood seat chair manufacturing establishments, which give employment to 2000 men, women, and children. Over 200 different varieties of chairs are made and shipped to all parts of the world. The annual product of these factories is over $2,000,000. The town also contains a national and savings bank, a newspaper, and good public buildings. Pop. of tp. 3333.
A. G. BUSHNELL, ED. "THE GARDNER NEWS."

Gardner, tp. of Door co., Wis., on Green Bay, Lake Michigan. Pop. 403.

Gardner (AUGUSTUS KINSLEY), A. M., M. D., b. at Roxbury, Mass., July 31, 1821; studied three years at Harvard College, which in 1852 conferred the honorary degree of A. M. upon him, he having taken the medical degree there in 1844; after which he studied in Europe; settled in New York, where he has occupied prominent positions in various hospitals, dispensaries, and asylums; was for a time professor of diseases of females and clinical midwifery in the New York Medical College; author of *Old Wine in New Bottles*, 1848; *Causes and Treatment of Sterility; Conjugal Sins; Our Children; Ships and Shipbuilders of New York;* and of many professional and other papers; has given special attention to the subject of importing foreign birds as destroyers of insect larvæ; to the establishment of drinking-fountains in New York; to the investigation of the swill-milk business; to the reformation of the established code of medical ethics; and to influence of the sewing-machine on health, etc. His enlarged edition of Tyler Smith's *Lectures*, and his translation of Scanzoni's *Diseases of Females*, are standard text-books. D. Apr. 7, 1876.

Gardner (CHARLES K.), b. in New Jersey 1786; entered the U. S. army as ensign 6th Infantry May, 1808; subsequently served as captain 3d Artillery and major 23d Infantry. In the war of 1812 he was prominent as the adjutant-general of the division of the North, under Maj.-Gen. Brown, participating in the battles of Chrystler's Fields, Chippewa, and Niagara, and at the siege and defence of Fort Erie; appointed adjutant-general Mar. 12, 1814. In 1818, Gen. Gardner resigned from the army, and during the administration of President Jackson was first assistant postmaster-general; auditor of the treasury for the P. O. department under Van Buren's administration, subsequently commissioner to investigate and settle affairs connected with the Indians in the Southern States; was postmaster of the city of Washington during Polk's, and surveyor-general of Oregon during Pierce's administration; he was then transferred to an office in the treasury department, which he held till 1867, when he was compelled to resign from advanced age and infirmity. Possessing a literary mind, he was a frequent contributor to various periodicals and magazines, and was the author of a *Compend of Infantry Tactics*, *Dictionary of the Army*, etc. D. at Washington, D. C., Nov. 1, 1869.

Gardner (HARMONY C.), authoress, was b. July 31, 1821, at East Weymouth, Mass. She was married, in 1842, to Rev. Abel Gardner, A. M. Her writings are numerous, and distinguished by their humor and high moral tone. Among them are *Rosedale, a Story of Self-Denial; Extracts from the Diary of a Country Pastor; Ellinor Gray; Annie Lee, and her Irish Nurse; Fault-finding, and What*

Came of It; Rosamond Dayton; The Power of Kindness; The King's Daughter; Miss Carrol's School; Harry Love; Holiday Poems; Mehitable, etc. ABEL STEVENS.

Gardner (Gen. JOHN LANE), b. in Boston, Mass., Aug. 1, 1793; entered the U. S. army in 1812 as third lieutenant of infantry; saw active service first in Canada; was wounded in the attack under Gen. Wilkinson on La Cole's Mill Mar. 30, 1814; was afterwards on the staff of Gen. T. A. Smith, and at the peace was transferred to the artillery. From 1820 to 1830 he served as assistant quartermaster-general, with the rank of captain. In 1833 he was brevetted major in the 4th Artillery; served with this regiment during the Florida war, and was reported as having shown "the utmost activity, skill, and intrepidity" at the battle of Wahoo Swamp; in Oct., 1845, was promoted to the full rank of major; commanded his regiment throughout the Mexican war, and was brevetted lieutenant-colonel for "gallant and meritorious service" in the battle of Cerro Gordo. At the battle of Contreras he commanded the right column of attack, and was brevetted colonel for gallant service. In 1849-50 he commanded the district of Florida; became lieutenant-colonel 1852, and some years later was placed in command of Charleston harbor, where he was stationed in 1860. Though having less than fifty effective men in Fort Moultrie, he obtained, by an arrangement with Col. J. P. Taylor, commissary-general (unknown to the secretary of war), six months' provisions, and announced his intention to defend the fort to the last extremity. Secretary Floyd thereupon relieved him from command, ordering him to report to Gen. Twiggs in Texas. Major Anderson, his successor, on removing his command to Fort Sumter, secretly carried thither the provisions which Col. Gardner's foresight had secured. He was promoted to be colonel of the 2d Artillery July 23, 1861, and in the following year, being disabled for active service, he was at his own request placed on the retired list, and employed on recruiting service. After the peace he was sent by Gen. Grant to his old command in Charleston. In 1865 he was brevetted brigadier-general "for long and faithful service." D. at Wilmington, Del., Feb. 19, 1869.

Gard'ner's, tp. of Wilson co., N. C. Pop. 1178.

Gareschè (JULIUS P.), b. in Cuba, of parents who were American citizens, in 1821; graduated at West Point July, 1841, and entered the army as second lieutenant 4th Artillery; served on the northern frontier and in garrison duty 1841-46; in the Mexican war 1846-48; and from 1855 to 1862 as assistant adjutant general in Washington, D. C.; promoted to be major and A. A. G. Aug., 1861. On the outbreak of the civil war he sought active service, and was appointed chief of staff to Maj. Gen. Rosecrans, commanding the army of the Cumberland, having previously declined the commission of brigadier-general of volunteers. At the battle of Stone River, Tenn., in a gallant attempt to recover the battle, which then appeared to be lost, he, with the commanding general and his staff, dashed forward, and was struck in the head by a cannon-ball and killed, Dec. 31, 1862.

Gar'field (JAMES A.), LL.D., 20th Pres. of the U. S., b. in Orange, Cuyahoga co., O., Nov. 19, 1831; graduated at Williams Coll., Mass., 1856; studied and practised law; member of the Ohio senate 1859-60. In the civil war he entered the service in 1861 as colonel 42d Ohio Volunteers, and served in S. E. Kentucky, where (Jan., 1862), in command of a brigade, he forced Humphrey Marshall with his command to evacuate Kentucky, for which service he was promoted to be brigadier-general of volunteers Jan. 11, 1862, and served at Shiloh, Corinth, etc.: in 1863, Gen. Rosecrans appointed him his chief of staff, with whom he continued to serve until Dec. 5, 1863, having in the mean time (Sept. 19, 1863) been promoted to be major general of volunteers for gallantry at the battle of Chickamauga, when he resigned to occupy his seat in 38th Congress, to which he had been elected, and was re-elected to each succeeding Congress, serving as chairman of the committees on military affairs, banking, and appropriations. Elected U. S. Senator from Ohio Jan. 13, 1880; nominated for President of U. S. by the Republicans at Chicago, Ill., with Chester A. Arthur for Vice-President, June 8, 1880, and elected Nov. 2, 1880; shot and mortally wounded July 2, 1881, by Charles J. Guiteau, who was lying in wait for him at the R. R. dépôt in Washington, D. C., as the Presidential party was about leaving for an extended pleasure-trip through New England. President Garfield was removed in a critical condition Sept. 6, 1881, from the White House at Washington in a specially arranged car to Long Branch, N. J., where he died Sept. 19, 1881. G. C. SIMMONS.

Gar-Fish, the name of several fishes: (1) Those of the genus *Belone* and family Scomberesocidæ, partly marine and partly fluviatile. The *Belone vulgaris* of the European seas is a long, active fish, with alligator like jaws. It is prized as food, like *Belone longirostris* of the American seas and rivers. There are fresh-water species in various tropical countries. (2) The names gar and alligator-gar are given in the U. S. to the gar-pikes, of the genus *Lepidosteus*, of the family Lepidosteidæ. They are remarkable for their ganoid scales and the power of turning the head from side to side—a power which no other fishes possess. They somewhat resemble the true gars (*Belone*) in appearance, but are worthless as food. They are a kind of link between fishes and reptiles. Various species are found in the Northern lakes and Western and Southern rivers, and others in tropical America.

Gar'ganey, or **Summer Teal**, the *Anas querquedula*, a wild-duck of Europe, Africa, and Asia, highly prized as food. It is sixteen inches long, and beautifully variegated with white, brown, and green.

Gar'gano, a mountainous peninsula of Southern Italy, in the province of Capitanata, stretching 20 miles into the Adriatic. The northern range of its mountains is still famous for its honey, as it was in the time of Horace; the southern range is naked and cheerless.

Garget-Root, Poke, or **Skoke**, the *Phytolacca decandra* (order Phytolaccaceæ), a large perennial herb of the U. S., naturalized to some extent in Southern Europe. Its root is useful in veterinary practice, and in the diseases of mankind it has some power as an alterative. Its young shoots are used as a potherb, but should only be so used when very young, and care should be taken to boil them thoroughly, otherwise they may prove a powerful irritant poison. The berries afford a rich but fugitive purple, employed in France for coloring wines; but the berries share in the poisonous properties of the plant. The root, when given to cattle, is cut up into plugs, which are thrust into potatoes or turnips, and thus eaten. The root should not be given to the horse, for it is believed to be very poisonous to that animal. Several other species of *Phytolacca*, growing in China, India, Cayenne, Chili, etc., share the properties of this plant, and are used as potherbs to some extent.

Gar'goyle, in architecture, the carved lower end or outlet of the water-spout from the roof of a building. In mediæval times these were often curiously shaped in imitation of men, beasts, birds, and fanciful creatures. In quite recent times we find an absurd custom of making gargoyles without water-pipes, or any possible use other than that of grotesque adornment.

Garibal'di (GIUSEPPE), a great Italian general and patriot, b. at Nice July 4, 1807. In his youth he made many voyages as a sailor, but having taken part, in 1833 and 1834, in the movement of the Young Italians, which ended in the unhappy expedition of Savoy, he was driven into exile. In 1836 he arrived in South America, having served in the mean time in the French navy. He at once offered his services to the republic of Rio Grande, and showed such zeal in her defence that after having fought many a hard battle, and won especial glory in that of San Antonio, Feb. 6, 1846, he received the well-merited title of "the hero of Montevideo." Indeed, the narrative of the heroic exploits and the romantic adventures and escapes of Garibaldi during his South American campaigns forms one of the most stirring chapters in military story. Remote posterity will regard the life and labors of Garibaldi as mythic, or perhaps suppose, as the ancients thought of Hercules, that one fortunate hero has absorbed in his single name the fame of many. But he had not forgotten his native land; and, roused by the events of 1848, in April of that year, he, with his wife Anita, a Spanish American, and a few brave comrades, left Montevideo and returned to Italy. At the moment of his arrival the army of Charles Albert, at first successful in Lombardy, had begun to give way. Garibaldi offered him his services; they were refused. Finally, however, the provisional government of Lombardy, when the affairs of those provinces were already drawing near their sad conclusion, entrusted Garibaldi with the command of a body of volunteers. With these the brave Nizzard obtained some successes, though of small military importance. Lombardy having fallen once more wholly into the hands of the Austrians, Garibaldi offered his sword to the republic of Rome, and the supreme command was given to him and to Gen. Roselli. The glory of the admirable and heroic defence of Rome against French intervention in 1849 chiefly belongs to Garibaldi. Escaping from Rome, after the fall of the city, with 3000 of his followers, in the hope of being still able to effect something against Austria, he took refuge in San Marino, but being surrounded on all sides by the Austrian forces, he found himself obliged to disband his troops. His plan then was to make his way, with a few faithful companions, to Venice, which still held out. But the news soon arrived that Venice too had fallen. Nothing then remained but to seek a place of safety for his wife and him-

self; but Anita, exhausted by fatigue and privation, died in childbirth near Ravenna. The heroic patriot, alone in his grief, repaired to Chiavari in Liguria, and there the government of the king of Sardinia offered him the choice between prison and exile. Garibaldi sailed for Tunis, but through the intrigues of the French consul that town refused to receive him. Thereupon he went back to the island of Maddalena, near which lies the little islet of Caprera that was one day to become the solitary and renowned seat of the great captain. Here he provided for himself for some time by hunting and fishing, but finally went again to America. There he was prosperous in business, and was able on his return in 1854 to purchase the northern part of Caprera. Here he remained until 1859, in which year he organized and commanded the glorious band of the "cacciatori delle Alpi," or Alpine chasseurs—a body of volunteers that made the whole Lombard campaign, having crossed the Ticino eleven days before the French troops. After the peace of Villafranca, so unfortunate for Italy, Garibaldi formed in Central Italy the corps of the "cacciatori degli Apennini," or chasseurs of the Apennines, and trained them with the view of throwing himself upon the papal provinces and once more liberating Rome. The policy of Piedmont prevented him from carrying out this plan; but, on the other hand, Count Cavour assisted him in the expedition against Sicily with all the means he could dispose of without compromising his government. The island being in a state of insurrection, on May 5, 1860, Garibaldi sailed mysteriously from Quarto in Liguria with 1000 armed comrades, eluded the vigilance of the cruisers of the Bourbon fleet, and with astonishing boldness landed on May 11 at Marsala, gave battle near Calatafini on the 15th to the Bourbon army, which he defeated with his single thousand, and on May 27, after various partial but successful engagements and some most skilful manœuvring, entered gloriously into Palermo. This part of the Garibaldian legend is truly epic. The hero was soon regarded by the superstitious Sicilians as a saint, a liberating angel, invulnerable, and sent by God. At Palermo, Garibaldi assumed the dictatorship of the island. On July 20 he gained a new and decisive victory over the Bourbon troops; on the 28th the fortress of Messina fell into his hands. On Aug. 25 he gave battle at Reggio in Calabria, conquered, and then marched rapidly and victoriously upon Naples. The Bourbons were terrified; there were numerous desertions from the army; King Francis fled from Naples to Gaeta; Garibaldi alone, and to the astonishment of the world, entered triumphant into Naples, and was there proclaimed dictator of the Two Sicilies. Count Cavour feared that the victorious Garibaldi might prove untrue to the motto upon his banner, "Italy and Victor Emmanuel;" that a republic might be proclaimed at Naples; that Garibaldi might march upon Rome, and so draw upon Italy the indignation and the arms of France. He therefore sent, under the pretext of assisting him, a body of Piedmontese troops into the ex-kingdom of Naples. Garibaldi and the Piedmontese together gained the victory of Volturno, after which took place a *plebiscito* or *universal* vote for the annexation of the kingdom of the Two Sicilies to that part of Italy which was then governed by King Victor Emmanuel. The annexation being voted on Nov. 9, 1860, Garibaldi, after what may be styled emphatically the *gran dono* to King Victor Emmanuel—the bestowal of a kingdom which, had he wished, he might have made his own—retired, great as Cincinnatus of old, to his island solitude of Caprera. But he did not cease to occupy himself with his beloved Italy. The cession of Nice and Savoy to France having taken place, he entered the Italian Parliament and protested energetically against surrendering to a foreign power a portion of the Italian soil—that very soil where he, the liberator of Italy, first saw the light. Nevertheless, he did not lose heart; he knew that Venice and Rome were still to be liberated. For the former, in May, 1862, he undertook the expedition of Sarnico, which, through the intervention of the Italian government, was broken up in its very beginning; then that of Rome with the cry "Roma o morte!" ("Rome or death!"), which ended in the fatal battle of Aspromonte, where not the enemies of Italy, but Italian riflemen, assailed him, wounded him with a ball in the foot, and took him prisoner on Aug. 29, 1862—a day of mourning for Italy. On Dec. 19, 1862, Garibaldi, amnestied and with his wounds healed, returned to Caprera. In 1864, Gen. Garibaldi visited England, where he was received with most enthusiastic demonstrations by all classes. On the breaking out of the war of 1866 for the liberation of Venice, Garibaldi assumed the command of a body of volunteers, with whom he advanced into the Trentino, and the only Italian victories of the inglorious campaign of that year were those obtained by the Garibaldians. The following year Garibaldi once more attempted with his volunteers to liberate Rome; he entered the Campagna, defeated the papal troops at Monterotondo on Oct. 25, 1867, and marched upon Rome; but near Mentana, meeting the French and papal army under the command of Gen. Failly—who by order of Napoleon III. was to make upon Italians the first trial of the "miraculous" powers of the newly-invented *chassepot*—he was defeated in spite of the most heroic efforts. Garibaldi was for some time held a prisoner in the fortress of Varignano, near Spezzia; afterwards he was permitted to return to Caprera. In 1870 the misfortunes of France and a warm appeal from Gambetta touched him, and decided him to hasten with his sword, his courage, his fortune, and his sons to the aid of the French republic against the Prussians. In France he received the command of a corps called the "volunteers of the Vosges;" his son Ricciotti on Oct. 19 obtained a small victory over the Prussians; and that these latter advanced no farther in that direction was wholly due to the corps commanded by Garibaldi. As an acknowledgment, after the capitulation of Paris he was elected deputy to the Assembly at Bordeaux, but there, in the attempt to exercise freedom of speech, French gratitude put him down by tumultuous demonstrations of ill-will, and, renouncing his deputyship, he returned to Caprera. Since 1870, Garibaldi has published three romances—*Clelia*, *Cantoni il Voluntario*, and *I Mille*—but all three are below mediocrity. The general has not had sufficient literary culture to be a good and tasteful writer, and his printed works are not calculated to increase his reputation. He is a man of heart and of action, but neither a statesman nor a man of letters.

The frequent collisions into which Garibaldi has been brought with the royal government, while they have not lessened his love for his native country—for Nice is essentially Italian—or his generous devotion to her good, have nevertheless produced in him an alienation of sentiment towards the dynasty and the governing classes in Italy, which, in combination with his ardent republicanism, has often led him to treat the present political organization of the people as a failure. This opinion cannot be admitted to be well founded; and in justice to the Italians and their government it must be remembered that the latter has repeatedly offered Garibaldi most tempting titles, honors, and rewards, which he has magnanimously declined; that though its unhappy dependence on France—a relation now, it may be hoped, severed for ever—has compelled it to resist his military movements, and even temporarily to restrain him of his liberty, yet it has always, up to the present day, shown him unbounded personal consideration; and that he enjoys, in the universal gratitude of his countrymen, the highest reward to which the soul of a patriot can aspire. Member of the Italian Parliament for 1875. (Among the numerous biographies of Garibaldi, one of the most faithful and valuable is that written by his venerable friend and former companion in exile at Montevideo, Giambattista Cuneo, Turin, 1865.)

F. A. P. BARNARD.

Gariglia'no [Lat. *Liris*], a river of Southern Italy, which receives the water of Lago di Fucino, forms the marshes of Minturnæ (famous in the history of Marius and Sulla), and enters the Mediterranean 9 miles E. of Gaeta.

Gar'land, county of W. Central Arkansas. Area, about 540 square miles. Formed since the census of 1870 from Montgomery, Hot Springs, and Saline cos. Its surface is broken; the mineral resources great and varied. The county abounds in mineral and thermal springs, serviceable in many diseases. Cap. Hot Springs.

Garland, post-tp. of Penobscot co., Me., 25 miles N. W. of Bangor, has 3 churches, and manufactures of shoes, carriages, lumber, etc. Pop. 1306.

Garland (AUGUSTUS H.), a prominent lawyer, jurist, and politician of Arkansas, b. in Tipton co., Tenn., June 14, 1832, and educated at Bairdstown; studied law; removed to Arkansas, and soon rose to eminence; opposed secession as a policy until his State passed her ordinance withdrawing from the Union, then cast his fortunes with hers; was elected to the provisional Congress of the Confederate States in 1861; was re-elected to the House of the same Congress in 1862; was afterwards elected to the Confederate Senate, which office he held till the surrender in 1865. After the war he devoted himself with great success to his profession, and in 1874 was elected, by a very large majority, governor under the new constitution of Arkansas.

A. H. STEPHENS.

Garland (HUGH A.), b. in Nelson co., Va., June 1, 1805; graduated at Hampden-Sidney College 1825; was professor of Greek there 1825–30; became a leading lawyer of Mecklenburg co., Va.; clerk of the U. S. House of Representatives 1838–41; removed in 1841 to a farm near Petersburg, Va., and in 1845, having lost his property, removed to St. Louis, Mo., where he d. Oct. 15, 1854. Author of

Lives of Jefferson and John Randolph.—His son, Hugh A., a lawyer of Missouri and a Confederate colonel, was killed in battle in Tennessee in 1864.

Garland (John), b. in Virginia in 1792, and appointed a first lieutenant 35th regiment of infantry, U. S. A., Mar. 31, 1813. At the close of the war with Great Britain he was retained in the army, and promoted to be captain in 1817, major in 1836, lieutenant colonel in 1839, and colonel in 1849. He bore an active part in the war with Mexico, and in the taking of the city of Mexico was severely wounded; brevetted brigadier-general for gallant services. D. at New York June 5, 1861.

Garland (Landon Cabell), A. M., LL.D., mathematician and scholar, b. at Lovingston, Va., Mar. 21, 1810; was educated at Hampden Sidney College, Va.; was professor of chemistry at Washington College, Va., from 1830 to 1833, and in Randolph-Macon College, Va., from 1833 to 1835, then its president to 1846, and at the same time professor of pure and mixed mathematics. In 1847 he became professor of English literature, and afterwards of mathematics, in the University of Alabama, and in 1855 its president; since 1866, professor of physics and astronomy in the University of Mississippi; is professor-elect of physics in the Vanderbilt University at Nashville, Tenn. Has written on plane and spherical trigonometry, and also largely in the periodicals of the Methodist Episcopal Church, South.

Garlas'co, town of Italy, in the province of Pavia. It is of some interest as a Roman and a mediæval town, and contains monuments of the latter period. Pop. 6500.

Gar'lic, the *Allium sativum*, a cultivated plant allied to the onion (order Liliaceæ), and much used as a condiment in Southern Europe. The part chiefly employed is the bulb, or rather the collection of small bulbs (cloves of garlic). The wild species are numerous on both continents, especially on the eastern. Garlic has a taste resembling that of the onion, but much stronger. It is employed in medicine as a stimulant, expectorant, diaphoretic, and revulsive. It is for the most part used externally. It abounds in the peculiar volatile oil of garlic, to which it owes most of its active properties.

Garlic, Oil of, obtained by distilling the garlic bulbs, which yield about 0.2 per cent. of crude brown oil. By careful rectification about two-thirds of this is obtained as a pale yellow oil, lighter than water. By further treatment with chloride of calcium, and distillation from a little potassium, it is obtained pure and colorless. It consists of sulphide of allyl $(C_3H_5)_2S$, which was associated in the crude oil with oxide of allyl $(C_3H_5)_2O$ and another sulphur compound. This oil has the peculiar penetrating odor of garlic; it is also found in oils of onions, radishes, etc.

Oil of black mustard contains the sulphocyanide of allyl, C_3H_5CNS. These two oils are mutually convertible; by distillation with potassium the sulphocyanide is changed to sulphide; and by treating oil of garlic with corrosive sublimate, and distilling the precipitate with sulphocyanide of potassium, oil of mustard is produced. This oil is also found in horseradish, scurvy-grass, etc.

C. F. Chandler.

Garnavil'lo, post-tp. of Clayton co., Ia. Pop. 1226.

Gar'ner, tp. of Union co., Ark. Pop. 456.

Garner, post-v. of Hancock co., Ia., at the junction of the Milwaukee and St. Paul and the Iowa and Minnesota R. Rs., near the centre of the county, 1 mile from the county-seat, surrounded by good prairie-land, suitable for grain and stock raising. It has 4 stores, a hotel, a saloon, a wagon shop, a printing-office, a weekly newspaper, 2 store-houses for grain, a lumber-yard, and in its vicinity a good nursery; 80,000 bushels of wheat were brought here in 1874.

W. C. Hayward, Ed. "Signal."

Gar'nersville, a v. of Haverstraw tp., Rockland co., N. Y., has important print-works. It is 2 miles N. W. of Warren.

Gar'net, a precious stone belonging to the monometric or cubic system of crystallization, its secondary forms being generally the rhombic dodecahedron and trapezohedron. Specific gravity, 3.6 to 4.2; hardness, 6.5 to 7.5. It occurs in the mountainous regions of most countries, usually in mica-slate, hornblende-slate, and gneiss; less frequently in granite, serpentine, and lava. There are several varieties, differing in color and chemical composition, but agreeing in other properties. When colorless, the common garnet consists of silica, lime, and alumina in the proportion of about 38 parts of each of the two former to 24 of the latter. The precious or Oriental garnet (*almandine*) owes its fiery brightness to an infusion of about 40 per cent. of the protoxide of iron, the lime being absent. The composition of the *pyrope*, or Bohemian garnet, is somewhat different, comprising a less proportion of iron in the form of a peroxide; it has also an infusion of magnesia and the oxide of chromium. These, with the *essonite*, or cinnamon stone, found chiefly in Ceylon, and containing no iron, are the only varieties used in jewelry. There are also, however, the *grossularite* and *ouvarovite*, green; the *colophonite* and *spessartine*, brown; the *succinite*, *melanite*, and *leucite*, yellow, black, and white respectively. The Oriental garnet, or almandine (so called from the city of Alabanda, where it was anciently wrought), is found in alluvial soil, into which it has been washed out of its matrix, in Pegu, Siam, Ceylon, and India. When very large, as is frequently the case, it is cut *en cabochon*—*i. e.* with a flat base and convex upper surface—and is then termed a *carbuncle*. The pyrope, or Bohemian garnet, found chiefly in Austria and Germany, is smaller, less splendid in tint, more common, and less esteemed. Notwithstanding its beauty, the commercial value even of the Oriental garnet has greatly declined in modern times, owing to the numbers brought into the market. A fine carbuncle, according to Mr. Emanuel, is worth about £20. They are sometimes sold as "Ceylon rubies." The garnet was frequently selected for engraving upon by the artists of the Roman empire; one of the finest specimens of antique skill, the head of Sirius in the Marlborough collection, is upon a garnet. It was also a favorite gem with the engravers of the Sassanian period, but is rarely employed now, owing to its hardness and brittleness, which too severely tax the abilities of modern artists.

R. Garnett.

Gar'nett, a post-v., cap. of Anderson co., Kan., 52 miles S. of Lawrence, on the Pottawattomie River, a small tributary of the Osage or Marais des Cygnes. The Paola Garnett and Fall River and the Leavenworth Lawrence and Galveston R. Rs. intersect here. It has 2 newspapers, 2 banks, 2 large mills, a cheese-factory, an extensive planing-mill and furniture manufactory, 2 hotels, a college under the auspices of the United Presbyterian denomination, and 8 churches. The town has a large and very fine union school building. The village is well built, the business portion mainly of brick and stone. All departments of trade are well represented. Pop. 1219.

W. R. Spooner, Ed. "Plaindealer."

Garnett (Alexander Yelverton Peyton), M. D., was b. Sept. 20, 1820, in Essex co., Va.; graduated in the medical department of the University of Pennsylvania 1841; entered the U. S. navy same year, and rose to full surgeon in 1848. Having been elected professor of clinical medicine in the National Medical College, he resigned his naval appointment in 1850. In 1861 he left the capital and returned to Virginia; went to Richmond, where he was appointed on the examining board of surgeons, then surgeon-in-chief to the military hospitals; and being the family physician of Mr. Jefferson Davis, accompanied him on the evacuation of that city in 1865. After the downfall of the Southern Confederacy, Dr. Garnett returned to Washington City, where he was re-elected professor in the National Medical College, which position he resigned in 1872; was made emeritus professor; and still resides in that city.

Paul F. Eve.

Garnett (James M.), b. June 8, 1770, at Elmwood, Essex co., Va.; served several years as member of the legislature of that State, and served as a member of Congress from 1805 to 1809; was also a member of the constitutional convention of Virginia in 1829. D. at Elmwood May, 1843.

A. H. Stephens.

Garnett (Muscoe R. H.), b. in Essex co., Va.; educated at the university of the State; became a lawyer by profession; was a member of the constitutional convention of Virginia in 1850; was a member of the house of delegates of that State in 1853–54 and 1855–56; was a member of Congress from 1857 to 1859, and was re-elected to the 36th Congress, but resigned his seat on the secession of Virginia (1861), and d. during the war.

A. H. Stephens.

Garnett (Richard Brooke), b. in Virginia in 1819; graduated at West Point July, 1841, and entered the army as second lieutenant 6th Infantry; served in the Florida war and on garrison and frontier duty. On the outbreak of civil war he resigned from the U. S. army, May, 1861, and was appointed colonel in the Confederate army, serving in Western Virginia; but was afterwards promoted to be brigadier-general, and transferred to Gen. Lee's army and commanded a brigade. Killed at the battle of Gettysburg, Pa., July 3, 1863.

Garnett (Robert Selden), b. in Virginia in 1820; graduated at West Point July, 1841, and entered the army as brevet second lieutenant of artillery; served on the northern frontier and as assistant instructor of infantry tactics at West Point till 1844; was aide-de-camp to Gen. Wool in 1845. In the Mexican war he distinguished himself at the battles of Palo Alto, Resaca de la Palma, Monterey, and Buena Vista; was promoted to be first lieutenant Aug., 1846, and served as aide-de-camp to Gen. Taylor from

June, 1846, till Jan., 1849; was brevetted captain and major for gallant conduct at Monterey and Buena Vista: transferred to the infantry in 1848, and served against the Seminole Indians in Florida and on frontier duty in Texas 1850; as commandant of cadets at Military Academy 1852–54; appointed captain 1st Cavalry Mar. 3, 1853, and major 9th Infantry Mar. 27, 1855; he commanded the Yakima expedition in 1856, and the operations against Puget Sound Indians in 1858. On the outbreak of civil war he resigned from the U. S. army and espoused the cause of the Confederates, being appointed a brigadier-general and placed in command of the department of Western Virginia; at the action of Carrick's Ford, July 13, 1861, Gen. Garnett was killed while attempting to rally his forces. G. C. SIMMONS.

Garnier (JEAN LOUIS CHARLES), French architect, b. at Paris Nov. 6, 1825; entered the École des Beaux Arts 1842, and in 1848 gained the grand prize; subsequently travelled in Greece and Italy, where he continued his studies. In 1859, in open competition with the leading architects of Paris, his plans were unanimously adopted for the new Paris opera-house, which has but recently been completed under his direction. In 1864 the cross of the Legion of Honor was bestowed upon him.

Garnier-Pagès (LOUIS ANTOINE), a French author and statesman, b. at Marseilles July 18, 1803; made his *début* under the patronage of his brother, who was one of the leaders of the republican party under the Restoration. During the reign of Louis Philippe, Garnier-Pagès was a member of the Chamber of Deputies. In 1848 he secured the office of minister of finances in the provisional government of the republic, and became unpopular on account of the famous over-taxation called the "45 centimes." When the empire was established, Garnier-Pagès returned to private life until 1864, when he was elected deputy to the Corps Législatif. In 1869 he was elected again, but, though he sat on the opposition benches, his popularity was gone, and he did not exercise any influence upon the events which followed the revolution of Sept. 4, 1870. He has written an *Episode of the Revolution of 1848*, *History of the Executive Commission*, *History of the Revolution of 1848*. D. at Paris, France, Nov. 1, 1878. FÉLIX AUCAIGNE.

Gar'nishment [Fr. *garnir*, to "warn" or "furnish"], a process of attachment by which a creditor obtains the security of property belonging to his debtor which is in the possession of third persons. It consists in a *warning* or notification given to the person holding the property, who is called a *garnishee*, commanding him not to make payment or delivery to the debtor, but to be in readiness to answer the plaintiff's claim by retaining the property in his own hands. Whenever a debtor against whom an action is instituted has himself a claim against a debtor of his own, the latter may be made a garnishee. The system of garnishment in England grew out of the custom of foreign attachment, which has existed from time immemorial in London, Bristol, and a few of the larger cities, and which permits the enforcement of a plaintiff's demand against debts due the defendant from third persons. (See FOREIGN ATTACHMENT.) But garnishment, as established in 1854 and at present in use, has a considerably less extensive scope of application than foreign attachment, since it only permits the seizure of a debtor's property or choses in action after the recovery of judgment against him, instead of at the time when suit is brought. In the U. S. a different rule is generally maintained, and the process of garnishment is therefore made more completely remedial, and can be adopted with much greater advantage by a creditor. The necessity of delay until judgment is obtained gives a defendant an opportunity to enforce payment against his debtors, or to effect a compromise with them; and if he adopt this course, the judgment creditor may be left entirely remediless.

The effect of garnishment is to place the garnishee in a position resembling that of a trustee. On this account it is known in some of the States, especially in New England, as the "trustee process." If, after notice of attachment has been served upon the garnishee, suit is brought against him by his own creditor, A, for whose debt to the garnisher, B, the attachment has been made, the pendency of the attachment is sufficient to effect a stay of proceedings; and if judgment should be rendered against A in the action instituted against him by B, and execution should be levied against the money or effects in the hands of the garnishee, the latter would be relieved from all obligation towards A, and might plead the execution in bar of any subsequent action by that person against him. As a general rule, any person is capable of being made garnishee, not excepting corporations and persons acting in a representative capacity as executors and administrators. A non-resident person cannot be made garnishee unless he has property of the defendant in the State or is bound to pay him money within the State. But an officer of the law, as a clerk or receiver, or a trustee holding funds as agent of a court, a financial agent of the government, a sheriff holding funds in an official capacity, or an assignee in bankruptcy, cannot be made garnishees. The same is true of an agent, unless he has an independent control of the goods, since his possession is the possession of his principal. Provision is generally made for the examination of a garnishee under oath in relation to the nature and amount of his indebtedness, and he may make any defence against the attaching creditor which might be made against the person to whom the debt was primarily due or to whom the property was to be rendered. If the garnishee have any lien upon the articles in his possession, he is entitled to have it satisfied. The process of garnishment is virtually a secondary suit against some third person by a suing creditor, who claims the rights of the defendant against whom his primary action is brought. (See ATTACHMENT.)
GEORGE CHASE. REVISED BY T. W. DWIGHT.

Garonne, a river of France, rises in the Pyrenees, within the Spanish frontier, at the foot of Mont Maledetta, becomes navigable at Cazères, is at Toulouse connected with the Mediterranean by a canal, joins at Blaze the Dordogne, and assumes the name of Gironde, entering the Atlantic through an estuary 50 miles long. It often overflows, and sometimes changes its bed, which makes its navigation difficult.

Gar'rard, a beautiful and fertile county of E. Central Kentucky. Area, 250 square miles. The surface is undulating. The soil is based upon limestone. Cattle, grain, tobacco, and wool are the chief products. It is traversed by a branch of the Louisville and Nashville R. R. Cap. Lancaster. Pop. 10,376.

Garrard (Col. JAMES), b. in Stafford co., Va., Jan. 14, 1749; served in the Revolutionary war and in the Virginia legislature, where he was an efficient friend of religious freedom. He removed early to Kentucky, and in 1782 settled in Bourbon co., near Paris. He became one of the most prominent citizens of Kentucky, of which he was governor 1796–1804. D. at Mount Lebanon, Bourbon co., Ky., Jan. 19, 1822.—His sons, Gen. JAMES and Col. THEOPHILUS T. GARRARD, were distinguished citizens of Ky.

Garrard (KENNER), b. in Kentucky in 1828; graduated at the U. S. Military Academy July, 1851, and entered the army as brevet second lieutenant of artillery; transferred to the 1st Dragoons in 1852, and received his full commission as second lieutenant Oct., 1853; promoted first lieutenant of cavalry 1855; captain 1861; and major 1863. Served principally in garrison and on frontier duty 1851–61, being captured at San Antonio, Tex., Apr., 1861, and not exchanged as prisoner of war until Aug., 1862, serving in the mean time in commissary department and as instructor and commandant of cadets at West Point. In Sept., 1862, he was appointed colonel 146th New York Volunteers, and was engaged in the battles of Fredericksburg, Chancellorsville, and Gettysburg. Appointed brigadier-general of volunteers July, 1863, he served with the Army of the Potomac till December, when he was placed in charge of the cavalry bureau at Washington. In Feb., 1864, he commanded a cavalry division in the Army of the Cumberland, was engaged in the various engagements about Chattanooga and in Georgia during the Atlanta campaign, pursuit of Confederate army to Dalton, and with his command in the 16th army corps at the battle of Nashville, Tenn., Dec., 1864. In the operations against Mobile, 1865, he led the party which stormed and captured Blakely. In Aug., 1865, he was mustered out of the volunteer service. For gallant services in the field during the war he was brevetted colonel, brigadier-general, and major-general U. S. A. Resigned 1866. D. at Cincinnati, O., May 15, 1879. G. C. SIMMONS.

Gar'rett, the westernmost county of Maryland, formed in 1872, bounded N. by Pennsylvania, and W. and S. by West Virginia. It is mountainous, has extensive forests, with fine pasture-lands, and abundant iron ore, soft coal, fire-clay, and hydraulic limestone. It is traversed by the Baltimore and Ohio R. R. and by the watershed between the Potomac and the Ohio river-valleys. Cap. Oakland.

Garrett, tp. of Douglas co., Ill. Pop. 1599.

Garrett (JOHN W.), b. in Baltimore July 31, 1820; educated at Lafayette College, Pa.; was for some years engaged in commercial business in Baltimore; was one of the capitalists who carried to completion the Baltimore and Ohio R. R.; became in 1857 one of its directors, and in 1858 its president.

Garrett (LEWIS), a minister of the Methodist Episcopal Church, South, b. in Pennsylvania Apr. 24, 1772; d. in Mississippi Apr. 28, 1857. He entered the Western Conference in Kentucky in 1794, and performed herculean labors in that State, Tennessee, Virginia, North Carolina, and Mis-

sissippi. He has left a little volume of *Sketches* of his life and times. T. O. SUMMERS.

Garrett (THOMAS), a Quaker abolitionist, b. at Darby, Pa., Aug. 21, 1789; became a cutler and scythe-maker, and acquired wealth. In 1807 the kidnapping of a servant from his father's family made him a strong and active abolitionist. In 1820 he removed to Wilmington, Del., and became an iron merchant, and after 1850 lost all his estate as damages for freeing slaves, but again acquired a competence. D. at Wilmington, Del., Jan. 23, 1871.

Gar'rettson (FREEBORN), a noted preacher, was b. in Maryland Aug. 15, 1752; joined the Methodist ministry in 1775; was a chief founder of his denomination in Nova Scotia, in New York, and in Western New England. He took a prominent part in the organization of the Methodist Episcopal Church at Baltimore in 1784. D. Sept. 26, 1822.

Gar'rettsville, post-v. of Portage co., O., on the Atlantic and Great Western R. R., Mahoning division, 37 miles S. E. of Cleveland. It has a national bank, a savings and loan bank, a newspaper, a literary society library, machine-shops and manufactories, 3 churches, 2 hotels, and a number of stores. Principal business, farming and dairying. Pop. [illegible]. CHARLES B. WEBB, ED. "JOURNAL."

Gar'rick (DAVID), an English actor, b. at Hereford Feb. 20, 1716. He was of French extraction. His grandfather, bearing the name of Garrique, a French Protestant, came to England on the revocation of the Edict of Nantes. His father was a captain in the English army; his mother was the daughter of a vicar of Lichfield cathedral. The lad's education seems not to have been systematic or thorough. He attended the grammar school at Lichfield, but at the age of twelve or thirteen his studies were interrupted by a visit to an uncle in Lisbon. Subsequently, when eighteen years old, he became one of the pupils in Dr. Samuel Johnson's academy. His passion for the stage early showed itself in remarkable gifts for mimicry and recitation, and in a desire to frequent theatres. When but eleven years old he performed Sergeant Kite in the *Recruiting Officer* before a select company, being even then a juvenile manager. In 1737 he went to London with Dr. Johnson, proposing to study law, but gave it up, lacking the means of support. A short experience as a wine-merchant in partnership with his brother Peter satisfied him that trade was not his calling, and he adopted the theatrical profession, making his first appearance at Ipswich, under the assumed name of Lyddal, in the tragedy of *Oroonoko*. The effort was applauded, but not as rapturously as his subsequent appearance in comedy. On the strength of his provincial reputation he resolved to try his fortune in London, and, finding the popular theatres closed to him, made his first appearance on Oct. 19, 1741, at the obscure theatre in Goodman's Fields, the play chosen being *Richard III*. The success was wonderful. In a few weeks the house was crowded, people deserting Drury Lane and Covent Garden to see the man who so attractively introduced a natural school of acting in place of the artificial tradition of the English stage. At the close of the season of 1742 he played three nights at Drury Lane, and made an engagement there on a salary of £500 a year. Dublin was the next scene of his triumphs. There, in 1745, he joined Mr. Sheridan in the management of the Royal Theatre. Two years later he opened the Covent Garden Theatre, London, on which occasion he spoke the prologue written for him by Dr. Johnson, who recognized, as did all the judges, his distinguished talent. In June, 1749, Mr. Garrick married the Viennese dancer, Eva Maria Violetta, an amiable and accomplished woman, who had graced the boards of Drury Lane. She brought him a moderate fortune, and was to him a faithful wife. At this time Garrick was the greatest figure on the English stage. The public opinion of the Continent, which he visited in 1763, ratified the judgment of his countrymen. His return was welcomed with enthusiasm, the king himself bidding him play in *Much Ado about Nothing*. The Shakspeare Jubilee at Stratford-on-Avon, which continued three days and was represented ninety-two successive times at Drury Lane, was arranged by him in 1769. Four years afterwards the death of his partner, Mr. Lacy, threw on him the whole management of the theatre; his health failed; he played less and less frequently, and in 1776, after acting for each his favorite character—the last performance being for the benefit of the Decayed Actors' Fund, established by himself—he retired from the stage. His elegant villa at Hampton was the resort of men of taste and letters, wits, and luminaries of Church and State; good people loved him, brilliant people admired; his vivacity, versatility, and kindness of heart gained him many friends. But his broken health was not restored by rest. An old disease tormented him continually. Finally, a sudden attack prostrated him; he was taken to his house in the Adelphi, London, and there d., Jan. 20, 1779. On Feb. 1 he was buried with great pomp in Westminster Abbey, beneath the monument to Shakspeare. Garrick was a man of varied talents; as an actor he excelled in the most opposite styles, in high tragedy and in broad farce: he was in his profession an author too; he wrote verses, prologues, epilogues, farces, and adapted many plays for the stage. Though self-conscious and vain, he was popular for his friendly, generous, and charitable qualities, and respected for his solid virtues. In person he was of middle height, slight of figure, animated in countenance, quick and expressive in action, effective though not imposing in presence. His voice was musical, and his sensitive temperament made amends for the absence of great physical advantages. Pope said of him: "He never had his equal as an actor, and never will." Mrs. Garrick survived her husband many years. She was ninety-eight years old when she d., in full possession of her faculties, on Oct. 16, 1822. O. B. FROTHINGHAM.

Gar'rison (WILLIAM LLOYD), the pioneer and leader of the modern anti-slavery movement in the U. S., b. in Newburyport, Mass., Dec. 12, 1804; served an apprenticeship to the printing business in the office of the *Herald* in his native place, and while doing so wrote extensively for that and other journals, mainly upon political topics, carefully preserving his incognito. A series of articles which he contributed to the Salem *Gazette* evinced such power that they were attributed by Robert Walsh to no less a personage than Timothy Pickering. Such was his ability that the proprietor of the *Herald* left him for some time, when he was but nineteen years of age, in full charge of his paper and business. Having ended his apprenticeship in 1825, he soon afterwards assumed the editorship of the *Free Press*, a new paper, in his native place. The paper not proving a success, he became, in 1827, editor of the *National Philanthropist*, published in Boston, and devoted to the cause of temperance. In 1828, at the earnest invitation of citizens of Bennington, Vt., he went to that place to edit a new paper, the *Journal of the Times*. It was mainly devoted to the support of John Quincy Adams for the Presidency, but Mr. Garrison took occasion therein boldly to declare his hostility to slavery, war, and intemperance. His anti-slavery utterances attracted the attention of Benjamin Lundy, a Quaker, who was engaged in the publication of the *Genius of Universal Emancipation* in Baltimore, and who went to Bennington to induce him to join him in the editorship of that paper. The *Journal of the Times* not having proved successful, Mr. Garrison yielded to the Quaker's persuasions, and went to Baltimore in the fall of 1829. In the very first number of the *Genius of Universal Emancipation* which appeared under his and Mr. Lundy's joint editorship was developed a radical difference in their opinions, Mr. Lundy advocating gradual and Mr. Garrison immediate emancipation as the inalienable right of the slave and the duty of the master. Subsequently another difference appeared, Mr. Lundy favoring and Mr. Garrison opposing the scheme for colonizing the slaves as a condition of emancipation. They were one, however, in a common hatred of slavery, and as each appended his own initials to whatever he wrote in the paper, the partnership was agreeable to both parties. In May, 1830, Mr. Garrison was convicted, by a court and jury of slaveholders, of a libel upon Capt. Francis Todd. The libel consisted in denouncing Capt. Todd as guilty of "domestic piracy" in conveying a cargo of slaves from Baltimore to New Orleans. For this he was sentenced to pay a fine of $50 and costs of court. Being unable to pay this money, he was committed to jail. His imprisonment awakened much sympathy in the Northern States, which found utterance through the press. His writings while in prison, especially several sonnets which he inscribed with a pencil on the wall of his cell, were widely copied and admired as expressions of the true spirit of liberty. At the end of seven weeks he was set at liberty, his fine being paid by Mr. Arthur Tappan, a merchant of New York. Henry Clay had made arrangements to do what Mr. Tappan did, but was too late. He now turned his steps toward the Northern States, delivering lectures in Philadelphia, New York, New Haven, Hartford, and Boston, in which he depicted the sinfulness and the cruelties of slavery, and sought to enlist the people in the work of promoting emancipation. He insisted that every slave had a right to immediate emancipation without expatriation, and that it was a sin to hold him in bondage for a single instant. Others had denounced slavery as an evil, but Mr. Garrison was the first to declare it a sin, and demand its immediate abolition in the name of God and of humanity. He thus became the leader of an anti-slavery movement founded upon the principle of immediate in distinction from gradual emancipation. He made special efforts to enlist the sympathy and co-operation of the clergy and the churches of different denominations, but without much success, slavery being powerful both in Church and State, and the popular contempt for

the negro such that it was not easy to excite sympathy in his behalf. On Jan. 1, 1831, he commenced, in partnership with Isaac Knapp, the publication, in Boston, of *The Liberator*, a weekly journal, the motto of which was, "My country is the world—my countrymen are all mankind." The voice of this paper was soon "heard around the world;" the North was deeply moved, while the South was filled with excitement and alarm. The dead calm that had followed the enactment of the "Missouri Compromise" of 1820 was completely broken up, and the discussion of slavery in all its relations to civil and religious institutions, went on with constantly augmenting force, in spite of every effort to arrest it, from that time until the war of 1861-65. *The Liberator* was kept alive only by great economy, diligence, and self-sacrifice on the part of its editor and its publisher. For a long time they set the types mainly with their own hands, while their small and obscure office was their only home, and they subsisted on the humblest fare. A Southern magistrate having begged the interposition of the mayor of Boston to suppress the "incendiary" sheet, that officer, the distinguished Harrison Gray Otis, wrote in reply that his agents had "ferreted out the paper and its editor, whose office was an obscure hole, his only visible auxiliary a negro boy, his supporters a very few insignificant persons of all colors." In Dec., 1831, the legislature of Georgia offered a reward of $5000 to any person who should arrest, bring to trial, and prosecute to conviction, under the laws of that State, the editor or the publisher. On Jan. 1, 1832, under Mr. Garrison's direct inspiration, was organized the New England Anti-Slavery Society, the first association ever formed in this country on the principle of immediate emancipation. He soon afterwards published his work, *Thoughts on African Colonization*, in which he contended that the colonization scheme was an ally of slavery. He soon afterwards went to England as an agent of the New England Anti-Slavery Society, and was warmly received by Wilberforce, Clarkson, Brougham, and the great body of English abolitionists, who were then on the eve of their great triumph over slavery in the West Indies. The act of emancipation was passed by the Parliament while he was there, in consequence of which he was able to persuade Mr. George Thompson, who had taken a very prominent part in the struggle, to come over to the U. S. and lend his aid to the cause here. In Dec., 1833, the American Anti-Slavery Society was organized in Philadelphia. The Declaration of Sentiments issued by the convention was from Mr. Garrison's pen, and embodied the doctrines of which he was the recognized champion. In Oct., 1835, a pro-slavery mob of "gentlemen of property and standing" broke into the anti-slavery office in Boston, dispersing a meeting of women, and seizing Mr. Garrison and dragging him through the streets with a rope around his body. His life was saved with great difficulty, and only by the city authorities taking him to jail for protection. He was released the next day, but was compelled to go into the country for safety. In 1838 he took a prominent part in the organization of the New England Non-Resistance Society, writing its Declaration of Sentiments. In 1839–40 the abolitionists were divided upon the question of admitting women to take part in the proceedings of the anti-slavery societies; Mr. Garrison warmly took the affirmative, and when the World's Anti-Slavery Convention, which met in London in 1840, refused to admit the women who were sent as delegates from this country, he declined to take a seat in the body himself. About this time there was also a division in the anti-slavery ranks upon the question of forming an anti-slavery political party. Mr. Garrison took the negative of this question, contending that the measure was unnecessary and unwise, and that its tendency would be to destroy the purity of the anti-slavery movement and postpone its triumph. He subsequently came to the conclusion that the conditions of union between the North and South, as expressed in the Constitution, were in themselves immoral, and therefore that it was wrong to take an oath to support that instrument. Henceforth he was an open advocate of the dissolution of the Union, which he declared to be, in Scripture phrase, "a covenant with death and an agreement with hell." In 1846 he went to England upon an anti-slavery mission for the third time. In 1843 he was chosen president of the American Anti-Slavery Society, and held the office until the close of the civil war in 1865, when, slavery having been abolished and its rehabilitation made impossible by an alteration of the U. S. Constitution, he resigned, announcing that his career as an abolitionist was ended, and that in his judgment the society ought to be dissolved. He continued the publication of *The Liberator*, however, until the close of that year, and in the last issue had the satisfaction of putting on record the official proclamation of the adoption of the amendment to the Constitution for ever prohibiting slavery in the U. S. His paper thus covered the whole period from the beginning of the agitation for the abolition of slavery in 1831 until the final and complete triumph of the cause in 1865. Mr. Garrison made another visit to England in 1867, when he was recognized and honored by the friends of freedom in England as the great leader of the anti-slavery movement in America. In 1843 appeared a volume of his *Sonnets and other Poems*, and in 1852 a volume of selections from his writings and speeches. D. May 24, 1879. OLIVER JOHNSON.

Gar'rot, a name sometimes given to ducks of the genus *Clangula*, including, besides other birds, the HARLEQUIN DUCK (which see) and the buffle-head or spirit duck (*Clangula albeola*) of North America, rare in Europe. The latter is very hard to shoot, and is not highly prized as food. (See also GOLDEN-EYE.)

Garro'te [Sp., a "stick"], a form of capital punishment employed in Spain and Spanish America. A metallic collar is put around the neck of the victim, and a screw at the back of the collar is turned in such a way that its point crushes the spinal cord, causing instant death. Originally a stout cord was tied about the neck, and the culprit was strangled by twisting the cord with a stick (*garrote*). Robbery, accompanied by choking of the person robbed, is often called *garroting*.

Gar'side (WILLIAM BRIGGS), M. D., b. at Harrison, Hamilton co., O., Feb., 1835; was educated at Farmer's College, O.; took his medical degree at the Physio-Medical College, Cincinnati, 1858, and New York Homœopathic College 1868; is lecturer on physiology in the New York State school for training nurses, and holds important positions in the Homœopathic Hospital and the Maternité, Brooklyn, N. Y.

Gar'ter, Or'der of the, the most illustrious British order of knighthood, founded, according to Selden, who follows Froissart, on Apr. 23, 1344, by King Edward III.; but the exact date is much disputed, some even tracing it back to 1192, when on St. George's Day, Richard I. made twenty-six of his best knights wear a thong of blue leather on the leg in a fight with the infidels. But the common tradition is that King Edward was dancing with the countess of Salisbury at a ball, when she let fall her garter, which the king at first tied about his own leg, but observing that the act excited much attention, he restored it to the fair owner, exclaiming, *Honi soit qui mal y pense*—"Evil be to him who evil thinks"—words which are still the motto of the order; and the king said further, "that shortly they should see that garter advanced to so high an honor and renown as to account themselves happy to wear it." The order was founded in honor of the Holy Trinity, the Blessed Virgin, St. Edward the Confessor, and St. George, but the latter was its principal patron. Ladies were admitted as late as the reign of Edward IV., since which time no ladies but the sovereign are received into it. At present there are, besides the sovereign, the prince of Wales and such other princes of the blood as may be chosen; twenty-five regular knights of the Garter, and extra knights are admitted by special statute; vacancies occurring in the regular knighthood of the Garter being filled from the extra knights, many of whom are foreign reigning princes. In 1874 there were forty-nine knights, none of a rank below that of earl. In 1873 the shah of Persia received the Garter. Anciently, gentlemen not of the titled nobility were admitted. The bishop of Winchester is prelate of the order, the bishop of Oxford is chancellor, the dean of Westminster is registrar, and there is a king of arms and an usher of the black rod; but none of these officials are knights of the Garter. The distinguishing badges of the order are the collar, badge, star, garter, George, and lesser George; there are also a mantle, surcoat, hood, hat, and plume appropriate to the order; and in strict language the knights are termed "knights of the Golden Garter," or "knights of the most noble order of St. George and the Garter."

Gar'ter Prin'cipal King of Arms, the chief herald of England and of the order of the Garter. As Principal king of arms he is the head of the college of heralds, subject to the earl marshal. As Garter king of arms he is independent of that officer. He takes precedence not only of Bath, Clarenceux, and Norroy kings of arms, but of Lyon and Ulster, the heraldic kings in Scotland and Ireland. According to most authorities, Henry V. first instituted this office, but others say that Henry VIII. first gave the title to Guienne king of arms, his first herald for the French possessions. At present (1875) this officer holds also the position of king of arms for the order of St. Michael and St. George.

Garth (Sir SAMUEL), M. D., b. at Bolam, Durham, England, in 1660; studied at Peterhouse, Cambridge; took his medical degree 1691; removed to London 1693; was physician to George I. and physician-general of the army;

became a Whig leader; joined the Kit-Cat Club, and was knighted 1714; and d., a Roman Catholic, at London Jan. 18, 1719. Chiefly remembered for his satirical poem, *The Dispensary* (1699), directed against the selfishness of the apothecaries who opposed the gratuitous distribution of medicines to the poor; translated a part of Ovid's *Metamorphoses*, and wrote *Claremont*, a poem, etc., and delivered the Harveian oration for 1697.

Gart'land (FRANCIS XAVIER), b. in Ireland in 1805, came to the U. S., and in 1850 was consecrated bishop of Savannah (Roman Catholic), the first of the title. D. at Savannah Sept. 20, 1854.

Gar'vin, tp. of Anderson co., S. C. Pop. 1577.

Garvin, tp. of Pickens co., S. C. Pop. 1478.

Ga'ry (GEORGE), a venerated Methodist divine, was b. at Middlefield, N. Y., Dec. 8, 1793; joined the Methodist ministry in 1809; occupied important churches in Western New York; was six times sent as delegate to the General Conference; appointed superintendent of the Oregon mission in 1844. D. Mar. 25, 1855. He was distinguished by his wisdom in council and the purity of his character.

Gas, a word invented by Van Helmont, and thus defined by him: Gas est spiritus non coagulabilis qualis è fermentante vino; itemque ruber ille, qui chrysulcâ [aqua regia] operante eructatur, etc. (See J. B. VAN HELMONT, *Opera*, Francofurti, 1682, *explicatio*, after preface, and, very fully, chapters *Progymnasmata Meteori* and *Gas Aquæ*.)

Gas. According to the usual definition, *a gas is a permanently elastic fluid*—permanently elastic, that is, under the usual atmospheric conditions, and thus distinguished from a *vapor*, which is the aëriform condition of a substance normally existing in the liquid or solid state. By a *fluid* in this definition is designated a condition of matter in which the particles have great freedom of motion—a condition common both to gases and liquids. By *elastic* is meant a condition in which the material particles are in a state of tension, and in consequence of this tension exert pressure against every surface with which the body comes in contact. By virtue of its inherent elasticity a gas tends to expand indefinitely; and this tendency can only be restrained by enclosing it in some containing vessel whose form the aëriform mass assumes. By virtue of its fluid condition a gas transmits the pressure it exerts equally in all directions, and when at rest and under uniform conditions throughout its whole extent, a mass of gas presses against different surfaces with forces which are proportional to the area of those surfaces, and independent of their form or position. A liquid also, when rendered elastic by stress of any kind, transmits pressure equally in all directions, but this elasticity is dependent on the external force; it is not inherent in the liquid; and a liquid mass comes to rest in an open vessel, forming a definite surface of its own. The tension of an aëriform mass is measured by the pressure which this tension produces on the unit of area, and which may be estimated as so many pounds on a square inch, or so many grammes on a square centimètre, according as we use the English or the metric system of measures and weights. It may also be measured by the height at which it sustains a column of mercury in the tube of a barometer; and since, according to the laws of mechanics, this height is directly proportional to the pressure, so distance or a value as the height of a mercury column becomes a legitimate measure of the tension of a gas. We speak, therefore, of the tension of a gas as so many inches or so many centimètres of mercury, and in mathematical expressions we represent the tension of a gas by H, which stands for a certain number of inches or centimètres, the height of the mercury column which the tension supports. The normal tension of the atmosphere at the level of the sea (that of a column of mercury 30 inches or about 76 centimètres) high, but, as is well known, the tension lessens as we rise in the atmosphere, and at the same place it varies, within somewhat narrow limits, with meteorological changes. A tension of 30 inches in the English and of 76 centimètres in the metric system is called *one atmosphere*, and high tensions are usually estimated in *atmospheres*. The English standard temperature is 62° F., and the tension measured by a mercury column 30 inches high at this temperature corresponds to a pressure of 14 7/10 pounds on a square inch. The French standard temperature is that of melting ice, or 0° C., and a mercury column at this temperature 76 centimètres high corresponds to a pressure of 1033 grammes on a square centimètre. Remembering also that 30 inches equal 76.2 centimètres (very nearly), it is easy, by means of these standard values, to compare the various measures of tension.

The common mercurial barometer is simply a glass tube open at one end, which, having been filled with mercury and the open end temporarily closed, has been inverted and the aperture opened under a basin of mercury. The column of mercury falls in the tube until it balances the tension of the air, and slowly oscillates as this pressure varies. As in filling the tube great care is taken to drive out all the air, there is no atmosphere above the mercury, and therefore no pressure exerted upon the upper surface of the column. If, however, we introduce a small amount of gas or vapor into such a tube, a pressure will be at once exerted upon the upper surface which will depress the mercury column, and the vertical height through which the column is depressed is obviously the measure of the tension of the confined aëriform body. The value is easily ascertained by comparing the depressed column with a perfect barometer at its side; and this method of measuring tensions is capable of very wide application, but is necessarily limited to cases in which the tension is less than one atmosphere. The barometer itself, although exceedingly valuable for observing the varying tensions of our atmosphere, is not, on account of its size and shape, a convenient instrument for measuring the tension of a confined and limited volume of gas. Moreover, although theoretically we might have a barometer of any length, yet the difficulties connected with filling the tube increase so rapidly with the length that we are practically limited to something less than one mètre, and therefore the ordinary forms of the instrument could not, in any case, be used if the tension were much greater than one atmosphere. We can, however, use a mercury column for measuring tension up to several atmospheres by so arranging the apparatus that the pressure of the confined gas acting on the surface of the mercury shall force the liquid up a vertical glass tube open at the top, so that the column shall be lifted against the pressure of the atmosphere. Evidently, under such circumstances the height of the column measures the difference between the tension of the gas and the tension of the air; and to find the value of the first we must add to this height the height of the barometer at the time. Such an instrument is called a manometer, but, although susceptible of great accuracy, the mercurial manometer is difficult of application when the tension exceeds two or three atmospheres. The manometer which is usually used in the arts for measuring approximately the tension of steam consists of a spiral flattened metallic tube. The pressure of the steam on the interior of this tube tends to uncoil the spiral, and the motion, multiplied by a system of levers, appears in the movement of an index over a dial. The figures on the manometer usually used in this country indicate the number of pounds pressure per square inch above the atmospheric pressure; and a boiler is said to carry 25 pounds of steam, for example, when the pressure of the steam on the interior surface exceeds that of the air on the outer surface by 25 pounds per square inch. A metallic barometer is made on the same principle; and in another form of metallic barometer, called an aneroid, a tight metallic box, having a corrugated top, which rises and falls with the varying pressure, takes the place of the spiral tube.

Gases differ from liquids in their compressibility even more markedly than in their elasticity. Liquids are frequently called *incompressible fluids*; for even when exposed to the greatest attainable pressure, their volume alters so slightly that the shrinkage can be detected only by delicate experiments. Gases, on the other hand, are very *compressible fluids*; and the simple law which obtains between the volume and tension of a mass of gas is the most characteristic feature of the aëriform state. When a mass of gas is exposed to pressure the volume diminishes until the increased tension balances the pressure; and, if the temperature does not change, we find, in general, that the tension is inversely proportional to the volume—the less the volume the greater the tension; and on the other hand, when the gas is allowed to expand, the larger the volume the less the tension. If we represent by V and V′ two different volumes of the same mass of gas, and by H and H′ the corresponding tensions, measured by columns of mercury, $H : H' = V' : V$. Hence, $HV = H'V'$; that is, for every mass of gas at an invariable temperature the product of the tension and the volume is a constant quantity. This law was discovered by the chemist Boyle in England in 1662, and verified by the Abbé Mariotte somewhat later; and it is by some called the law of Mariotte, and by others the law of Boyle. This law, however, is to be regarded as a typical condition of aëriform bodies, rather than a state which is ordinarily realized. There is no gas known which at the ordinary temperature absolutely obeys Mariotte's law. Except in the case of hydrogen, the tension increases as the volume diminishes less rapidly than the law requires, while that of hydrogen increases more rapidly. It is true that with oxygen, hydrogen, nitrogen, and a few other gases the deviations from the law are so small that in almost all cases the differences may be neglected without appreciable error; but with most gases the differences are very marked, and rapidly augment as the pressure increases. As the temperature increases these differences

lessen; and there is probably for every gas a temperature at which it exactly obeys the law. When this point is passed, differences again appear, but in the opposite direction; and we have in hydrogen a gas which at the ordinary temperature is beyond the typical point.

With certain very prominent exceptions all gases, by the combined action of pressure and cold, may be condensed to liquids, and the deviations from Mariotte's law we have just noticed are closely connected with the transition from the lighter to the more dense state of aggregation. When by pressing a piston into a cylinder we reduce the volume of a mass of sulphurous oxide gas, for example, we find that the tension increases, but in an ever-lessening ratio, up to a certain value. As soon, however, as this value is reached, a further reduction of volume causes no increase of tension, but a portion of the gas becomes a liquid, and afterwards the piston descends under a constant pressure until the whole mass is liquefied. It then occupies only a small portion of its original volume, and yields scarcely perceptibly to any further attempts to compress it. This greatest value which the tension reaches is called the *maximum tension* of the gas; and although it varies with the temperature, yet for a given temperature it has a definite value for each gas that can be liquefied by pressure alone. Those gases, however, which closely conform to Mariotte's law cannot be condensed by pressure alone; and there appears to be for each gas a temperature which has been called the *critical temperature*, below which the gas presents phenomena similar to those obtained with sulphurous oxide, as just described, and above which it is in a condition in which its tension increases indefinitely, however great the pressure to which it is exposed. If we define a perfect gas as one which conforms to Mariotte's law, such a gas, of course, could not be condensed to a liquid by pressure alone; and, as has been said, it is probable that every aëriform body can be brought into this condition by heat—at least when not chemically changed in the process. The *critical temperature*, therefore, must be passed before the body reaches the condition of a perfect gas; and this temperature seems to mark the transition from the state of vapor to the state of gas, and points out a more philosophical distinction between these two phases of aëriform matter than the popular definitions imply.

Another characteristic feature of gases appears in the fact that the same change of temperature causes in all of them the same change of tension or volume. When a gas is confined, the effect of heat is to increase its tension; when free to expand under a constant pressure, the effect is to increase its volume; and, as Mariotte's law requires, these two effects would be strictly proportional in every perfect gas. Since, under ordinary circumstances, the gases with which we have to deal are not perfect, this result, although very closely approached, is not absolutely realized, and in general the effects of heat on masses of different gases are not strictly identical, the slight differences observed being of the same order of magnitude as the deviations from Mariotte's law above referred to, and resulting doubtless from the same cause. Disregarding these slight differences, the effect of heat on all aëriform matter is correctly represented in the following illustration: Conceive of a vessel of invariable size containing air which at the temperature of melting ice has a tension of 273 millimètres, as shown by a barometer. If, now, this vessel is heated to the temperature of water when boiling under the normal atmospheric pressure, the tension of the confined air will become 373 millimètres; that is, between these two standard temperatures the tension increases 100 millimètres. Evidently such an apparatus would serve as a measure of temperature. The 273d division on the millimètre scale of the barometer would indicate the freezing-point, the 373d division the boiling-point of water, and the intermediate divisions would divide the difference between these two fixed points into 100 degrees. Such an instrument would serve as an air thermometer, and the degrees of temperature thus marked would closely correspond to those of the ordinary mercury thermometer, graduated on the centigrade system. The degrees of such a thermometer, however, are merely arbitrary points in the scale of temperature until we determine the relation between the change of tension and the amount of heat which enters or leaves the confined air. But if it can be shown that equal accessions of heat produce equal increments of tension, then it would follow that the air thermometer is an accurate measure of thermal values. Unfortunately, our experimental evidence on this point is not as direct as we could wish. The only safe standard to which we can refer our measures of heat is what we may call the fuel standard—that is, the weight of some combustible, like hydrogen, by whose burning the heat is generated; and could we show experimentally, for example, that the heat from one gramme of hydrogen increased the tension of our confined air exactly 100 times as much as that from one centigramme of the same fuel, and this, too, from whatever point on the scale of temperature we might start, then there could be no question that the increments of tension were the legitimate measures of the heat which entered the air, and therefore of the differences of temperature thus produced. Such direct observations, however, are impracticable; and it would not be possible with a few words to make clear to the reader how far the conclusion just stated is justified by such indirect experimental evidence as we have been able to obtain. It must be sufficient to say, first, that within moderate limits of temperature the experiments prove the increase of tension to be very nearly, if not exactly, proportional to the amount of heat which enters such a confined mass of air as is described above; and secondly, that the accepted theory of heat leads us to believe not only that the increase of tension is proportional to the accession of heat within the latitude and limits of error of our experiments, but also that in a perfect gas this law would hold without variation throughout the whole range of temperature.

Accepting, then, the law provisionally, we find that it leads us to a most remarkable conclusion. Starting with the apparatus assumed above at the temperature of melting ice, and the barometer indicating a tension of 273 millimètres, let us impart to the air successive increments of heat, and raise the temperature degree by degree, and the tension millimètre by millimètre, until the barometer marks 546 millimètres. Knowing the weight of the air, we can easily determine how much heat, estimated on the fuel standard, is required to produce this result: and we shall find that it is represented by a very small weight of hydrogen gas. If our theory is correct, $\frac{1}{273}$d of this amount would correspond exactly to one millimètre of tension, the same for the last degree as for the first. Returning now to the freezing-point, what must be the result if we withdraw heat in similar successive portions? Evidently, the temperature will fall degree by degree, as the tension is reduced millimètre by millimètre; and if the law holds to the last, when we have removed the quantity of heat represented by the same amount of hydrogen as before—that is, at 273 degrees below the freezing-point—the tension must fall to zero, and we there reach the absolute zero of the thermal scale. If, then, the law we have deduced from our experiments on the thermal relations of gases is well established, and holds to the end, the absolute zero of temperature is at 273 degrees below the melting-point of ice on the scale of the air thermometer; and, moreover, the amount of heat which natural bodies contain is very limited, and is equivalent to an amount of fuel which in many cases can be definitely stated. Of course, until the validity and scope of the law can be placed beyond doubt, this remarkable result must be regarded as only ideal. It should be added, however, that there are several natural phenomena which point to a definite lower limit of temperature, and, in one or two instances, which indicate the same limit as that just assigned. But even if our absolute zero is merely a fancy, the point we have assigned to it is the natural zero of the scale of the air thermometer, graduated as described above; and we find one great advantage in counting our degrees of temperature from this point; for the tensions of gases under constant volumes, or their volumes under constant tensions, are directly proportional to the temperatures thus expressed—at least within the limits of ordinary observations. Between the freezing- and boiling-points of water the degrees of a common mercury thermometer graduated on the centigrade system are essentially the same as those of our air thermometer, and hence by adding 273 to temperatures expressed in centigrade degrees, we obtain the values referred to the absolute zero, which we will call the absolute temperatures; and, as just said, the volume or tension of any mass of gas under otherwise constant conditions is proportional to the absolute temperature. Suppose we have measured 250 cubic centimètres of gas at 20° C., and wish to know how much it would measure under the same circumstances at 4° C. We first add 273 both to the 20° and to the 4°, and then make the proportion, $293 : 277 = 250 : x = 236.3 +$. Thus we reduce from one temperature to another all observations on the volume or tension of aëriform bodies, and we call the law we have been discussing on which the method is based the law of Charles. Charles was a French physicist, who near the close of the last century discovered the equality of the dilatation of the principal gases when heated from the freezing- to the boiling-point. We owe, however, our knowledge of the limitations of this general truth, as well as the exact measurement of the amount of expansion, to modern investigators, and especially to Regnault.

A third characteristic quality of aëriform matter is the power of motion inherent in its parts. The parts of a solid or a liquid show no disposition to leave the mass. Isolate in a vacuous space, so far as possible, a solid or liquid body;

no separation from the mass takes place, except in so far as by evaporation from the surface the material changes into the aëriform condition, and thus acquires power of motion. But open to a mass of gas an aperture into a vacuum, and the material rushes through the door with an enormous velocity. The rate of motion varies for different gases very greatly. The late Thomas Graham named this motion *effusion*, and showed experimentally that when other conditions were the same the rates of effusion of any two gases are inversely proportional to the square roots of their densities. In Graham's experiments the gases entered the vacuum through a pin-hole in a thin metallic plate, and he observed the number of seconds occupied by a given volume in passing through this narrow opening. He found slight deviations from the law in the times both of the very light and of the very heavy gases, but these he traced to the tubularity of the aperture, arising from the unavoidable thickness of the metallic plate. When a gas flows through a capillary tube into a vacuum, a wholly new class of phenomena appear, which entirely mask the law of effusion. The motion of a gas through a capillary tube Graham called *transpiration*, and he carefully observed the velocity of the flow of different gases under the same conditions. The effects thus obtained seem to depend not simply on the friction of the gas against the surface of the tube, but much more on the friction of the gas particles against each other, and the transfer of momentum which thus results; and a comparison of the velocity of transpiration with that of effusion has led to important conclusions in regard to molecular magnitudes. The inherent power of motion in a mass of gas is manifested not only by its *effusion* into a vacuum, but also by what is called its *diffusion* into the space already occupied by another aëriform body. If a jar of chlorine is opened on the table of a lecture room, the presence of this suffocating gas will be perceived before long at the farther end even of a large hall, because this material, although two and a half times as heavy as air, slowly spreads through the whole space. Graham discovered that the relative rates of diffusion of different gases are precisely the same as their relative rates of effusion; or, in other words, that a gas diffuses through the space filled by another gas according to the same law which governs its effusion into a vacuum. As before, the relative rates of diffusion are inversely proportional to the square roots of the densities. Thus, oxygen, which is *sixteen* times *heavier* than hydrogen, diffuses *four* times *less* rapidly. But although an aëriform body offers no *permanent* resistance to the expansion of a gas, and the final result is the same as if it expanded into a vacuum, yet the velocity of the diffusion is vastly less than that of the effusion; and, to use an illustration of Dalton, one gas offers to another the same kind of resistance which stones in the channel of a stream oppose to the flow of running water. Loschmidt of Vienna has recently supplemented the experiments of Graham by measuring in a number of cases the absolute, as well as the relative, velocity with which diffusion proceeds. The phenomena of effusion and diffusion are obviously manifestations of the same mechanical condition that determines the pressure exerted by aëriform matter upon all surfaces against which it rests. Pressure implies the possibility of motion, for the same force which produces pressure will cause motion when the support is removed. And we have finally to consider a theory which attempts to explain what the mechanical condition thus indicated is.

The modern theory of chemistry regards every mass of matter as an aggregate of small isolated particles which cannot be further subdivided without destroying the identity of the substance, and these particles it calls molecules. The molecules of the same material are supposed to be alike in every respect, and those of different materials to differ in all those qualities which distinguish substances. Thus, a lump of sugar is an aggregate of very small isolated masses of sugar, each of the same weight and pattern. These molecules are not metaphysical abstractions, but, to use the words of Sir William Thomson, they are "pieces of matter of measurable dimensions, with shape, motion, and laws of action, intelligible subjects of scientific investigation." The lump of sugar is an aggregate of such pieces in the same sense that a stellar cluster is an aggregate of suns. So long as the sugar remains sugar, the integrity of the molecules is preserved, but when in a chemical process the sugar disappears and new products result, the sugar molecules are broken up and new molecules are formed from the fragments. In every chemical process the change takes place between molecules, and in these changes definite proportions by weight are preserved, because the different molecules have definite weights. When, for example, hydrochloric acid gas combines with ammonia gas, 36½ parts of the first substance unite with 17 parts of the second, simply because these numbers represent the relative weights of their respective molecules, which in the chemical process pair with each other, and form the molecules of the resulting product. This product is called sal ammoniac, and each of the molecules of this compound weighs 43½, the combined weight of its constituents. The modern theory of heat assumes that all thermal phenomena are the manifestations of molecular motions, and that molecular activity is the measure of that condition of matter which we call temperature. In a solid or liquid the molecules are crowded together, and, although in motion, their path is exceedingly circumscribed; but in a gas the molecules are widely separated, and their free path, although not larger than the waves of light, is still large as compared with their own dimensions. This path is limited by the frequency of their collisions; not only with each other, but also against the walls of the containing vessel. As the molecules are perfectly elastic, there is no loss of moving power in these collisions, and if the surrounding temperature is constant and the walls immovable, the total moving power of the molecules in a mass of gas remains invariable. There may result from the collision an accumulation of moving power in some molecules, and a corresponding loss to others, but the mean value will remain unchanged; and this mean value is the measure of the temperature of the aëriform mass. If the surrounding temperature is different from that of the gas, there will be a transfer of moving power through the walls of the vessel until a condition is reached where the transfer of moving power through the walls in one direction exactly balances the corresponding transfer simultaneously taking place in the opposite direction; and any two bodies are at the same temperature when thus related. Moreover, as any material walls must consist of molecules, power can most readily pass through such barriers, as along a line of ivory balls in a familiar experiment of mechanics. If a portion of the walls of a containing vessel are movable, the impact of the molecules may impart motion to the mass, as to the piston of a steam-engine or to a cannon-ball; if, however, the walls are fixed, the only effect of the colliding molecules is to produce pressure.

The pressure exerted by a gas being the effect of molecular impacts, the law of Mariotte is a necessary consequence of this mechanical condition. For if the temperature is constant, the molecules of the gas have a definite mean velocity and a definite mean momentum; and since, if we consider an interval sufficiently long, each molecule must on an average strike the sides of the vessel the same number of times and with the same average impulse, it follows that each molecule must contribute an equal share to the whole pressure. This pressure, therefore, other things being equal, must be proportional to the number of molecules in the vessel, or, what amounts to the same thing, to the quantity (or weight) of the given gas which the vessel contains; and this is a form of statement of Mariotte's law. According to this law, the pressure of a gas is inversely proportional to the volume, or, what comes to the same thing, directly proportional to its density; and our theory not only explains this general principle, but further shows that if different portions of gas are forced into the same vessel, each must exert its own pressure independently of the rest; and this, too, whether these portions be of the same gas or not. Assume next that while the number of molecules (that is, the quantity of gas) in the vessel remains the same, their mean velocity increases; it is evident that each molecule will now strike the sides of the vessel a greater number of times in a second, and also that the momentum of each impact will increase in the same proportion. Hence, the part of the pressure due to each molecule will increase not simply as the velocity, but as the square of the velocity; and, if we represent by m the common weight of the molecules of a given mass of gas confined to a constant volume, and by V their mean velocity, then the pressure exerted by the gas on the unit-area, or the height of the mercury column which measures that pressure, will be proportional to the product mV^2, or to $\frac{1}{2}mV^2$, which represents the moving power of the molecules. But the height of a mercury column so related (in the form of the air thermometer described above) is our actual measure of what we have called the absolute temperature; and thus we reach not only a perfect dynamical explanation of that feature of gases on which the air thermometer is based, but also a remarkable confirmation of the generalization we drew from these phenomena. Moreover, as the same general result must follow, whatever be the nature of the gas (m in our formula representing the molecule of any gas), we also find in our theory a simple explanation of the fact discovered by Charles, that all gases undergo equal changes of volume or tension when heated or cooled through the same number of degrees. Again, Prof. Maxwell has proved that if "molecules of different masses (that is, of different gases) knock about

together," the exchange of velocities which result from the collision will tend to bring the whole mass to a condition in which on an average every molecule, great or small, has the same moving power, the lighter molecules acquiring a sufficiently greater velocity to compensate for their smaller mass. This principle must be equally true when the molecules of the different gases are separated by any partition through which velocity may be transferred; and hence when masses of two different gases are at the same temperature $\frac{1}{2}mV^2 = \frac{1}{2}m'V'^2$. From this theorem of molecular mechanics several important consequences follow. In the first place, equal volumes of different gases at the same temperature and pressure must contain an equal number of molecules. For, consider two similar vessels filled with different gases under these conditions. As we have seen, the part of the pressure due to a single molecule in either vessel is proportional to its moving power; and if the average value of the moving power of the molecules in the two vessels is the same, it is evident that the total pressure must depend in each case on the number of molecules, and, these pressures being equal, the number of molecules must be the same. This important truth, which is thus shown to be a necessary consequence of our dynamical theory, is known as the law of Avogadro or Ampère. It was first stated by Amedeo Avogadro, an Italian physicist, in 1811, and was reproduced by Ampère, a French physicist, in 1814. In the second place: the molecular weights of different substances must be proportional to their densities in the state of gas. For, if the unit-volumes of two gases contain, under like conditions, the same number of molecules, it is evident that the weights of these equal volumes must be as the weights of the molecules. Hence, molecules may be weighed against each other simply by determining gas or vapor densities; and since the results thus obtained closely correspond with the combining proportions of chemistry, the facts of this science furnish still further confirmations of our molecular theory. In the third place: if $\frac{1}{2}mV^2 = \frac{1}{2}m'V'^2$, then $V : V' = \sqrt{m'} : \sqrt{m} = \sqrt{\delta'} : \sqrt{\delta}$; and it follows that under like conditions the velocities of different molecules are inversely as the square roots of the densities of the aëriform masses of which they are parts; and here we see the simple mechanical principle underlying the laws of effusion and diffusion discovered by Graham. Moreover, our theory explains the peculiar relations of these two classes of phenomena. When the molecules of any gas rush into a vacuum, they hurry through the aperture with a rapidity which is commensurate with their great velocity; but when they rush into the equally empty space between the molecules of another gas, they are so jostled about in the frequent collisions which ensue that they make but very slow progress. Still, as the molecules of all gases are retarded in the same proportion, the relative rate of their motion forward is not altered thereby.

The dynamical theory enables us to calculate not only the relative but also the absolute velocity of the molecules of different gases. A cubic centimètre of hydrogen gas, at the normal temperature and pressure, weighs $\frac{896}{10000000}$ths of a gramme, and exerts a pressure of 10.33 grammes on each face of the cube; and it is easy to calculate the velocity with which the parts of this small mass must move in order that the component in the direction of either face of the cube should produce such a pressure. The result is 1843 mètres in a second; and although the velocity of the molecules of other gases must be less in proportion as their mass is greater, according to the law already stated, the velocity is in all cases very large as compared with that of a rifle-ball. The velocity of the molecules of gases and their relative masses are values accurately known, because they are direct deductions from observations which can be made with great precision; and even if our theory is false and there are no such things as molecules, these values are quantitative relations which any new theory must equally explain. The scope of our dynamical theory, however, is far wider than could possibly be exhibited in a brief popular article. It embraces molecular magnitudes of which our knowledge is far less accurate and certain than in regard to those we have described, both because the relations involved are more doubtful, and because the values depend on measurements which are not susceptible of the same accuracy. Among these may be mentioned the length of mean path, the number of collisions in a second, and finally the number of molecules in a cubic centimètre of any gas under normal conditions, and the absolute diameter and mass of molecules of different kinds. We will conclude this article with a table taken from an article* on molecules by Prof. Clark Maxwell, in which the magnitudes are classified according to the certainty of our knowledge in regard to them:

Nature, Sept. 25, 1873.

Molecular Magnitudes.

	Hydrogen	Oxygen.	Carbonic oxide.	Carbonic dioxide.
RANK I.				
Mass of molecules when that of hydrogen is 1...	1	16	14	22
Velocity (of mean square) mètres per second at 0° C..................	1859	465	497	392
RANK II.				
Length of mean path in ten billionths (10^{-10}), of a mètre..................	965	560	482	379
Collisions in a second, number of millions.....	17,750	7646	9489	9720
RANK III.				
Diameter in hundred billionths (10^{-11}), of a mètre..........................	†58	76	83	93
Mass in ten million million millionths (10^{-25}), of a gramme....	46	736	644	1012

In a cubic centimètre of any gas at the standard temperature and pressure there are nineteen million million million (19×10^{18}) molecules. J. P. COOKE.

Gascoigne (GEORGE), b. 1535, probably in Westmoreland, England; studied at Cambridge, and in 1555 was admitted to Gray's Inn; became distinguished as a dramatist, but being disinherited by his father, Sir J. Gascoigne, in consequence of his excessive expenses at court, he took ship for Holland 1572, where he served with distinction, but was made prisoner by the Spaniards, who sent him back to England, where he resumed his occupations as dramatist, courtier, and poet. D. at Stamford, Lincolnshire, Oct. 7, 1577. He was "the first English satirist" and "the first English critic in poesy;" now chiefly remembered for *The Steele Glas* (1576), a blank-verse satire, and *The Complaynt of Philomene*, a rhyming elegy (1576).

Gasconade, county of Missouri, bounded on the N. by the Missouri River. The surface is hilly, the soil of the lowlands fertile. Area, 540 square miles. Cattle, grain, wine, fruit, and wool are staple products. Iron, lead, sulphur, copper, burrstone, and limestone are among the mineral products. It is traversed by the Missouri Pacific R. R. Cap. Hermann. Pop. 10,093.

Gasconade River rises by several head-streams in Wright co., Mo., and flows nearly N. N. E. through a broken and densely-wooded region, which affords much timber. It is navigable at high water by small steamboats for 66 miles. It flows into the Missouri River 40 miles below Jefferson City.

Gascon'da, tp. of Laclede co., Mo. Pop. 655.

Gas'cony [Fr. *Gascogne*], an old province of France, between the Pyrenees, the Garonne, and the Atlantic. In the sixth century it received its name from the Basques (*Vascones*), who were driven by the Visigoths across the Pyrenees and settled here. Half a century later it became a part of Aquitania, and in 1152, when Eleanor married Henry Plantagenet, it became an English possession, and remained so until 1453, when the French reconquered it. It is now divided into four departments.

Gas-Engine, a name given to certain prime movers of moderate dimensions introduced in recent years, in which the motive-power is derived from the explosive energy of a mixture of inflammable gas with atmospheric air. These engines were originally operated by means of the gas in ordinary use for artificial illumination; but it has been found that the vapor of any volatile hydrocarbon will serve equally well; and this fact has contributed to the general availability, if not to the economy, of this source of motive-power. The earliest attempts to direct the energy of powerful explosives to the uses of the industrial arts were made with gunpowder. By exploding a moderate charge of gunpowder in a close chamber with valves opening freely outward, the air will be expelled from the chamber, and a vacuum or a near approach to one produced. The apparatus employed, however, by the early experimenters (among whom was the illustrious Huyghens) were exceedingly rude; and no economically useful results were reached in this direction. The possibility of securing a better success by the use of inflammable gas subsequently occurred to more than one inventor; and at length, as early as 1799, an engine was devised, and actually patented in France, by an ingenious artisan named Lebon, which was in every essential particular identical in principle and in construction with one of the most successful gas-engines of the present day; but which was nevertheless not a success, having attracted no notice in the scientific world of the

† Two million hydrogen molecules in a row would occupy a little over one millimètre.

period, and inspired no confidence in the industrial. The engine of Lebon had the general form of a reciprocating steam engine, and operated as follows: From a reservoir containing a sufficient supply of inflammable gas, a certain measured charge was drawn and introduced, in mixture with a similarly measured charge of atmospheric air, into the cylinder, on alternate sides of the piston successively; and this mixture was then fired by means of the electric spark. The inventor seems to have overlooked no provision necessary to secure the success of his design. His engine was entirely self-regulating, and mechanically as well as theoretically it was a success. But economically it failed; for at that time inflammable gas had not been introduced for the general purposes of illumination, and its preparation for the engine involved a disproportionate expense; static electricity, so dependent on atmospheric conditions for its regularity of action, was the only known source of the electric spark; and finally the mechanic arts were yet unequal to the requisitions of a problem involving the peculiar difficulties which the construction of this engine presented.

A reproduction to all intents and purposes of the engine here described, was patented in France in 1860 by an inventor named Lenoir. A description of it in detail may be found in the *Annales du Conservatoire des Arts et Métiers*, of Paris, for the year 1866, and in the report by the present writer made to the government of the U. S. on the Machinery and Processes of the Industrial Arts and the Apparatus of the Exact Sciences in the Universal Exposition of 1867, which forms the third volume of the reports of the U. S. commissioners on that exposition. Such a detailed description is unnecessary here, since the particulars which it embraces, which relate to the mechanical expedients employed for introducing and firing the charge, and for maintaining the action when the motive-force is zero or negative, do not in any manner concern the principle. In its general appearance this engine very much resembles an ordinary reciprocating steam engine; but there is a very important difference between the two, in the respect that, in the steam-engine, the pressure on the piston is maximum when the induction-valve is open; while in the gas-engine, on the contrary, in which the charge does not force its own way into the cylinder but is drawn in by the movement of the piston, the pressure during this period, as shown by the indicator card, is negative, and uniformity of movement can only be maintained by means of a heavy fly-wheel. The inequality of pressure at different periods of the effective stroke is also very great, the maximum being between five and six atmospheres, and the mean not more than half an atmosphere. The engine of Mr. Lenoir has found its way somewhat extensively into use, having been employed not only in Paris and most of the provinces of France, but also in other European countries including Russia, and in Cuba, Peru, and Chili. It cannot be called an economical source of power, since from the test experiments made on it by Prof. Tresca, assistant director of the Conservatoire, its consumption of gas under the most favorable circumstances amounted to two and seven-tenths cubic mètres (about 100 cubic feet) of gas per horse-power per hour. Six pounds of coal employed in raising steam would perform the same work, and at six dollars a ton would cost but two cents, while 100 cubic feet of illuminating gas costs in Paris about a franc, and in the cities of the U. S. 25 to 35 cents.

Another engine belonging to this class, and in many respects resembling the one just described, is that of Mr. Hugon, also of Paris. Hugon's engine employs two little constantly burning gas-jets placed just outside the valve-box, instead of the electric spark, to fire the successive charges in the cylinder. Two little movable jets in recesses constructed in a slider operated by the engine, are alternately lighted at the external burners, and then drawn inward by the slider, so as to inflame the charges at the proper moment. The movable jets are of course extinguished by the explosion; but on the reversal of the movement of the slider they are relighted again at the external burners. Another peculiarity of this engine is that, along with the explosive charge, there is introduced a small amount of water, which, being converted into steam by the heat generated in the explosion, moderates the violence of the action, and sustains better the pressure during the stroke. At the Universal Exposition of 1862 in London a gas-engine was exhibited by the well-known engineers W. and C. F. Siemens, in which this peculiarity—viz. the introduction of water into the cylinder—was carried much farther than it is done by Mr. Hugon, the object being to generate as much steam as the heat furnished by the combustion of the gas would allow. A regenerator was also employed to receive the heat of the exhaust gases, and to transfer it to the entering charge. Though no exact statements of the economy of working this engine appear to have been published, it would seem in theory to be preferable to either of those described above, both as it regards steadiness of action and the cost of maintenance. It appears, nevertheless, to have been abandoned. The consumption of gas in the Hugon engine, including that employed in maintaining the permanent lights, amounted to 2.6 cubic mètres per horse-power per hour. There is also in this engine the same inequality of pressure at different periods during the stroke, that has been remarked in the Lenoir engine.

In all engines of this class it is necessary that a current of cold water should be kept constantly circulating around the cylinder, to prevent its becoming overheated; and in order to facilitate this object, the cylinder is surrounded by a jacket, leaving a free interval for such circulation.

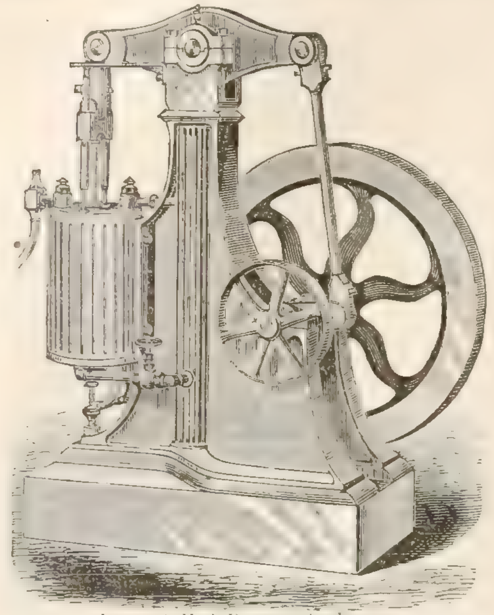
A gas-engine quite different in principle from either of the foregoing was exhibited at the Paris Exposition of 1867 by its inventors, Messrs. Otto and Langen, of Cologne in Rhenish Prussia. Externally, this engine presents the appearance of a Doric column, somewhat more than a mètre in height, upon the enlarged capital of which is fixed a horizontal plate which supports the arbor of the fly-wheel and other parts of the machinery. This column is the working cylinder. The mixed gases—common coal-gas and air—are introduced at its base, and fired by an ingenious mode of communication with a gas-jet which is constantly burning. The base is surrounded by a jacket between which and the cylinder itself there is maintained a refrigerating current. By the explosion of the gas, the piston, which is rather heavily weighted, is driven to the top of the cylinder. The collapse which immediately follows produces a partial vacuum beneath the piston; and this now descends, urged by the pressure of the atmosphere with its own weight superadded. In order to transfer this force to the working arbor of the machine, the piston-rod is on one side provided with a rack which acts on a spur-wheel on the arbor. This wheel is loose on the arbor, but is free to turn in one direction only—that is, the direction which corresponds to the rising of the piston. Two tall uprights serve as guides to the piston and give stability to the machine. When the piston descends, its energy is transferred to the arbor through the spur-wheel above mentioned. A fly-wheel maintains the movement during the intervals in which the piston is ineffective. (For a more full description of this engine see the report by the present writer, cited above.) From experiments made upon this engine with a Prony dynamometer before a jury of the exposition, it appeared that its consumption of gas amounted, on an average, to a very little over one cubic mètre (say 38 cubic feet) per horse-power per hour. It exhibits, therefore, a large economy over the engines of Lenoir and Hugon; but it is very noisy in its operation, and the violence of its action, during the first part of each pulsation, is such as to limit its employment to comparatively low powers.

It has been already stated that the vapor of the more volatile hydrocarbons may be substituted in all of these motors for the permanent inflammable gases, without prejudice to their mechanical efficiency; but in point of economy it is probable that coal-gas will generally be found to be the cheaper fuel of the two. (See FUEL.) Some inventions of this class have nevertheless been devised with special reference to the use of such vapors. One of these, by Mr. Julius Hock of Vienna, presented at the International Exposition in that city in 1873, and put forward with a good deal of pretension, as "differing completely from anything which had ever been done before," was nevertheless in every essential respect a Lenoir engine burning vapor instead of gas, and is therefore entitled to no further mention here.

A very different judgment must however be pronounced upon an American invention patented by George B. Brayton Apr. 2, 1872, and known as Brayton's Ready Motor, in which petroleum is the fuel ordinarily used, though it was originally designed for gas. This engine employs, like those already described, a mixture of gas or vapor with atmospheric air in explosive proportions—say one part of the former to twelve of the latter—but, unlike the others, it burns this mixture in the cylinder without explosion, and expends upon the piston the energy derived from its combustion with the same steady pressure as that exerted by steam in the steam-engine or by rarefied air in the hot-air engine. This remarkable effect is produced by the simple expedient of delivering the gaseous mixture into the cylinder through the meshes of a separating sheet of wire-gauze, and inflaming the mixture on the surface of the gauze next the cylinder. The same phenomenon occurs here which is seen in Davy's safety lamp. When the lamp is lighted and immersed in an explosive mixture, the gas which passes through the meshes of the wire-gauze cap burns quietly in the interior, so that the whole cap seems to be full of flame; but the gauze effectually prevents this

flame from reaching and igniting the mixture outside. So in this engine, the flame is confined to the cylinder and is prevented by the wire-gauze screen from running back through the passages and exploding the mixture in the reservoir. For greater security, two or three successive screens are introduced. As this engine is evidently destined to occupy a very important place in many industries, it seems to deserve a more particular description than we have

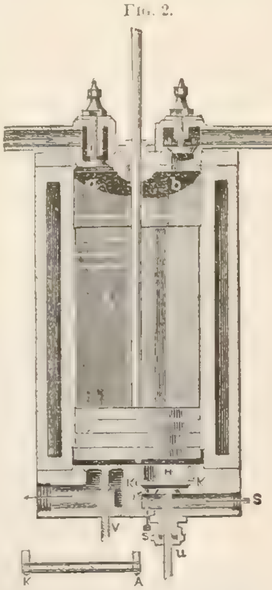
Fig. 1.



Brayton's High-Pressure Gas-Engine.

given to those previously mentioned. Fig. 1 presents a perspective elevation showing the cylinder, working-beam, fly-wheel, and driving-pulley with certain pipes the purpose of which will be better understood from Figure 2. This figure shows a section of the cylinder, piston, and valves of which there are four. As the engine is only single-acting, the upper valves *a* and *b* may for the moment be disregarded. The induction-valve is *u*, and the exhaust-valve, *v*. The valve *u* admits the combustible mixture to enter by the pipe S through the shallow chamber H, in which are placed the wire-gauze diaphragms *k k*, into the cylinder beneath the piston. Through the valve-seat there is made a small perforation which may be closed more or less nearly by the pointed screw *r*. The pipe S is that which, in Fig. 1, carries the screw-valve between the cylinder and a reservoir within the fluted column, in which a certain quantity of

Fig. 2.



Section of Brayton's Gas-Engine: induction chamber, enlarged.

the combustible mixture is contained under pressure. When the screw-valve is opened, the gas, entering through S, makes its way by the small aperture in the valve-seat at *r* into the shallow chamber H. When it is desired to set the engine in motion, the piston is brought near the bottom of the cylinder by turning the fly-wheel, and a lighted match is introduced from without into the chamber H by an aperture not shown, which is then closed. The gas in H takes fire, and as the supply is continuous it continues to burn. The fly-wheel is then turned a little farther so as to open the induction-valve, when the engine immediately begins to operate. Its motion can only be arrested by cutting off the supply by means of the screw-valve.

We will now give attention to the valves at the top of the cylinder. The left-hand valve communicates with a gasometer which itself receives supplies through two inlets —one introducing atmospheric air and the other inflammable gas, in the proportion of twelve to one. As the piston descends, the cylinder behind it is filled through *a* with this explosive mixture. As it reascends, the valve *a* closes and *b* opens, the charge in A being forced through this into the reservoir from which the supply of the cylinder is drawn. The upper part of the cylinder is somewhat enlarged, so that when the piston is at its highest point, there still remains in it a quantity of gas equal to about one charge. It is easily seen that, if the cut-off is placed low, the volume of gas admitted at each stroke will be proportionally less than that driven into the reservoir; but as it is also obvious that, after running a short time, the *mass* of gas drawn out in a given time, must be exactly equal to that forced in in the same time, the pressure under which the engine works may be increased by shortening the cut-off, or diminished by lengthening it.

To prepare the engine to start, it is obvious that a certain pressure must first be got up in the reservoir. This need be only sufficient to set the engine running. After it has once started it will regulate itself, and will soon create the pressure due to the length of cut-off. In small engines this preliminary pressure may be got up by a few turns of the fly-wheel. For large ones a force-pump must be used; but when once got up, there is no need that it should run down, if the valves are close, even in long intervals of repose. As the reservoir has the capacity of only three or four charges, it is not a great labor to prepare it.

The efficiency of this engine is due to the expansion of the air introduced, and of the products of combustion (carbonic acid and steam) by the heat generated in the same combustion. The pressure in the cylinder is no greater than that in the reservoir. The opposing pressure is at first only that of the atmosphere, but rises towards the end of the stroke to be equal also to that in the reservoir. The action of the engine therefore in every respect resembles that of a hot-air engine; and it is to this class, rather than to the class of gas-engines, that it properly belongs. Though hot-air engines are in theory the most economical of engines driven by heat, the economy of theory has never been realized from them in practice, in consequence of the extreme difficulty of imparting heat to air. Radiant heat in this case produces but little effect; and to heat air thoroughly by contact requires a complicated construction which seriously impedes circulation and increases the resistance of friction. The Brayton motor has practically solved this difficulty, by mingling the fuel with the air itself, so that the whole heat of combustion is imparted to the air directly. It is therefore a hot-air engine without a furnace, or one in which the furnace is the cylinder itself.

The economical performance of this engine has been tested by Prof. R. N. Thurston of the Stevens Technological Institute, Hoboken, and R. H. Buel, Esq., mechanical engineer of New York. These gentlemen found the consumption of gas to amount to $32\frac{86}{100}$ cubic feet per horse-power per hour; being less than that of the Otto and Langen engine by about 18 per cent. But the steadiness of action of this engine adapts it to high as well as low powers; and it works silently while the one just mentioned creates an intolerable din. It is obvious that the Brayton engine might be made double-acting by employing separate pumps for the reservoir. F. A. P. Barnard.

Gaskell (Elizabeth Cleghorn, *née* Stevenson), b. at Chelsea, England, in 1811, married a Unitarian minister of Manchester: author of *Mary Barton*, 1848; *Moorland Cottage*, 1850; *Ruth*, 1853; *North and South*, 1855; *Round the Sofa*, 1859; *Sylvia's Lovers*, 1863; *Wives and Daughters*, 1866, and other novels, all of high moral purpose, and mostly written with cleverness; also of *The Life of Charlotte Bronté*, 1857. D. at Alton, Hampshire, Nov. 12, 1865.

Gas'kill, tp. of Jefferson co., Pa. Pop. 478.

Gas-Lighting [Ger. *Gasbeleuchtung*: Fr. *l'éclairage au gaz*]. 1. *Gas-Wells.*—Combustible gases issue from the earth in various parts of the world, constituting what are called gas-springs or wells. The holy fires of Baku, on the Caspian, and many of the sacred fires of the Greeks, were thus supplied with fuel. The Chinese have for ages used the gas which issues from some coal-beds near Peking for evaporating brines. In 1659, Shirley described a gas-well in Lancashire. Sir James Lowther in 1733 called attention to the gas which issued in a coal-mine at Whitehaven. This spring was afterwards walled in, and the gas burned through a 2-inch tube, and thirty years later it was proposed to light the streets of Whitehaven with it. Fredonia, N. Y., was lighted fifty years ago with natural gas, and the Kanawha salt-wells have long delivered gas in large

quantities. The city of Erie, Pa., has now thirteen gas-wells, bored as such, which furnish gas to be used as fuel under steam boilers. One of these furnishes gas under a pressure of 200 pounds per square inch. The wells are 600 feet deep, cost $1500 each, and yield from 10,000 to 30,000 feet each per day. A wonderful gas well occurs at Bloomfield, Ontario co., N. Y. It was bored to a depth of 500 feet for oil, and yields 800,000 feet daily of 14½ candle gas. A well at Burning Springs on the Little Kanawha, West Va., 900 feet deep and 4 inches in diameter, supplies, through a 2 inch pipe over a mile long, 28 boilers of 12 horse power each, 50 stoves, and many lights. (See *Sill. Am. J. Sci.*, xlix., 1845, p. 406; article on Ohio gas-wells by J. S. NEWBERRY, *Am. Chemist*, i., 201, 1870; and article by H. WURTZ on American gas wells, *Am. Gas-Light J.*, Dec. 2, 1871, p. 162.) The *fire-damp* of coal-mines is the same gas, which was produced during the formation of the coal from vegetable matter, and is liberated by the pick of the miner, to make an explosive mixture with the air of the mine. The gas which bubbles to the surface in stagnant pools is of the same character. In all cases these combustible gases consist chiefly of *marsh gas*, or *methane* (CH_4), also called light carburetted hydrogen, with smaller proportions of ethane, propane, etc., the lighter members of the paraffin series of hydrocarbons, of which petroleum is chiefly composed. (See PETROLEUM.)

2. *Early History of Gas Lighting.*—About the beginning of the seventeenth century Van Helmont noticed that when animal or vegetable substances were heated in close vessels, vapors or spirits were obtained which burned with a bright flame. Some time previous to 1691, Dr. John Clayton prepared gas from the bituminous coal of Wigan, collected it in bladders, and burned it for the amusement of his friends. In 1726, Dr. Stephen Hales made similar experiments with Newcastle coal. The bishop of Llandaff showed in 1767 how gas evolved from coal might be conveyed in tubes, and in 1786, Dr. Pickel, professor of chemistry at Würzburg, lighted his laboratory with the gas obtained by the dry distillation of bones. In 1787, Lord Dundonald of Culross Abbey in Scotland took out a patent for making coal-tar, and erected ovens for the purpose. The coal-gas produced was burned at the abbey as a curiosity. The real inventor of practical gas-lighting was William Murdoch, who in 1792 lighted his house and office at Redruth in Cornwall with gas made from coal, and astonished his neighbors still more by adapting the new light to a small steam-carriage in which he rode to and from the mines. He soon removed to Scotland, and in 1797 lighted his premises at Old Cumnock, in Ayrshire, with coal-gas. In 1798 he constructed gas-works at the shops of Boulton, Watt & Co. at Soho, and first publicly exhibited the gas in 1802 at the Peace of Amiens, when he showed two enormous flames of coal-gas burning from two copper vases at these works. In 1805 the cotton-mills of Phillips & Lee at Salford were lighted with gas by Boulton, Watt & Co., under the direction of Murdoch; and at about the same time the mills at Sowerby Bridge were lighted by the same firm, under the direction of Mr. Clegg. In 1799 the French engineer Le Bon took out a patent in France for making gas from wood, with which he proposed to light Paris. In 1804, Winsor lectured on gas at the Lyceum Theatre in London, exhibiting the gas, but making a great mystery of the process. He finally obtained permission to light a few street lamps with gas in Pall Mall, which he did in 1809, and organized the National Light and Heat Co., applying for a charter, which was refused. A great newspaper war was then initiated by him, in order to create a popular interest in the new light. In 1810, Parliament authorized His Majesty to grant a charter within three years. On Dec. 31, 1813, Westminster Bridge was lighted, and soon after the oil-lights in the streets of St. Margaret's, Westminster, were replaced by gas, and the next year (1815) Guildhall was lighted. Still, prejudice against the new light was so intense, even on the part of men of science, that it seemed at one time to present an insurmountable obstacle to its further progress. Davy (afterwards Sir Humphry) ridiculed the idea by asking if it were intended to take the dome of St. Paul's for a gas-holder. The popular ignorance with regard to gases in general was so great that when gas was finally admitted into the House of Commons, the architect directed that the pipes be placed four or five inches from the walls, lest their heat should fire the building. Popular prejudice was by no means the only obstacle to the introduction of gas lighting. The apparatus and machinery had to be invented; men had to be instructed to make them, and others to use them. Suitable pipes for distributing the gas could not be obtained. Wood and paper were patented, gun barrels were screwed together, till finally wrought-iron pipes were supplied. In 1822 there were four great companies in London, using 1315 retorts and 47 gas-holders, and making 397,000,000 cubic feet of gas annually. Now, every large city in the civilized world is lighted by gas, giving rise, with the collateral business of making the fixtures, burners, etc., and working up the waste products, to one of the most extensive industries.

The manufacture of gas was first attempted in the U. S. at Baltimore, without success till 1821. It was introduced in Boston in 1822, and in 1823 the New York Gas-Light Co. was started, though it was not in successful operation till 1827. There are now probably 400 to 500 companies in the U. S., with an aggregate capital of $50,000,000 or more.

3. *Materials used for Making Gas.* All vegetable and animal substances when exposed in close vessels to a red heat undergo destructive distillation, yielding gas, water, and tar, and leaving a residue of charcoal or coke. A few only are adapted for the economical production of illuminating gas. Bituminous coal is the material generally selected, though under certain circumstances several others have been, and are even now, employed. The most important of these are petroleum or some of its less valuable products (as naphtha or residuum), rosin, wood, peat, cheap oils, and fats. The mixture of hydrogen and carbonic oxide, called "water-gas," produced by passing steam over red-hot coke, charcoal, or anthracite, or a mixture of steam and petroleum vapor or gas through a red-hot retort, has been, and is now, employed with success in the manufacture of illuminating gas, its want of illuminating power being supplied by rich gases from other materials.

4. *Coal-gas* is made from bituminous coal. The following are the most important varieties of mineral coal:

1. Anthracite.
2. Bituminous. { Non-caking, Caking, Cannel.
3. Lignite, or brown coal.

In addition to these coals, there are bituminous shales, such as the Boghead mineral from Scotland, the Wallongongite from Australia, and the paper shales of Germany. There are also asphaltic minerals, which, while they are never used alone, are very important when added to poor coals, to the extent of 5 or 10 per cent., as enriching materials, for the purpose of improving the quality of the gas. The most important of these asphalts are albertite from Nova Scotia and grahamite from West Virginia. These asphalts produce large quantities of extremely rich gas, but their cost limits the quantity that can be used. Next to them in quantity and quality of the gas come the rich bituminous shales above mentioned, but they too are not found in sufficient quantities to be used alone. Of true coals, the cannels yield the richest gas, and in England they are sometimes used exclusively. The caking coal is, however, the chief material employed. The advantage of this variety of coal is due to its abundance and consequent cheapness, and to the fact that when heated it undergoes a kind of fusion, and furnishes a compact porous coke of great value as fuel. The gas from caking coal is inferior in illuminating power, but this deficiency is supplied by the use of a certain proportion of richer cannels and other enriching materials. The table on the next page illustrates the character of a few of the more important gas-coals and enrichers.

The percentage of sulphur in gas-coal is a matter of considerable importance, as, while about half of this sulphur remains in the coke, the other half passes into the volatile products, and is divided between the gas, the ammonia-water, and the tar. As the sulphur contained in the gas must be removed in the process of purification, the cost of this part of the process increases with the percentage of the sulphur contained in the coal. The sulphur is present in the coal chiefly in the form of iron pyrites (FeS_2). Some American gas-coals contain considerable percentages of sulphur. The Nova Scotia coals (Glace Bay, Bridgeport, International, etc.) contain from 3 to 5 per cent.; Red Bank, Pa., 0.89; Westmoreland, Pa., 1.50; Murphy's Run, West Va., 1.88 to 3.06; Orrell, Eng., 1.75 to 2.[illegible]4. The last column in the above table shows the number of feet of gas purified by one bushel of lime, which is a tolerable indication of the amount of sulphur which goes into the gas.

The manufacture of coal-gas includes three distinct operations: (1) the distillation of the coal; (2) the separation of the water, tar, and other condensable matters—*condensation*; (3) the removal of sulphur compounds and carbonic acid—*purification*.

Retorts.—The distillation is effected in long horizontal, semi-cylindrical, D-shaped retorts of cast iron, or more generally of clay, which consist of two parts—the body and the mouthpiece (Fig. 1, C). They are closed when in use by a lid, properly luted and held in place by a screw. The retorts are set in groups or *benches* of three, five, six, or seven, heated by one fire of coke. In Paris the Siemens regenerating furnace has been introduced for heating gas-retorts. At the Vaugirard station one furnace furnished fuel for 128 retorts, set in benches of 8, with regenerating

	Volatile matter.	Fixed carbon.	Ash.	Gas per ton of 2240 lbs. in cubic feet.	Candle-power of gas.	Coke per ton of 2240 lbs.		Gas purified by 1 bushel of lime, in cubic feet.
						Pounds.	Bushels.	
I. Caking Coals.								
New Castle, England	32.70	65.55	1.75	10057	10.11	1536	49	3500
Glace Bay, Cape Breton	....	....	......	9560	12.50	1484	38	1945
Lingan, Cape Breton	35.20	60.80	4.00	9520	12.92	1450	42	2200
Block House, Cape Breton	40.80	57.70	1.50	10217	17.32	1460	40	2304
Pittsburg, Pa	36.76	51.93	7.07					
Westmoreland, Pa	36.00	58.00	6.00	10642	16.62	1544	40	6420
Sterling, O	37.50	56.90	5.60	10528	18.81	1480	36	3993
Despard, West Va	40.00	53.30	6.70	10765	20.41	1540	36	2494
II. Cannel Coals.								
Kirkless Hall, England	40.30	56.40	3.30	10012	21.47	1410	36	2000
Darlington, O	43.00	40.00	17.00	9800	34.98	1320	32	2805
Petonia, West Va	46.00	41.00	13.00	13200	42.79	1380	32	4519
III. Enriching Materials.								
Boghead mineral, Scotland	51.60	15.70	32.70	13619	26.45	1378	35	3400
Grahamite, West Va	53.50	44.50	2.00	15000	28.70	1056	44	
Albertite, Nova Scotia	57.70	41.90	0.40	14784	49.55	806	16.8	
Wollongongite, Australia	82.50	6.50	11.00	15716	131.00	424	......	5686

chambers beneath each bench. The saving in fuel is said to amount to 29 per cent. The coal is charged in at the front of the retort through the mouthpiece, generally in an iron scoop, which is inverted before it is withdrawn, having the coal evenly distributed on the bottom of the retort. When the distillation is completed, the lid is removed and the red-hot coke is drawn out into an iron wheelbarrow, spread out in the yard, and quenched with water. About one-third of the coke obtained is required for heating the retorts; the rest is sold. The work of charging the red-hot retorts and drawing the coke is very laborious and exhausting, and an effective machine for performing this duty has long been a desideratum. Such a machine has been invented by Mr. T. F. Rowland of Greenpoint, N. Y., and is figured and described in the *Coal and Iron Record* of Sept. 24, 1873. The working model certainly accomplishes all that can be desired. The intensity and duration of the heat to which the coal is exposed are matters of great importance. For iron retorts a dull cherry (1470° F.) to a clear cherry red heat (1830° F.) is most suitable. For clay retorts a deep orange (2010° F.) to a clear orange (2190° F.), or even a white heat (2370° F.), is employed, the coal itself being exposed in either case to a temperature of 1500° to 1600° F. The effect of too low a temperature is to produce a larger proportion of condensable vapors, which are lost in the form of tar, while too high a temperature injures the quality of the gas by decomposing it into non-luminous marsh-gas and hydrogen. When the charge of 160 or 200 pounds of coal is first introduced into the hot retort, the outer layers only of the coal undergo distillation, yielding condensable vapors very rich in carbon; these, passing through the red-hot retort on their way out, are decomposed into fixed gases of high illuminating power. As the heat continues these outer layers of coal become converted into coke, which is soon raised to a red heat. In the mean time the heat reaches the interior of the charge, and the vapors produced, passing through the red-hot layers of coke, are in turn converted into fixed gas. As each successive portion of vapor has to pass over a larger surface of red-hot coke, it is more and more completely decomposed, and its percentage of carbon, and consequently its illuminating power, reduced. For this reason the quality of the gas deteriorates as the process of distillation continues, till finally little besides hydrogen is evolved. At the last stages of the process the sulphur contained in the coke is said to form bisulphide of carbon, which is a most objectionable impurity. It is considered better, therefore, to interrupt the process at the end of four hours than by continuing it to impair the quality of the whole product by the poor gases of the later stages of the distillation. To prevent the reduction of the illuminating power of the gas by too high a temperature, it is also necessary to remove the gas from the retort as soon as possible, and not to permit its pressure to be increased by obstacles to its ready escape. For the accomplishment of this object an exhauster, or gas-pump, is employed—not so much to suck the gas out of the retort (the partial vacuum produced in the retort rarely exceeds one inch of the water-column in the pressure-gauge) as to push the gas ahead through the condenser, washer, and purifiers into the holder, and thus make room for more gas to follow from the retort. The effect of too low heats is shown to an exaggerated degree in the following comparison of the results obtained from the same coal when distilled at a bright red heat for gas, and at a heat hardly red (750° to 800° F.) for coal-oil. One ton of 2240 pounds of Newcastle coal yielded—

I. When distilled for gas, at a high temperature.		II. When distilled for oil, at a low temperature.	
Gas	7450 cu. ft.	Gas	1400 cu. ft.
Coal-tar	18½ gals.	Crude oil	68 gals.
Coke	1200 lbs.	Coke	1280 lbs.

The Standpipe.—From the retorts the gas and vapors pass up through the ascension or *standpipe*, which is attached to the mouthpiece, to the *hydraulic main.*

The Hydraulic Main (Fig. 1, B).—This is a large horizontal tube half filled with tar which condenses from the gas, the constant level of which is maintained by an overflow to the tar-well. To prevent the escape of gas from the hydraulic main when the retorts are opened, the standpipe makes a double turn and enters the hydraulic main from above, its end dipping three or four inches into the tar, which makes an effective seal. The hydraulic main is really the first element of the condensing apparatus, for here the condensable vapors begin to separate, as tar and ammonia-water.

The Exhauster (not shown in Fig. 1).—From this main the gas passes to the *exhauster*, or gas-pump, which pushes it forward to the *condenser*, or refrigerator. There is a popular idea that the exhauster is a convenient device to enable the gas companies to draw in air through the open retorts, and thus dilute the gas. No one is more interested in preventing this than the gas companies, for air exerts a most fatal influence on the quality of the gas. Two per cent. of air diminishes the illuminating power of the gas 10 per cent., 5 of air, 30 per cent., 7 of air, 48 per cent., 10 of air, 66 per cent., and 20 of air, 88 per cent. The exhauster is provided with a special device to prevent the drawing in of air.

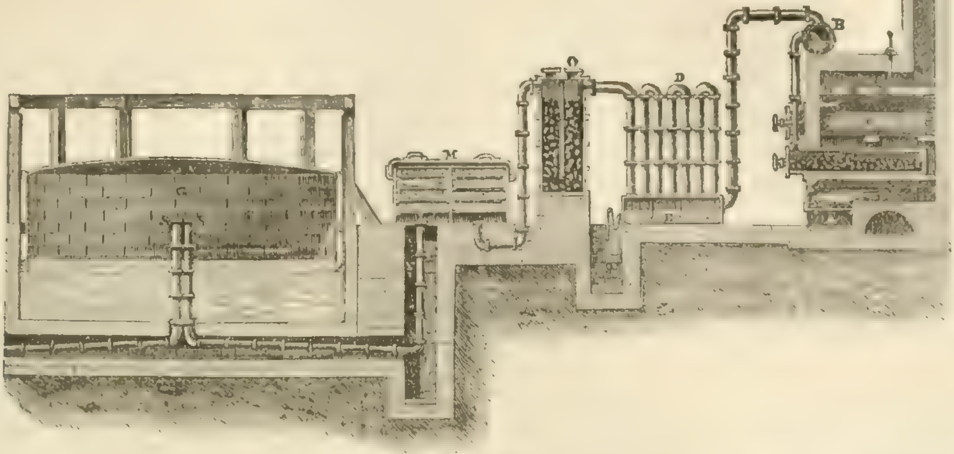
The condenser (Fig. 1, D) consists of a series of iron tubes placed in the open air, or more commonly in cisterns of cold water. By a simple contrivance (Fig. 1, E) the tar and ammonia-water which separate from the gas as it traverses the condenser readily flow off into their respective wells. From 50 to 100 square feet of tube-surface is allowed for every 1000 feet of gas to be cooled per hour. At the works of the New York Gas-Light Co. a multitubular condenser is in use, consisting of two sets of eight boxes, each containing 100 tubes, 3 inches in diameter and 15 feet long. The gas passes up in one set of tubes and down in the next, through the entire series of sixteen boxes, thus traversing 240 feet of 3-inch pipe, cooled by a constantly changing water-supply outside. The action of this condenser is more than its name implies. While the warm gas contains steam and various condensable vapors, which are liquefied and separated here, it also bears along a considerable quantity of tar, in the form of globules, spray, or fog, too minute to be deposited by gravity. This tar is already condensed to liquid, and it requires for its separation actual contact with a bath of tar, as in the hydraulic main, or with surfaces wet with tar, as in the tubes of the condenser; the tortuous journey is also favorable for the *licking up* of the tar-globules by the tarry surfaces.

The Washer (not shown in Fig. 1).—The gas next enters the *washer*, and then at many works a scrubber, both designed to render more complete the separation of the tar and ammonia, and also to separate some of the sulphur compounds. The washer consists of a series of compartments, through which the gas passes, and where it is exposed to jets of water. At the East-side works of the Manhattan Co. the washer consists of a series of 36 cells, 3 feet square and 10 feet high, each supplied with two jets of water, which enter at the side and are thrown into spray by impinging against an iron plate. The gas passes through the entire series.

The scrubber (Fig. 1, O) is a large chamber partially filled with coke, fragments of fire-brick or paving stones, which are kept constantly wet by a spray of water. It serves to remove the last portions of tar, etc.

Apparatus of St. John and Rockwell.—The free use of water on the gas is found to be objectionable, as some of the rich illuminating gases and vapors present are dissolved out by it, and the illuminating power is reduced

Fig. 1.



Coal-Gas Works.

thereby. For this reason dry scrubbing is sometimes resorted to, or washing and scrubbing with the ammonia-water derived from the gas itself. Messrs. St. John and Rockwell have devised an apparatus (figured and described in the *Am. Gas Light Journal* of Jan. 16, 1875) which takes the place of condenser, washer, and scrubber, and entirely avoids the use of any water save that condensed from the gas. It consists of a series of compartments by which the gas from the hydraulic main is made to bubble through the tar and ammonia-water, and to pass over a latticework of iron, which catches the tar-globules. The writer tested this apparatus (now used by the Harlem Gas Light Co.) for a week, using 163,120 pounds of Pennsylvania and 470,445 pounds of Murphy Run coal. The yield averaged 10,897 feet of 17.06 candle gas, which contained, after being purified with oxide of iron, only 2.65 grains of ammonia and 23.58 grains of sulphur in 100 cubic feet. Prof. Wurtz (*Am. Gas Light J.*, Jan. 2, 1875) reported the results of his analyses of the gas before and after it passed this apparatus, as follows (the numbers in the first two columns represent grains in 100 cubic feet):

	Crude gas from hydraulic main.	Gas after passing the apparatus.	Percentage of each impurity removed.
Water	3515	2675	23.92
Tar	515	44	91.46
Soot, dust, etc.	266	56	79.05
Naphthaline	123	25	79.77
Ammonia	339	237	30.18
Sulphuretted hydrogen	1235	1105	10.51
Carbonic acid	1698	1522	10.36

Products of the Distillation of Coal. Before proceeding to describe the process of purification, it will be well to exhibit the composition of the products produced from the coal in the process of gas-making:

I. Coke.

	Per cent.
1, Carbon	90 – 95
2, Sulphide of iron (Fe_7S_8)	3 – 10
3, Ash	3 – 15

II. Ammonia-Water.

1, Acid carbonate of ammonia	NH_4HCO_3.
2, Hydrosulphate of ammonia	NH_4HS.
3, Sulphocyanide of ammonium	NH_4CNS.
4, Cyanide of ammonium	NH_4CN.
5, Chloride of ammonium	NH_4Cl.

III. Tar.

1. *Hydrocarbons.*

	Formula	Sp. gr.	Boiling points	
1, Benzol	C_6H_6	.850	82° C.	= 179.6° F.
2, Toluol, methyl-benzol	C_7H_8	.870	111°	= 231.8°
3, Ethyl-benzol	C_8H_{10}	......	132°	= 269.6°
4, Xylol, dimethyl-benzol	C_8H_{10}	.867	140°	= 284.°
5, Cumol, propyl-benzol	C_9H_{12}	.870	153°	= 307.4°
6, Methyl-ethyl-benzol	C_9H_{12}	......	160°	= 320°
7, Tri-methyl-benzol (pseudocumol, mesitylene)	C_9H_{12}	......	166°	= 330.8°
8, Isobutyl-benzol	$C_{10}H_{14}$	......	159° C.	= 318.2° F.
9, Cymol, methyl-propyl-benzol	$C_{10}H_{14}$	.861	178°	= 352.4°
10, Di-ethyl-benzol	$C_{10}H_{14}$	......	178°	= 352.4°
11, Di-methyl-ethyl-benzol (ethyl-xylol)	$C_{10}H_{14}$	......	184°	= 363.2°
12, Amyl-benzol	$C_{11}H_{16}$	.859	193°	= 379.4°
13, Methyl-amyl-benzol	$C_{12}H_{18}$	......	213°	= 415.4°
14, Di-methyl-amyl-benzol (amyl-xylol)	$C_{13}H_{20}$	......	232°	= 449.6°
15, Phenylene	C_6H_4	......	91°	= 195.8°
16, Cinnamene, styrolene	C_8H_8	.924	145°	= 293°
17, Naphthalene	$C_{10}H_8$	1.153	220°	= 428°
18, Di-phenyl	$C_{12}H_{10}$	......	240°	= 464°
19, Anthracene	$C_{14}H_{10}$	1.147	300°	= 572°
20, Pyrene	$C_{16}H_{10}$			
21, Chrysene	$C_{18}H_{12}$			
22, Benzerythrene (*and probably*)				
23, Quintane	C_5H_{12}	0.60	30°	= 86°
24, Sextane	C_6H_{14}	.669	68°	= 154.4°
25, Other paraffines	C_nH_{2n+2}			
26, Quintene, amylene	C_5H_{10}	....	35°	= 95°
27, Sextene	C_6H_{12}	....	68°	= 154.4°
28, Other olifines	C_nH_{2n}			
29, Quintine, valerylene	C_5H_8	....	46°	= 114.8°
30, Sextine, diallyl	C_6H_{10}	....	58°	= 136.4°
31, Other acetylenes	C_nH_{2n-2}			
32, Dipropyl	$(C_3H_7)_2$	.678	68°	= 154.4°
33, Dibutyl	$(C_4H_9)_2$	.706	106°	= 222.8°
34, Diamyl	$(C_5H_{11})_2$	.711	158°	= 316.4°
35, Dicaproyl	$(C_6H_{13})_2$	.757	202°	= 395.6°
36, Other alcohol radicals	$(C_nH_{2n+1})_2$			

2. *Alcohols.*

1, Phenol, carbolic acid	C_6H_5OH	1.065	180° C.	= 356° F.
2, Cresol, cresylic acid	C_7H_7OH	...	200°	= 392°
3, Phlorol, phlorylic acid	C_8H_9OH	1.037	[illegible]	[illegible]
4, Xylenol	C_8H_9OH	...	213.5°	= 416°
5, Thymol	$C_{10}H_{13}OH$	...	220°	= 428°
6, Methyl thymol	$C_{11}H_{15}OH$			
7, Ethyl-thymol	$C_{12}H_{17}OH$			
8, Amyl-thymol	$C_{15}H_{23}OH$			

3. *Acids.*

1, Acetic	$H.C_2H_3O_2$	1.062	117.2° C.	= 243° F.
2, Butyric	$H.C_4H_7O_2$	.9817	164°	= 327.2°
3, Rosolic	$C_{20}H_{16}O_3$			
4, Brunolic	?			

4. *Bases.*

1, Ammonia	H_3N	Gas.		
2, Methylamine	CH_5N	Gas.		
3, Ethylamine	C_2H_7N	.696	19° C.	= 66.2° F.
4, Diethylamine	$C_4H_{11}N$	...	57.5°	= 135.5°
5, Aniline, phenylamine	C_6H_7N	1.028	182°	= 359.6°
6, Toluidine	C_7H_9N	...	205°	= 401°
7, Xylidine	$C_8H_{11}N$	...	215°	= 419°

	Formula.	Sp. gr.	Boiling points	
8, Cumidine..........	$C_{10}H_{13}N$	.952	225°C.	= 437° F.
9, Cymidine..........	$C_{11}H_{15}N$	...	250°	= 482°
10, Pyridine..........	C_5H_5N	.985	117°	= 242.6°
11, Picoline..........	C_6H_7N	.961	133°	= 271.4°
12, Lutidine..........	C_7H_9N	.946	154°	= 309.2°
13, Collidine..........	$C_8H_{11}N$	.921	179°	= 354.2°
14, Parvoline..........	$C_9H_{13}N$	...	188°	= 370.4°
15, Coridine..........	$C_{10}H_{15}N$	...	211°	= 411.8°
16, Rubidine..........	$C_{11}H_{17}N$	1.017	230°	= 446°
17, Viridine..........	$C_{12}H_{19}N$	1.017	251°	= 483.8°
18, Pyrrol..........	C_4H_5N	1.077	133°	= 371.4°
19, Leucoline, chinoline..........	C_9H_7N	1.081	238°	= 460.4°
20, Iridoline, lepidine..........	$C_{10}H_9N$	...		
21, Cryptidine, dispoline..........	$C_{11}H_{11}N$	...	273.9°	= 525°

5. *Pitch.*

Oxidized bituminous bodies, whose nature has not been accurately determined.

IV. Gas.

1. *Luminants.*

	Formula.	Density.
1, Vapors of paraffines..........	C_nH_{2n-2}	
2, Propyl..........	$(C_3H_7)_2$	
3, Other alcohol radicals..........	$(C_nH_{2n+1})_2$	
4, Olefiant gas, ethene..........	C_2H_4	.976
5, Propene..........	C_3H_6	1.490
6, Butene..........	C_4H_8	1.940
7, Vapors of other olifines..........	C_nH_{2n}	
8, Acetylene..........	C_2H_2	.920
9, Vapors of other acetylenes?..........	C_nH_{2n-2}	
10, Valelene?..........	C_nH_{2n-4}	
11, Benzole..........	C_6H_6	2.71
12, Vapors of toluol, xylol, etc..........	C_nH_{2n-6}	
13, Phenylene, etc.?..........	C_nH_{2n-8}	
14, Cinnamene, etc.?..........	C_nH_{2n-10}	
15, Naphthalene..........	$C_{10}H_8$	
16, Diphenyl, etc.?..........	$C_{12}H_{10}$	
17, Anthracene?..........	$C_{14}H_{10}$	
18, Pyrene?..........	$C_{16}H_{10}$	
19, Chrysene?..........	$C_{18}H_{12}$	
20, Phenol, etc. (alcohols)..........	$C_nH_{2n-7}OH$	
21, Bases above mentioned..........		

2. *Diluents.*

1, Hydrogen..........	H	.0691
2, Marsh-gas, methane..........	CH_4	.5594
3, Carbonic oxide..........	CO	.9727

3. *Impurities.*

1, Sulphuretted hydrogen..........	H_2S	1.1747
2, Ammonium sulphydrate..........	NH_4HS	
3, Bisulphide of carbon..........	CS_2	
4, Oxysulphide of carbon?..........	CSO	
5, Sulphurous acid (anhydride)?..........	SO_2	
6, Mercaptan, etc..........	C_2H_5HS	
7, Sulphur bases, etc..........		
8, Ammonium sulphocyanide..........	NH_4CNS	
9, Ammonium cyanide..........	NH_4CN	
10, Ammonium mono-carbonate..........	NH_4HCO_3	
11, Carbonic acid (anhydride)..........	CO_2	1.5240
12, Nitrogen..........	N	.9760
13, Oxygen..........	O	1.1026
14, Aqueous vapor (water)..........	H_2O	.6201

Purification.—The above-mentioned impurities, which are not separated from the crude gas either in the condenser, washer, or scrubber, are all more or less objectionable. All the sulphur compounds produce sulphurous acid, and probably some sulphuric acid, when the gas is burned, which vitiate the atmosphere, and may even cause serious damage to books, and silks and other textile fabrics. Ammonia is objectionable, because it attacks the fittings, corrodes the metres, and fixes the stopcocks. It also has the property of holding tar in suspension. When burned it is partially converted into nitrous acid. Ammonia is in some respects advantageous; it unites with the sulphuric acid produced during combustion, and forms harmless sulphate of ammonia; and it is also said to prevent the deposition of naphthalene in the mains. The nitrogen and oxygen which are generally present in gas are supposed to be entirely due to atmospheric air, which unavoidably gains admission when retorts are charged, purifiers changed, etc. Nitrogen diminishes slightly the illuminating power of the gas, as it absorbs a portion of the heat of combustion, without contributing either heat or light. It may also form nitrous or nitric acid, and thus vitiate the atmosphere. Oxygen is more objectionable than nitrogen; it diminishes the illuminating power of the gas very materially, as already stated in connection with the *exhauster*. Carbonic acid also occasions a considerable loss of light; 1 per cent. of this gas is said to diminish the illuminating power of coal-gas 5 per cent.

The following table, prepared by Firle (*Polyt. Centralblatt*, 1861, 811), indicates the percentages of the impurities at different stages of the manufacture at Breslau:

In the gas from—	Carbonic acid.	Sulphuretted hydrogen.	Ammonia.
1, The condenser..........	3.72	1.06	0.95
2, The scrubber..........	3.87	1.47	0.54
3, The washer..........	3.39	0.56	0.00
4, The Laming purifier..........	3.33	0.36	0.00
5, The lime purifier..........	0.41	0.00	0.00

A. Buhe (*J. f. Gasbeleuchtung*, 1869, 420) has given more elaborate statements, among which are the following:

Gas from Zwickau Coal.

In the gas from—	Carbonic acid.	Sulphuretted hydrogen.	Cyanogen.	Ammonia.
1, The hydraulic main.	2.91	.23	.07	1.10
2, The condenser..........	3.88	.40	.07	.24
3, The scrubber..........	3.86	.44	.06	.15
4, The washer..........	3.64	.34	.09	.04
5, The purifiers..........	4.11	.00	.00	.00

Gas from Nettlesworth (England) Coal.

In the gas from—	Carbonic acid.	Sulphuretted hydrogen.	Ammonia.
1, The hydraulic main..........	1.10	0.19	0.70
2, The condenser..........	1.04	0.09	0.88
3, The scrubber..........	1.00	0.10	0.66
4, The washer..........	0.98	0.01	0.39
5, The purifiers..........	1.13	0.00	0.00

There are four methods of purifying gas now in use:

1. *The Wet-Lime Process.*—This process involves passing the gas through milk of lime. It is the oldest process in use, and is very effective in removing both the sulphur compounds and the carbonic acid. It has been generally abandoned, however, on account of the difficulty of disposing of the foul milk of lime, called "blue billy." Occurring as a liquid, the "blue billy" is not easily transported; and as it does not rapidly undergo oxidation, it is not well adapted for use as a fertilizer. Running it into rivers and streams has been forbidden by law, as the pollution of the waters by it was intolerable, while the extremely offensive smell which it emits makes it impossible to store it until it becomes dry enough for transportation.

2. *The Dry-Lime Process.*—In this process dry or slightly moist hydrate of lime is placed on trays in iron boxes, through which the gas is made to pass. This process is very effective, and has very generally superseded the wet-lime process. It removes the sulphur compounds and the carbonic acid equally well. When the foul lime is removed, however, it evolves the same odor which caused the wet-lime process to be abandoned. When exposed to the air it rapidly undergoes oxidation, becoming heated in consequence. During this process it evolves sulphide of ammonium, and some other compounds whose exact nature is not known, but whose odor is extremely offensive. This is the cause of the "gas nuisance" so loudly complained of a few years ago, when all the New York companies employed this process of purification. After the oxidation of the foul lime is completed, it ceases to be specially offensive, the peculiar stench being evolved during the first hour or two of exposure. The offensiveness of this foul lime became such a constant cause of complaint in the large cities of Europe that the gas companies were compelled to abandon the process, as they had previously abandoned the wet-lime. A system of ventilating the foul lime has been invented, and is now in use at both the stations of the Manhattan Co. in New York, which effects its oxidation in such a manner that the offensive gases evolved are not permitted to escape into the atmosphere, but are passed through a washing apparatus, and finally through a special purifier, by which they are rendered comparatively inoffensive. This invention seems to obviate the nuisance of dry-lime purification.

3. *The Laming Process.*—In 1849, Mr. Laming introduced the hydrated sesquioxide of iron as a substitute for lime for purifying gas, preparing it of a suitable quality by mixing copperas (sulphate of iron) with slaked lime and sawdust, and exposing the mixture to the air to oxidize the protoxide of iron to the sesquioxide. The resulting mixture contains hydrated sesquioxide of iron, sulphate of lime, and sawdust. When an excess of hydrate of lime is employed, the resulting mixture contains this substance also. This material is very effective in removing the sulphur compounds from the gas. There is, however, some difference of opinion as to the completeness with which the carbonic acid is removed, due perhaps to variations in the proportions of the ingredients. Two important advantages attend the use of this mixture: first, when fouled it

does not evolve offensive odors on exposure to the air; second, by exposure to air the sesquioxide of iron, which has been changed to sulphide of iron in the purifier, is regenerated, the sulphur being liberated and sesquioxide of iron again formed. The mixture may therefore be used again and again, till it becomes so clogged with the sulphur liberated that it does not act promptly on the gas. It is then found to contain from 40 to 60 per cent. of sulphur, and may be used for the manufacture of sulphuric acid. I have seen mixtures which had been in use twelve months.

4. *The Iron-Ore Process.*—A few months after Laming introduced the artificial hydrated sesquioxide of iron in France, Mr. J. M. Hills applied the natural hydrated sesquioxide of iron, or "bog iron ore," in England. This material, like the Laming mixture, may be used again and again, and does not evolve offensive odors when exposed to the air. A modification of this process is now used by the New York Gas-Light Co. It was invented by Messrs. St. John and Cartwright, and has been in use nearly seven years, giving entire satisfaction. As the bog iron ores of this neighborhood are not sufficiently pulverulent to act promptly on the gas, Messrs. St. John and Cartwright add to the ore a quantity of iron borings or turnings, which they then convert into an artificial hydrated sesquioxide of iron by moistening the whole with ammoniacal liquor and exposing it to the air. The resulting mixture of natural and artificial oxide receives an addition of coarsely pulverized charcoal. This mixture is always sprinkled with ammoniacal water before it is placed in the purifier. In Germany several varieties of sesquioxide of iron are now in use, prominent among which are "the Oberuseler mixture," an iron ore containing some oxide of manganese; the "Mannheim oxide," and "Deicke's oxide," very pure artificial oxides of iron.

Extent to which the Different Methods of Purification are Employed.—The wet-lime method has been almost entirely abandoned. The only works at which I know it to be used at present are at Cork, in Ireland. These works are of moderate size, and are situated out of the city. Moreover, the gas is freed from ammonia by means of sulphuric acid before it comes in contact with the lime. The foul lime does not, therefore, evolve sulphide of ammonium when exposed to the air. The dry-lime process, though still in general use in this country, has been almost universally abandoned in Europe—abandoned, firstly, because the foul lime was an intolerable nuisance; secondly, because the process is too expensive, as the lime can be used but once, and when exhausted has but a trifling value as a fertilizer. The Laming mixture is now used in many of the European gasworks. All the gas supplied to Paris is purified by this material. The German gas engineers have found that this mixture owes its efficacy entirely to the oxide of iron which it contains, and that the sulphate and hydrate of lime present do not take any appreciable part in the purification. Hence they are abandoning this mixture for the natural or artificial oxides of iron, which are cheaper and more efficient. The iron-ore method is now most generally used in Europe, and has obtained a foothold in this country, being used by the New York Gas-Light Co., the Harlem Co., and several companies in Massachusetts and elsewhere. All the Liverpool gas, much if not all of the London gas, and that of most of the German cities, is now purified either by iron ore or one of the artificial oxides of iron.

Comparative Advantages of the Different Methods.—The lime methods effectually remove the carbonic acid, and reduce the sulphur compounds to a minimum. Were there no objections to the use of dry lime on the score of cost or offensiveness, I think this agent would be generally preferred. Lime was first abandoned on account of the nuisance which it occasioned, but the iron oxides are now actually preferred by the European gas engineers on account of their greater economy. Mr. King, the engineer of the Liverpool works, assured me that the oxide of iron purification, which he had used exclusively for the past seven or eight years, costs less than half as much as the dry-lime process used previously. Two objections are urged against the iron methods by those who are prejudiced in favor of lime. First, they do not remove carbonic acid; second, it is claimed that they do not remove the sulphur compounds as completely as lime. The first is generally conceded to be true. But the only objection to carbonic acid is that it reduces the illuminating power of the gas: 1 per cent. of carbonic acid diminishes the illuminating power 5 per cent. The average quantity of carbonic acid is, say $2\frac{1}{2}$ per cent.; then the illuminating power of the gas will suffer to the extent of $12\frac{1}{2}$ per cent., or one-eighth. There are two ways in which this difficulty can be effectually met: First, by using better coals for making the gas, or adding a few pounds of rich cannel or some other enriching material to the ordinary gas-coals; or secondly, by taking less gas from the coal. The last gas drawn from the coal is always inferior to that which comes off first. Mr. A. Buhe, already referred to, says: "It has become more and more the custom to leave the carbonic acid in the gas, and to neutralize its bad influence on the illuminating power by taking less gas from the coal, thus getting a better gas." Dr. Schilling says: "Carbonic acid is of no consequence to the consumer; cannel coal is the remedy." The second objection to the iron processes is the alleged imperfect removal of the sulphur compounds. None of the methods in use entirely remove the sulphur from the gas. The question arises, therefore, How much sulphur can be safely left in the gas? The English Parliament has answered this question by fixing the limit at 20 grains of sulphur to 100 cubic feet of gas; and to see that the companies come within this limit, chemists are appointed whose duty it is to analyze the gas and report its quality. I have before me the report of Dr. Letheby for the months of Jan., Feb., and Mar., 1869. He states the grains of sulphur found in 100 cubic feet of gas to be as follows:

	Maximum.	Minimum.	Average.
City of London Gas-Light and Coke Co.	18.92	11.50	15.00
The Gas-Light and Coke Co.	21.15	15.75	19.49
Great Central Gas Consumers' Co.	24.00	7.03	12.28

From this it will be seen that the gas of London, although purified by iron, does not average 20 grains of sulphur in 100 cubic feet. With regard to the Paris gas, which is purified by Laming's oxide-of-iron mixture, Prof. J. Lawrence Smith, one of the U. S. commissioners to the French Exposition of 1867, who is the president of the Louisville Gas Co., has given us a very decided opinion. On page 88 of his report, which was published by the U. S. government, he says: "The gas of these works is most thoroughly purified, and the dealers in silks and other delicate fabrics, who, a few years ago, always suffered more or less loss from the results of the combustion of impure gas acting on their fabrics, now no longer suffer from this cause." Dr. Letheby (*Journal of Gas-Lighting*, 1869, p. 83) has argued that 20 grains of sulphur should not be left in the gas, and proposes, therefore, as the most effective method of purifying gas, this treatment: first with ammoniacal liquor; second, with hydrated oxide of iron; third, with dry lime. As the iron will have removed the sulphuretted hydrogen, the refuse lime will not be offensive, while it will effectually remove the carbonic acid. This system of purification will, he thinks, reduce the quantity of sulphur to 10 or 12 grains per 100 cubic feet. Most gas engineers and chemists differ from Dr. Letheby on this point, however. Dr. Schilling says (in his *Journal für Gasbeleuchtung* for 1869, p. 184): "20 grains of sulphur in 100 cubic feet of gas are entirely unobjectionable. Under the most favorable circumstances, with no ventilation whatever, it would give the atmosphere of a room only 1 part of sulphurous acid in 500,000 parts of air." Prof. William Odling, secretary of the London Chemical Society, has spoken very clearly on this subject in his lecture to the British Association of Gas Managers, June 2, 1868, which appears in the *Journal of Gas-Lighting* for 1869, p. 81, and I have found that his views are those generally entertained by chemists and gas engineers. He said: "I am altogether at issue with the public when they maintain that the sulphur of gas produces, by its combustion, oil of vitriol, or that the amount of sulphur ordinarily contained in gas is of any consequence whatever; and a little consideration will, I think, satisfy you of the soundness of this position. We will assume that coal-gas contains not 20, but 40 grains of sulphur in 100 feet—a quantity, at any rate, greatly exceeding the reality. Now, making another extravagant assumption, that the whole of these 40 grains of sulphur would be completely burned—and in reality they would be burned very incompletely—they would furnish, by their combustion, 80 grains of sulphurous acid gas. This quantity of the produced sulphurous acid would occupy at ordinary temperatures about $\frac{1}{15}$th part of a cubic foot, and since 100 cubic feet of our coal-gas gives $\frac{1}{15}$th of a cubic foot of sulphurous acid, 1500 cubic feet of coal-gas would be required to furnish one cubic foot of the acid, even upon the extravagant assumptions we have purposely made. But the combustion of 1500 feet of coal-gas would produce something besides sulphurous acid. It would produce at least 1000 cubic feet of carbonic acid, and, in addition to its dilution by other gases and vapors, we should have our sulphurous acid diluted by 1000 times its volume of carbonic acid. Now, if we can get at the proportion of carbonic acid in the atmosphere of a room highly illuminated with gas, and take the $\frac{1}{1000}$th part of that proportion, we shall be able to form some notion of the amount of sulphurous acid present. You will remember that the amount of carbonic acid furnished by the breath of one individual is equal to that furnished by two 5 feet gas burners, and that the maximum amount of carbonic acid found in the atmosphere of a crowded theatre was 0.32 per cent. Now, if, in addition

to our previous unreasonable suppositions, we further suppose that an atmosphere contains 0.2 per cent. of carbonic acid furnished by gas combustion, you will see that the whole matter becomes a *reductio ad absurdum*—that we might actually have one-half millionth part of sulphurous acid present in the air of a gas-lighted room." The facts and opinions here quoted effectually dispose of the second objection to oxide-of-iron purification.

Composition of the Purified Gas.—The following table shows the percentage composition of the purified coal-gas as it is delivered to consumers:

	Heidelberg	Bonn.	Chemnitz.	London common	London cannel
Hydrogen	44.00	39.80	51.29	46.00	27.70
Marsh-gas	38.40	43.12	36.45	39.50	50.00
Carbonic oxide	5.73	4.66	4.45	7.50	6.80
Olefiant gas and other hydrocarbons	7.27	4.75	4.91	3.80	13.00
Nitrogen	4.23	4.65	1.41	0.50	0.40
Oxygen	not det.	not det.	0.41	not det.	not det.
Carbonic acid......	0.37	3.02	1.08	0.70	0.10
Aqueous vapor ..	not det.	not det.	not det.	2.00	2.00

The difference in the percentages of carbonic acid is largely due to the method of purification. When lime is used, nearly all of this gas is removed, otherwise not. As the specific gravity or density of the hydrogen and marsh-gas is much less than that of olefiant gas and the rich hydrocarbon vapors, the specific gravity of the gas made from the same coal is a tolerably accurate measure of its richness in illuminating constituents. The specific gravity of air is taken at unity (1000), hydrogen is 0.0691; marsh-gas, 0.5594; carbonic oxide, 0.9727; olefiant gas, 0.976; propene, 1.490; and butene, 1.940; benzol and other rich vapors, much higher. Hughes in his treatise on gasworks gives the following estimate of the specific gravities of gases of different illuminating powers: 12-candle gas, .400; 14-candle, .425; 16-candle, .450; 18-candle, .475; 20-candle, .500, etc. This would not be even approximate for gas containing much carbonic oxide, as that prepared by the aid of steam. (See WATER-GAS.)

As it is sometimes desirable to estimate the yield of gas from coals in percentages by weight, the following data will be useful: (1) the specific gravity is the ratio of weight compared to that of air as a unit; (2) 1000 cubic feet of air weigh 76.708 pounds avoir.; (3) multiply 76.708 by the specific gravity, and the product is the weight of 1000 cubic feet of the gas. Hydrogen has a specific gravity of .0691; $76.708 \times .0691 = 5.30$ pounds; marsh-gas = specific gravity .5594; 1000 cubic feet weigh 42.91 pounds; 1000 cubic feet carbonic oxide, specific gravity, $.9727 = 74.61$ pounds; 1000 cubic feet olefiant gas, specific gravity, $.976 = 74.86$ pounds.

The station-meter is the apparatus through which the purified gas next passes on its way to the holder. This is constructed on the same principle as the wet meter, described farther on; it measures the gas produced and registers the quantity in cubic feet.

The holder or gasometer is the vessel in which the gas is stored. It consists of an enormous bell, or a cylinder with a conical top, constructed of iron plates, and floating in a cistern of water. The bell is supported by chains led over pulleys fastened to iron columns, and provided with weights to counterbalance the greater part of the weight of the holder, which is not allowed to exert a pressure on the gas more than equivalent to a column of water six inches high, this pressure being sufficient to force the gas through the mains to the consumers. In order to economize depth in the cisterns, the holders are often telescopic. The largest holder in the world is in London; it is 230 feet in diameter, and holds 3,000,000 cubic feet of gas. The largest holder in the U. S. is that of the New York Gas-Light Co. on 21st street. It is 168 feet diameter, is supported by 16 columns 72 feet high, and stands 70 feet high when full. Its capacity is 1,500,000 cubic feet.

The governor or pressure-regulator is an automatic valve through which the gas passes from the holder to the consumers. It serves to regulate the pressure of the gas in the mains.

The mains distribute the gas throughout the city, being laid about three feet under ground. They are generally made of cast iron, and are from 24 inches down to 3 inches in diameter. They are cast in convenient lengths, one end being enlarged into a socket, which receives the small end of the next length. The joint is made tight with hempen rope and lead. A certain percentage of leakage is unavoidable, but this can be reduced to a minimum by the exercise of a little care. The best plan is to test each length of pipe by closing one end with a plug, connecting the other end with a small forcing air-pump, such as is used by gas-fitters, and while the pipe is immersed in water forcing air into it. Bubbles of air passing through the pipe will reveal every imperfection in the metal. The location of each leak can be recorded by making a circle around it with chalk. Small holes can be closed by hammering the metal together; if large holes are detected, the pipe should be rejected. Immersing the pipes in hot coal-tar is a very effective preventive of leakage. Leakage is said to often amount to 16 per cent. of all the gas produced, or even more; by the above-mentioned precautions it may be reduced to 2 per cent. As there is always a certain condensation of water and oily or tarry matter in the mains, receivers or *wells* are constructed at convenient points, and the mains are laid inclining towards them. From time to time the condensed liquids are pumped out of the wells into a portable tank and thrown into the tar-well at the works. Complaint is sometimes made of an excessive condensation of naphthalene in crystals or crusts, which seriously diminish the capacity of the pipes. According to J. Lawrence Smith, bitumenized iron pipe is extensively used for gas in France. It is made from 1¾ to 28 inches in diameter. The base of the pipe is sheet iron, leaded, varying in thickness according to the required size and pressure; each section of pipe is made of two sheets, that are first riveted together separately with tinned rivets, and plunged into a bath of melted lead; these two pieces of pipe are then riveted together, and the junction of the two well tinned. The entire pipe is now 13 feet long. On the ends are convenient sockets and spigots, made of a mixture of lead and antimony, which serve to unite the sections of pipe when laid in the ground. The exterior surface of the pipe is coated with tar, and around this is wrapped a cord; this cord is then covered with melted pitch, and the pipe then rolled in coarse sand until it has acquired a thickness of from one-fourth to five-eighths of an inch. Chameroy & Co. of Paris manufactured between the years 1838 and 1867, of this pipe for gas, 3160 miles; for water, 897 miles—of a total value of $7,708,400.

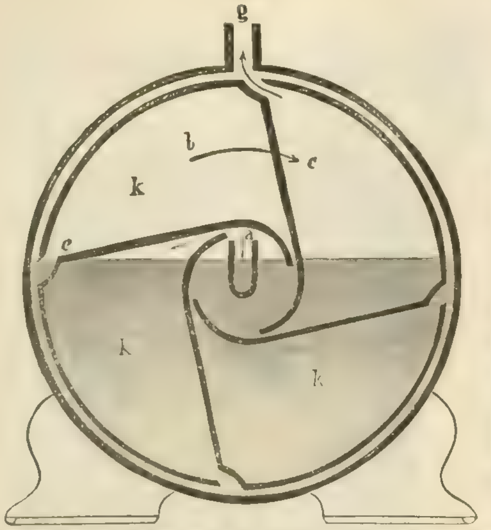
Service-pipes of wrought iron convey the gas from the mains to the buildings of the consumers. They should be protected when crossing sunken areas, as otherwise they are liable in cold weather to be entirely closed by the hoar-frost formed in them by the freezing of the aqueous vapor always present in gas.

The house-meter receives the gas when it enters the premises of the consumer, measures the quantity which passes through it, and records it in cubic feet on a series of dials. In the early days of gas-lighting, consumers were supplied by contract, according to the number of burners and the number of hours the gas was burned. To avoid excessive use beyond the time agreed upon, the gas was turned on and off the premises at the proper times by an employé of the gas company. Sir John Congreve invented an "hour-meter," to be connected with the inlet cock, which was simply a clock which ran only while the cock was open, and thus recorded the hours of consumption. This system resulted in an enormous waste of gas, as the consumer who paid as much for lighting one burner as for all his burners was sure to light them all. The ingenuity of the gas engineers was then severely taxed to invent a meter by which the quantity of gas actually consumed could be accurately measured. Their efforts were at last entirely successful, and the meters now in use are wonderfully simple and extremely accurate. The measurement of gas presents difficulties not encountered in any other case. The gas must be measured while in actual use, as no system of measurement and storage would be practical. Its flow must not be interrupted in the slightest degree, as otherwise the lights would be extinguished, or at least be made to flicker in a manner that would be unendurable.

Samuel Clegg in 1815 constructed the first meter, consisting of two gas-holders working alternately, which was a failure. In 1816 he invented a rotating meter, applying the principle on which all wet meters are now constructed. This meter was still very imperfect. In 1819, John Malam invented the four-chambered drum meter, which was improved by Crosley, Wright, and others, and is now in use. Malam also invented a dry meter in 1820, consisting of six bellows radiating from a shaft. In 1833, Bogardus, an American (Bojardin, a Frenchman, some say), invented a dry meter, which consisted of a vessel divided by a flexible diaphragm, which was the parent of all subsequent dry meters. Defries invented the three-chamber dry meter now in use, and Croll and Richards invented the two-chamber or double-bellows meter now very generally used. Two kinds of meters are now employed: (1) the "wet meter," which must be partially filled with water to be effective; (2) the "dry meter," which requires no liquid. *The wet meter* consists of a hollow metal case containing the measuring drum, and a box front containing the regulating valves and the gearing which connects the measur-

ing drum with the index dials. The measuring drum is divided into four compartments or chambers by oblique

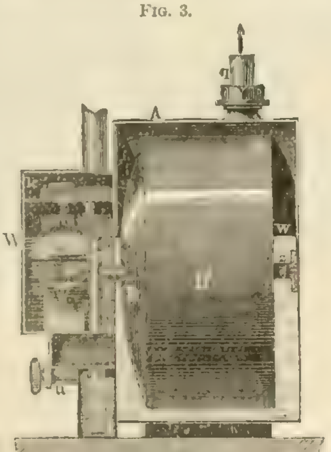
Fig. 2.



Vertical section of the early wet meter. The gas enters the chambers b at the centre through the tube a, and passes out through the slits c on the periphery of the drum, escaping at the outlet e.

partitions. This drum revolves upon a horizontal axis. It is immersed about three-fifths in water, receives the gas

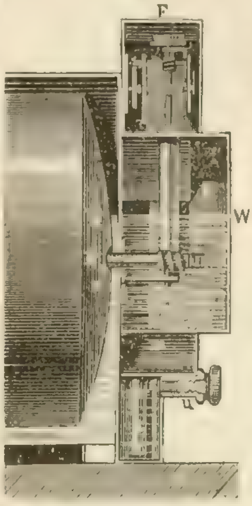
Fig. 3.



Section of the modern wet meter, shown also in Figs. 4 and 5. The gas enters by the inlet-pipe l to the space k, passes through the valve i to the space E, through the tube n to the space B of the drum through the inlet slits to the measuring chambers, thence through the outlet slits to the space above the water-line W, and through the outlet pipe q to the burners. The tube n serves also as an overflow, and carries the excess of water to the waste-water cistern u (Fig. 4). W is the water-level, regulated by the overflow-tube n. If the level falls, the float h drops and closes the valve i, preventing the passage of gas through the meter.

through inlet slits on one side, and discharges it through outlet slits on the opposite side. The compartments are occupied successively by gas and water. The position of the slits of each compartment is such that one or the other is always below the water line; thus the gas can never enter the chamber and escape from it at the same time. The surface of the water forms the bottom of the measuring chamber, and the water-level determines the capacity of the gas space in each chamber. As the drum revolves, the inlet slit emerges above the water line, when gas enters, imparting an impetus to the drum, which continues to revolve, the space in the chamber above the water line receiving gas till the chamber is full. Although there are four chambers in the drum, the obliquity of the dividing partitions makes nearly a half revolution necessary to bring the outlet slit above the water line; this occurs an instant after the inlet slit on the opposite side has passed below the water line. As the chamber now passes below the water-level, the gas escapes, and the chamber is finally filled with water, the drum operating on the principle of a turnstile. It is the pressure of the gas acting on the compartments of the drum in succession that causes it to revolve. Unless

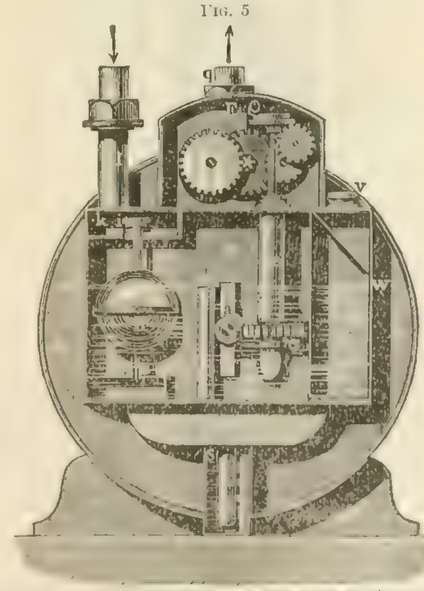
Fig. 4.



Section of the modern wet meter, shown also in Figs. 3 and 5, described under Fig. 3.

there is a free escape for the gas from the meter through the burners, the rotation of the measuring drum ceases, as the pressure on the outlet side of the drum becomes equal to that on the inlet side, and there is no pressure against the compartments. The revolutions of the drum are registered by the action of an endless screw on its axis, which moves a train of toothed wheels bearing hands on dials, which indicate cubic feet. As the position of the water-line regulates the capacity of the measuring chambers, it is carefully protected by very simple devices. To prevent its falling by evaporation of water into the gas, and thus causing the meter to pass more gas than it registers, a float valve is provided (h i, Figs. 3 and 5), which shuts off the gas as soon as it registers 2 or 3 per cent. against the company. To prevent its rising by the return of condensed water from the house-pipes into the meter, and thus registering against the consumer, the tube (n, Figs. 3 and 5) which admits gas to the drum is set in such a position that it serves as an overflow, conveying superfluous water to a waste-water cistern below. When this cistern is filled, the water rises and prevents the flow of the gas to the drum.

Fig. 5



Front section of the modern wet meter, shown also in Figs. 3 and 4. a is the screw on the axis of the drum which turns the toothed wheel a, the axis of which passes through the tube z to the system of wheels in the space I which move the hands on the index-dials shown in Fig. 8.

Thus, if the meter *tends* to become inaccurate, it refuses to deliver gas, and demands either a further supply of water or to be relieved of an excess; either of which forms of relief can be readily applied by any intelligent person who understands the construction of the meter.

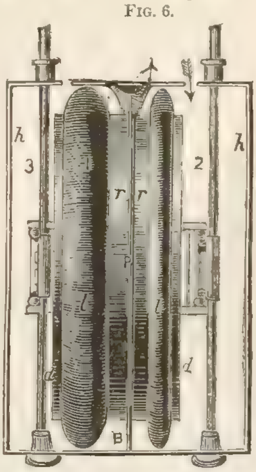
Meters are liable to freeze, when the drum becomes fixed and the flow of gas is prevented. A frozen meter may be readily thawed out by covering it with a cloth and pouring boiling water over it. In exposed positions the meter should always be protected by some non-conducting material, such as woollen cloths, felt, straw, tan-bark, sawdust, or sand, or the water in the meter may be replaced by glycerine or a solution of chloride of calcium in water, containing 4 pounds in each gallon. These liquids neither freeze nor evaporate.

When the gas goes out in a house supplied through a wet meter, it may be due to (1) a deficiency of water, (2) excess

of water, (3) freezing of the meter, (4) freezing of the service-pipe, (5) condensation of water in the house-pipes. The best and safest plan is to send for a gas-fitter or to the office of the company; but as the difficulty is most likely to occur during the evening, when help can rarely be obtained, it is well to know how to meet the emergency. (1) Close the cocks of all the burners which are open save one; (2) go to the meter with a candle, which must be held at a distance to avoid explosion; (3) turn off the gas at the main cock between the street service-pipe and the meter; (4) unscrew the plug *u* (Figs. 3 and 4) of the waste-water cistern, to let out any excess of water present; (5) unscrew the supply-plug *v* (Fig. 5) and the overflow plug (not shown in the figures, the tube *u* serving as an overflow in this meter), and pour in gently a small quantity of water till it issues from the overflow or at *u*. When it ceases to flow, carefully replace all the plugs and turn on the gas, when the meter will be in working order. (6) If the meter is frozen, pour boiling water over it, and run a little hot water through the orifice *v*, letting it escape at *u*, or at the overflow. (7) A frozen service-pipe generally necessitates an excavation and the application of heat outside the house. (8) Condensation in the pipes is first indicated by a flickering or jumping of the lights, due to the partial obstruction of the gas by the accumulation of water in the depressions in the line of pipe, which breaks it into bubbles. Removing a burner and blowing violently into the pipe will sometimes force the water beyond the hollow. The aid of the gas-fitter will generally be necessary to remedy this difficulty, by placing the meter in a cool situation or inclining the pipes so that condensed water will all trickle back to the meter.

The dry meter consists of two or three chambers, each divided by a flexible partition or diaphragm, by the motion

FIG. 6.

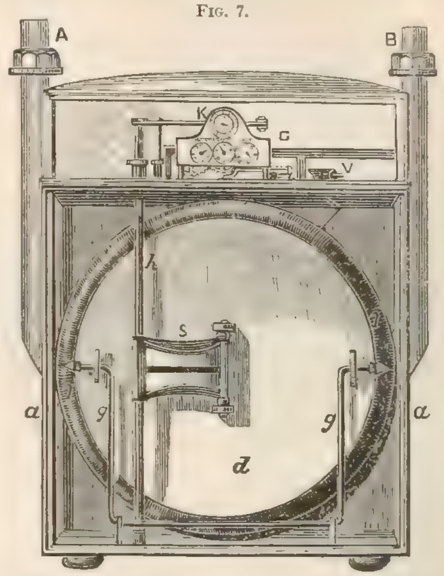


Side view of the measuring chambers of a dry meter. The case is divided by the partition P into two independent compartments; in each of these is a flexible chamber, formed by the rings *r r*, the disks *d d*, and the leather belts *l l*. Each disk is supported and kept in the same plane in its motion by means of the horizontal arm *s* (Fig. 7), and the guides *g g*. The rods *h h*, bearing the arms *s s*, pass through a stuffing-box into the upper chamber C, and bear horizontal jointed levers, giving motion to the slide-valves which regulate the flow of gas into the various compartments, and also working the system of toothed wheels which record the quantity of gas passing through the meter on the index-dials.

of which the capacity on one side is diminished, while that on the other is increased. By means of slide-valves like those of a steam-engine, worked by the movement of the diaphragms, the gas to be measured passes alternately in and out of each space. The movements of the partitions are recorded by clockwork on dials which indicate cubic feet. The diaphragms in all the chambers are so connected that they move in concert. The two-diaphragm meter of Croll and Richards (Figs. 6 and 7) is most used. Defries' three-diaphragm meter is also extensively employed. If a dry meter has been standing for some time, it sometimes fails to move, from the adhesion of the surfaces of the slide-valves. It can often be started by turning off the gas at the meter, opening all the burners in the house, and then turning the gas on at the meter again suddenly and fully. This treatment is specially effective just at dark, when the pressure in the mains is greatest. If the lights be unsteady with a dry meter, it is due to a stiffness of the working parts, and the meter should be repaired.

Comparative Advantages of Wet and Dry Meters.—Wet meters being simpler in construction, composed entirely of metal, and having no valves except the float, are most durable and less liable to get out of order. They are, however, liable to stop from freezing, from too much or too lit-

FIG. 7.

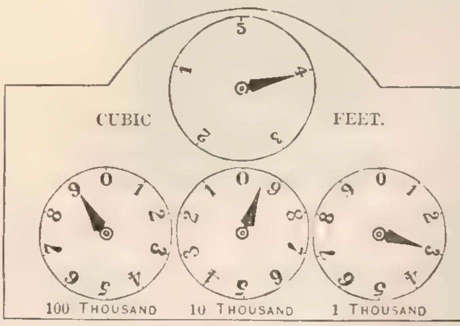


Front view of the dry meter. A is the inlet, B the outlet. The gas enters at A, passes to the valve-box V, enters the space 2 (Fig. 6), and the left-hand chamber *l r*, while its pressure forces the gas out of the space 3 and the right-hand chamber *r l*. When the left-hand chamber is full and its companion empty, the slide-valves reverse the flow of gas, and the empty chamber and the space 3 receive, while the full chamber and the space 2 deliver gas.

tle water, and from sending moisture into the pipes. They also register vapor of water as gas, though the quantity is too small to be of any consequence. The dry meter is not liable to any of these objections, but being more complicated and more delicate, it is more liable to wear and to get out of order. The inaccuracies which result from wear or corrosion are generally in favor of the consumer, as gas leaks from one space to another and escapes being measured. The dry meter is now more generally used.

The index of the meter is very simple. It consists of a number of dials like that of a watch, except that while the

FIG. 8.



The index of a dry meter.

hour and minute hands of a watch traverse the same dial, the different hands of the meter have each a separate dial. Fig. 8 is a dry-meter dial. The dial at the top, which indicates units of feet, is only used in testing the meter. The other dials show 89,300 feet to have passed through the meter; if a month hence the hands indicate 93,400, then 4100 feet will have passed the meter during the month.

The accuracy of the meters is very often questioned by consumers. The resemblance of the dials leads them to infer that, like clocks, the meters may run fast or slow. But the case is not parallel; the meter is an engine in which the gas is the motive-power, and unless the gas passes through the meter, it cannot move. On its dials are faithfully recorded the number of its revolutions in cubic feet. All waste and leakage is recorded as well as the useful consumption. Some think that the increased pressure makes the meter spin round faster and record against the consumer; but if he regulate the burners so as to prevent "blowing," he at once neutralizes the effect of the increased pressure. From the nature of things, the injury which the meter suffers in use must generally be against

the company. If a valve leaks or a rust-hole occurs in the measuring drum, or a crack in the leather, gas gets through without being recorded. Sometimes the valves of a dry meter become fixed in such a position as to let the gas through without moving. The meters are all tested by State inspectors by passing a certain number of cubic feet through each, and noting whether it is properly recorded on the dials. In New York and Massachusetts a meter is stamped correct when it varies less than 2 per cent.; in Ohio the tolerance is 3 per cent. Prof. Wormley, State inspector for Ohio, in testing 2,321 new meters found only 13 that varied over one-half of 1 per cent. Mr. Stimpson, State inspector in Massachusetts, in one year tested 11,309 meters; only 148 failed to come within the requirements of the law. Very few of these varied 5 per cent.; 62 averaged 6.47 per cent. against the companies; and 86 averaged 4.5 per cent. short.

FIG. 9.

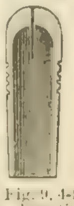


FIG. 10.

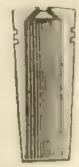


Fig. 9, 4-foot bat-wing, lava tip. Fig. 10, 2-foot fish-tail, lava tip.

Gas burners now in use are of three kinds: (1) the *bat-wing*, a burner with a slit (Figs. 9, 11, 14); (2) the *fish-tail*, with two oblique holes in the end facing each other (Figs. 10, 12, 15, 18, 19.); (3) the *argand*, a circular burner with a ring of small holes, and provided with a glass chimney and an interior supply of air (Figs. 16, 17).

FIG. 11.

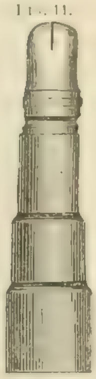


FIG. 12.

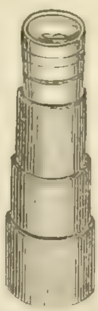
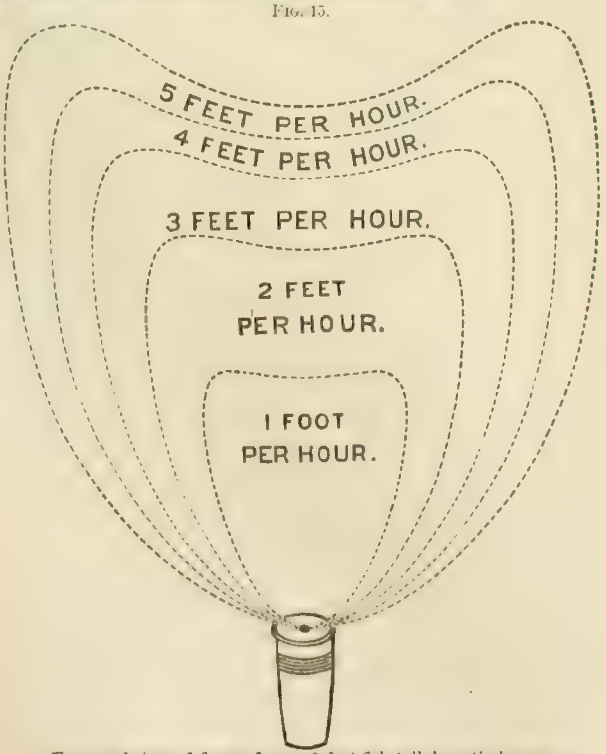


FIG. 13.

FIG. 14.

Fig. 11, 7-foot bat-wing, lava tip, mounted in pillar. Fig. 12, 6-foot fish-tail, lava tip, mounted in pillar. Fig. 13, brass pillar for lava tips. Fig. 14, 7-foot bat-wing, lava tip.

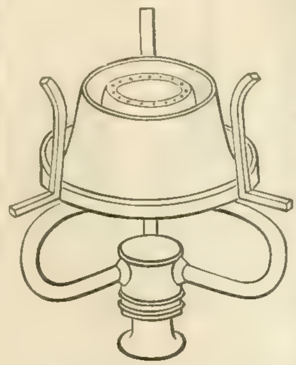
FIG. 15.



Form and sizes of flames from a 5-foot fish-tail, lava-tip burner.

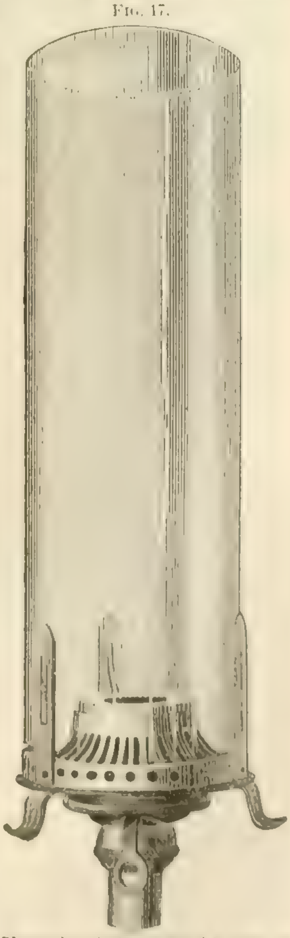
Burners are made of iron, brass, or soapstone ("lava"): the latter is preferable, as the holes are not liable to be stopped by rust. The amount of light produced by a given gas varies enormously with the conditions under which it is burned. The maximum amount of light is obtained by burning it on the verge of smoking, while in the Bunsen burner, used for heating purposes in chemical laboratories, the flame is blue and non-luminous. The loss of light is due to a too rapid mixing or contact of the gas with the air. This is controlled by the size and shape of the holes in the burner, the height of the chimney, and the distribution of the air (in the argand), and in all cases by the pressure. The holes and slits for rich gas should be small, as such gas requires more air than poor gas. Under the same pressure a burner which consumes 4 feet of gas per hour gives more light than two burners consuming each 2 feet. There is no economy of light in small burners. The pressure of the gas is a most important consideration. Argands give most light under a pressure of $\frac{1}{10}$ inch, bat-wings and fish-tails under a pressure of $\frac{3}{10}$ to $\frac{4}{10}$ inch. As gas is supplied to consumers under pressures varying from 3 or 4 inches down to $\frac{1}{10}$, it is very desirable to check the flow of gas when it is excessive. This can be done by the use of regulators, by turning the gas off at the meter, by partly closing the cocks on the fixtures, or by introducing a check into the burner. Check-burners should always be used; they are constructed in various ways—always by placing some obstruction in the way of the gas to retard its escape. A very simple plan is to screw a 5 or 6 foot burner over a 3 or 4 foot burner. With regard to a choice of form, the *argand* is best for ordinary gas; it gives a very steady flame and consumes the gas to the best advantage. The best form of argand made

FIG. 16.



Sugg's London burner, lava.

FIG. 17.



Gleason's noiseless argand burner, of brass, with valve.

in the U. S. is shown in Fig. 17. It is provided with a cut-off or check of very simple construction. The best

FIG. 18. FIG. 19. FIG. 20. FIG. 21.

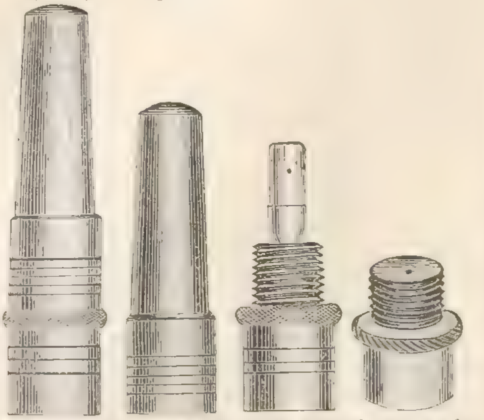


Fig. 18, check burner, a 5-foot burner screwed upon a 3-foot burner. Fig. 19, 5-foot brass, fish-tail burner. Fig. 20, 3-foot base for a check burner. Fig. 21, another base for a check burner.

burner yet constructed is Sugg's London burner, shown in Fig. 16 without its chimney. *Bat-wing* burners cannot be used in globes or shades, as the flame is so broad as to crack the glass; *fish-tails* must then be employed. Five or six foot lava tipped check bat-wings are the most economical burners for general use. The gas referees of London found that some burners gave only one-fourth the light obtained from the same quantity of gas by a Sugg's burner. They estimated that the use of good burners in London would save one-fourth of the $10,000,000 annually paid for gas.

The loss of light by the use of shades, chimneys, etc. is very considerable, largely due to the conversion of light into heat. The following numbers, selected from the results of William King of Liverpool and Prof. F. H. Storer of Boston, are a sufficient illustration:

Description of glass.	Thickness of glass	Loss of light
Clear glass (King)........................	....	10.57
Ground glass "	....	29.48
Smooth opal "	....	52.83
Ground opal "	....	55.85
Thick English plate (Storer)............	$\frac{1}{3}$ inch....	6.15
Crystal plate "	$\frac{1}{8}$ "	8.61
English crown "	$\frac{1}{8}$ "	13.08
Double English window "	$\frac{1}{8}$ "	9.39
Double German (Belgian) (Storer)....	$\frac{1}{8}$ "	13.00
Single German (Belgian) "	$\frac{1}{16}$ "	4.27
Double German (Belgian) ground (Storer)..................................	$\frac{1}{8}$ "	62.34
Single " " " "	$\frac{1}{16}$ "	65.75
Berkshire, Mass., ground (Storer).....	$\frac{1}{16}$ "	62.74
Orange-colored window-glass "	$\frac{1}{16}$ "	34.48
Purple " " " "	$\frac{1}{8}$ "	85.11
Ruby " " " "	$\frac{1}{16}$ "	89.62
Green " " " "	$\frac{1}{16}$ "	81.97
A porcelain transparency "	$\frac{1}{16}$ "	97.68

Lighting gas by electricity has recently been introduced in theatres, halls, etc. with great advantage. As it is an instantaneous operation, it results in great economy by rendering it unnecessary to light the gas before it is actually wanted, and in sparing the attendants the great exertion required in applying the torch at great heights. It may be effected by stretching a fine platinum wire above each burner, and heating it to a white heat by a current of electricity when the gas is turned on. A better plan is to use the Ruhmkorff coil. In this case each burner is isolated from the house-pipes by a hard rubber connecting ring. A series of wires is then arranged by which the electric current is made to leap in sparks to the tip of each burner in succession when the gas is turned on. Systems have been invented by which the gas of the street-lights is turned on and off and lighted by electricity from a central office.

Pressure.—As already stated, a certain amount of pressure is required to force the gas through the street-mains, house-meters, pipes, and burners. The pressure is measured by the height of a column of water supported by the gas in a U-shaped tube, one end of which is open to the air, while the other is connected with the gas-supply. It is estimated that there should be a pressure of 1 inch at the entrance to the premises of every consumer, 0.2 inch being required to force the gas through the meter, 0.2 inch for the house-pipes, and 0.6 inch for the burners. This pressure is exerted by the weight of the great gas-holders at the works. Were the consumption of gas uniform during the entire twenty-four hours, the holder could be properly balanced once for all, and a uniform pressure would be exerted at all times—four or five inches are found to be necessary for large districts—but when no gas is burned, no pressure is required, and when little gas is burned, four or five inches would be excessive. Consequently, the pressure must be graduated according to the hourly consumption. For this purpose the *governor*, already mentioned, is employed at the works to regulate the flow, and consequently the pressure, of the gas from the holder to the street-mains. The following table exhibits the variation in pressure caused by irregularities of consumption. The holders of the New York Gas-Lighting Co. are on East 21st street; its district extends from Grand street to the lower end of the island at Whitehall street; Hester street is well within the district.

Pressure of the Gas in Inches of Water.

	2 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	10 P. M.	12 P. M.
21st street.........	1.7	2.	5.5	4.2	2.9	1.9	1.0
Hester street.....	1.6	1.7	2.4	2.2	1.9	1.6	1.2
Whitehall street.	1.0	1.	0.6	1.1	1.1	1.0	0.8

It is thus seen that a uniform pressure throughout the district supplied is absolutely impossible. In order to secure a sufficient pressure at the extremities of the district, an excessive pressure must be produced at the intermediate points; and as the pressure must be varied from hour to hour at the works, it will vary at the premises of most of the consumers. The consumer must therefore regulate the pressure for himself: (1) by carefully adjusting the main cock at the meter; (2) by adjusting the cock at each burner; (3) by using check burners; (4) by attaching a regulator at the meter. It sometimes happens that the consumer cannot get sufficient pressure to supply his burners, when he of course fails to get the light he requires, and concludes that the gas is poor. This difficulty may be due to several causes: (1) insufficient pressure at the works; (2) the street-mains are too small or are obstructed; (3) the service-pipe is too small or obstructed; (4) the meter is too small or out of order; (5) the house-pipes are too small or obstructed; (6) the fixtures are obstructed; (7) the burners are too small, defective, or obstructed. By comparing notes with neighboring consumers, and consulting an intelligent gas-fitter, the real cause of the deficient light can generally be ascertained. In large buildings there should be a separate cock and regulator on each floor to prevent irregularity of pressure.

Regulators are constructed on the same principle as the governor at the works. They contain automatic valves which partially close when the pressure increases, and open when it diminishes. They may be applied to the entire supply of gas at the meter or to each burner.

The illuminating power of gas is dependent upon several conditions (see FLAME): (1) liberation of solid particles of carbon from the olefiant gas and rich hydrocarbon vapors by the heat of the flame, or the oxidation of the hydrogen at points in the flame when the supply of oxygen is not sufficient for both hydrogen and carbon; (2) to the temperature of the flame, which renders the carbon particles luminous; (3) to the density of the materials burned; (4) to the density of the products. These conditions depend upon the chemical composition of the gas and the manner of its combustion. Gases rich in olefiant gas and heavy hydrocarbons furnish the most luminous flames. The character of the burner, the dimensions of the chimney with argands, and the pressure determine the manner of combustion by regulating the supply and admixture of air. A low pressure with a burner which secures a supply of air just sufficient to prevent smoking—*i. e.* the escape of unconsumed carbon—secures the maximum amount of light. The pressure and quality of the gas being fixed, it was formerly supposed that the light produced was directly as the rate of combustion, and that consequently two like burners consuming each 3 feet of gas per hour would give the same amount of light as one similar burner consuming 6 feet. Recent investigations make it extremely probable that the amount of light increases as the square of the consumption. (*Farmer's Theorem.*) Consequently, the light from the two burners would be $3 \times 3 + 3 \times 3 = 18$, while that from the one 6-foot burner would be $6 \times 6 = 36$. Thus, the large burner gives twice as much light for the same consumption as the two small burners; hence, the economy of a few large burners over many small ones.

Carburetting or Carbonizing Gas.—It having been established that the illuminating power of gas depends upon the presence of heavy hydrocarbon vapors, numerous means have been contrived and patented for adding such vapors to the gas. The materials available are the naphtha of coal-tar and the naphtha of petroleum or coal-oil. Coal-tar naphtha is by far the most effective, though most

expensive. It consists of benzol, C_6H_6, and its homologues, which are very dense and very rich in carbon. Petroleum and coal oil naphtha consist of hydrocarbons of the marsh-gas series (see PETROLEUM), such as quintane, C_5H_{12}; sextane, C_6H_{14}; heptane, C_7H_{16}, etc., in which the ratio of carbon to that of hydrogen is less than half what it is in benzol, etc. Dr. Letheby (*Chem. News*, xi. 1865, p. 126) found that while 1 grain per cubic foot of gas of some naphthas increased the illuminating power 9 per cent., the same quantity of other naphthas raised it only 1.69 per cent. Under favorable circumstances he found that a gallon of coal-tar naphtha would enrich 6000 feet of gas, adding over 10 grains per cubic foot, and increase its illuminating power 68 per cent., thus making it equal to 10,000 feet of the original gas. The practical gain is 4000 feet, costing the price of 1 gallon of naphtha, about $1. The conditions which effect the carbonization are, (1) quality of the gas, (2) quality of the naphtha, (3) construction of the carburetter, (4) temperature of the carburetter. The last condition is very essential to success. If the carburetter is placed in a warm situation, the naphtha evaporates too rapidly, the gas becomes overcharged, and the flames smoke. The burners must be adjusted to the character of the gas, and if the gas varies from day to day from irregularity in the carbonization, the annoyance becomes intolerable. Another difficulty arises from the condensation of the naphtha in the house-pipes and fixtures, by which they become obstructed and cease to deliver gas. These difficulties have led to the ill-success which has attended this apparently logical method of enriching gas.

Testing Gas.—In order to determine the value of gas for illuminating purposes, several modes of testing have been suggested: (1) Photometrical tests, by which the amount of light actually produced by a given quantity of gas is determined; (2) specific-gravity test; (3) tests for special objectionable impurities, particularly sulphur compounds and ammonia; (4) special tests intended to determine the comparative illuminating power of the gas: *a*, percentage of rich hydrocarbons condensed by chlorine, bromine, or fuming sulphuric acid; *b*, Henry's explosion test, showing the quantity of oxygen necessary to burn the gas and the quantity of carbonic acid produced; *c*, Fyfe's durability test, by which he determines the time required to burn a given volume of the gas through a jet $\frac{1}{33}$-inch in diameter with a flame 4 inches high; *d*, Erdmann's test, which determines the amount of air necessary to deprive the flame of the burning gas of a given size of all illuminating power; (5) gas analysis, by which the different constituents are accurately determined. The practical examination of gas is generally limited to the photometric test, the specific-gravity test, and the determination of ammonia and sulphur. For special purposes analysis is often resorted to. In England, where the quality of the gas is regulated by law, the specification is limited to photometric illuminating power and fixed maxima of ammonia and sulphur.

Photometric Test. (See PHOTOMETER.) Two forms of the photometer only are used for testing illuminating gas: (1) Bunsen's photometer; (2) Lowe's jet photometer. *Bunsen's photometer*, as improved by Dr. Letheby, consists of a graduated bar about 98 inches long, placed on edge, having at one end a candle-holder, at the other a gas-burner. A saddle rests on the bar, and bears a disk of white paper made transparent by paraffine, except a spot in the centre. The instrument is set up in a dark room with dull black walls and ceiling. The test candle is of spermaceti, of uniform calibre, and of such a size as to consume as nearly as possible 2 grains of spermaceti per minute. The accessory apparatus consists of a balance to weigh the candle before and after the experiment, a governor to regulate the pressure of the gas, a pressure gauge to show the pressure, a very accurate meter to show the consumption during each minute, a clock to strike minutes. The clock and meter are now combined with a single dial, bearing one hand to indicate minutes, and another to mark the consumption of gas, so arranged that when the consumption is exactly 5 feet of gas per hour the two hands move together, one exactly covering the other. To make a test the gas is lighted at the burner, the pressure regulated at 0.5 inch, the cock fixed so as to make the consumption as nearly as possible 5 feet per hour, or .0833 feet per minute. The candle is lighted, balanced, time when balanced noted, and the candle carefully placed in its socket at the end of the bar. The disk of paper is then moved along the bar till both sides are equally illuminated, which is easily determined by the disappearance to the eye of the opaque spot. This position of the disk is the point between the candle and the gas-burner at which equal quantities of light fall on the same area of surface. By the principle that the amount of light which falls on a given surface is inversely as the square of the distance, it is easy to determine the comparative illuminating power of the gas as compared with the candle. If the disk is midway between them, then the gas-flame equals the candle. If the disk is only half as far from the candle as from the gas, the gas-flame $= \frac{2 \times 2}{1 \times 1} = 4$ times the illuminating power of the candle. If one-third as far from candle, $\frac{3 \times 3}{1 \times 1} = 9$ candle-power; one-fourth, $\frac{4 \times 4}{1 \times 1} = 16$ candle-power. The bar being graduated on this principle, the observer, having found the proper position for the disk, reads the value of the gas-flame in candles. It is customary to make ten observations in as many minutes, and average the results. If on weighing the candle it is found to have consumed exactly 2 grains per minute, and if the meter shows a consumption of exactly 5 feet per hour, the test is complete. Otherwise, a correction must be made as follows: *Multiply the average observed candle-power by the grains of candle burned in 15 minutes, divide by the hourly consumption of gas, and divide the quotient by 6.* This gives the value of 5 feet of gas expressed in standard spermaceti candles burning 2 grains per minute or 120 grains per hour. (Note what has been already said with regard to Farmer's Theorem.) To determine the cost of such light, we have only to remember that 1 pound avoir. = 7000 grains. Thus, if the 16 candle gas costs $3 per 1000 feet, and spermaceti candles 40 cents per pound, 1000 feet of gas = 120 grains × 16 candles × $\frac{1000}{5}$ hours ÷ 7000 grains in a pound = 54.85 pounds; and 1000 feet of the gas ($3) furnishes as much light as 54.85 pounds of candles ($21.94). The same method of examination is applicable to oils and to the comparison of burners. The burner now used as the standard for ordinary coal gas is Sugg's London patent (Fig. 16). *Lowe's jet photometer* is not properly a photometer. Its use is based on the production of a flame of a given height through the same single-jet burner. Under a standard pressure the flame will maintain a uniform height as long as the gas is unchanged in composition. The moment the density of the gas changes by the increase or decrease of any of its constituents, its flow—which is always inversely as the square root of its density—will be accelerated or retarded, and the flame will rise or fall. This instrument is an indicator of *constancy of quality*, not a photometer or *light-measurer*.

The Specific Gravity Test.—As already stated, the chief diluents of coal-gas are hydrogen, specific gravity 0.069, and marsh-gas, 0.559, while the luminants are olefiant gas, 0.976, propene, 1.49, butene, 1.94, benzol, 2.71, naphthalene, 4.43, etc. The specific gravity of the mixture will depend, to a certain degree, on the ratio of heavy luminants to light diluents. This does not hold true in the presence of any considerable quantity of carbonic oxide, specific gravity 0.967, as when water-gas is a component, or of air, as in the Rand and Gale naphtha-gas. The table, at the end of this paragraph from Muspratt's *Chemistry*, will sufficiently illustrate the relation of specific gravity to illuminating power in coal-gas made by the usual process. The specific gravity was formerly determined by carefully weighing the gas in a light glass globe provided with a stopcock, making suitable corrections for temperature and pressure. Recently, a very simple method has been introduced, by which the operation can be accurately performed in a few minutes. The diffusive power of gases being inversely as the square root of the density, the density will be directly as the square of the diffusion. It is only necessary to determine the number of seconds required for equal volumes of air and of the gas to escape through the same opening, and to divide the square of the gas seconds by the square of the air-seconds; the result is the specific gravity of gas.

$$\text{Sq. air-seconds} : \text{sq. gas-seconds} = \underset{\text{Sp. gr. of air}}{1} : \underset{\text{Sp. gr. of gas.}}{x}$$

W. W. Goodwin, Esq., of Philadelphia, supplies the simple apparatus for this determination under the name of "the density test." (See *Am. Chemist*, ii. 177, 216.)

Name of Coal.	Cubic feet of gas per ton of 2240 lbs.	Illuminating power in candles.	Sp. gr. of gas.
1, Ponesfield	10,500	11.50	.398
2, Gosforth	10,000	12.00	.402
3, New Pelton	10,500	12.00	.415
4, West Hartley	10,500	12.50	.420
5, Pelaw	11,000	12.75	.420
6, Hasting's Hartley	10,300	12.50	.424
7, Leverson	10,800	12.50	.425
8, Pelton	11,000	14.00	.430
9, Washington	10,000	14.00	.430
10, Dean's Primrose	10,500	13.50	.430
11, Blenkinsop	9,700	14.00	.450
12, Washington cannel	10,500	18.00	.500
13, Pelton cannel	11,500	18.50	.521
14, Leverson cannel	11,600	18.00	.523

Impurities.—Ammonia is detected by moistened turmeric

paper: 2 grains in 100 cubic feet quickly redden it. It is determined by passing a measured quantity of gas through a glass tube filled with glass beads, moistened with a known quantity of a standard solution of oxalic acid. (See *Am. Chemist*, ii. p. 247.) Sulphur in the form of sulphuretted hydrogen is rarely found in purified gas, as it is all removed by the purifiers; but sulphur in other forms, bisulphide of carbon and sulphur compounds of unknown composition, is always present. Lime purification reduces the sulphur in these forms to 7 or 8 grains per 100 cubic feet. Iron purification is not so effective, as it leaves from 12 to 40 grains of sulphur per 100 cubic feet. (See what has been said under *Purification*.) The total sulphur is determined by burning a certain quantity of the gas through a Leslie burner, and collecting the sulphurous and sulphuric acids produced by ammonia, oxidizing all to sulphuric acid by bromine, and weighing as sulphate of baryta. (See *Am. Chemist*, ii. 247.) *Special tests* by chlorine, etc. are fully described in the works on gas mentioned at the close of this article.

Gas analysis, by which the more important gases are determined, is conducted over mercury in graduated tubes. (See BUNSEN'S *Gasometry*, translated by Roscoe, 1857; REGNAULT, *Cours élémentaire de Chemie*, Paris; *Neues Handwörterbuch der Chem.*, i. 493; WATTS, *Dict. Chem.*, i. 268; *Suppl.* 140; LETHEBY in *Am. Chemist*, ii. 177.)

The waste products of the manufacture of coal-gas consist of (1) coke, (2) ammoniacal liquor, (3) tar, (4) the spent lime or oxide of iron used in purification. (See lecture by Dr. Letheby on the waste products of coal-gas, *Chem. News*, xvi., 31, 44, 55, 68, 91, 95, 106.) *Coke*, the fixed residuum which remains in the retorts, and which amounts in quantity to about 66.66 per cent. of the coal, is a very valuable fuel and finds a ready sale. (See COKE.) *The ammoniacal liquor* is the source of nearly all the ammonia salts of commerce. By far the larger part of the nitrogen of the coal, which varies from less than 1 per cent. to nearly 2 per cent., is not converted into ammonia; it forms cyanides, sulphocyanides, bases, etc. The strength of the ammoniacal liquor depends chiefly upon the amount of water used in washing and scrubbing the gas. The strength of the liquor is estimated in degrees (Twaddle), or by the number of ounces of oil of vitriol required to neutralize a gallon. Each degree of Twaddle is equal to about 2 ounces of acid per imperial gallon. The liquor varies from 3° Tw. to 10° or 11° Tw. The maximum yield of ammonia is perhaps 45 gallons of 8-ounce liquor per ton of coal, equivalent to 34 pounds of sulphate of ammonia. The ordinary yield is about 25 gallons of 8-ounce liquor, equivalent to 20 pounds of sulphate of ammonia. In London only about half this quantity is obtained. In 1866 there were obtained at the Paris Gasworks 3000 tons of ammoniacal products, either sulphate or aqua-ammonia, from 421,000 tons of coal, or 0.712 per cent., or 16 pounds per ton. The ammoniacal liquor contains the ammonia in the form of hydrosulphate, acid carbonate, cyanide, sulphocyanide, chloride, and benzoate. By mixing it with lime and blowing steam through it the ammonia is expelled, and conducted to vats containing sulphuric acid, where it is absorbed and combined as sulphate, which is obtained in crystals on evaporation. This salt is used as a fertilizer, in the manufacture of alum, and for the preparation of other ammoniacal compounds. The tar is a very complex body. It was formerly thrown away, but is now the source of a great variety of useful products. The quantity obtained from a ton of coal varies with the character of the coal and the temperature to which it is exposed—the higher the heat the smaller the yield of tar; 11 to 18 U. S. gallons is the usual yield of tar from caking coals, the average being about 12 gallons. The Paris gasworks averaged 12¼ U. S. gallons in 1866. Cannel coals, used in some works in England and Scotland, yield a larger quantity. The principal constituents of the tar have been already enumerated in this article. The tar is used as a rough paint or varnish for iron and wood; for waterproofing paper and felt for roofing purposes; and for the manufacture of pitch for roofing, paving, etc.; NAPHTHA, DEAD OIL, BENZOL, TOLUOL, ANILINE, ANILINE COLORS, NAPHTHALENE, NAPHTHALENE COLORS, CARBOLIC ACID, CARBOLIC ACID COLORS, PICRIC ACID, etc., CRESYLIC ACID, ANTHRACENE, ARTIFICIAL ALIZARENE (which see; see also TAR). *The Refuse Oxide of Iron.*—The oxide of iron is used over and over again, being regenerated by exposure to the air, by which the sulphur extracted from the gas is liberated from the iron and left as free sulphur. When the proportion of sulphur reaches 40 or 50 per cent. the mixture is treated for the extraction of ammonia salts and sulphur, the purified oxide of iron being then returned to the gasworks to be used again. The refuse iron contains considerable cyanogen, which may be extracted by potash and sold as yellow prussiate. The *spent lime* is very offensive when fresh, as explained under *Purification*, and is useless for any purpose. After being weathered, however, it may be used with advantage as a fertilizer. Dr. A. Völcker gives the following analysis of weathered gas-lime; dried at 212° F.:

Caustic lime	18.23
Carbonate of lime	49.40
Sulphite of lime	15.19
Sulphate of lime (gypsum)	4.64
Magnesia and alkalies	2.53
Oxide of iron and alumina	2.49
Phosphoric acid	a trace
Insoluble sand, etc	0.28
Water of combination, with a little organic matter	7.24
	100.00

The fresh gas-lime contains considerable sulphide of calcium and hyposulphite of lime, which makes it useful for removing the hair from hides.

Gas from Coal-Tar.—Ever since the manufacture of coal-gas became an established industry the importance of converting the tar into gas, or of so conducting the destructive distillation as to prevent its formation, has been fully recognized, and the greatest variety of processes has been patented, all of which claim to make *more gas and better gas* from a ton of coal. The actual possibilities are estimated by comparing the weight of tar with the weight of gas from the same coal. 2240 pounds of average caking coal yield from 9000 to 10,000 cubic feet of gas of a specific gravity of, say, 0.430, equivalent to 296.86 or 329.84 pounds of gas. The same coal yields, say, 12 U. S. gallons of tar, the specific gravity of which is from 1.12 to 1.15, or 9.33 to 9.58 pounds per gallon, equal to 112 to 115 pounds. If this tar could be entirely converted into gas of .430 specific gravity, it would add 3394 to 3488 cubic feet to the yield of gas. The case is still more striking when, as in some cities in England and Scotland, cannel coal is exclusively employed, cannel coal yielding 10,000 cubic feet of gas having a specific gravity of .500, or 383.5 pounds of gas, yields, say, 30 gallons of tar, specific gravity 0.990, or 247.38 pounds of tar, which, if converted into gas of specific gravity .500, would add 6449 feet to the yield of gas. The proportion of carbon in coal-tar is so great, however, that under no system can it be converted into gas without the formation of a considerable proportion of fixed coke, probably from 25 to 40 per cent. of its entire weight. This fact reduces very considerably the possible gain of gas from the tar; in the case of caking coal, the usual material, from the 3394 to 3488 cubic feet of gas to not much above 2000 feet. To secure this gain, the tar, which has a market-value of from 33 to 50 cents per ton of coal, must be sacrificed, and more complicated apparatus and a larger consumption of fuel and labor must be resorted to. It is for these reasons that none of the methods suggested for producing gas from the tar have as yet been successful. In 1818, John Grafton patented the conversion of the tar into gas by delivering it into a second retort, heated to redness and filled with iron filings, coke, etc. In 1820, Mr. Lowe contrived an arrangement of five retorts—three below and two above—for the same purpose. The retorts were charged in the usual way with coal, and when the carbonization had gone on for three hours, the tar was admitted into the back part of the upper hotter retorts by a syphon tube. Some have mixed the tar with small coal, others with peat, sawdust, porous stones, etc. In 1827, Bernard Chaussenot patented in France the use of one vessel or retort heated to a low temperature for distilling "resin and all hydrogenous matters liquid and solid" into rich vapors, and a second retort heated to a high temperature for converting these vapors into permanent gas. This principle has been the basis of numerous patents—Robertson (in 1848), Gesner (1849), Hanson (1853), Gale (1858), Fryer (1868), Eveleigh (1870?), etc. While this principle has not been successful if applied to coal alone, it is probably essential to the production of gas from petroleum or any of its products, and is in successful operation in several works where petroleum naphtha is used as an enricher for coal-gas, as at the Harlem and the Mutual works in New York, the Citizens' and the People's works in Brooklyn, and many others. This is, after all, but a subdivision of the process which actually takes place in every coal-retort, as already stated in this article. The coal is always distilled at a low heat, and the condensable vapors are subsequently converted into permanent gas after they leave the coal.

V. *Oil-Gas.*—As a matter of fact, whenever oil is burned in lamps, it is first converted into gas at the wick. This is by far the most economical method of making oil-gas. Nevertheless, when gas-lights were first introduced coal was quickly replaced by oil. Cheap refuse oils and fats were employed, kitchen grease, and whale oil. The gas was obtained by allowing a stream of the oil or melted fat to trickle into a red-hot tube or a retort filled with coke or

similar porous solid. The oil was at once converted into a permanent gas, which, owing to the freedom of the oil from nitrogen and sulphur, contained no ammonia or sulphur compounds, and consequently required no purification, merely washing with water to condense the liquid products. A considerable residue of charcoal is always left in the retort. Oils and fats consist chiefly of oleine, $C_3H_5(C_{18}H_{33}O_2)_3 = C_{57}H_{104}O_6$, and stearine, $C_3H_5(C_{18}H_{35}O_2)_3 = C_{57}H_{110}O_6$, which are converted by destructive distillation into a mixture of gases consisting largely, often to the extent of 30 or 40 per cent., of rich olefines and benzole vapors, the remainder being hydrogen, marsh-gas, etc. Oil-gas is consequently a very heavy gas, its sp. gr. ranging from 0.600 to 1.100. Hydrogen .0693, marsh gas 0.5576, olefiant gas .9702, propylene 1.4553, butylene 1.9404, amylene 2.4255, benzol vapor 2.704. Oil-gas possesses a very high illuminating power, several times that of ordinary coal-gas, and must be burned through very small burners to prevent smoking. The yield of oil-gas depends upon the temperature at which the oil and its vapors are decomposed; a low temperature gives a smaller quantity of very rich gas, with the minimum deposit of carbon. A high temperature yields more hydrogen and marsh-gas, and a larger deposit of carbon. A gallon (U. S.) of oil weighs about 8 pounds; 1000 cubic feet .900 gas weighs 69 pounds. Were there no waste, and were it possible to obtain 8 pounds .900 gas from 1 gallon of oil, 8.63 gallons of oil would make 1000 cubic feet of gas. In practice the results are very variable, from 80 to 100 feet per gallon being reported. From 1824 to 1828 the New York Gas-Light Company used oil exclusively, selling gas at $10 per 1000 cubic feet.

VI. *Gas from Soap-Water.*—In some parts of Europe the refuse soap-water in which sheep, wool, etc. have been cleansed is employed for the manufacture of gas. It is treated either with lime, which forms an insoluble lime-soap which separates as a precipitate, or with sulphuric or hydrochloric acid, which frees the fatty acids as an oily layer. Both these products yield an excellent oil-gas by destructive distillation.

VII. *Rosin-Gas* was introduced when oil-gas became too expensive. The rosin was melted either alone or with a little oil of turpentine, and allowed to run into a red-hot retort containing coke, etc.; 100 pounds rosin yielded from 1000 to 1300 cubic feet of gas, which required no purification, except by cold water to condense certain oily vapors. The gas has a sp. gr. of 0.660 to 0.850, and is little inferior in illuminating power to oil-gas. From 1828 to 1848 the New York Gas-Light Company supplied rosin-gas to its consumers exclusively, at $7 per 1000 cubic feet. It was then replaced by coal gas at $2.50.

VIII. *Wood-Gas.*—When dry wood is subjected to destructive distillation it yields (1) gas, (2) tar, (3) water containing acetic acid and wood naphtha, and leaves (4) a residuum of charcoal. In 1799, Lebon patented a process for making wood-gas, but his gas possessed so little illuminating power that the process was a failure. The gas obtained by heating wood to the temperature of boiling mercury contains—

Marsh-gas	7.0
Carbonic oxide	35.6
Carbonic acid	57.4
	100.

In 1849, Pettenkofer of Munich found that when the volatile products of the distillation of wood at a temperature from 482° F. to 572° F. (the gas, tar, etc.) were passed through a red hot tube, the volume of the gas was increased, while by the decomposition of the tarry oils a considerable quantity of olefiant gas and rich hydrocarbon vapors were produced, a rich and valuable gas being obtained. The following analysis of crude wood gas from the Munich R. R. station illustrates the result of the process:

Olefiant gas and rich hydrocarbon vapors	6.91
Marsh-gas	11.06
Hydrogen	15.07
Carbonic oxide	40.59
Carbonic acid	25.72
	99.35

This process has been introduced in many European cities where coal is not available. The wood is kiln-dried by the waste heat of the retorts, fir being generally selected. In some cases a little boghead mineral or other rich coal or shale is added as an enricher. The charge of 100 pounds or more of wood requires only one and a half hours' exposure to a low heat; consequently, 16 charges can be run off in 24 hours. The yield is from 500 to 600 feet of gas, and from 18 to 25 pounds of charcoal, from 100 pounds of wood. The charcoal is quenched with wet sand. The following analyses exhibit the composition of purified wood-gas: A is an average of 4 analyses by Reissig; B and C are by Gibbs and Genth: B, gas from old field pine; C, gas from small second-growth oak.

	A.	B.	C.
Olefiant gas and rich hydrocarbon vapors	7.86	10.57	6.46
Marsh-gas	25.38	21.50	33.12
Hydrogen	34.96	32.71	30.44
Carbonic oxide	31.80	27.11	26.11
Oxygen	none	0.16	none
Nitrogen	?	2.55	3.39
	100.	100.	100.
Specific gravity		0.663	0.580

Owing to the high specific gravity of wood-gas, often reaching .700, and the large percentage of carbonic oxide, the flame from an ordinary burner with small holes and high pressure is scarcely luminous, but from burners with large openings and low pressure the light equals and sometimes exceeds that of coal-gas. Liebig and Steinhill found the light from 4½ feet to be 20 per cent. greater than from the same amount of coal-gas. Among the advantages claimed for wood-gas are (1) cheapness of material; (2) smaller and simpler apparatus, owing to the short heats being one and a half hours; a wood retort will yield 10,000 feet in 24 hours, while a coal retort yields only 4000 feet in the same time; (3) more valuable in products, charcoal, tar (2 per cent.), acetate of lime (0.5 to 0.75 per cent.). This gas has been introduced in Switzerland, Norway, Sweden, Russia, etc. In 1856 wood-gas was made at the Philadelphia gas-works, and was found to be cheaper than coal-gas, and fully equal to it in illuminating power. (See *J. Frank. Inst.*, xxxii. 136; xxxiii. 313; xxxiv. 126, 349; also WAGNER'S *Jahresbericht* (vols. i. to x.) and *Handbuch der Holz- und Torf-gas Fabrikation*, Munich, 1863.)

IX. *Peat Gas.*—The following products are obtained on subjecting air-dried peat to destructive distillation:

	Vohl.	Kane and Letheby.
Gas	17.625	25 to 58
Tar	5.375	2 " 5
Aqueous distillate	52.000	11 " 38
Charcoal	25.000	19 " 40
	100.	

The gas contains after purification—

	A	B
Olefiant gas and hydrocarbon vapors	9.52	13.16
Marsh-gas	42.65	33.00
Hydrogen	27.50	35.18
Carbonic oxide	20.33	18.34
Nitrogen	?	0.32
	100.	100.

The tar is rich in paraffine, burning and lubricating oils, and creosote (carbolic acid?); the aqueous distillate yields ammonia, acetic acid, and methylic alcohol; the charcoal is a valuable decolorizer and disinfectant. The yield of gas is variously stated at from 2.51 to 5.80 feet per pound, or from 5622 to 13,000 feet per ton of 2240 pounds. The gas is said to be of good quality, from 15.65 to 22.50 candles. (See W. REISSIG'S *Handbuch der Holz- und Torf gas Fabrikation*, Munich, 1863; URE'S *Dict.*, article "Peat;" and *Report on the Nature and Products of the Destructive Distillation of Peat*, Parliamentary Blue book, 1851.)

X. *Petroleum and Naphtha Gas.* See PETROLEUM. XI. *Air-Gas.* See PETROLEUM. XII. *Water Gas.* See WATER-GAS. XIII. *Oxy hydrogen Gas-lighting.* See OXYGEN.

For further details with regard to gas-lighting the following works may be consulted: MUSPRATT'S *Chemistry;* MUSPRATT'S *Handbuch der Technische Chemie*, 3te Auf., 1875; WURTZ'S *Dictionnaire de Chimie; Neues Handwörterbuch der Chemie; Le Gaz;* WAGNER'S *Jahresbericht der Chemischen Technologie;* MATTHEWS'S *History of Gas lighting*, 2d ed. 1832; BLOCHMANN'S *Beiträge zur Geschichte der Gasbeleuchtung*, 1871; *Abridgments of Specifications of Patents relating to the Production and Applications of Gas*, 1860; ACCUM'S *Practical Treatise on Gaslight*, 4th ed. 1818; ACCUM'S *Description of the Process of Manufacturing Coal Gas*, 1819; BOWDITCH, *The Analysis, Technical Valuation, Purification, and Use of Coal Gas; The Gas Manager's Handbook*, THOMAS NEWBIGGING; BOWER, *Gas Engineer's Book of Reference;* CLEGG, *On the Manufacture of Coal Gas;* COLBURN, *The Gasworks of London; Gas Consumer's Guide;* HUGHES, *Gasworks and Manufacturing Coal Gas;* MASON, *The Gasfitter's Guide;* D'HURCOURT, *De l'éclairage du Gaz;* RICHARD, *Gas Consumer's Guide;* SUGG, *Gas Manipulation, with a Description of the various Instruments and Apparatus employed in the Analysis of Coal and Coal Gas;* WILKINS, *How to Manage Gas;* SCHILLING, *Handbuch für Steinkohlengas;* SCHILLING, *Traité d'éclairage par le Gaz;* KNAPP'S *Lehrbuch der Chem. Technologie*, 3te Auf., 1865; BOLLEY'S *Handbuch der Chem. Technologie*, 1862; and the authorities previously cited in this article.

C. F. CHANDLER.

Gasparin, de (Agénor Étienne), Count, b. at Orange, France, July 10, 1810, the son of Count Adrien Étienne Pierre de Gasparin (1783–1862), an Orleanist statesman of liberal views. The son was much in public life until 1846; disapproved of the revolution of 1848, and after Napoleon III. came into power retired to Switzerland, where he engaged in literary pursuits. D. at Geneva May 14, 1871. De Gasparin was a Protestant, a friend of safe reform measures, a pronounced enemy of slavery, and was the author of several volumes, chiefly upon religious and social questions: two of which, *Les États-Unis en 1861* (1861) and *L'Amérique devant l'Europe* (1862), maintaining the justice of the Federal cause in the U. S. during the recent civil war, were translated into English and widely read in the U. S.—Mme. Valérie Boissier de Gasparin, his wife, has also written much upon topics kindred to those discussed by her husband.

Gaspé, county of Quebec, bounded upon the N. and E. by the Gulf of St. Lawrence. It is rocky, but very fertile, and contains the eastern extremity of the Notre Dame Mountains. The fisheries are important. Lead, gold, and petroleum are reported as existing here. Grindstones are quarried. Cap. Percé. Pop., exclusive of Magdalen Islands, 15,557.

Gaspé Basin, a port of entry on Gaspé Bay, and in Gaspé co., Quebec, Canada, has a splendid harbor and is surrounded by a fertile region. It has cod and whale fisheries, a steam lumber-mill, and several new wharves. It is defended by Fort Ramsay. Pop. about 700.

Gas'per, tp. of Preble co., O. Pop. 895.

Gas'port, post-v. of Royalton tp., Niagara co., N. Y., on the Erie Canal, has a natural spring of burning gas. Here are a dry-dock and some manufactories.

Gassendi (Pierre), b. at Champtercier, Provence, Jan. 22, 1592; was a poor peasant's son, but by his remarkable precocity of intellect attracted the attention of a rich relative, who sent him to school. When ten years old he delivered a Latin address before the bishop of Digne; when nineteen (1614) took for a time the professorship of theology at Digne; became professor of philosophy in the university at Aix 1616; took priest's orders 1617; became canon and then provost in the diocese of Digne 1623, but did not assume the latter office for some years. At the same time he was pushing his researches in every department of human learning, and attained renown in many fields. He became in 1645 professor of mathematics at Paris. Galileo, Hobbes, Kepler, and Descartes were his friends and correspondents, and with the last mentioned he held a famous controversy, in which the learning, argumentative skill, and good temper of Gassendi gained a victory over his more original and brilliant, but less accomplished, opponent. Gassendi was an able opponent of the Aristotelian scholastic philosophy, and by his championship of Epicureanism drew upon himself the charge of infidelity; but he was a devout churchman and a conscientious conservative, who espoused the cause of physical science from a conviction of its truth, rejecting the old philosophy simply on account of its inconsistency with the facts of science, but adopting a new philosophy equally inconsistent with the doctrines of his own religious system. Molière was his pupil. D. at Paris Oct. 24, 1655. His best works are *De vita moribus et placitis Epicuri* (1647), *Syntagma Philosophiæ Epicuri* (1649), and the admirable *Lives* of Tycho, Copernicus, Regiomontanus, and Purbach. He published in 1630 a severe attack upon Robert Fludd. His *Institutio Astronomica* (1645), an able work, has a value now chiefly historical. His *Syntagma Philosophicum* (1658), a work of great erudition, sets forth his own eclecticism. His philosophy in some parts remarkably resembles that of Locke. His doctrine in some respects was identical with the sensualistic dogma of his friend Hobbes; and in spirit and manner Gassendi has much in common with Bacon, whose disciple he professed to be. He was a most amiable and benevolent man, austere in his life, and a laborious student. His cautious spirit led him to oppose the important physiological discoveries of Harvey and Pecquet. His *Life* was written by Bougerel (1637), by Sorbière (1658), by Camburat (1770), and by A. Martin (1853). C. W. Greene.

Gasse'rian Gan'glion [named from Giulio Casserio (*Gasserius*), 1556–1616, its discoverer], a large semilunar ganglion upon the large or sensory root of the fifth cranial nerve, near the apex of the petrous portion of the temporal bone. It is found in man and many of the lower animals, and at once recalls the ganglia upon the posterior roots of the spinal nerves, of which it is the analogue.

Gas Tar. See Tar, by Prof. C. F. Chandler, Ph. D., LL.D., M. N. A. S.

Gas'tein, a beautiful valley, some 30 miles long, in Austria, to the S. of Salzburg. It is traversed by the Ache, and has on either hand steep mountains with some glaciers, and containing mines of gold and silver. Here are three villages, Hofgastein, Dorfgastein, and Wildbadgastein, the last one of the most fashionable watering-places in Europe. It has thermal springs, renowned for their efficacy in the treatment of many chronic diseases. Wildbadgastein was in 1865 the place of the convention held by the sovereigns of Austria and Prussia and their diplomatic agents for the purpose of settling the affairs of Sleswick-Holstein.

Gastein, The Convention of, was concluded at Wildbadgastein (Aug. 14, 1865) between Austria and Prussia, and was intended to regulate the relations of these two powers with respect to the duchies, Sleswick, Holstein, and Lauenburg, which they had taken from Denmark, and now occupied in common. By the convention they agreed that Sleswick should be placed entirely under Prussian, Holstein entirely under Austrian administration, while Lauenburg should be annexed to Prussia, Austria ceding its part of it for 2,000,000 thalers. Aug. 20 this convention was signed at Salzburg by the emperor Francis Joseph and King William. August Niemann.

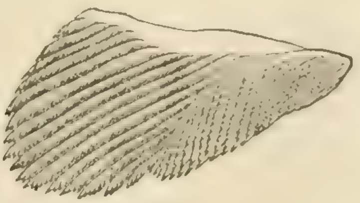
Gas'teropods, or **Gas'tropods** [Gr. γαστήρ, "belly," and πούς, "foot"], a class of the typical mollusks or Mollusca vera (having three well-developed pairs of ganglia —that is, cerebral, pedal, and branchial or parietosplanchnic), distinguished, in contrast with one or other of the remaining classes (Cephalopods and Lamellibranchiates), by the development of a head more or less differentiated from the body, and generally bearing eyes and tentacles; an "odontophore" (also called "radula" or "lingual ribbon") armed with chitinous "teeth" (rarely atrophied); a foot arising from the hæmal or ventral surface of the body (whence the name); and a mantle (at least in the young), which is undivided and continuous round the body, and which, in most forms, secretes a univalve or uniserial multivalve shell. These are the only characters which are common to all the members of this class (and even in a few cases one or other of the parts referred to is suppressed), but nevertheless the limits of the class, or at least the common agreement of all its constituents in positive as well as negative characters, is almost universally admitted. The most familiar representatives of the class are the ordinary univalve shells, and they will convey a good idea of the characters common to most of the species of the division; but a wider survey is necessary to check the impressions that would be derived from their uniformity in many characters. These typical forms have an unsymmetrical body, with the visceral sac spiral and separated, as a strangulated hernia, from the body, and fitting into a spiral shell secreted by a so-called mantle; a foot with a broad flat surface, separated by a decided constriction from the body; a well-developed head; and tentacles, on or near which are eyes at the anterior portion of the head. Many of them are also provided with a peculiar element which is generally either corneous or calcareous, and which is called the operculum; this is developed from a peculiar lobe of the foot, called the operculigerous lobe. None of these characters, however, are universal, and deviations from the type in such respects may be found in forms that are otherwise closely allied.

Inasmuch as the teeth of the lingual ribbon and the operculum are parts much used in classification, it is necessary to enter upon their consideration in more detail.

The lingual ribbon on which the so-called teeth are borne is called by Prof. Huxley "odontophore." The odontophore is well described by him as consisting "essentially of a cartilaginous cushion, supporting, as on a pulley, an elastic strap, which bears a long series of transversely disposed teeth. The ends of the strap are connected with muscles attached to the upper and lower surface of the hinder extremities of the cartilaginous cushions; and these muscles, by their alternate contractions, cause the toothed strap to work backward and forward over the end of the pulley formed by its anterior end. The strap consequently acts after the fashion of a chain-saw upon any substance to which it is applied, and the resulting wear and tear of its anterior teeth are made good by the incessant development of new teeth in the secreting sac in which the hinder end of the strap is lodged. Besides the chain-sawlike motion of the strap, the odontophore may be capable of a licking or scraping action as a whole." This organ is developed in almost all the Gasteropods, having recently been found in several forms to which it had been formerly denied, although none has yet been discovered in the Pyramidellidæ, Eulimidæ, and Styliferidæ. The number of rows of these teeth is generally coincident with other important characters, and, together with the structure of the teeth, form an excellent index to the relations of the various Pectinibranchiate forms. The chief modifications in the number in a transverse row and the form of

the several teeth are illustrated in the accompanying figures, and will obviate the necessity of further explanation, except to say that the number of rows is very considerable,

1



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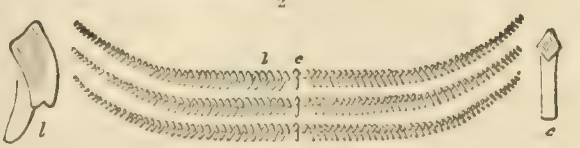

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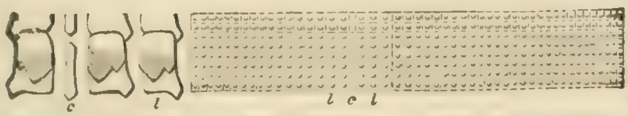
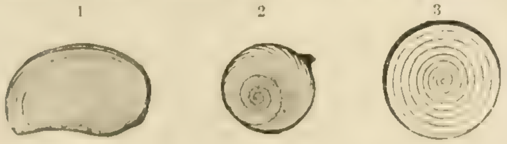


1. Buccal plate of *Triton*, magnified 40 diameters. 2. Section of lingual ribbon of *Siphonaria* showing three complete rows of teeth: *l*, lateral teeth; *c*, central teeth. 3. Lingual teeth of *Achatina fulica*: *l*, lateral or pleural teeth; *c*, central or rhachidian teeth. Specimens of each at the left are more highly magnified.

and may amount to several hundred, and that the central teeth in a row are called "rachidian," and the lateral "pleural."

The operculum, although of less significance as an index of the relations of the superior combinations of Gasteropods, is very important for the determination of their minor affinities. The form is generally coincident with that of the aperture or mouth of the shell, but is sometimes much smaller. In the shells provided with a long siphon-like tube, the operculum is therefore elongated and more or less claw-shaped, while in those shells whose aperture is circular the operculum has a corresponding form. There is also a very considerable difference in the mode of growth in different forms. Commencing from the nucleus, (1) sometimes the increase takes place regularly around it (as in *Ampullaria*, *Viviparus*, etc.), in which case it is called concentric; in others the growth is in a spiral direction; (2) sometimes (as in *Turbo*) with a few rapidly widening whorls, in which case we have a paucispiral operculum; (3) sometimes (as in *Trochus*) with the whorls numerous and slowly increasing in width, and then a multispiral one is formed; (4) in others (as in *Strombus*) the increase is chiefly in a more or less curved axis, when an unguiculate or claw-shaped operculum is generated; (5) in others still (e. g. *Purpura*) the increase is from a marginal or lateral nucleus, and extends in a diverging direction from that nucleus, and an imbricated or lamellar operculum is the result; (6) finally in some forms (e. g. *Nerita*) a process is

1 2 3



4 5 6

Opercula of (1) *Ampullaria*, (2) *Turbo*, (3) *Trochus*, (4) *Strombus*, (5) *Purpura*, (6) *Nerita*.

developed from the free terminal margin, and it is then said to be articulated. As to texture, there is also much difference, but there is no connection between texture and form, for the same shaped operculum (especially in the spiral types) may be either corneous or calcareous, or compounded of both kinds.

In almost all cases caution must be exercised lest the differences in one group prepossess us too much in favor of the value of any given characters, and induce us to apply to corresponding differences in another the same value. Thus, although in the ordinary types of Gasteropods (the Pectinibranchiates) the dentition of the lingual ribbon is an excellent index to the affinities of the groups, it fails in this respect in others, and especially in the Nudibranchiate and Tectibranchiate Gasteropods; but at the same time we must dismiss any prejudices respecting the value of the form of the shell in the determination of the affinities of the animals to which they belong; the same kind of shell may, for example, be common to forms that are radically different in their organization, and there is no *a priori* reason why the modifications of the shell should be of any greater value than those of any other single part of the organism. We should in all cases allow ourselves to be guided by the consideration of the sum total of characters. Indeed, so far is the shell from being of paramount value, there are reasons derived from its development and teleology why it should be—as in fact it is—of comparatively little systematic importance. We need not be surprised, then, to find that shells like the polished *Helices* of the older writers should belong to forms which differ very much in other respects; again, the operculum in its modifications is very characteristic of many groups, while in others it is very variable, and may be present—and then variously modified, varying in structure and size—or absent in groups whose members agree in all essential respects.

It has already been remarked that the shell may be variously developed in members of the same natural group. In some it is capable of receiving and concealing the entire animal, and in others so reduced as to be almost or altogether wanting. Nevertheless, in the embryo the shell is present in almost all except the Chitonidæ or Polyplacophora. In that stage, too, in the normal Gasteropods which are developed in the ocean, there are a pair of ciliated fins which are the outgrowths from those portions of the foot called "epipodia," while the other portions of the foot are then scarcely at all developed; these epipodial wing-like fins are retained in a modified condition throughout life in one great group (sub-class Pteropoda) of the Gasteropods; but in most of them they soon become aborted and disappear, and the shell likewise becomes, in many forms, aborted. In all species retaining shells, this minute embryonic shell is retained for at least a portion of the life, and is distinguishable as the nucleus of the more fully developed form; in a number of forms, however, the nucleus is broken off as the shell increases in size.

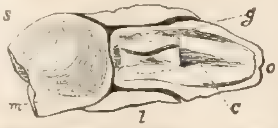
The fry of *Æolis*.

The principal modifications of structure are exhibited in the following groups, to which have been assigned the rank of sub-classes.

(1) The DIŒCA have the body, as well as the heart and generative organs, more or less asymmetrical, with the abdominal viscera generally in a spiral sack, around which is secreted a univalve shell. The mantle extends in a roof-like manner behind the head, and leaves an extensive aperture into the branchial cavity; in this cavity and in advance of the heart (hence sometimes called Prosobranchiates) are situated the gills, which are generally pectinated, but sometimes plume-shaped, and otherwise formed, while sometimes they are modified for aërial respiration. The head is well developed, and tentacles, as well as eyes, are almost always present. The teeth of the odontophore are comparatively few in number in each transverse series; the generative organs (except in the Valvatidæ) are differentiated into distinct individuals, male and female (and hence the name of the, sub-class). As an additional character, Prof. Huxley has also attributed to these, as well as to the Opisthobranchiates, an alimentary canal, "that is always bent upon itself, at first not to the neural, but to the hæmal or heart side of the body—the rectum very commonly opening into the mantle cavity above the cephalic portion of the body," and hence has distinguished these forms as a class under the name Branchiogasteropoda. To this sub-class belong the orders PECTINIBRANCHIATA, RHIPIDOGLOSSA, and DOCOGLOSSA.

(2) The PULMONIFERA agree with the Diœca in the asymmetry of the body and of the organs of relation, and in the shell (except in its development). The mantle, however, is attached in front, and restricts the respiratory orifice to a contracted valve-like aperture. The respiratory cavity has its whorls partially modified into a vascular lung-like apparatus, and there are no gills; the head, tentacles, and eyes are essentially like those of the Diœca;

the teeth of the lingual ribbon are very numerous, comparatively similar, and in a transverse series; the generative organs are united in the same individual. The species, it is said by Prof. Huxley (but with very justifiable reservation), also agree among themselves, and differ from the preceding and the Opisthobranchiates in having the primary bend of the intestine not to the hæmal but to the neural side, "the eventual termination of the intestine on the hæmal side being the result of a second change in its direction;" and for this reason Prof. Huxley has separated this group as a sub-class named Pulmogasteropoda. The only order of this division is the PULMONATA, which includes all the inoperculate land and fresh-water shells.



Bullæa aperta: o, mouth; c, head, or cephalic disk; l, side-lobes of foot; m, mantle; s, shell; g, gizzard, the last two seen through the translucent integument.

(3) The OPISTHOBRANCHIATA form a third sub-class, and, like the preceding, have the body and principal organs asymmetrical; the mantle is variable in its development; there is no branchial cavity, but the gills are more or less exposed on the back and sides and towards the hinder part of the body, and they are generally arborescent or fasciculated; the head, tentacles, and eyes are generally (but not always) developed, but vary widely in form and connections in the different families; the teeth of the lingual ribbon are also extremely different in forms which in all other respects closely agree with each other; the generative organs are united in the same individual, as in the Pulmonifera; the intestinal canal, according to Huxley, corresponds in its flexures with that of the Diœca. In the group are two orders, the TECTIBRANCHIATA and the NUDIBRANCHIATA, both of which have shells in an embryonic condition, but in the latter order the shell is wanting in the adult.

(4) The POLYPLACOPHORA have the body and the visceral organs symmetrical; the heart is in the middle axis of the body, and is an elongated organ like the dorsal vessel of worms; the sexual organs are also symmetrical, and are repeated on each side; the form is a more or less elongated ellipse, and coextensive with the shell, which is formed of eight transverse plates arranged in a longitudinal axis, successively imbricated, and connected by a marginal leathery mantle; the gills are typically in two lamellar series, one on each side of the hinder part of the body, under the edge of the mantle; the head is scarcely differentiated externally, and there are neither tentacles nor eyes; the teeth of the odontophore are in considerable number in each transverse row. Such are the chief distinctive characters of the Chitons, which constitute this sub-class, as well as an order. It is to be further remarked


Dentition of *Chitonellus.*

that the development of these mollusks is quite dissimilar from that of the normal Gasteropods, there being no shell or epipodial appendages in the early embryo, as in those of the other groups; the shell is developed at a later period; its homology with the shells of the other Gasteropods is doubtful.

(5) The PROSOPOCEPHALA are another peculiar sub-class. These also have a symmetrical body and organs of relation; the shell is elongate-conic, and resembles in form an elephant's tusk; there are two gills, which are symmetrical and behind the heart; the head is rudimentary, and the eyes and tentacles are both wanting; the teeth on the lingual ribbon are few in the transverse series; the sexes are probably united in the same individual. This group has been, by some, considered as a class; by others, as a family of Pteropods; by others, still, as most nearly related to the bivalve mollusks; but by most as a family related to the Trochidæ. It comprises several forms, which are known popularly as "tooth-shells," and are combined in the family Dentaliidæ. (For further information see SOLENOCONCHÆ.)

(6) The PTEROPODA form the sixth and last sub-class, which resemble, in some respects, the embryonic stage of the typical Gasteropods, and have the epipodia of the foot extending into lateral fin-like appendages, while the rest of the foot is not developed; in other respects there is much variation among the members, which are distributed among two orders—the THECOSOMATA and the GYMNOSOMATA. All the species of the group are pelagic, floating upon the high seas, and are of small size. THEODORE GILL.

Gas'ton, county of North Carolina, bordering on South Carolina, and bounded on the E. by the Catawba River. Area, 350 square miles. Its surface is uneven, its soil fertile, producing grain and wool. Limestone, iron, gold, soapstone, iron pyrites, and baryta are abundantly found, and silver, copper, lead, zinc, tin, arsenic, bismuth, and many other metals are reported to exist. Cap. Dallas. Pop. 12,602.

Gaston, post-tp. of Sumter co., Ala. Pop. 480.

Gaston, a v. and tp. of Northampton co., N. C., at the junction of the Raleigh and Gaston and the Gaston branch of the Petersburg and Weldon R. R., 85 miles N. E. of Raleigh. Pop. 11; of tp. 2310.

Gaston (WILLIAM), b. at Killingly, Conn., Oct. 3, 1820; graduated at Brown University; studied law with B. R. Curtis of Boston: practised his profession at Roxbury (now a part of Boston, Mass.) until 1867, when he removed to Boston and became law-partner of Harvey Jewell and W. A. Field; was mayor of Roxbury 1861–62; State senator 1868; was elected mayor of Boston 1871, and again in 1872; was chosen governor of Massachusetts in 1874, having previously been several times a Democratic candidate for Congress, and once (1873) for governor.

Gaston (WILLIAM), LL.D., b. at New Berne, N. C., Sept. 19, 1778; studied at Georgetown College, Md.; graduated in 1796 at Princeton with first honors; came to the bar in 1798; was in Congress from North Carolina 1813–17, where he was one of the ablest of the Federalists; judge of the State supreme court 1835–44, although a Roman Catholic, and as such incapable of holding office by the constitution of North Carolina; opposed in 1835 the disfranchisement of free colored voters, which was provided for by the constitution of that year; declined the U. S. Senatorship 1840. D. at Raleigh Jan. 23, 1844.

Gaston de Foix, a nephew of Louis XII. of France, b. 1489: became duke of Nemours 1505; led the army of Louis XII. in Italy; vanquished the besiegers of Bologna; defeated the army of Venice near Brescia, and took the city by storm; won the great battle of Ravenna (Apr. 11, 1512), and by rash exposure after the victory was killed on the same day.

Gas'tric Juice [Gr. γαστήρ, the "stomach"], the fluid which in the stomachs of the higher animals adapts certain food-elements for immediate absorption into the circulatory system, and assists in the reduction of the residue to the substance generally known as chyme. Its existence, long before suspected, was first demonstrated by Réaumur in 1752. It is a clear yellowish liquid, with a strong acid reaction, a slight odor, and a saltish taste, and will keep with but little change for a great length of time. It holds in solution various inorganic salts (chiefly chlorides and phosphates); a nitrogenized substance, called pepsin or gasterase, precipitated from solution by lead-acetate and by alcohol; and a free acid, regarded by some as lactic, by others as hydrochloric, by others as a peculiar "chlorohydropeptic" acid, while some assert that a part or all of its acidity is due to acid phosphate of lime. By its action, either in the test-tube or in the stomach, albumen, caseine, fibrine, etc. are reduced to states in which they are called peptones (albuminose). Fats, sugar, and starch are not acted upon by it to any great extent, though it may assist in converting cane-sugar to grape-sugar, preparatory to its absorption into the nutritive fluid. It appears, further, that the action of the gastric juice upon meats and most other solid substances is not entirely final. While a certain amount of albuminose is made ready for absorption, and is actually taken up by the vessels of the stomach, the great bulk of the food is passed on as chyme, in a partly prepared state for the further action of the pancreatic secretion, the intestinal juice, and the bile, all of which play important parts in digesting food. The pepsin appears to act chiefly as a ferment or catalytic agent. The gastric juice is secreted by those stomach-tubes which contain pavement epithelium. The amount daily produced is placed at fourteen pounds, but as it is constantly being reabsorbed, there is at no time much of it present in the stomach. Its production appears to be to a great extent under the control of the pneumo-gastric nerves. REV. BY WILLARD PARKER.

Gas-Wells. See GAS and GAS-LIGHTING.

Gatch (PHILIP), b. in Maryland Mar. 2, 1751; entered the Methodist ministry in 1774; labored with great zeal and success in the Middle States and Virginia; removed in 1798 to a point near Cincinnati, where, after long and very useful services as a preacher, he d. Dec. 28, 1835.

Gatchi'na, town of Russia, 30 miles S. W. of St. Petersburg, has an imperial palace surrounded by one of the most beautiful parks in Europe. Pop. 8337.

Gates, county of North Carolina, bounded on the N. by Virginia and on the W. by the navigable Chowan River. Area, 500 square miles. Its surface is well timbered, and in some parts swampy. Grain, cotton, and forest products are exported. Cap. Gatesville. Pop. 7724.

Gates, tp. of Clarke co., Ala. Pop. 640.

Gates, post-tp. of Monroe co., N. Y. Market-gardening and the nursery-business are important industries. The township is the western suburb of Rochester. It has 3 churches, and is traversed by the New York Central R. R. Pop. 3541.

Gates (Horatio), b. in England in 1728; in early life entered the British army, attained the rank of major without purchase, and laid the foundation for his future military success. At the capture of Martinico he was aide to Gen. Monkton, and after the Peace of Aix la Chapelle was among the first troops to land at Halifax under Lord Cornwallis. He was with Braddock at his defeat in 1755, where he was shot through the body. At the conclusion of war he purchased an estate in Virginia, on which he resided till the commencement of war with Great Britain in 1775, when he was appointed by Congress adjutant general with the rank of brigadier general. He accompanied Gen. Washington when that officer went to take command at Cambridge, and in June, 1776, was appointed to the command of the army in Canada; in May, 1777, he was superseded by Gen. Schuyler, but in August following in turn superseded that officer in the northern department. The success which attended his arms in the capture of Burgoyne and surrender of the British army at Saratoga in October gave to him a brilliant reputation. After the capture of Gen. Lincoln he was appointed, June 13, 1780, to command the southern department; on Aug. 16 following he was defeated at Camden by Cornwallis, and in December was superseded by Gen. Greene, but restored in 1782, after the surrender of Cornwallis. After the peace he retired to his farm in Berkeley co., Va., where he remained till 1790, whence he went to reside in New York, having first emancipated his slaves. D. at New York Apr. 10, 1806. Geo. C. Simmons.

Gateshead, town of England, co. of Durham, on the Tyne, opposite Newcastle, with which it is connected by two bridges. It is chiefly inhabited by workingmen from the neighboring collieries and quarries (the famous "Newcastle grindstones"), and from the extensive iron manufactories of the town itself. Pop. 48,592.

Gatesville, post-v., cap. of Gates co., N. C., 110 miles N. E. of Raleigh. Pop. 156; of Gatesville tp. 1155.

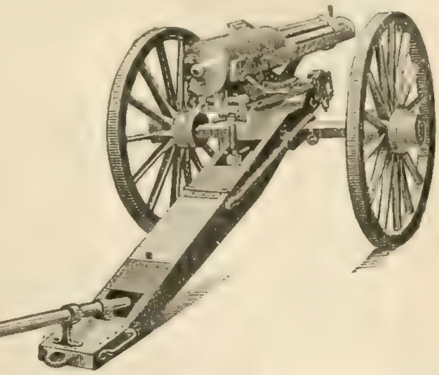
Gatesville, post-v., cap. of Coryell co., Tex., is on the Leon River, 40 miles from the Houston and Texas Central R. R., in the heart of a rich valley, which will soon be traversed by the Gulf Colorado and Santa Fé R. R. It has a large and elegant stone court house, 2 churches, 1 school, 16 business-houses, 1 hotel, 1 saw and flouring mill, and 1 newspaper. Principal business, farming. Pop. about 800. I. W. Vandiver, Ed. "Sun."

Gath, in Palestine, was one of the five cities of the Philistines, and, as it stood on the frontiers of Judah, it played a conspicuous part in the wars between those two peoples. Goliath was born there. Porter (1857) identifies it with *Tell-es Sâfieh*, 10 miles E. of Ashdod. Thomson (*Land and Book*, 1858) thinks that Gath, Bethogabra, Eleutheropolis, and *Beit Jibrin* (about 5 miles S. E. of *Tell-es Sâfieh*) are all one and the same city. At each of these points is a small modern village in the midst of ruins. R. D. Hitchcock.

Gat'ling (Richard Jordan), an American inventor, b. in Hertford co., N. C., Sept. 12, 1818, and now residing in Hartford, Conn. His first invention was a screw for the propulsion of water-craft, in which he found, upon application for letters patent, that he had been anticipated a short time by Ericsson. He subsequently devised a machine for sowing wheat in drills, which found a ready sale in the West; and then studied medicine, attending lectures in 1847–48 at the Indiana Medical College, then located at Laporte, Ind., and in 1848–49 at the Ohio Medical College at Cincinnati, O. He also discovered a method of transmitting power through the medium of compressed air, and invented a double-acting hemp-break, still in use in some parts of the West for breaking hemp. Dr. Gatling's greatest invention, made in 1861–62, is the mitrailleuse, a repeating machine-gun, universally known as the Gatling gun. At the first trial of this gun, in the spring of 1862, it fired 200 shots per minute. After making some improvements in its mechanism, the arm was submitted to trial by our government at the Frankford, Washington, and Fort Monroe arsenals, and at other places, and has since been adopted into the service for use with troops and for the flank defence of fortifications. It has also been adopted by Russia, Great Britain, and other nations.

Gatling Gun, a repeating machine-gun or mitrailleuse invented by R. J. Gatling (which see), and shown on its carriage in Fig. 1. It is made of various calibres and weights. For mountain-service the lighter guns may be transported on animals and fired from a tripod. The gun consists of a number of simple breech-loading rifled barrels

Fig. 1.

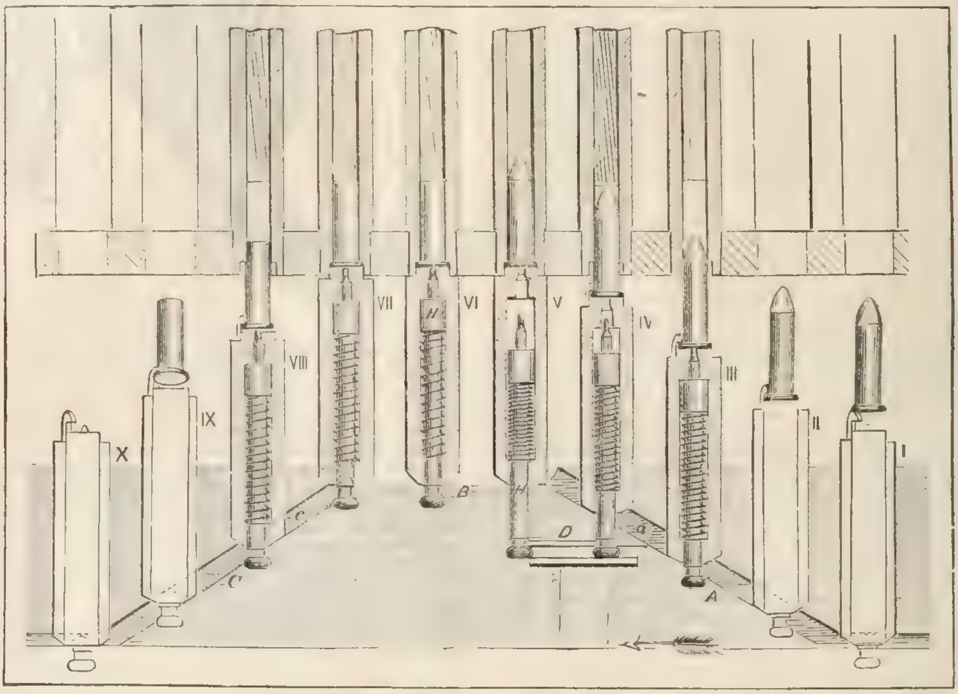


Gatling Gun.

grouped around and revolving about a common axis, with which they lie parallel. These component barrels are loaded and fired while revolving, the empty cartridge-shells being ejected in continuous succession. Each barrel is fired only once in a revolution, so that the ten-barrel Gatling gun fires ten times in one revolution of the group of barrels. The working of the gun is simple. One man places one end of a feed-case full of cartridges into a hopper at the top of the gun, while another man turns a crank, by which the gun is revolved. As soon as the supply of cartridges in one feed-case is exhausted another case may be substituted without interrupting the revolution or the succession of discharges. The usual number of barrels composing the gun is ten. The bore of each barrel extends through from end to end, and the breech is chambered to receive a flanged "centre-fire" metallic case cartridge of the kind used in the Springfield rifle and other small-arms. The breech-ends of all the barrels are firmly screwed into a disk or *rear barrel-plate*, which is fastened to the central shaft, while the muzzles pass through another similar disk, called the *front barrel-plate*, on the same shaft. The central shaft extends backward some distance behind the breeches of the barrels, and upon this extension, directly behind the open barrels, a hollow cylinder of metal called a *carrier-block* is fastened, in the exterior surface of which ten semi-cylindrical channels are cut, which form trough-like extensions of the cartridge-chambers of the barrels to the rear, and are designed to receive and guide the cartridges while they are being thrust into the barrels, and to guide the empty cases while they are being withdrawn. Behind the *carrier-block* the shaft carries another cylinder, called the *lock-cylinder*, in whose surface ten guide grooves are formed, which are in line with the barrels, and in which slide ten long breech-plugs or locks, called *lock-tubes* or *plungers*, by which the cartridges are thrust into the barrels, and which close the barrels and resist the action of the charges when they are fired. This cylinder is called the *lock-cylinder*, because each plug or lock is acted on by a spiral spring acting on a firing-pin or hammer, by which the charge is fired. The shaft, the group of barrels, the *carrier-block*, and the *lock-cylinder* are rigidly connected, and revolve together by means of a toothed wheel fastened to the shaft, and worked by an endless screw on a small axle located at right angles to the shaft, and furnished outside with a hand-crank. The revolution of the *lock-cylinder* carries the locks around with it, and imparts to them a longitudinal reciprocal motion by their rear ends sliding along a groove in the inclined surface of a stationary spiral cam, so that the several locks in succession are pushed forward towards their respective barrels. Fig. 2 shows the spiral cam and firing mechanism as they would appear if cut open longitudinally through the top and developed on a plane surface, the ten locks being shown in their relative positions abutting against the cam surfaces, six of them being shown in section. The diagram shows the ten locks, each at a different point in its revolution. When firing the locks and barrels move in the direction of the arrow-head, and each barrel is discharged near the lowest point in the revolution. At I the cartridge has just dropped in front of the lock; at II it is pushed somewhat forward; at III still more; at

IV it is nearly home, the head of the hammer being held back by the *cocking rib* D, partly compressing the spiral mainspring; at V the lock has reached the straight transverse part of the cam, and its forward motion is arrested, and the mainspring is fully compressed; at VI the hammer, released from the *cocking rib*, has sprung forward and exploded the cartridge; at VII the lock has commenced to retreat; at VIII it is still farther from the cartridge-chamber, and the empty cartridge case is partly withdrawn; at IX the empty case is dropping down from the gun; and at X the lock is fully drawn back, and is again about to assume the first position at I, ten shots, one from each barrel, having been delivered. The locks are made interchangeable, and spare locks are kept on hand. If one or more locks should become permanently disabled, and are not replaced, they can be removed through an opening in the cascabel plate, the gun remaining entirely serviceable, although with a proportionally diminished fire. The piece is elevated and depressed like the ordinary field gun, and in addition has an automatic oscillating movement for spreading its fire through a small sector. The *cases* for feeding the gun are long, narrow tin boxes, open only at the lower end, containing forty cartridges arranged horizontally one above the other. When firing the case stands

FIG. 2.



Gatling Gun, calibre 0.42 inch. Development of the spiral cam and firing mechanism, showing also the action of the locks relatively to the barrels.

in an upright position on the top of the gun, directly over the *hopper*. An able-bodied man can turn the crank of a .45-inch calibre gun forty times per minute for two or three minutes, or at the rate of 400 shots per minute. This is equal, as shown by competitive trials at Fort Monroe, to forty Springfield rifles served with average skill in the number of shots delivered. But at 150 yards the Gatling gun, using the oscillator, will hit a target 9 feet high by 45 feet long 38 per cent. more times than the forty rifles, and at 200 yards, 79 per cent. more. But the rifles, for an equal number of hits, would be more effective against a column of troops, by reason of their greater dispersion vertically. At about 200 yards one Gatling gun, used with the oscillator to spread the fire, would not deliver more than half as many hits against a column of troops as one 8-inch howitzer fired with double charges of canister, each containing 440 lead balls, but the disabling effect, hit for hit, would be much greater from the Gatling gun. Without the oscillator the Gatling gun will put every shot into a target 9 feet by 45 feet at a greater distance than 200 yards. At 500 yards, one Gatling gun fired with the oscillator gives 58 per cent. more hits in a target 9 feet by 45 feet than two 12-pounder Napoleon guns and one 8-inch howitzer together, each firing 1½ minutes. At 800 yards, target 9 feet by 45 feet, one Gatling gun hit 320 times, against 38 hits for two Napoleons and one 8-inch howitzer together, each firing 1½ minutes. In firing against time at a column of ten targets each 6 feet by 50 feet, representing a regiment of infantry in column, approaching or retiring from the battery, the nearest company being 1000 yards and the farthest 1150 yards distant, one Gatling gun gave 17 per cent. more hits than the 8-inch howitzer firing spherical case, and 144 per cent. more than the 4½-inch rifle firing shrapnell. At 1200 yards distant, target 9 feet by 45 feet, the Gatling gun fired without the oscillator gave 180 hits on the first trial, and 413 on the second. Number of shots fired at each trial, 600; time, 1½ minutes. The advantages possessed by this gun are the lightness of its parts; the simplicity and strength of its mechanism; the rapidity and continuity of its fire without sensible recoil; its effectiveness against troops; its general accuracy at all ranges attainable by rifles; its comparative independence of the excitements of battle; the interchangeableness of its ammunition with that of the same calibre of small-arms; and its great endurance. Its disadvantages compared with all shell-guns are its inability to deliver a curved fire, so as to reach behind intervening obstacles; its want of effectiveness against troops covered by rifle-pits and slight intrenchments, or lodged in houses or in heavy woods; and its entire want of breaching power. It is peculiarly adapted to the defence of intrenched positions and villages; for protecting roads, defiles, and bridges; for covering the embarkation or debarkation of troops or the crossing of streams; for silencing batteries by driving off the gunners; for increasing the infantry-fire at the critical moment of a battle; for supporting field batteries against assaults and charges; for covering a retreating column; and its economy in men for serving and in animals for transporting it. These guns are made of calibres of 1-inch, weight, 650 pounds; .75-inch and .65-inch, each weighing 450 pounds; .55-inch, weight 400 pounds; and .50-inch, .45-inch, and .42-inch, each weighing 200 pounds. The gun-carriage and limber complete for the three smaller calibres weigh 713 pounds. (For further details see report of a board of officers, of which the writer was a member, published by the ordnance department U. S. Army.)

Q. A. GILLMORE.

Gauchos. See GUACHOS.

Gauden'tius, bishop of Brescia in the fourth century, is remembered for his discourses, of which twenty-one are now extant. He was the friend of Ambrose and Chrysostom. Of his life little is known.

Gauge, or **Gage,** an instrument for measuring capacity, dimension, or some special force. Thus, the diameter of wire is determined by the wire-gauge. The anemometer is sometimes called the wind-gauge. There are also steam-gauges, instruments to determine the pressure of steam in boilers, etc.

Gaug'ing is the finding the approximate capacity of vessels, and especially of casks containing liquids, by means of a graduated rule called the gauging-rod. Measurements by this rod, treated in accordance with certain specified mathematical formulas, give the contents with tolerable accuracy.

Gaul. See GALLIA.

Gau'ley Moun'tains, in West Virginia, are a part of the ridge known farther S. W. as the Cumberland Mountains. The name is sometimes given to the Little Gauley Mountains in Nicholas co., and is sometimes extended indefinitely to the same range farther to the N. E. The mountains contain much wild and sublime scenery.

Gau'ley Riv'er, in West Virginia, rises in Pocahontas co., drains a valley having the Gauley and Birch Mountains on the N. W. and the Greenbrier Mountains on the S. and S. E. It falls into the Great Kanawha.

Gauls. See CELTS.

Gault, The, originally a provincial name for a stratum of stiff blue calcareous clay or marl occurring in several localities in the S. and E. of England, but now accepted as a geological term to designate a stratigraphical horizon in the Cretaceous formation of Europe. When represented in the series (and it is often wanting), this stratum of clay, varying in thickness from 80 to 200 feet, is regarded as the commencement of the Upper Cretaceous. It intervenes between the Lower and the Upper Greensands, and lithologically is very distinct from either; palæontologically, its fossils, abundant and often beautifully preserved, represent a fauna marked by a strong preponderance of forms identical with or closely related to those of the Upper Greensand or of the chloritic marl above. E. C. H. DAY.

Gaulthe'ria [named in honor of Dr. *Gaultier* of Quebec, a physician of the eighteenth century], a genus of shrubs mostly very small, found in North and South America, Asia, Australia, etc. Many of them produce edible fruits. The typical species is the *Gaultheria procumbens*, the wintergreen or checkerberry of the U. S. and Canada. Its fruit and young leaves are edible, and abound in the oil of wintergreen, a fragrant volatile oil used in pharmacy and confectionery. The *Gaultheria* (now *Chiogenes*) *hispidula*, the sweet birch (*Betula lenta*), and several other plants yield the same oil. The *Gaultheria Shallon* of the Pacific coast (the *Salal* of the Indians) is sometimes three feet high, and produces very pleasant edible berries, which are pressed into cakes and largely used for food.

Gault'ney's, tp. of Alexander co., N. C. Pop. 1126.

Gaur, a large and ferocious wild ox (*Bibos gaurus*) found in the jungles of parts of India. It has no dewlap, and is characterized by a high ridge along the back, caused by the great development of the spinous processes of the vertebræ. It is reported to be incapable of domestication, and so fierce that no tiger will molest it. It goes in herds. The gaur has been called the largest of the ox tribe. It is peculiarly marked by white hair upon the legs. When in herds, though a brave and spirited beast, it is not often vicious and irascible. Its flesh is excellent. Its voice is quite different from that of the ox.

Gauss (KARL FRIEDRICH), b. in Brunswick, Germany, Apr. 30, 1777; was educated at the expense of the duke of Brunswick, who had heard of his precocious mathematical talents; solved when eighteen years old the problem of the division of the circle into seventeen equal parts, and afterwards became famous for skill in the indeterminate analysis and in curious numerical questions; demonstrated Fermat's theorem; became in 1807 professor of astronomy at Göttingen and director of the observatory; received in 1810 the Lalande medal for calculating by a new method the orbits of Ceres and Pallas; was made in 1816 a court councillor, and in 1845 a privy councillor of Hanover; made after 1821 important improvements in geodetic methods and instruments; after 1831 devoted much attention to terrestrial magnetism. D. at Gottingen Feb. 23, 1855. Gauss is regarded as one of the first mathematicians of the century. His principal works are *Disquisitiones Arithmeticæ* (1801), *Theoria motus corporum cœlestium* (1809), *Theoria combinationis observationum* (1823), *Intensitas Vis Magneticæ* (1833), reports of the *Magnetischer Verein* (1836, with Weber, and 1837–40), *Atlas der Erdmagnetismus* (1840), *Dioptrische Untersuchungen* (1841), and collections of papers on geodesy and related subjects.

Gau'tama, properly the name of the great Solar race of East Indian warrior princes, but more especially the name of SAKYA MUNI (*Sakya* is a family name; *muni* = μόνος, "solitary"), otherwise called GAUTAMA BOODDHA, the alleged founder of BOODDHISM (which see). He was b. 624 B. C., the son of Suddhôdana, king of Kapalavastu, in the N. of India, and in youth was called *Siddhârta*. The story of his life is a tissue of monstrous fables, and H. H. Wilson supposes the whole to be perhaps allegorical; but it is generally believed that there is a historical basis to the story. In early life he was of ascetic habits, but, tempted by his father, he abandoned himself to every pleasure for a time; but his singular wisdom (which, like his other marvellous gifts, was the fruit of merits gained in previous states of existence) led him to renounce the world, and after years of profound study, severe bodily maceration, and long contemplation, he discovered the supreme truth that to return to the ignorance and state of non-sentient repose whence man sprang is the highest possible good and the final reward of the just and pure. After this discovery he was made a *booddha*, and after a time passed into Nirvana, or unconsciousness, having d. at Kusinagara in 543 B. C. His body was burned, but numerous relics of him were preserved and became objects of veneration. The Brahmans teach that he was the ninth *avatar* of Vishnu, sent to delude and destroy the Asura race.

Gautier (THÉOPHILE), b. at Tarbes, France, Aug. 31, 1811; studied at the College of Charlemagne, and tried, without success, to become an artist. In 1830 he published a volume of poems, and from that time took position as a Parisian *littérateur* of the romantic school; was 1836–56 art-critic and dramatic censor for the *Presse;* became literary editor of the *Moniteur Universel* 1856; of the *Journal Officiel* 1869. D. in Paris Oct. 23, 1872. Author of *Albertus* (poem, 1832), some pleasant books of travel, many good novels, and other works, among which are *Les grotesques* (1844), *Trésors d'art de la Russie* (with Richebourg, 1860–63), *Histoire de l'art dramatique en France* (6 vols., 1859), with several poems, librettos, and many fugitive pieces. His style is delightfully clear, but is without the piquancy so much affected by most French writers. His criticism shows the influence of the German philosophy, by which he was profoundly influenced, but without losing his own independence as a thinker.

Gauze, a light fabric of silk or silk and cotton, woven so loosely and with such delicate threads as to be quite transparent. It is believed to take its name from *Gaza*, in Palestine, where it was once made. Switzerland, France, and Scotland now chiefly produce it. The name is also given to other light fabrics, such as the woollen or silk-and-woollen material used for summer undershirts. Fine wirecloth is called wire-gauze. It is often made of surprising delicacy and transparency.

Gau'zu-vi'va, the *Coassus nemorivagus*, a delicate little sheep-like deer of Brazil. It is of a grayish-brown color, and has small horns. It is but twenty-six inches long.

Gavarni, a name assumed by SULPICE GUILLAUME PAUL CHEVALIER, b. in Paris 1801; first published sketches of the valley of Gavarnie in the Pyrenees, whence his pseudonym; attained great fame by his humorous delineations of Parisian life, exposing the foibles of good society, as well as the laughable eccentricities of low life. He also illustrated several books, among which the best known is Sue's *Wandering Jew*. Gavarni's designs are very numerous. D. at Auteuil Nov. 23, 1866.

Gava'zzi (ALESSANDRO), an eloquent champion of Italian independence, unity, and evangelization, was b. at Bologna in the year 1809. In 1825 he joined the monastic order of Barnabites, and was afterward appointed professor of rhetoric at Naples. Shortly after the accession of Pope Pius IX. (1846) he removed to Rome, drawn thither by sympathy with the reformatory spirit of the new pontiff. In 1848 he was made suddenly famous by an impassioned oration which he pronounced in the Pantheon in commemoration of the patriots who had fallen on the plains of Lombardy in the war with Austria. The pope, who then shared in the national enthusiasm, appointed him chaplain general and almoner of the Roman legion (16,000 strong) raised to take part in the struggle. These troops, which had marched to Vicenza, were soon recalled. But Gavazzi, instead of returning with them, broke with the pope, and became another Peter the Hermit, preaching a new crusade. Florence, Genoa, and Bologna, all rang with his appeals. The new republic made him chaplain-general of the army. The French occupation of Rome (in July, 1849) drove him into exile. He visited England, Scotland, the U. S., and Canada, lecturing against the Papal Church. In 1851, while in London, he published first his *Memoirs*, and a few months later his *Orations*. In 1860 he was with Garibaldi in Sicily. In 1870 he was again in England, and in 1873 came once more to the U. S. He is now (1875) an evangelist in Rome and lectures on rational theology and homiletics in the college of the "Free Christian Church in Italy."

R. D. HITCHCOCK.

Gav'elkind, a system of land tenure prevailing in England in the county of Kent, by which the land of a father is equally divided at his death among all his sons,

or the land of a brother among all his brothers if he have no issue of his own. This custom is said by some writers to have existed universally throughout the kingdom before the Norman Conquest, and to have been retained by the inhabitants of Kent as a part of their ancient liberties. It is a peculiarity of this tenure that the estate has never been subject to forfeiture in case of attainder for felony, and when feoffment was in use as a mode of conveyance, the heir was capable of selling the land and giving livery of seizin at the early age of fifteen. (See FEOFFMENT.) The special mode of inheritance appertaining to lands held in gavelkind is distinct alike from the usual English system of primogeniture and the more equitable law of descent prevailing in the U. S., by which all the children of an intestate, females as well as males, take equal shares in the land. GEORGE CHASE. REVISED BY T. W. DWIGHT.

Ga'vi, town of Italy, in the province of Alessandria. It is of ancient origin, and is still surrounded by its mediæval wall with gates. The old fortress is now used as a prison. The parochial church, although much restored, dates back to the Carlovingian period. Pop. 6304.

Ga'vial, or **Na'koo** (the *Gavialis Gangeticus*), the largest of living Crocodilidæ, inhabiting some of the streams of India, and at times attaining a length of thirty feet. It is characterized by long and narrow jaws and has 120 teeth. The male has a large cartilaginous lump near the nostrils. This creature is inoffensive to man, feeding chiefly upon fishes and other small animals. Closely related African species are described.

Gavial.

Gavilan' Mountains, a group of mountains in Monterey co., Cal., near the Pacific coast. The highest point is Mt. Pacheco, 2845 feet high.

Gavot' [It. *gavotta;* Fr. *gavotte*], in music, a gay and spirited dance-tune, written in common time. It has two strains, each of which is repeated, the latter being usually the longer. The gavot was familiar in the seventeenth century and later, and often appears in connection with the *minuet*—as, *e. g.*, in the forty-eight sonatas of Corelli.

Gay, tp. of Taylor co., Ia. Pop. 248.

Gay (GEORGE WASHINGTON), M. D., b. at Swanzey, N. H., Jan. 14, 1842; graduated at Harvard Medical College 1868; one of the surgeons of the City Hospital, Boston, Mass.; author of various professional papers.

Gay (JOHN), b. in Devonshire, England, 1688; was apprenticed in London to a silk-mercer; published *Rural Sports*, a poem (1711), which won him Pope's lifelong favor; became in 1712 secretary to the duchess of Marlborough, and in 1714 secretary to Clarendon, who was then ambassador to Hanover; acquired wealth, but lost it in the South Sea Bubble, and after 1727 was a dependant upon the bounty of the duke of Queensberry. D. in London Dec. 4, 1732. Was the author of several very successful dramas, some fine ballads, and other poems remarkable for wit and other choice qualities, but some of his pieces are needlessly indelicate. The excellent *Fables* (1726) and *The Beggar's Opera* (1727) are especially noteworthy.

Gay (WINCKWORTH ALLAN), an American landscape-painter, b. in Hingham, Mass., Aug. 19, 1821; studied with Prof. Robert Weir of West Point, afterward with Constant Troyon in Paris; passed several years in Europe, but is best known in his own country in Boston, where his quiet, meditative pictures, chiefly of New England scenery, are much prized. O. B. FROTHINGHAM.

Gay'ah, city of British India, the cap. of the district of Bahar, on the Phalga, which empties into the Ganges. The Phalga is a sacred river, and more than 100,000 pilgrims visit it annually, which chiefly gives Gayah its importance. The city consists of two parts—the old city, inhabited by the Brahmans; and the new city, which is the business quarter. Pop. 35,000.

Gayal', a variety, perhaps a species (*Bos gavæus*), of the domestic ox, found in parts of Bengal and Farther India, where it is reared in great herds for its hide and flesh. It has very rich but scanty milk.

Gayarré (CHARLES E. ARTHUR), b. at New Orleans, La., Jan. 3, 1805, was educated at the College of New Orleans, and studied law in Philadelphia; admitted to the bar in 1829; was sent in 1830 to the legislature, and several times in later years; in 1831 became deputy attorney-general of Louisiana; presiding judge of the New Orleans city court in 1833; was elected in 1835 to the U. S. Senate, but did not take his seat; was secretary of state in Louisiana 1846–53. He is best known as the author of a series of important works upon the history of Louisiana, partly in French and partly in English (1830, 1847, 1848, 1851, 1852, 1854): *Philip II. of Spain* (a history, 1866); *Fernando de Lemos* (a novel, 1872), besides a drama and a number of lectures and printed addresses.

Gay-feather, a popular name for the *Liatris scariosa* and *spicata*, and perhaps for other species of that interesting genus of composite herbs. They grow extensively throughout most of the U. S.; have bulbous roots, a terebinthinate taste, and active medicinal properties. These plants are among those locally known as "rattlesnake master." They have beautiful purple flowers, and are worthy of extensive cultivation in flower-borders.

Gay Head, post-tp. of Dukes co., Mass., is a bold headland forming the W. portion of the island of Martha's Vineyard. It takes its name from the brilliant colors of its cliffs. To the geologist its rocks are peculiarly interesting from its miocene fossils—coprolites, bones, lignite, iron ore, etc. It has a flashing white light of the first order 170 feet above the sea; lat. 41° 20′ 52″ N., lon. 70° 49′ 47″ W. Most of the inhabitants are Indians, who gain a living by farming and fishing. They rear a breed of small horses called Gay Head ponies. Pop. 160.

Gayle (GEORGE W.), an able lawyer and Democratic politician of Selma, Ala., was U. S. district attorney under President Jackson, and became a prominent State legislator. His offer, during the late war, of a reward of $1,000,000, Confederate money, to any one who would destroy President Lincoln, led to his arrest after the war as an accomplice in the assassination of Mr. Lincoln, but he was released without a trial. D. Apr. 1875.

Gayle (JOHN), b. in Sumter district, S. C., Sept. 11, 1792; was educated at South Carolina College; removed in 1813 to Alabama; entered the legislature in 1817; became a district solicitor 1820; a judge of the Alabama supreme court 1823; in 1829 Speaker of the House; governor 1831–35; was in Congress 1847–49; became in 1849 a judge of the U. S. district court for Alabama, and d. at Mobile July 20, 1859. A man of brilliant talents, his usefulness was diminished by irregular habits.

Gay'ler (CHARLES), b. in New York in 1820; became connected with the press of Cincinnati; removed in 1850 to New York, and attained distinction as a journalist and writer of dramatic pieces, among which are *The Gold-Hunters; The Frightened Fiend*, operetta; *The Love of a Prince; Galieno Valiero; Isms; Taking the Chances; The Son of Night*, and many others, nearly all highly successful upon the stage.

Gay-Lussac (JOSEPH LOUIS), an eminent French chemist, b. at St. Leonard, Haute-Vienne, Sept. 6, 1778; was admitted Dec. 27, 1797, to the Polytechnic School; assigned in 1800, while still a pupil, as assistant to Berthollet in the government chemical works at Arcueil, where he speedily won the high approbation of his superior, and was promoted soon after to be assistant professor in the Polytechnic. In 1804 made two balloon ascensions, the first in company with Biot, Aug. 24, and the second alone, Sept. 16, for the purpose of observing the variation with altitude of magnetic intensity, attaining in the last ascent the great height of 7016 mètres, or 23,000 feet. In the same year became associated with the illustrious Humboldt in eudiometrical experiments, in the course of which he incidentally demonstrated that oxygen and hydrogen unite to form water in the proportions by volume of 100 of the first to 200 of the second. This led to the investigation which resulted in the subsequent announcement (in 1808) that gases always combine in definite proportions by volume. In 1805, in company with Humboldt, he left Paris on a scientific tour through Southern France, Italy, Switzerland, and Germany, reaching Berlin on the 16th Nov. During their visit to Naples the travellers had an opportunity of witnessing a grand eruption of Vesuvius, accompanied by one of the most fearful earthquakes ever experienced in that city. Was elected to the Academy of Sciences in 1806, professor of chemistry at the Polytechnic School in 1809, and also professor of physics at the Sorbonne; and in 1832 professor of chemistry at the Jardin des Plantes. In 1807 determined the coefficient of expansion of gases at constant pressure with increase of temperature. In 1808, associated with Thenard, discovered a chemical process for obtaining, from their alkaline oxides, potassium and sodium in quantity — metals which had been previously obtained by Sir Humphry Davy by electrolysis. Other results arrived at by these two discoverers, and published in 1809, were the decomposition of boracic acid and the production of boron, and the demonstration

of the probably elementary nature of chlorine (then called oxygenated muriatic acid gas). In 1813, Gay Lussac investigated the nature of iodine, accidentally discovered two years before by Courtois, a manufacturer of saltpetre in Paris, and pointed out the analogy between chlorine, iodine, and sulphur. In 1815 was made his most remarkable chemical discovery, that of the compound radical cyanogen, with its singularly energetic compounds, especially cyanhydric or prussic acid. In 1816 he invented his portable syphon (or mountain) barometer, since so extensively used. In 1818 he was appointed superintendent of the government gunpowder and saltpetre works, and was subsequently called on to advise in the administration of the excise; and in 1829 was made chief assayer to the mint. While acting in these several capacities he originated many ingenious processes and instruments for the application of scientific principles to industry. In 1831 was chosen delegate to the Chamber of Deputies from St. Leonard, and in 1839 was made a peer of France. This honor, according to his biographer, Arago, would have been conferred on him many years earlier but for the fact that "he worked every morning at the assay-office with his own hands"—a fact esteemed by the bestowers of such distinctions incompatible with the dignity of the peerage. It would be useless to attempt here an enumeration of the various important memoirs by which Gay-Lussac contributed to advance the progress and enlarge the literature of science. Their titles alone would fill many pages. They may be found principally in the *Mémoires de la Société d'Arcueil* and in the *Annales de Chimie et de Physique*, of which latter for many years, jointly with Arago, he was the editor. D. in Paris May 9, 1850, of atrophy of the heart.
F. A. P. BARNARD.

Gayo'so, post-v. and tp., cap. of Pemiscot co., Mo., is situated near the bank of the Mississippi River. It was located in 1852, and during the late war was nearly destroyed. It has a court house, a church, a school house, a hotel, 1 weekly newspaper, and a number of stores. Pop. of tp. 463.
GEO. W. CARLETON, ED. "DEMOCRAT."

Gays'port, borough of Blair co., Pa., separated by a small stream from HOLLIDAYSBURG (which see). Pop. 799.

Ga'za ["the strong;" now *Ghuzzeh*], in Palestine, the southernmost and strongest of the five royal cities of the Philistines. Along with Damascus, it is one of the oldest cities in the world. Commanding the road to Egypt, it has been the scene of repeated and desperate struggles. Samson's exploits have made it famous. It was captured by Alexander the Great after a siege of nearly five months. In 634 it fell into the hands of the Saracens for a time, and since the battle of Haltin in 1187 has remained Mohammedan. Gaza is now about 3 miles from the Mediterranean, nearly the whole space between it and the sea being covered with ruins. It consists of a group of villages. The nucleus stands on a hill, with its buildings of stone, the suburbs containing only mud-hovels. The population is estimated at about 15,000, mostly Mohammedans.
R. D. HITCHCOCK.

Gaza (THEODORUS), b. about 1405 at Thessalonica; left that town on its capture by the Turks in 1430; was rector and professor of Greek in the gymnasium of Ferrara; was employed 1450–56 by Pope Nicholas V., and 1456–58 by Alfonso the Magnanimous of Naples. Bessarion procured him a small benefice in Southern Italy. D. in 1478. His Greek grammar (1495) was long famous. His letters, his Greek treatise on the calendar, and numerous translations from Latin to Greek and Greek to Latin, added to his merited reputation as a man of learning.

Gazelle [Arab. *gazâl*], the *Gazella dorcas* and the nearly allied species, antelopes of Africa and Asia. The above-mentioned species is found in Northern Africa, but the ariel gazelle of Asia is a more graceful variety of the same species. The gazelles are celebrated for their elegant forms and the beauty of their eyes. They are easily tamed, and become great favorites from the gentleness of their disposition. *Gazella Sœmmeringii* and *Isabella* are among the other closely-kindred species. Both are African.

Gazette [from *gazeta*, a former coin of Venice, worth about a farthing, which gave its name to a sort of news bulletin which sold for that price], a periodical, a printed journal; applied especially to the official newspaper printed semi weekly in London, Edinburgh, and Dublin, and containing the new appointments and official acts and proclamations of government, bankrupt notices, and the like.

Gazetteer' [Fr. *gazetier*], a geographical dictionary; a work containing some account of civil and natural divisions, as in geography, of mountains, rivers, lakes, seas, etc., arranged in alphabetical order. Gazetteers often are local or national, but there are many, more or less complete, which describe places in all parts of the world.

G Clef, in music, the sign or mark indicating the treble staff. Its place is on the second line, or, rather, that line is the axis around which it entwines. This clef was originally compounded of the letters *g* and *s*—the former giving its location the name of G (as two octaves above gamut G), and the latter representing *sol*, or the fifth (in the scale of C) of the series of syllables used in solmization. The name G being thus given to notes on the second line, all others, above and below, on the same staff derive their names from it. In organ and pianoforte music the treble clef is prefixed to the part played by the right hand, and the bass, or F clef, to that for the left.
WILLIAM STAUNTON.

Gear'ey, post-v. of Roane co., West Va. Pop. 950.

Gearing. See WHEEL-WORK.

Gear'y (JOHN WHITE), b. in Mt. Pleasant, Westmoreland co., Pa., Dec. 30, 1819; studied at Jefferson College, Cannonsburg, Pa.; became a civil engineer. In the war with Mexico (1846–48) he went to the seat of war as lieutenant-colonel 2d Pennsylvania Vols., serving during the campaign from Vera Cruz to the city of Mexico with distinction; was wounded once; was promoted to the coloneley of his regiment, and on the capture of the city of Mexico was placed in command of the citadel. In 1849 he was appointed by President Polk postmaster of San Francisco, Cal., with authority to organize the postal service throughout our then new Pacific coast territory. Soon afterwards he was elected alcalde of the city, and was appointed by the military governor judge of the first instance for San Francisco. He remained in San Francisco till 1852, performing at different times the ex-officio duties of sheriff, recorder, probate judge, etc., and exercising a large influence in organizing the government of that city, whose first mayor he was (1850). Returning to Pennsylvania in 1852, he remained in private life till 1856, when he was sent by President Pierce to Kansas as governor. His territorial administration was not successful, and becoming involved in trouble with Judge Lecompte, Geary was forced to retire, returning to Pennsylvania and remaining in private life till the outbreak of the civil war (1861), when he raised and equipped the 28th Pennsylvania Vols., which regiment he commanded in several engagements in the Shenandoah Valley. In Apr., 1862, he was appointed brigadier-general, and the next year promoted to be major-general and placed in command of a division, remaining in active service till the close of the war. In 1866 he was elected governor of Pennsylvania by the Republican party, and re-elected in 1869. D. suddenly at Harrisburg Feb. 9, 1873.

Gear'y Cit'y, a v. of Wayne tp., Doniphan co., Kan., on the Missouri River. Pop. 102.

Geau'ga, county of N. E. Ohio, in the "Western Reserve." Area, 400 square miles. The surface is undulating and well timbered; the soil heavy, but very productive. Cattle, grain, fruit, wool, and dairy products are the staples. Cheese, carriages, and wagons are extensively manufactured. It is traversed by the Painesville and Youngstown R. R. Cap. Chardon. Pop. 14,190.

Gebang' Palm, one of the most valuable of known palms, the *Corypha Gebanga* of Java and the neighboring regions. It yields sago, roofing thatch, material for hats, fishing-nets, cloth, cordage, etc., and its roots afford a valuable remedy for the diarrhœa so prevalent there.

Geb'weiler, town of Upper Alsace, Germany (formerly *Guebwiller*, Haut-Rhin, France), in a valley near Mount Gebweiler, the highest point of the Vosges. It has important and varied manufactures. It is 14 miles S. S. W. of Colmar, on the river Lauch. Pop. 11,558.

Geck'o (so named from the cry of one of the species), a name given to numerous thick-tongued nocturnal lizards of the family Geckotidæ. There are not less than forty species, among which the *Ptyodactylus gecko* of Africa (whose footsteps were thought to be the cause of the leprosy, and which was considered able to eat steel) and the *Gecko verus* of Asia are among the best known. Other species are found in America, Australia, etc. They generally have the power of climbing walls, walking upon ceilings with the back downward, etc., after the manner of flies.

Ged'des, post-v. of Onondaga co., N. Y., on the Erie Canal, the Oswego and Syracuse R. R., and Onondaga Lake, 5 miles N. W. of Syracuse. Geddes in 1870 manufactured 1,411,474 bushels of salt from salt-wells. It has also extensive iron works, potteries, etc. Pop. 3629. The township contains State asylum for idiots. Total pop. [illegible].

Geddes (GEORGE). See FIRST BIENNIAL SUPPLEMENT.

Geddes (JAMES), b. near Carlisle, Pa., July 22, 1763; removed to New York, and settled at Geddes, Onondaga co., N. Y. (named in his honor), 1794; was a prominent mover and agitator of the subject of a canal from Lake

Erie to the Hudson River, and in 1808 was appointed to make the preliminary surveys of the route, reporting the plan practicable and not difficult to accomplish: in addition to his duties of judge of Onondaga co., he accepted (1816) the appointment of engineer of the Erie Canal; appointed chief engineer of the Champlain Canal 1818; and in 1822 engineer to make surveys for a canal from the Ohio River to Lake Erie; in 1827 employed by the U. S. government to locate the Chesapeake and Ohio Canal, and 1828 by the State of Pennsylvania upon its canals. D. at Geddes Aug. 19, 1838. G. C. SIMMONS.

Ged'dings (ELI), M. D., was b. in Newberry district, S. C., in 1799; in 1820 was licensed by an examining board to practise medicine; in 1821–22 attended lectures at the University of Pennsylvania, and during 1824 removed to Charleston, where he received the first degree conferred by the medical college of his State (1825). Dr. Geddings then spent a year in Europe, studying his profession, and on his return home was appointed demonstrator in his alma mater. He subsequently filled the chairs of anatomy and physiology, then that of surgery, and that of the theory and practice of medicine; was also called to the universities of Maryland and New York City, where he was a professor for a short time; but having subsequently declined these and other calls tendered him, he now occupies his old position, that of surgery, in the school at Charleston. Beyond the allotted period of man, he still remains an active member of the profession. P. F. EVE.

Gedro'sia, the name given by Romans and Greeks to what is now the *Mekrân*, or coast-region of Beloochistan, a dry and unfruitful region.

Gee'long, town of Victoria, Australia, 40 miles S. W. of Melbourne, on Corio Bay, has 7 banks, 3 newspapers, fine public buildings, and is connected by rail with Ballarat and Melbourne. It is a centre of the Australian wool-trade. Pop. with suburbs, 22,618.

Geer (GEORGE JARVIS), D. D., b. Feb. 24, 1821, in Waterbury, Conn.; graduated at Trinity College, Hartford, in 1842, and in 1845 received the degree of A. M. from the same college; graduated from the General Theological Seminary 1845; ordained deacon in Christ church (Protestant Episcopal), Hartford, Conn., by Bishop Brownell, June, 1845; became rector of Christ church, Ballston Spa, N. Y., Sept., 1845; ordained presbyter in Ballston Spa by Bishop De Lancey June 11, 1846; became associate rector of the church of the Holy Apostles, New York, Nov., 1852; became rector of St. Timothy's church, New York, Oct. 22, 1857; received the degree of S. T. D. from Columbia College, New York, June, 1862; received the degree of D. D. from Union College, N. Y., in Aug., 1862. In 1858, as joint editor with Rev. Dr. Muhlenberg and Bishop Bedell, by appointment of the bishops, he published the *Tune-Book of the Protestant Episcopal Church;* in 1871 published a book on *The Conversion of St. Paul.* Is (1875) rector of St. Timothy's church, New York; was the first president of the Free Church Guild of New York; was a member of the General Convention of 1874 from the diocese of New York.

Geez. See ETHIOPIC LANGUAGE AND LITERATURE, by PROF. C. F. A. DILLMAN, PH. D.

Geffrard (FABRE), a president of Hayti, was b. at L'Anse à Veau, Hayti, Sept. 19, 1806, was the son of Gen. Nicolas Geffrard, who had co-operated with Dessalines and Pétion. Young Geffrard was early distinguished for ability, and though himself a *griffe* (three-fourths African blood), took the part of the mulattoes against the blacks. In 1845 he became a lieutenant-general, and in 1849 was made a duke by Soulouque. In 1858 he led in the revolution against Soulouque, and banished him in 1860. Geffrard was president of Hayti 1860–67, when he was himself banished, and retired to Jamaica. D. Dec. 31, 1878.

Gef'le, town of Sweden, on the Gulf of Bothnia, 100 miles N. of Stockholm. It has considerable trade in iron, timber, tar, and flax. Pop. 13,315.

Gehen'na [Heb. *Ge-hinnom*, the "vale of Hinnom"], a deep gorge, the valley of Hinnom, lying S. of Jerusalem. It was called also Tophet, "place of fire," because the practice of burning infants as sacrifices to heathen gods was carried on here by idolatrous Jews (it is, however, denied by some that they were actually burned). To break up this detestable practice, Josiah defiled the place by making it the receptacle of human bones and of all sorts of filth. We are told that perpetual fires were kept up to destroy this offal; hence, Gehenna and Tophet became synonyms for HELL (which see).

Gei'ger Grade, tp. of Washoe co., Nev. Pop. 55.

Gei'jer (ERIC GUSTAF), one of the richest geniuses in modern Swedish literature, and its most celebrated historian, was b. at Ransäter, in Wermland, Jan. 12, 1783, and studied, after 1799, at the University of Upsala. In 1803 obtained the first prize from the Academy of Sciences in Stockholm for his dissertation on Steen Sturé; in 1806 graduated as a master of arts; in 1809 travelled in England; and in 1810 was appointed lecturer in history at the University of Upsala. After a short residence in Stockholm as inspector of the archives, he returned in 1815 to Upsala as professor of history, in which position he remained until in 1846 ill-health compelled him to resign. He retired to Stockholm, where he d. Apr. 23, 1847.

After the revolution of 1809, by which the liberty of the press was established in Sweden, a fierce contest arose in literature between the French classicism, represented by the Academy, and the romantic school, originated in Germany and represented in Sweden by two parties—the Phosphorists, headed by Atterbom, and the Goths, headed by Geijer and Tegnér. But while the Phosphorists, like their brethren in Germany, rushed through all countries and all ages in search of the most wonderful subjects and the most fantastic forms, the Goths concentrated themselves on the national, and took their subjects from the old Scandinavian sagas and the Swedish popular songs of the Middle Ages. The Goths did not take part in the battle, but when the fight was over they kept the field, and the articles of Geijer in *Iduna*, the organ of the party, as well as his poems, contributed very much to the establishment of the taste of the Swedish people, which had been roused, but also completely unsettled, by the Phosphorists. His poems are not numerous, neither have they the brilliancy of those of Tegnér, but they are very powerful. *The Viking* makes an impression as if it were not written on paper, but hewn in stone, and many of his psalms have been incorporated into the Swedish hymn-book. In connection with A. Afzelius he produced (1814–16) an edition of the Swedish popular songs in 3 vols., and to many of his own songs he composed beautiful melodies, which immediately became very popular. It was as an historian, however, that Geijer acquired his greatest fame, especially as author of *Svenska Folkets Historia* ("History of the Swedish People"), published in 3 vols. from 1832 to 1836, and translated into German by Leffler, into French by Lundblad, and into English by Turner. His first historical work was *Svea Rikes Häfder* ("Annals of Sweden"), 1825, a series of essays on the earliest history of Sweden. In 1839 he published *Sketch of the State of Sweden from Charles XII. to Gustavus III.*, and in 1844, *Life of Charles XIV. John.* He also edited the posthumous papers of Gustavus III. in 1843, and, in connection with Fant and Schroeder, the *Scriptores Rerum Suecicarum Medii Ævi*, from 1818 to 1828. His *History of the Swedish People* is a most remarkable book, and ranks among the very first works of historiography. It is not merely a history of Swedish politics, but a history of Swedish society in the true sense of the word—a history of the Swedish people, of their manners and customs, of their ideas and passions, of their character and destinies. It has no extraordinary force, either of description, analysis, or argumentation, but it has a most extraordinary power of unfolding views large, complete, calm, and yet inspiring by the restrained enthusiasm in which they are written. CLEMENS PETERSEN.

Geiss'ler's Tubes, tubes made of very hard glass, and containing each some one gas (oxygen, carbonic acid, nitrogen, hydrogen, etc.) in a highly rarefied state. Each end of the tube is pierced with an electrode from an induction coil; and if the glass, the rarefied gas or "vacuum," and the current be properly adjusted to each other, the most surprising and beautiful luminous appearances may be seen. The carbonic acid vacuum in a small spiral Geissler tube emits so much light that it has been employed in the endoscope as a means of illuminating the cavities of the human body for diagnostic purposes. Each gas gives its own peculiar light and spectrum.

Ge'la, city of Sicily, situated on the southern coast, was founded in 690 B. C. by a colony of Rhodians, and grew so rapidly that 100 years later it sent out a colony itself, which founded Agrigentum. Under its tyrants, Cleander, Hippocrates, and Gelon, it conquered the whole of Sicily, but in 485, when Gelon removed his residence to Syracuse, it began to decline, and in 280, Phintias, the tyrant of Agrigentum, utterly destroyed it by removing all its inhabitants to the new city he was founding. In the times of Augustus it lay in ruins, which can still be seen in the neighborhood of the present town of *Terra Nuova.*

Gela'sius I., SAINT, pope, succeeded Felix III. Mar. 1, 492, and, according to Protestants, was the first pope who claimed complete independence of the synods and the civil authority. He wrote against the Nestorian and Eutychian heresies, but several works ascribed to him are probably spurious. D. Nov. 19, 496, and was succeeded by Anastasius II.—GELASIUS II., POPE (GIOVANNI DI GAETA), succeeded Pascal II. in 1118, but was imprisoned in the

same year; escaped and fled to Gaeta. The emperor Henry V. caused the antipope Gregory VIII. to be chosen in his stead. Gelasius d. at Cluny Jan. 29, 1119, and was succeeded by Calixtus II.

Gel′atine, a semi solid substance of a soft, tremulous consistence, produced from certain animal membranes (skin, fibrous tissue, etc.) by the action of hot water. Isinglass, calf's foot jelly, glue, etc. are chiefly composed of gelatine. In its ordinary form it contains much water, which may be dried out, leaving a glassy, brittle mass, which swells, but does not dissolve, in cold water. The gelatine from cartilage is called chondrine, and is somewhat different from true gelatine. Dry gelatine is reported as consisting of 50.05 parts carbon, 6.9 hydrogen, 11.7 nitrogen, and 27.65 oxygen. (*Scherer.*) Others believe that it contains a little sulphur. It has been long known that it exists abundantly in bone soups, etc. For a long time it was held to be innutritious, but at present a considerable (but not high) nutritive value is conceded to it. Gelatine is thrown down from the watery solution by alcohol, by a solution of corrosive sublimate, by tannic acid, and by chlorine gas. Gelatine is extensively used in the arts—as *finings* for beer, as a dressing for silk and other fabrics, as a coating for dragees and pills, as a material for the capsules which hold unpleasant medicines, for preparing tracing-paper, as a material for delicate casts, as the basis of numerous jellies for the table; and dried gelatine plates are employed in photo-lithography and the kindred arts. (See GLUE, ISINGLASS, etc.)

Gel′derland, province of the Netherlands, bounded by the Zuyder-Zee, Prussia, and the provinces of Overyssel, Utrecht, and Brabant. Area, 1972 square miles. Pop. 432,693. Along the rivers Rhine, Waal, and Yssel the soil is a rich loam, carefully cultivated, and large crops of wheat, rye, buckwheat, and tobacco are gathered. Farther back the ground becomes hilly and sandy, covered with large forests of pine and oak. Excellent cattle are reared; the horses are highly esteemed, both in France and Germany. Considerable brewing and distilling is carried on, besides manufactures of linen, paper, and leather. Principal towns, Arnheim, Nymwegen, and Zutphen.

Gel′dern, town of the Rhine province, Prussia, on the Niers, 17 miles S. W. of Wesel, and on the railway from Cologne to Cleves. It has important manufactures, and was the ancient capital of Upper Gelderland, which was ceded by the Netherlands in 1713 to Prussia. Pop. 5096.

Gelée (CLAUDE), better known as CLAUDE LORRAINE, where he was b. (in the little town of Chamagne) in the year 1600. His parents were poor, and the youth, early left an orphan, passed through severe struggles in pursuing the bent of his genius. His first studies were with an elder brother, a wood engraver at Fribourg. Thence he went to Rome, thence to Naples, thence back again to Rome. He travelled through Romagna and Lombardy, worked some time in Venice, visited parts of Germany, studied the scenery of the Tyrol, remained a short time in Nantes, returned to Italy by way of Lyons and Marseilles, and finally made his residence in Rome, where his great works were painted and where he died, of gout, Nov. 21, 1682. During his lifetime this painter's fame was very high; his patrons were people of eminence in nearly all the great cities of Europe. Orders came from Antwerp, Amsterdam, and Madrid. After his death his reputation increased, and even yet he ranks with the greatest landscape-painters of the world. Claude was a close and patient student of the principles, rules, and forms of his art; he frequented the academy to make himself acquainted with the best models, paid careful attention to the anatomy of the human frame, and was interested in architecture, for which, in his youth, he had a strong predilection. But his passion was for natural scenery. In representing this he put forth all his power of observation, sentiment, imagination, and technical skill. His studies were made in the open air with the most painstaking accuracy. The foliage of trees, the shapes of mountains, the effects of light and shade on natural objects, were delicately noted and delineated. The gradations of light, the perspective, the impression of breadth and distance, have always been admitted to be admirable features in his work. On these he prided himself, not on the figures or architecture, which were incidental and conventional. The landscapes of Claude are not literal copies of nature, but copies of nature suffused with sentiment and feeling. According to Sir Joshua Reynolds, Claude was of opinion that taking nature as he found it seldom produced beauty. His paintings are therefore, to a greater or less degree, "compositions." Dr. Lübke (*Hist. of Art*, London ed., 1868) writes of Claude: "In his works there is all the splendor, light, untroubled brightness, and harmony of the first morning of creation in Paradise." The *Liber Veritatis*, as it is called, is a collection of drawings made by Claude himself for the purpose of identifying his pictures and detecting counterfeits. There were six volumes. The one at Chatsworth, containing 200 drawings, was engraved by Richard Earlom and published by Boydell. In person, Claude was dignified and winning; his disposition was amiable and peaceful; his moral character without stain. The smallness of his fortune at his death is ascribed to the munificence of his charities. His works commanded high prices, and were numerous. Smith's *Catalogue raisonné* describes 400 pieces. They are found in all the European galleries, but the most celebrated of them are in England. Their general character is familiar through engravings. For dissenting opinions in regard to the merits of Claude one should consult the *Discourses* of Sir Joshua Reynolds and Ruskin's *Modern Painters*. Sir Joshua was of opinion that before there was another Claude there would be another Raphael. Ruskin declares that "Claude's capacities were of the most limited kind," and that "his work resembled nothing that ever existed in the world."

O. B. FROTHINGHAM.

Gell (Sir WILLIAM), b. at Hopton, Derbyshire, England, 1777; graduated 1798 at Emanuel College, Cambridge, and took a fellowship; was knighted 1803; passed M. A. 1804; became chamberlain to the princess of Wales 1814; resided mostly in Italy, and d. at Naples Feb. 4, 1836. Author of a number of works, mostly illustrating the topography of ancient Greece and Italy, published in a costly style which deprived them of extended use.

Gellius. See AULUS GELLIUS.

Ge′lon [Gr. Γέλων], tyrant of Syracuse, was of an ancient family of Gela, and was chief commander of the horse to Hippocrates, tyrant of his native town, of which place he made himself master in 491 B. C., and became tyrant of Syracuse in 485. (*Müller.*) Having depopulated Camarina, Eubœa, and the Sicilian Megara, he enriched Syracuse with their spoils, and increased his population by enforced colonization and the enslavement of captives; destroyed the army of Carthage in the great battle of Himera (480 B. C.). D. 478 B. C. Gelon was an exceedingly popular ruler, his good fortune and lavish expenditures of money probably serving to conceal his faults from popular scrutiny. Though exceedingly ignorant and selfishly ambitious, his name became proverbial for goodness and wisdom.

Gelse′mium [from *gelsemino*, an Italian name for the jasmine], a genus of plants of the order Loganiaceæ. The yellow jasmine of the Southern States is a beautiful evergreen climber (the *Gelsemium sempervirens*), having large, yellow, fragrant flowers, appearing in early spring. The whole plant is poisonous, but is a valuable medicine. In a proper dose it has excellent sedative effects, but should be given with caution. An overdose causes great prostration and calls for stimulants.

Gem [Lat. *gemma*], in art and archæology, a small stone, generally precious as to material, cut in ornamental designs or with inscriptions. While on one side, gems are in close relation to the jeweller's art, since it is generally admitted that they are meant to be worn as personal ornaments, they are in reality, as consisting of miniature sculpture, more nearly allied to the highest art, since there are no objects known which in so small a sphere call for such elegance of taste and perfect skill. The two divisions of the art are the making of intaglios—which, as the name in Italian denotes, are *cut in* like a seal—and *cameos*, a word of doubtful origin, but which probably comes from a Greek term signifying "ground." Cameos are simply bas-reliefs, and the term minute sculpture is so naturally applicable to them that since the days of Greek art it has been usual to copy celebrated statues in this manner; and there can be little doubt that we have at present in this form the types of the most celebrated images of antiquity. Intaglios, the earliest gems, first appear as the *scarabs* (*scarabæi*) or beetle-shaped signets worn in rings by the Egyptians from a very early period, though those on hard stone are of course rare, owing to their greater cost, especially from the earlier dynasties. On the flat side was engraved the name of the king or of the wearer, and the other was shaped like a beetle. Many of these were exquisitely cut. This form of gem was of course oval, and pierced from end to end with a hole, through which there passed a strong wire, which kept the stone in place in a ring. When worn, the flat or seal side rested against the finger, but when used as a seal it was turned. The Greeks, though the latest in the field of gem cutting, speedily excelled all their predecessors, for there were in this art few works of real excellence before they attempted it. The finger ring, as is shown by the story of Prometheus, and its name *daktulion*, was a purely Greek invention. These were popular in Greece 600 years B. C., and about this time Herodotus mentions the famous emerald of Polycrates (*Lib.* 37, c. 2) and the fame of its engraver, Theodorus of Samos, though he adds that in his time it held a low rank among

the jewels with which it was placed. Samos was the focus of the glyptical art of Greece, and there it was that Mnesarchus, the father of Pythagoras (B. C. 570), "sought rather for fame than for riches by engraving gems in the most skilful manner." Contemporary with the Greeks, the Etruscans attained great excellence in gem-engraving, manifesting profound knowledge of anatomy and high finish, but coupled with harsh realism, while the Greeks aimed at ideal beauty. On these early gems of Etruscan or Greek origin can be read, as in a book, the forms of their religion and the subjects of popular interest in politics, song, or fable, for centuries. The art finally attained its highest perfection in Sicily and Magna Græcia. Ælian observes that in Cyrene there was "a wonderful multitude of skilled gem-engravers, and that the poorest men there wore rings worth ten minæ." Among the Romans gem-engraving flourished, and under Augustus it reached its very highest point. Cabinets of gems became numerous, and most gentlemen prided themselves on possessing camei and intagli of value. The collections of Scaurus and Marcellus were doubtless of great extent, and Cæsar is said to have sent *six* such cabinets to the temple of Venus. Among the most celebrated intagli are the Ariadne, the Demetrius Poliorcetes of the Pulszky cabinet, and the portrait of Demetrius Soter, once the property of Horace Walpole. The latest intaglio in ancient style was the signet of Lothaire (A. D. 823). The finest sapphire ever cut is an intaglio of the Devonshire collection bearing a head of Augustus. Among the finest gems accessible to the public are, in the British Museum, the Cupid and Goose (aquamarine intaglio), the Julius Cæsar of Dioscurides, the Livia by Epitynchanus, cutter of the famous head of Germanicus in the Paris cabinet, the Perseus, Bacchus on red jasper, the wonderful Dying Amazon, the Cupid and Psyche (red sard), and the Laughing Faun by Ammanius. (See C. W. KING, *Antique Gems and Rings* (2 vols., London, 1872); MILLIN, *Introduction à l'Étude des Pierres gravées* (Paris, 1796); KÖHLER, *Geschnittene Steine* (St. Petersburg, 1851).) (See PRECIOUS STONES.) CHARLES G. LELAND.

Gemara. See TALMUD, by REV. SAMUEL ADLER, PH. D.

Gembloux, or **Gemblours,** town of Belgium, province of Namur, has about 3000 inhabitants, and is celebrated as the scene of the great victory of Don John of Austria over the United Netherlanders in 1578. The Benedictine abbey founded here in 922, and now the seat of an agricultural academy, was in the twelfth and thirteenth centuries famous for its riches and for the learning of its monks.

Gemelli (LODOVICO), b. Jan. 18, 1757, at Olivadi, Calabria; entered the Capuchin order in 1772; was appointed professor at Castelmare in 1784, and d. at Nicastro Jan. 5, 1835. He wrote *Elementi di Storia filosofica* (1793) and *Saggi di Filosofia morale* (1801).

Gem'ini (the "Twins"), a sign of the zodiac, into which the sun enters about May 21, and from which it passes June 21. Also, a constellation of the zodiac, now corresponding to the sign Cancer. Castor and Pollux are the two principal stars—the former a fine double one, the latter quadruple.

Gemis'tus (GEORGIUS), or **Georgius Pletho,** b. at Constantinople about 1390, held office under Manuel Palæologus in 1426; in 1438 was a delegate to the Council of Florence; was tutor to Bessarion and the associate of Cosimo de' Medici; was in 1441 engaged in the imperial service in the Peloponnesus, and is said to have lived one hundred years. He is chiefly remembered as a leader of the Restoration of learning; was the author of a great number of treatises on history, philosophy, geography, etc., many of which have never been printed, and was the prime mover in the revival of the Platonic philosophy in Italy.

Gemo'na, Italian town of considerable transit commerce, in the province of Udine. It has a fine cathedral and several other churches, containing interesting pictures by Pordenone, Cima da Conegliano, etc. The granite font in the Duomo is said to be a work of the eighth century. Many Roman antiquities are found here. It has an active and industrious population of about 7000.

Gems'bok [Dutch, *gemsbok;* Ger. *Gemse*, a "chamois," and *bok*, a "buck"], the *Oryx gazella*, the *kookam* of the natives, a fine large antelope of South Africa, found in small groups upon the open plains. It is often five feet long, and has straight horns two and a half feet long. It is courageous, and will successfully defend itself against the lion. It is hunted on horseback, and proves itself a swift and strong runner. It is asserted that it never drinks water, which is obtained in the succulent plants upon which it feeds.

Gems'horn, an organ-stop having conical tin pipes of very pleasant though peculiar tone.

Gemün'der (GEORG), b. at Ingelfingen, Würtemberg, Apr. 13, 1816; learned his profession, violin-making, in Paris, and in 1847 removed to Boston, Mass., where he acquired much fame as a musical-instrument maker. In 1852 he removed to New York. His violins took the first prize in the World's Fair of 1851, London, and a new violin shown by him at the Vienna Exposition of 1873 was pronounced an ancient Italian instrument of the best type. He makes use of the natural unprepared wood, believing that instruments made of artificially cured wood are sure to lose their value speedily.

Gen'der [from the same root with γίγνομαι, *genus*, etc.], in grammar, must not be confounded with sex in nature, though of course it was the observation of the latter which produced the former. The phenomenon of gender presents some of the hardest and most obscure problems which the science of language has to grapple with. Several languages —as, for instance, the Chinese, and, of the Turanian family, the Finnish and the Magyar—have no gender at all, and never have had. Others have had grammatical gender, but have lost it; as, for instance, the Persian, the Lettish, and the English. Some languages have only two genders, masculine and feminine; as, for instance, the Semitic and the Romanic. Others have three, masculine, feminine, and neuter; as, for instance, Greek, Latin, and German. Also the inflections or suffixes with which gender is expressed, and the influence which the gender of a noun may have on its attributes, present very intricate problems, and the question why a certain noun is masculine or feminine or neuter may bring the most learned grammarian to despair, while the most ignorant and unreflecting man never makes a mistake when he is born and bred to the language. There seem on this point to be particular laws hidden—laws of the imagination, which escape discovery because they are not actually at work at present.

Geneal'ogy [Gr. γενεά, "race," and λόγος, "discourse"], the science of descents. Genealogy, as a record of families, holds an intermediate place between biography, which treats of persons, and history, of which the subject is the rise and progress of the nation. The rules and principles of the three are not dissimilar, although the purpose of the first is a little different from the design of the other two. In England, as in most countries in which the feudal system has prevailed, the laws of the descent of families are intimately connected with those of the descent and tenure of lands. Where estates pass to a single heir, it is essential that the derivation of that heir from the blood of the first lord should be clearly proved; and as the lines of descent may become successively extinguished, the order in which collaterals succeed must be definitely settled. The latter is the work of the lawyer, and its principles are well stated in Blackstone's *Commentaries*. The former is the office of the genealogist, whose duty it is to trace out and record the history and growth of families and the relationship of the several branches to one another. Formerly, this was made the duty of the heralds, who in their periodical progresses through England inquired into the condition of all families which were entitled to bear arms, and recorded their pedigrees in the Herald's College. The "visitations," as the records of their labors are briefly called, are among the most important collections in the College of Arms in London. The visitations were discontinued about the middle of the seventeenth century. Since that time, although official records are still kept, they are derived from voluntary information. For many centuries great pains have been taken by the nobility and gentry to preserve the records of their descent. Every great house has its muniment-room, in which are preserved the title-deeds of the estate and documents relating to the history of the family. These precautions are necessary for the reason already given—viz. the possibility of remote collaterals being called to the succession. In America the work of the genealogist is a little different. The division of landed estates among the children or other representatives of the last proprietor obviates the necessity of the production of a single heir. The history of land-titles is provided for by a system of public records, and the functions of the genealogist are limited merely to the history of families. This, however, is a sufficient task. The immense field of investigation that is opened in tracing the ancestors and descendants of a single person is really astonishing. In the ascending line the ancestors double in every generation. In other words, in the first degree there are two ancestors; in the second, four; and in the fourth, sixteen; and by going back for twenty generations it will be found that every man has more than a million of ancestors. In the descending line the numbers are still larger. Every child of the common ancestor may become the founder of a family, and the relations of these several families to the main stock or oldest line of descent give rise to collaterals, all of whom should be included in a complete pedigree. The labors of American genealogists of late years have been turned in this direc-

tion. Undeterred by the greatness of the task, students have undertaken to record, for instance, all the ramifications of large families, usually beginning with some emigrant of the seventeenth century, and conscientiously tracing, in the male or female line, or sometimes in both, the history of his descendants.

The results of genealogical investigations are usually embodied either in pedigrees or family histories. The former are sometimes arranged as a tree, in which the common ancestor represents the root or stock, and the descendants are arranged in order in the branches. More commonly, however, pedigrees are constructed in the form of tables, in which the ancestor and the descendants, with a brief statement of the time of the birth, marriage, and death of each, appear in successive rows of squares or circles, properly connected by lines, which indicate the direct descent of every person. From these methods of arranging pedigrees are derived the common expressions, a family tree, a stock, branches, and lines of descent. The advantage of a pedigree is that it gives at a single view all the descendants of a common ancestor. The disadvantages are, that while it necessarily involves an extreme brevity, and sometimes even meagreness of statement, it nevertheless requires a great deal of room, and may readily become unmanageable from its size. Hence, genealogists more commonly adopt a narrative form, called a family history, by which means they are able to condense their records into a volume of moderate size, and at the same time to make their statements at greater length. The objections to this plan are, that unless it be managed with extreme care and system, it is sure to involve the reader in utter confusion in the course of a very few pages, and that under any circumstances the labor of consulting such a compilation is very great. To obviate the first of these objections in a measure, genealogists have adopted several methods of arranging the branches, and of designating the various lines of descent. The simplest method appears to be that of giving to every name its own number, which is placed before it in Arabic characters, and in designating the relations of every person to his parents and his brothers and sisters by Roman numerals. Some genealogists, however, prefer designating the successive generations, and not the individuals, by numbers. There is also a difference of opinion as to the order in which the successive lines of descent should follow one another, some thinking it better to take up the sons of the common ancestor in order, finishing the record of the descendants of the first before approaching the second, and so on through the whole; others recording every successive generation in its order. A question has also been raised, whether in such a history the descendants of daughters are entitled to stand side by side with those of sons. In England it is usual to exclude them, but there are special reasons for this in the connection of genealogy with the tenure of land. In male fiefs there can be no possibility of females or their descendants being called to the succession; and in those cases in which lands devolve upon an heiress, they descend afterwards either in the line of her husband, or, in the event of her dying without issue, to the collaterals of her father's family. In America, however, where the aim of the genealogist is strictly historical, this reasoning does not apply; and there probably is no good reason, beyond the inevitable increase of the labor of the genealogist and of the bulk of his volume, why the posterity of daughters should not be admitted into it. In answer to the second objection, it may be said that as a book of geography is rendered intelligible by means of maps, so it is easy for the reader of a family history to construct from it brief and compact pedigrees which will be apprehended at a glance.

Genealogy, as a science, insists upon evidence. No genealogist will accept a mere family tradition or an unauthenticated statement, but he always requires sufficient proof. In the great revival of the study which has taken place in the present century this has been found absolutely necessary, and has become the cardinal principle. There is so much uncertainty in family traditions that it is found that statements accepted by families and given in good faith are often not merely unfounded, but contrary to existing evidence. The principal sources of evidence are family records contemporaneous with the events which they commemorate, as, for instance, an account written by any person of his own children; public records, such as wills, deeds, and mortgages; church records, letters, and tombstones. A pedigree or a history of descents not authenticated by these or equivalent evidence is not to be trusted, and will surely be rejected by every well trained genealogist. B. R. Betts.

Gen'eral, in certain Roman Catholic religious orders, the highest officer of the order. The general of the Jesuits is chosen for life, and holds one of the most influential positions in the Church. He lives in Rome. Most other generals hold office for three years, and they usually reside at Rome. The general of the Augustinians must be of one of the Calceate congregations. The Franciscans have three generals—one each for the Observantines, the Capuchins, and the Tertiaries—besides procurators-general for the Reformed and Alcantarine congregations, and a minister-general for the Conventuals. The general of the Dominicans is chosen for life. Since the time of Simon Stock the Carmelites have had an unbroken line of generals. Other orders have superior officers with special titles. Thus, the chief of the Minims is called "general corrector," the superiors of their houses being called "correctors." (See General Officer.)

General Assembly. In the Presbyterian Church the General Assembly is the highest of four courts, the other three being, in their order, session, presbytery, synod. (See Presbyterian Church.) In America there are at present three general assemblies: (1) that of the Presbyterian Church North; (2) that of the Presbyterian Church South; (3) that of the Cumberland Presbyterian Church. The highest court of the smaller Presbyterian bodies is the synod. A description of the General Assembly of the Presbyterian Church North will serve substantially for all others in the U. S. This court is constituted of an equal number of ministers and laymen. Its meetings are held annually in different parts of the country, as may be agreed upon. Its members are styled *commissioners*, and are appointed by the presbyteries in the following proportion: "Each presbytery consisting of not more than twenty-four ministers shall send one minister and one elder; and each presbytery consisting of more than twenty-four ministers shall send two ministers and two elders; and in the like proportion for every twenty-four ministers in every presbytery." Its officers are, a moderator, chosen annually; a stated clerk, who is also treasurer; and a permanent clerk. The term of the last two officers is indefinite. Temporary clerks are chosen each year to assist the permanent clerk in making a fair record of the proceedings, etc. The duty of the stated clerk is to keep the records and to publish them, together with such statistical tables as the Assembly may direct. Each Assembly is "constituted" by prayer, and "dissolved" at its close by formal proclamation of the moderator. In every case the constituting act is preceded by a sermon, which is generally preached by the retiring moderator. The business of each meeting is directed in accordance with a simple manual of general rules. The province of this court is thus defined by the constitution of the Church: "The General Assembly shall receive and issue all appeals and references which may be regularly brought before them from the inferior judicatories. They shall review the records of every synod, and approve or censure them; they shall give their advice and instruction in all cases submitted to them in conformity with the constitution of the Church; and they shall constitute the bond of union, peace, correspondence, and mutual confidence among all our churches. To the General Assembly also belongs the power of deciding in all controversies respecting doctrine and discipline; of reproving, warning, or bearing testimony against error in doctrine or immorality in practice in any church, presbytery, or synod; of erecting new synods when it may be necessary; of superintending the concerns of the whole Church; of corresponding with foreign churches on such terms as may be agreed upon by the assembly and the corresponding body; of suppressing schismatical contentions and disputations; and, in general, of recommending and attempting reformation of manners and the promotion of charity, truth, and holiness through all the churches under their care." To effect these varied purposes each Assembly appoints a number of standing committees, whose duty it is to bring all business before the court in its order. For conducting the benevolent and evangelistic work of the Church a number of boards have been established, such as that of foreign missions, home missions, education, etc. These boards report to each Assembly, and receive instructions. During the sessions popular meetings in the interest of these boards are held. The legislative work of the Assembly has, in this country, gradually become subordinate. Cases of appeal are often decided by "commissions" appointed for that purpose on the mutual consent of the parties concerned. Questions of constitutional law, however, are always decided by direct vote, and each decision is regarded as defining the law. The effect is the same as that of a decision of the Supreme Court of the U. S. In Scotland and Ireland the General Assembly is somewhat different from the above as to constitution and method, yet in all essential particulars the same. Z. M. Humphrey.

General Bass, in music, the equivalent in German for thorough bass, or the system of harmony, as commonly written and illustrated by figures over or under a bass.

General Convention, The, was originally an association of members of the English (afterwards Protestant Episcopal) churches in several of the U. S., formed after the Revolution for the purpose of promoting a closer union among those churches. During the period of colonial dependence the English congregations had been under the jurisdiction of the bishop of London. When, however, at the close of the war, his authority was withdrawn, they found themselves not only without episcopal superintendence, but without any bond of union beyond that of a common faith and a common liturgy; but as every State, before the adoption of the present Constitution, was regarded as an independent sovereignty, and as the churches in every State asserted for themselves the rights and powers of national churches, there was a real danger that even this slender bond of union might speedily be lost. The problems which the members of the "Church of England in America" were called upon to solve were these: First, to secure an episcopal succession; and, second, to arrange a system by which there might be, as the celebrated Dr. Chandler expressed it, "a uniformity, or at least a similarity—*qualis decet esse sororum*—through the different States." The first was accomplished, after some delay, by the consecration of Dr. Seabury in Scotland, and of other bishops in England, for America. (See EPISCOPAL CHURCH.) The second was attained by the establishment of a General Convention. On May 11, 1784, several clergymen and laymen, members of a society for the "relief of widows and children of clergymen"—a society which still exists—met at New Brunswick, N. J., ostensibly for the purpose of arranging the affairs of that society, but with the further design of consulting one another about the interests of the Church in the several States. In accordance with arrangements made at that meeting, clerical and lay delegates from New York, New Jersey, Pennsylvania, Maryland, and Delaware assembled in New York in October of the same year, and after agreeing upon certain fundamental principles, resolved that a convention should be held in Philadelphia in 1785. At the convention of 1785 delegates from the above-named States, as well as from Virginia and South Carolina, were present. A "general ecclesiastical constitution" was adopted, founded upon the declaration of principles of the previous year; active measures were taken for the revision of the Prayer-Book; and the union of the churches in the Middle and Southern States was regarded as complete. The churchmen of Connecticut, Rhode Island, New Hampshire, and Massachusetts, however, were not at first disposed to accede to these arrangements. They doubted the propriety of giving seats and votes to laymen in an ecclesiastical assembly, and they strongly objected to a provision by which the bishops were made amenable to their own conventions. The latter provision was corrected, and the objection to the former was apparently withdrawn; and in 1789, Bishop Seabury and delegates from the Eastern States took their seats in the General Convention. In the same year a constitution was adopted, which, though it has been amended from time to time, yet in substance continues in force to the present day. It provides that there shall be a General Convention of the Protestant Episcopal Church in every third year; that the convention shall consist of the bishops, who form a separate house, and of four clerical and as many lay deputies, who must be communicants, from every diocese; and that all acts of the convention shall be authenticated by both houses. The General Convention has power to consent to the formation of new dioceses, to provide the mode of trying bishops, and to establish and revise a Book of Common Prayer. These are all the powers which are given in its constitution. The other articles, which treat of the principles and rules relating to the establishment of new dioceses, of the qualifications for holy orders, and of the consecration of bishops for foreign countries, really confer no powers, and may perhaps be regarded as a concordat between the churches in the several States. In point of fact, however, the General Convention has never limited itself to the powers given by its constitution, but has gradually developed into the governing body of the Protestant Episcopal Church in the U. S. Its extra-constitutional acts (if such an expression may be allowed) appear to extend to all points of discipline and doctrine. It has enacted a code of canons for the government of the Church; it has founded a theological seminary; it has established a system of missions, both within the U. S. and in foreign countries; it has published a hymn-book; and it has lately passed a canon which touches the doctrine of the Holy Sacrament. It would, in fact, be extremely difficult to designate with precision the powers which the General Convention possesses or assumes. Some theologians are inclined to limit its functions strictly to those which are specified in its constitution. The obvious objections to this view are that it has not been adopted by the General Convention itself, and that if it be correct, most of the acts of that body are unconstitutional and without authority. Other divines are disposed to regard it as an ecclesiastical parliament, possessing powers as vague and unlimited as those of the Parliament of England; but here the question arises, Whence could such a body derive such powers? This question has never been answered, and indeed appears to be incapable of solution. The former view seems to be that of Bishop Seabury, Dr. Chandler, and other leading theologians of the last century; the latter was adopted by the late Dr. Francis Vinton in his work on the law of the Church. No attempt is made here to reconcile these conflicting views, or to commend either of them to acceptance. They are mentioned as historical facts. B. R. BETTS.

Gen'eral Is'sue. In the common-law system of legal pleading the general issue is a summary, unqualified denial of the material allegations contained in the plaintiff's declaration. It is called a general as distinguished from a special issue, because it brings at once into controversy the entire substance of the charges alleged, and not some specific portion. The denial does not consist of a negation of the complaint made in its express language, but certain particular formulæ have been established as appropriate in the various instances in which a plea of general issue may be introduced, and their use is obligatory. For example, in actions for torts, where a recovery of damages is sought, as in trespass or trover, the general issue is *not guilty;* in debt on simple contract it is *nil debet* ("he owes nothing"); in actions for a breach of covenant or upon an instrument under seal it is *non est factum* ("it is not his deed or covenant"). A plea by general issue affords an opportunity for the introduction of a great variety of testimony which would serve to prove that the defendant was subject to no liability; if specific assertions only were made in defence, it would be necessary for the proof to correspond with them, and the range of evidence could not, in general, be as extensive as under a comprehensive form of denial. (See PLEADINGS.) GEO. CHASE. REVISED BY T. W. DWIGHT.

Generaliza'tion, a term defined by Whately in his *Logic* as "the act of comprehending under a common name several objects agreeing in some point which we abstract from each of them, and which that common name serves to indicate." He illustrates the definition as follows: "When we are contemplating several individuals which resemble each other in some part of their nature, we can—by attending to that part alone, and not to those parts wherein they differ—assign them one common name, which will express or stand for them merely as far as they all agree; and which, of course, will be applicable to all or any of them; which process is called generalization, and each of these names is called a common term, from its belonging to them all alike; or a predicable, because it may be predicated affirmatively of them or any of them." Sir William Hamilton groups this act and its kindred processes under the name of "elaborative faculty," which is the faculty of perceiving relations, the discursive faculty, faculty of comparison, "the judgment—διάνοια, as opposed to the νοῦς." He makes generalization to be "nothing but comparison." "Under comparison may be comprised all the acts of synthesis and analysis, generalization and abstraction, judgment and reasoning." The several phases of this process he arranges in the following order: 1, Composition or synthesis; 2, abstraction, decomposition, or analysis; 3, generalization; 4, judgment; 5, reasoning or inference. "Generalization is dependent on abstraction, but abstraction is not dependent on generalization." Kant holds that every act of judging is an act of synthetical unity performed by means of the "transcendental unity of apperception;" *i. e.* it is rendered possible by the "I think" or Ego, or subject in consciousness, which furnishes the unity for the multiplicity of sensation, and in so doing generalizes. Generalization is the essential phase of the act of reflection which accompanies all acts of rational intelligence. Even the activity of sense-perception is accompanied, in a conscious being, by the dim perception of self or Ego, as pure subject of the act of perceiving. The Ego or subject is always generic and abstract; indeed, the highest genus, or ultimatum of abstraction, free from all empirical determinations or characteristics, and as a factor of all concrete knowing, furnishes to the thinking being the means of rising above the multiplicity of empirical details through attention to this abstract factor of perception; which act of attention is called "second intention," being attention to the mental process, while "first intention" is directed to the object of the senses—a distinction noted by Avicenna, the great commentator on Aristotle. "When one thing without difference abides," says Aristotle (*Post. Analyt.*, ii. 19), "the universal arises in the soul. Primary things [generic entities] become known to us through induction;" induction being the ascent from the particulars of sense to the generic entity of the pure Ego. Self-consciousness is the basis of

all generalization, being the act of reflection or of turning back upon itself—the thread upon which all the faculties of the soul are strung—memory, imagination, conception, inference, speculative insight. Thus, "second intention" has several degrees, which might be named third, fourth, and fifth intentions also, each higher faculty being the result of a new act of attention upon the activity of the next lower faculty. (See FICHTE; also articles on IDEALISM, NOMINALISTS, REALISM, SCHOOLMEN, for the ultimate bearing of this theory.) WILLIAM T. HARRIS.

Gen'eral Lien, a right to retain chattels which one has in his possession, that they may afford security not merely for the satisfaction of claims in reference to the specific articles themselves, but also for the settlement of a general balance of account. This form of lien is not favored by the law, and it exists therefore only in cases where it is created by contract express or implied, by the usage in a particular business, or by a previous course of dealing between the parties. Factors have by usage a general lien upon the goods of their principals for advances made and commissions. In like manner, an attorney has a general lien upon the papers and money of his client in his hands. But a general lien does not apply in regard to all debts which may be due, but only to those which have been incurred in the particular kind of business in which the person detaining the goods has from time to time been employed. (See LIENS.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Gen'eral Of'ficer. The word "general" is from the Latin *generalis*, meaning very much the same thing as our adjective, *general* (common to many, or the greatest number, widely spread, etc.). In such a sense the word qualifies the designation of an officer (*e. g.* commissary general, quartermaster general, etc.), carrying with it also the idea of "having charge" or right of command, whether in the civil, military, or ecclesiastical hierarchy. Thus, the superior of "The Society of Jesus" is styled "The General." According to Bardin (*Dict. de l'Armée*, etc.), the word *captain* (*i. e. head, chief*) became so common in the Middle Ages that the title "captain-general" was appropriated to one who commanded all the rest (*i. e.* when numerous independent bodies each with its *chief*, a *captain*, were combined). By ellipsis, the adjective has become substantive, and a GENERAL, without qualification, is, properly speaking, one *over all*—a "commander" in the highest sense of the term. And the grade of "general," when it exists, should indicate an officer clothed with right of supreme command. But the designation "general officer" is applied in a qualificative sense to any officer of higher rank than colonel, and in this use it properly distinguishes those officers who form component parts of the essential units of army organization (regiments and companies) from those whose sphere of command is not thus limited; while various distinctive titles are employed to give lustre to the office of *general*, such as "captain general," "field marshal," or (in France) "marechal de France." In England the sovereign is captain-general. The commander-in-chief (under the sovereign) is a field-marshal, a rank held also by three or four others. There are also numerous "generals," as well as lieutenant-generals, major-generals, etc.: BRIGADIER-GENERAL implies, in the English military hierarchy, the command of a *brigade* (*i. e.* two or more regiments temporarily or permanently united); MAJOR-GENERAL, in our service and in some others, the command of a DIVISION (*i. e.* two or more brigades temporarily or permanently united); while lieutenant-general, implying deputed power, has had the sense in France of "lieutenant du roi," or viceroy, or a general commanding in place of his sovereign; and also, and more commonly, the general of a division. But the actual standing of these two last-named grades depends upon arbitrary legislation or regulation. The function of "major-general" under Napoleon was that corresponding to our notions of "chief of staff"—one who is the organ of communication between the "general" and his subordinates. ("The military language of France," says Bardin, "offers frequent examples of such disparities.") "General de division" is in France the style and rank of a division commander, while Napoleon gave to the commanders of his corps d'armée, when first organized, the grade of "lieutenant-general," which before the creation of "army corps" was sometimes the special designation of a division commander when the *division* was the largest unit into which an army was divided. Afterwards, during the empire, commanders of corps d'armée were usually "Marechaux de France."

In our own history and service it does not appear that the Continental Congress regulated the grades of general officers, but accepted them (major and brigadier generals) as it found them in the several States (or colonies, rather). Washington was chosen as "commander-in-chief," without other designation. Under the existing Constitution a series of legislative acts has regulated the number of brigadier and major generals. That of Mar. 2, 1799, declares that a "a commander of the army of the U. S. shall be appointed and commissioned by the style of 'general of the armies of the U. S.;'" while it abolished the office and title of lieutenant-general, created ten months previously (May 28, 1798, when war with France was apprehended) and conferred upon Washington. The act of Mar. 16, 1802, provided for but a single general officer of the grade of *brigadier*. The war of 1812–15 of course caused the creation of numerous major and brigadier generals; the act of Mar. 2, 1821, provided for one major and two brigadier generals. In 1846 (Mexican war) the President was authorized to add one major-general (Zachary Taylor, Gen. Winfield Scott being then the single major-general) and two brigadier-generals to the military establishment. Subsequently (Feb. 15, 1855) the grade of lieutenant-general, *by brevet*, was revived to acknowledge "the eminent services of a major-general of the army in the late war with Mexico" (Scott). It would be impracticable to recapitulate the legislation during the civil war by which the number of major and brigadier generals on the army list was greatly augmented. The grade of lieutenant-general, never before conferred by our government upon any one except Washington (and by "brevet" on Scott), was renewed and conferred (Mar. 2, 1864) upon Gen. Grant. In 1866 the grade of general was created and conferred on the same officer; that of lieutenant-general, thus vacated, on W. T. Sherman. At the present time there are, besides the general and lieutenant-general (grades to expire with the lives of the present incumbents, Gens. Sherman and Sheridan), three major and six brigadier generals, besides the adjutant-general, the chiefs of engineers and of ordnance, the quartermaster, commissary, and surgeon generals, and the judge-advocate-general, who hold the latter rank.

J. G. BARNARD.

Gen'eral Rules of the Methodist Episcopal Church, written by John Wesley, in consultation with his brother, Charles Wesley, in 1743, and published in a small volume entitled *The Nature, Design, and General Rules of the United Societies in London, Bristol, Kingswood, and New Castle-upon-Tyne.* Thenceforward the "General Rules" were the only conditions of membership in the Wesleyan societies; and when Wesley sent over Dr. Coke to organize "the Methodist Episcopal Church in the U. S. of America," they were inserted in the *Discipline* of the latter, and remain there still, as the "terms of membership." In Stevens's *History of the Methodist Episcopal Church* it is said that "the Articles of Religion and the General Rules are both parts of the organic or constitutional law of American Methodism," but the General Rules prescribe the "only condition" of membership, without allusion to the Articles. Conformity to the doctrines of the Church is required by its statute law as a functional qualification for the ministry, but church members cannot be excluded for personal opinions while their lives conform to the practical discipline of the Church, and they can be tried and expelled for sowing dissensions in the societies, by inveighing against their doctrines or discipline; that is, in other words, not for their opinions, but for their moral conduct respecting their opinions. These Rules form a remarkably liberal platform of church communion. The same author remarks, in *The History of Methodism*, that it comprises not one dogmatic statement, and hardly what would be called an ecclesiastical requisition. It consists almost entirely of practical requirements. At a later date Wesley exclaims in his *Journal*, "Oh that we may never make anything more or less the term of union with us but the having the mind that was in Christ, and the walking as He walked!"

ABEL STEVENS.

Gen'eral Ship, a ship offered by her master or owners to the patronage of the general public for the carriage of goods upon a particular voyage. The offer is usually made by advertisement, stating the proposed voyage, the time of sailing, the names of the ship and master, and the character of the articles which will be received to form the cargo. If the goods brought for transportation by any person are of the kind described, the shipmaster is under the same obligation to receive them as are other common carriers. If there is any material violation of the terms of the advertisement, in consequence of which a shipper is injured, the owner of the vessel is obliged to make compensation for the loss. (See SHIPPING.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Gener'al's Isl'and, one of the sea islands of McIntosh co., Ga. Pop. 19.

Genera'tion [Lat. *generatio*] will be more properly considered under the article REPRODUCTION (which see), by PROF. T. GILL, M. D., PH. D., M. N. A. S.

Genera'tion, Sponta'neous, the supposed (or real) origination of living organisms without parent organisms to produce them, out of inorganic, or at least non living, matter, and under the influence of forces purely physical. The fact that the minuter forms of organic life, both animal and vegetable, constantly make their appearance wherever conditions exist favorable to their preservation, notwithstanding the absence of all evidence of pre-existing germs from which they may have sprung, has given rise to two opposing theories in regard to this matter—viz. first, that such germs do exist; that they pervade the atmosphere in countless numbers and in nearly all places; that they possess an almost indestructible tenacity of life, and are developed into active growth wherever they find a suitable nidus; and secondly, that no such organic antecedents are necessary at all: that these microscopic forms of life are constantly coming into existence *de novo* under the operation of the ordinary powers of nature, and therefore that they originate by a generation which is truly spontaneous. It is to be observed that the advocates of this latter theory do not necessarily reject the former. They admit its possible truth, but they deny that it embraces all the truth, or even the essential truth: for the germ-theory can only account for the propagation of life after life has originated, whereas the theory of spontaneous generation accounts for the origin of life itself. No subject in the history of science has been more sharply debated than this; and no subject has ever been experimentally investigated with greater zeal, with more earnest solicitude to reach the truth, or with results more singularly or persistently discordant.

The notion of spontaneous generation is not, by any means, of modern origin. It has been entertained by naturalists in every age since the dawn of scientific history. But the earlier naturalists—Aristotle and Lucretius, for instance—conceived that organisms of a high order of complexity, such as insects or fishes or reptiles, might be directly produced out of the moist earth softened by showers, or out of the slime and mud of rivers; whereas those of our time have long since abandoned any such extravagant notions, and confine themselves to the assertion that life in its spontaneous origin is manifested only under the simplest forms.

The latest example of an hypothesis resembling the ancient is found in the argument presented in a work entitled *Vestiges of Creation*, which appeared about thirty years ago, in which the experiments of Mr. Andrew Crosse upon electric currents of low intensity directed for a long time through a solution of inorganic salt were supposed to have produced an insect of the *Acarus* family, such an insect having actually made its appearance during the course of the experiment. But this result has long since been recognized to have been merely accidental, and probably owing to the presence of ova of the insect introduced in some unexplained way into the apparatus. The modern advocates of the theory of spontaneous generation hold, however—or at least most of them hold—only to the certainty of the spontaneous appearance of organisms of a very low type, called bacteria, vibriones, and monads—organisms familiar to the microscopist, and which are sure to make their appearance in every putrefying organic infusion.

Less than three centuries ago the belief here spoken of, that living things may originate without eggs or germs or living parents from which to proceed, may be said to have been universal in Europe. Of the truth of this belief there was supposed to be visible evidence in the invariable occurrence of maggots in putrefying flesh. Curiously enough, scriptural authority was cited in proof of this view, and the Old Testament story of the bees found by Samson in the carcass of the dead lion was presumed to confirm it. The doctrine was therefore held as matter of faith, and those who first assailed it were naturally accused of impiety and irreverence. Prominent, and perhaps first among these, was Francis Redi, an Italian philosopher, scholar, and poet (b. in 1626). He presented a conclusive disproof of the spontaneous generation of maggots in putrefying flesh, by simply enclosing, in open-mouthed jars covered with gauze, pieces of flesh still sound, and leaving them in the sun to putrefy. Putrefaction occurred as before, but no maggots made their appearance. The maggots, nevertheless, did appear on the gauze, and a little observation made their origin manifest. The flies, of which they are the progeny in the larva state, being attracted by the odor of the flesh, but unable to reach it, laid their eggs upon the covering of the jar, and out of these the larvæ were presently developed. Having demonstrated the falsity of the popular belief on this subject in a case so conspicuous, Redi naturally generalized his conclusion, and took the ground that no living thing comes into existence without deriving its life from something previously living. He did not say, as it has been said later, "*Omne vivum ex ovo*," but "*Omne vivum ex vivo*." He still believed that out of a living plant may arise a living animal, as the insect within the gall of the oak, or the worm within the fruit which presents no external puncture. His doctrine was therefore that which Huxley has named *biogenesis*, in contradistinction to spontaneous generation, called by him *abiogenesis*, and by Bastian *archegenesis*. But archegenesis had been put aside only to return again under a new form. Among the earliest revelations of the microscope was the remarkable fact that whenever a dead organic substance is infused in water, myriads of minute creatures presently make their appearance in the infusion, all possessing most extraordinary, and many of them very varied, powers of reproduction. They multiply by means of *ova*, by means of buds or gemmation, and by means of self-division or fissuration. All this was strongly favorable to the doctrine of biogenesis. Where so many means of reproduction existed, every one of them so effectual and sufficient, to provide that the same forms of life should be produced without any organic antecedents seemed "wasteful and ridiculous excess." This view, however, met here and there with a dissentient. About a century and a quarter ago, John Turberville Needham, an English naturalist, resorted to an experiment which, with various modifications, has been since many hundreds, and possibly many thousands, of times repeated, with the view thoroughly to test the question whether, in its application to infusorial life, the doctrine of biogenesis is universally true. He prepared an infusion, thoroughly boiled it in a flask, corked it tight, sealed the cork with mastic, and covered the whole with hot ashes, designing to destroy by heat any germs which might be in the infusion, in the substance infused, or in the air above the liquid in the flask. After some days or weeks he found that, notwithstanding all these precautions, living organisms did make their appearance in the flask, precisely such as in freely exposed infusions habitually appeared earlier. This experiment was immediately repeated by Spallanzani, an Italian ecclesiastic and naturalist; but Spallanzani, instead of corking his flasks and cementing his corks, sealed the vessels by fusing the glass, and having thus completely cut off communication with the outward air, kept them at the boiling temperature for three-quarters of an hour. No life appeared in the infusions of Spallanzani, and the doctrine of biogenesis was again apparently triumphant.

The question was, however, not yet universally admitted to be settled. Dissentients made themselves heard from time to time: among them Gleichen, Otho Müller, and Treviranus, the latter of whom pointed out the significant fact that while the species of infusorial animals found in infusions of the same kind were constantly the same, those which appeared in different infusions were not so. Early in the present century the celebrated naturalist Lamarck ranged himself on the side of spontaneous generation. Oken took the same view, and subsequently Bory St. Vincent, J. Müller, Dujardin, Burdach, and Pineau, while on the opposite side appeared, among others, Schwann, Schultze, and Ehrenberg. The experiments of Schultze and Schwann were remarkable. They were undertaken for the purpose of testing the accuracy of those of Spallanzani. Since those experiments had been made, the importance of air—or of oxygen, one of its constituents—to the maintenance of animal life had been discovered, and doubts had arisen whether in those experiments the air had not been rendered unfit for the support of life by the operations to which it had been subjected. In repeating the experiments, Schultze admitted to the flasks, after boiling the infusions, only such air as had been passed through concentrated sulphuric acid, and Schwann only such as had been conducted through red-hot tubes. No animalcules made their appearance; and these results, reached as long ago as 1836 and 1837, were regarded by the great body of naturalists as finally settling the question.

The controversy, however, after resting for twenty years, was revived and prosecuted with even more animation than before, by Mr. Pouchet, in the first instance, on the side of spontaneous generation, and Mr. Pasteur on that of biogenesis, but more recently by many naturalists of distinction, among whom may be named Dr. Jeffries Wyman of our own country, whose experimental researches tend rather to the support of the archegenetic theory, and Prof. Huxley of London, whose opinion, given on a survey of the whole history of the controversy, and expressed before the British Association in 1870, is very decidedly the other way. While the controversy was between Mr. Pasteur and Mr. Pouchet, there can be no doubt that, in the judgment of the world, the former had by far the best of the argument. His experiments, which were substantially repetitions of those of Needham and Spallanzani, but which were variously modified, so as to render his demonstrations in every possible way cumulative, seemed to have disposed of the doctrine of spontaneous generation effectually and

for ever. In multitudes of instances infusions hermetically sealed while boiling remained for indefinite periods of time free from all traces of organic life, while portions of the same infusions exposed side by side with these, but open to the air, were speedily swarming with animalcules. He found that even an unsealed flask, of which the neck had been stopped during the boiling only with a plug of cotton closely pressed together, continued to be equally free from these organisms so long as the stopper remained in its place. This last experiment presented a rather curious resemblance to that of Redi with his gauze-covered jar; for the cotton forming the plug was found, on a microscopic examination, to contain the germs which its presence had prevented from entering the flask. Mr. Pasteur finally found—and this result was long supposed to have furnished an unanswerable reply to all the arguments of the advocates of archebiosis—that flasks containing infusions treated by boiling as before, required neither sealing nor stopping with cotton to prevent invasion of the contained liquids by these low forms of life; provided only that the necks of such flasks had been originally bent over, so as to direct their mouths downward. This result he had predicted as probable, holding, as he did, that the germs by which such infusions are repeopled when the living embryos they may contain have been destroyed by heat, must necessarily subside into them from the air above. Though the preparations made by Mr. Pasteur date back at this time twelve years or more, many of them still remain in their original condition, showing, after even this great length of time, no signs of life or evidence of putrefaction. So lately as Nov., 1874, Mr. Balard, in presenting to the Academy of Sciences of Paris a paper by Mr. Servel detailing certain recent experiments made by him, which in his view seemed to demonstrate the spontaneous generation of bacteria in animal substances completely excluded from the air, took occasion to state that he had then recently examined, in Mr. Pasteur's laboratory, unsealed flasks containing blood drawn more than eleven years ago directly from the veins of living animals, in which, during all this time, no bacteria had appeared, and no putrefaction had taken place. He added that the albumen of eggs similarly preserved by Mr. Gayon, eighteen months previously, continued still to be unaltered in character, and perfectly fit for eating.

The experiments of Wyman, Bastian, Cantoni, and others more recent than those of Pasteur, have led to results singularly—and at present, we must say, unaccountably—at variance with his. Prof. Wyman found that bacteria will make their appearance in infusions which have not only been boiled before being sealed up, but which, after being sealed, have been kept at a boiling heat for many hours. He found, moreover, that these same organisms perish when exposed to a heat not over 134° F. Bastian, in a very extended series of experiments, has pushed the heat in the tubes containing his infusions as high as 300° F., maintaining this high temperature, in some instances, not less than four hours; and has yet found that living forms do not fail subsequently to make their appearance in them. Such forms appear also, according to him, in solutions containing nothing of organic origin whatever, but which are composed entirely of certain salts of soda and ammonia; and he even affirms that in such solutions he has occasionally seen very remarkable fungi to present themselves with their full fructification, drawings of which he has given in his work, recently published, entitled *The Beginnings of Life*.

It seems impossible that any candid reader, whatever may have been his previous prepossessions, should rise from the perusal of the extraordinary book just mentioned without feeling that if it does not embrace and contain the conclusion of the whole matter, it is at least for the present unanswerable. It leaves us, nevertheless, still perplexed, perhaps more deeply perplexed than before; for it is impossible to understand how the results reached by so many naturalists, all in the first rank of scientific investigators, all conscientiously laboring to elicit the truth of this great question, should be, after all, so singularly discordant. And another weighty consideration adds to this perplexity. It is the existence of a practical refutation of the conclusions of the class of experimenters to which Dr. Bastian belongs, which is presented under our eyes every day on the grandest scale in the operations of one of the most important departments of modern industry. This consideration cannot better be stated than in the words of Huxley. "There must," remarks this distinguished physiologist, "be some error about these experiments, because they are performed on an enormous scale every day with quite contrary results. Meats, fruits, vegetables, the very materials of the most fermentable and putrescible infusions, are preserved to the extent, I suppose I may say, of thousands of tons every year, by a method which is a mere application of Spallanzani's experiment. The matters to be preserved are well boiled in a tin case provided with a small hole, and this hole is soldered up when all the air in the case has been replaced by steam. By this method they may be kept for years without putrefying, fermenting, or getting mouldy." He argues—and the argument has a weight that must be felt—that there is no mode of explaining this universal and invariable result but the exclusion of germs from these cans. And, in view of the marvellous discrepancy between the results on the small and the grand scale placed side by side, one can hardly repress the suspicion that if there be any such thing as spontaneous generation, it is a thing which occurs only under rare and extraordinary conditions—which conditions Dr. Bastian has unintentionally succeeded in establishing—while as a matter of practical importance or daily interest it is as if it were not.

But if this admission be made, it is an admission, after all, of all that the doctrine of spontaneous generation demands: it is an admission that life can originate spontaneously, and therefore, by inference, that the earliest life probably did originate spontaneously. This is a doctrine so at variance with all that revelation has taught us of creation, that it cannot be received with satisfaction by any who desire to preserve their reverence for the Sacred Scriptures unimpaired. To such it may afford some gratification to know that the processes employed by Dr. Bastian have not escaped criticism, nor have his results been allowed to take their place among the truths of science unchallenged. Few men of eminence in the scientific world accept at the present time the doctrine of spontaneous generation, while very many reject it, and many are silent. Whether this great question will ever be settled to the universal satisfaction is extremely doubtful, but in view of the vast amount of conflicting and irreconcilable evidence hitherto presented, we are compelled to say of it, in our own day, *adhuc sub judice lis est*. (See FERMENTATION and GERM THEORY.) F. A. P. BARNARD.

Genesee′, county of E. Central Michigan. Area, 600 square miles. The surface is dry, sandy, and undulating, with numerous forests. The soil is productive. Live stock, grain, wool, and dairy products are the staples. The manufactures are important, including lumber, flour, furniture, carriages, saddlery, castings, metallic wares, and farming implements. The Flint and Père Marquette and other railroads traverse the county. Cap. Flint. P. 33,900.

Genesee, county of Western New York. Area, 507 square miles. It is generally level or undulating, and has an extremely productive limestone soil. Cattle, grain, fruit, wool, and dairy products are the great staples. Carriages, cooperage, saddlery, harnesses, flour, and lime are manufactured. Building-stone, muck, and marl are abundant and excellent in quality. Mineral springs are numerous. It is traversed by the New York Central and other railroads. Cap. Batavia. Pop. 31,606.

Genesee, tp. of Whitesides co., Ill. Pop. 1271.

Genesee, a v. and tp. of Genesee co., Mich., on the Otter Lake division of the Flint and Père Marquette Railway, 8 miles N. E. of Flint. Pop. of tp. 1666.

Genesee, tp. of Allegany co., N. Y. Pop. 888.

Genesee, tp. of Potter co., Pa. Pop. 767.

Genesee, post-tp. of Waukesha co., Wis. Pop. 1462.

Genesee Falls, tp. of Wyoming co., N. Y. It contains the village of PORTAGEVILLE (which see), and takes its name from the Portage Falls of the Genesee River, which are very romantic. Pop. 979.

Genesee River rises in Potter co., Pa., and flows in a general northward course through the State of New York, and after a course of some 120 miles falls into Lake Ontario 7 miles N. of Rochester. It is navigable for 5 miles by lake vessels. There are grand falls at Portageville, at Rochester, and other points in its course. The Genesee Valley Canal renders its waters available for navigation, and it affords abundant water-power at many places. The Genesee Valley is a very fertile and beautiful region.

Genese′o, post-v. and tp. of Henry co., Ill., is the centre of a large and productive agricultural district, situated on the Chicago Rock Island and Pacific R. R., 159 miles W. by S. of Chicago and 23 miles E. of Rock Island, on the Mississippi River. It is one of the most important grain and stock shipping-points on the above-named road. It contains a national and a private bank, an iron-foundry, agricultural implement, tub and pail, furniture, wagon and carriage, cigar, and other manufactories; also, 2 flouring-mills. Besides a flourishing high school there are several select schools, 2 newspapers, 11 churches, 3 hotels, and a large number of stores, saloons, etc. It is a thrifty, enterprising town. Pop. of v. 3042, of tp. 1081.

GEO. A. HOBBS, ED. "REPUBLIC."

Geneseo, tp. of Cerro Gordo co., Ia. Pop. 240.

Geneseo, tp. of Tama co., Ia. Pop. 580.

Geneseo, post-v. and tp., cap. of Livingston co., N. Y., 30 miles S. of Rochester, on the Genesee River and the Erie R. R. It has the county buildings, a State normal school, an academy, a union free school, a free public library containing over 8000 volumes, a free reading-room, 6 churches, waterworks, gas, a national bank and 2 banking-offices, a large number of stores, shops, and factories, 3 hotels, a weekly newspaper, and a large job printing-office. Assessed valuation, nearly $2,000,000. Pop. of tp. 3032.

JAS. W. CLEMENT, PROP. "LIVINGSTON REPUBLICAN."

Gene'sius (JOSEPHUS), or **Joseph the Byzantine,** author of a history of Constantinople in four books, relating to the period beginning 813 and ending 886 A. D. He lived in the tenth century. (Best edition by Lachmann, in *Corpus Byzant. Hist.*, Bonn, 1834.)

Gen'esis [Gr. γενεσις, "generation;" called in Heb. *bereshith*, "in the beginning," which is its first word in the Hebrew text], the first book of the Pentateuch, one of the most venerable and ancient of existing books, containing an account of the creation, of man's original happy state, his sin and fall, of the Deluge, and the restoration and dispersion of mankind, ending with the story of Abraham and his early descendants. Its authorship is ordinarily ascribed to Moses, but some have questioned its unity, regarding it as a compilation from various older records; and still others have questioned its historical character. (For a discussion of these points see PENTATEUCH.)

Genest, or Genêt (EDMOND CHARLES), a brother of Mme. Campan, was b. at Versailles Jan. 8, 1763, and brought up at the French court; produced when twelve years old a history of Eric XIV. (after Celsius's history), for which Gustavus III. sent him a gold medal; declared himself a republican; was 1789–92 chargé d'affaires at St. Petersburg; French minister to the U. S. 1793–94, when Washington demanded his recall, Genest having taken unwarrantable measures with the design of forcing the U. S. into a war with Great Britain. After his recall, Genest settled at Schodack, Rensselaer co., N. Y., was naturalized, and married first (1794) a daughter of George Clinton, and then (after 1810) a Miss Osgood. Was translator of Idman's treatise on the Finns and their language (1778). D. at Schodack, N. Y., July 14, 1834.

Gen'et, a name given to various carnivorous mammals

The Genet.

of the family Viverridæ and genus *Genetta*. There are several species, mostly African. The common genet, found wild from France to the Cape of Good Hope, is the best known. It is the *Genetta vulgaris*. At Constantinople and other places it is domesticated, and used to destroy rats and mice. It is gentle, and prized for its soft and beautiful fur. It has a faint smell of musk. Is reddish gray, mottled and streaked with black, brown, and white, and appears to be a connecting link between the civet family and the cats, which it resembles in its claws and the pupils of its eyes.

Gene'va [Fr. *Genève;* Ger. *Genf*], town of Switzerland, the capital of the canton of Geneva, is situated on both sides of the Rhône, at the point where it issues from the Lake of Geneva. Its industry is nearly confined to the manufacture of watches, music-boxes, and jewelry, which, however, is very considerable. Its trade is simply retail trade. Its monuments are of no great magnificence, but its beautiful situation, the celebrated part it has played in European civilization as the residence of Calvin, and the remarkable manner in which its citizens, through centuries and at every risk, have shown themselves equal to their position, have made Geneva one of the most conspicuous places in Europe. As it was, in the time of Calvin, a religious and ecclesiastical centre whose influence was felt throughout Europe, so it has become, since the end of the last century, the centre of a remarkable scientific activity. De Luc in meteorology, the great De Saussure in general physics and geology, De Candolle in botany, De la Rive in electricity, Pictet in palæontology, Merle d'Aubigné in history, are all masters of the first rank in their respective sciences. The educational institutions of Geneva and its scientific collections are very celebrated. The duke of Brunswick, who d. at Geneva Aug. 19, 1873, bequeathed to the city his whole fortune, about $20,000,000. Pop. 46,783; with suburbs, 68,165.

Geneva, canton of the Swiss Confederation, bounded by the Lake of Geneva, the canton of Vaud, and France. Its area is 109 square miles. Pop. 93,239. Its soil is not remarkable, but it has been most carefully cultivated for many generations, and now the whole canton looks like a garden. Its constitution (of 1847) is, of all the constitutions of the Swiss republics, the most democratic, and under its shelter the country is rapidly developing.

Geneva, county of Alabama, bounded on the S. by Florida. Area, 576 square miles. It is in the great pine-region of Alabama, and is intersected by the river Choctawhatchie, which will be of great service in carrying its stores of valuable timber to a market. Rice and tobacco are at present the principal crops. Cap. Geneva. P. 2959.

Geneva, post-v., cap. of Geneva co., Ala. Pop. 126.

Geneva, post-v. and tp., cap. of Kane co., Ill., on Fox River, 35 miles from Chicago, on the Chicago and North-western R. R., and is connected with Aurora by the Chicago Burlington and Quincy R. R., and with St. Charles by a branch of the Chicago and North-western R. R. It has an excellent water-power, 1 foundry, 3 grist-mills, elegant county and very commodious school buildings, 1 weekly newspaper, and 4 churches. P. of tp. 1829.

CHAS. ARCHER, ED. "KANE CO. REPUBLICAN."

Geneva, tp. of Jennings co., Ind. Pop. 2037.

Geneva, post-tp. of Franklin co., Ia. Pop. 445.

Geneva, post-tp. of Allen co., Kan. Pop. 634.

Geneva, tp. of Tuscola co., Mich. Pop. 152.

Geneva, tp. of Van Buren co., Mich. Pop. 1086.

Geneva, post-tp. of Freeborn co., Minn. Pop. 378.

Geneva, post-v. of Ontario co., N. Y., at the foot of Seneca Lake, halfway between Rochester and Syracuse, on the New York Central R. R., is the northern terminus of the Geneva and Ithaca R. R., of the South-western R. R., and also of Seneca and Cayuga Canal. A daily line of steamers ply between Geneva and Watkins, at the head of Seneca Lake. Geneva has 10 churches, is the seat of Hobart College, has a graded union school and 6 branch schools, 2 banks, and 2 weekly newspapers. It derives its prosperity from its nurseries, owned by 35 firms, which occupy about 10,000 acres of land in and near Geneva, giving employment to over 1000 laborers and hundreds of agents in every State in the Union and the Canadas. Over $1,000,000 worth of nursery stock is shipped annually from Geneva. It has also a paid fire department, two fine parks, waterworks, and a water-cure. Pop. 5521.

FRED. BENNET, PROP. "GENEVA COURIER."

Geneva, post-v. and tp. of Ashtabula co., O., on the Lake Shore R. R., 45 miles N. E. of Cleveland. It has a national bank, a savings bank, a normal school, 1 newspaper, 2 hotels, 5 churches, a large manufactory of farming tools, and a number of stores, etc. Pop. of v. 1090; of tp. 2298. W. P. SPENCER, ED. "TIMES."

Geneva, post-v. and tp. of Walworth co., Wis., 10 miles S. E. of the county-seat, is on Geneva Lake and the Northern R. R. It has a flouring-mill, a ladies' seminary, a fine union public school, a newspaper, 4 churches, 3 hotels, and the usual number of stores. Principal business, farming. Pop. of tp. 1040. ED. "INDEPENDENT."

Geneva Bay, a v. of Walworth tp., Walworth co., Wis. Pop. 997.

Geneva, Lake of, or **Leman,** is situated 1226 feet above the level of the sea, between Switzerland and Savoy (now a part of France), extending 45 miles from E. to W. in the shape of a crescent. Its width varies from 1 mile at the W. end to nearly 10 miles at the E. end, where its greatest depth reaches 980 feet. It is traversed by the river Rhône, which discharges in it its muddy waters, and issues from it at Geneva a pure and transparent stream of a deep blue color. This lake, which fills a vast basin between the snowy Alps and the Jura Mountains, is much celebrated for the grandeur of the surrounding scenery and the loveliness of its shores, which teem with thriving cities and picturesque villages.

Geneva, The Convention of, concluded at Geneva Aug. 22, 1864, was intended to decrease and mitigate by legitimate means the evils attending war, and especially to better the situation of the wounded by proper attendance and by declaring neutral the physicians and the entire medical staff. First, Switzerland, Baden, Würtemberg, Prussia, the Netherlands, Belgium, Denmark, Hesse, and Italy agreed that, in case of war, all persons belonging to the hospitals or employed in the administration, transportation, and moving of the wounded should be considered as neutrals, and respected as such by the belligerent parties as far as they were acting simply within the proper limits of their office; also those places on the battle field where wounds are dressed, ambulances for the wounded, and buildings in which they were placed, should be considered neutral, and pains should be taken to avoid any concentration of the battle in the direction of any such point. In order to make such places and persons more easily recognized, it was furthermore agreed to distinguish the buildings and places by a white flag with a red cross, and the persons by a white band with a red cross, stamped by the respective military authorities, and to be worn around the arm. The ratifications of the convention were exchanged June 22, 1865; shortly after the governments of Greece, Great Britain, and Turkey acceded to it, and later those also of France, Austria, and the other European states. It contained also many germs fit for further development, and efforts have been made continuously since to extend and improve it. Thus, on Oct. 20, 1868, fifteen additional articles were agreed upon, chiefly relating to maritime wars. During the Franco-German war of 1870–71 it became apparent, however, that the humane intentions of the convention were in many ways frustrated or endangered by the very peculiarities of war, and by the passions which it necessarily excites. The enforcement of the laws agreed upon demands a calmness and judgment, an order and discipline, which the conquering party may have, but hardly the vanquished. In the summer of 1874 delegates from all the European powers met at Brussels on the proposition of the emperor Alexander of Russia, and the intention was to extend the principles of the Geneva convention to the population of the belligerent countries, to the organization of volunteers and reserve troops, and even to the arms and missiles employed; but the negotiations brought no results. Such humane measures are in opposition to the very nature of war, and in order to carry out the ideas of the Geneva convention it would be necessary to cease to make war. August Niemann.

Geneviève, Canons of St., a branch of the Canons Regular, first proposed by Charles Faure in 1614, who, with the assistance of Cardinal de la Rochefoucauld, established the new congregation. In 1634, Pope Urban VIII. confirmed the organization. They were called *Génovéfains* in France.

Geneviève, Daughters of St., called also **Miramions,** a former body of religious women in France who took no monastic vows, but devoted themselves to teaching and to caring for the sick. The order was founded in 1636 by Francesca de Blosset, and in 1665 was united to the proper Miramions (founded in 1661). The united order flourished, and attained extensive usefulness.

Gen'ghis Khan (the "greatest of khans"), originally **Temudjin,** b. Jan. 25, 1155, at Deylun Yeldak on the Hoang-Ho, son of the chief of the Mongol tribe Neyrun; succeeded his father when thirteen years old, but a civil war followed, and in 1178 he was compelled to flee to Toghrul Ungh, khan of the Keraite Tartars, whose daughter he married, and whose armies he commanded with success. In 1203 he made himself master of the Keraites, and in 1204 utterly overthrew the Nayman tribes and made himself chief of Mongolia. In 1206 he was declared *Genghis Khan,* or chief of rulers, and the civilized Eigurs submitted to him. He soon published his great code; attacked Cathay or Northern China; crossed the Great Wall 1211; sacked and burned Peking 1215; exterminated some rebellious tribes; attacked Allah-ed-deen Mohammed, sultan of Carism, 1218, had conquered all Toorkestan 1220, ravaged Balkh, Khorassan, and Persia; plundered all Asia as far S. as the Sutlej River, and penetrated Europe as far as the Dnieper, carrying slaughter and destruction everywhere. Genghis d. at Lupan in China Aug. 24, 1227. His four sons carried on his work of terror. Genghis was the founder of what became the Mogul empire. His chief capital was Karakorum in Tartary. It is stated that more than 5,000,000 persons were slain in his wars, which were carried on with the most heartless cruelty. But throughout his vast domains we are told that he enforced the strictest order, crime received due punishment, a postal system was established, and all religions were tolerated.

Gen'ipap, the whitish green fruit of *Genipa Americana,* a South American tree of the order Rubiaceæ. It has a rich purple juice and an agreeable vinous flavor. The fruit of *Genipa Brasiliensis* is not good until over-ripe, but is made into a confection. The juice of this latter fruit is used in dyeing, and affords a deep violet.

Gen'itive [Lat. *genitivus,* from *gigno, genitum,* to "beget"] is a grammatical term, the name of a case. In the Indo-Germanic languages certain relations between the different words of which a sentence consists are expressed by inflections or modifications of the words which are called cases, and are formed by adding different suffixes to the root. Latin has six cases; Greek and Icelandic, five; German, four; English and Danish, two—namely, the nominative and genitive; only in the pronouns is still an inflectional accusative left. In the Semitic languages these relations are expressed by prepositions, and in all modern European languages there is a tendency to obliterate cases and apply the system of prepositions. Thus, the Romanic languages have, properly speaking, no declensions at all. Of all cases, genitive seems to be the most obstinate. As above mentioned, it has still maintained itself in English, in which it is formed by the suffix *s.* It has lost, however, more than one-half of its original domain. Many relations which, in a language with its system of declensions still vigorous, would be expressed by putting the noun in genitive, must in modern English be expressed by the preposition *of.* Thus, the so called *genitivus objectivus*—the noun in genitive denoting the object of the governing noun—cannot be used at present. It is possible to say in German, "Die Furcht Gottes," meaning the fear which man has of God, but it is impossible in English to speak of "God's fear." It must be expressed by "the fear of God." There is a great difference between "God's love" and "the love of God." Furthermore, of the different classes of *genitivus subjectivus*—the noun in genitive denoting the subject of the governing noun—only those can be used in which the genitive expresses the origin or the ownership; as, for instance, "the king's son" or "the merchant's house." In cases in which the word in genitive simply performs the function of an adjective, and only modifies or defines the general idea conveyed by the governing word, the relation must be expressed in English by *of,* or by the position of the two nouns; as, for instance, "an officer of the navy" or "a navy officer," but not "a navy's officer." The several modes in which the English language can thus signify relations which other languages denote by the genitive alone (as in Latin) or by prepositions alone (as in French), give it a great richness and a peculiar delicacy of expression. Clemens Petersen.

Ge'nius, plu. **Ge'nii** [Lat. (akin to Gr. γίγνομαι), *gigno, genui;* perhaps related to the Arab. *jinni,* plu. *jinn;* see Jinn]. Among the Romans the genii were tutelary spirits attached to persons, peoples, or places. Genii were regarded as a kind of guardian angels, and correspond to the δαιμονες of the Greeks. The doctrine of genii was Etruscan. There were evil as well as good genii. These spirits received worship, especially at wedding festivities and other occasions of joy. Genii are figured in art as winged youths, or sometimes as serpents. In modern translations from the Arabic the Jinn (which see) are often called genii, but whether the names are kindred to each other is a disputed question.

Genius, in literature and art, may be best and most easily defined by distinguishing it from its correlative, talent. Genius is exclusively a gift; talent is more or less an accomplishment. Genius refers to a faculty only as far as it is natural and spontaneous; talent, although it depends on a natural aptness or disposition, always involves the idea of training and education. It is impossible to speak of acquired genius; we even cannot speak of the education of genius. Although genius is apt to run wild from lack of knowledge, and although a person's lack of education may be the ruin of his genius, still, that which education brings to genius is only material for its activity and direction for its application; it adds nothing to the faculty itself. The faculty is complete by itself, or it is not genius. On the other hand, we speak of natural talents, thereby designating a fitness in the hand for the use of certain tools, a dexterity in the finger for the performance of certain tasks, a disposition in the eye or the ear for distinguishing lines and sounds, forms and tones, a capacity in the mind for retaining names, handling figures, making mimicry, combining ideas, etc.; but we speak of natural talents as widely different from real talents, as the basis, foundation, opportunity only, which requires great exertions of training and education in order to be developed into actual talent. To say of a person that he has a natural talent involves a slight reproach, and is always felt so by the person himself, for, instead of taking it as a compliment, he immediately begins to defend

himself by explaining how he lacked time or means to utilize the natural opportunity and acquire a real talent. In speaking not of individuals, but of nations, genius refers to the general structure of the national mind, as it manifests itself in its difference from that of other nations, and for which there can be given no further account; while talent refers to those popular acquirements which the peculiarities of climate, surface of country, and political circumstances made it necessary for a people to have, and which then, by inheritance, became fixed as parts of its nature. Thus, we say of the Semitic races, which produced Judaism, Christianity, and Mohammedanism, that their genius is religious, and of the Indo-Germanic races, which in religion never reached farther than to mythology, but which have produced most of the poetry and art mankind possesses, that their genius is poetical. Or we say of the Americans that they have a mechanical talent; of the Jews, that they have a talent for trade; of the ancient Scandinavian women, that they had a medical talent—because we know the circumstances which made it necessary for these nations to acquire these accomplishments, and have seen how the individual acquirements by degrees developed into national talents.

Another distinction between genius and talent is this: genius is creative, talent only formative. Genius refers to the faculty as far as it produces something new and something perfect; the idea of perfection is an element of that of creation; if the new thing produced is poor, the creation is a failure. As far as the faculty only reduces into form or brings to manifestation, it is called talent. Thus, genius is nearly confined to the spheres of literature and art, and only exceptionally used in that of science, because literature and art must be creative in order to be anything, while science in its highest and noblest form is only discovering. Science describes things that are; literature and art invent things that shall be. Science defines the ideas which produce the world; literature and art create the ideals which govern mankind. In those departments of science in which invention plays a part the word genius is used, as invention is a sort of creation. We speak of a mechanical, mathematical, or military genius, because in mechanics, mathematics, and strategy inventions may be made. We even speak of a philosophical genius, because a philosophical system is in the deepest recesses of its origin a creation, an inspiration, exactly like that of a work of art; or—to use a strong but, with regard to certain modern philosophical systems, not altogether inappropriate appellation—a philosophical system is a useful invention which in course of time is sure to be superseded by another invention of the same kind still more useful. But we hesitate to use such an expression as an historical or a chemical genius. The meaning becomes equivocal. We feel instinctively that in these departments of science invention or creation is only the worst form of blundering. On the other hand, no one would ever call a singer or a pianist a musical genius on account of his rendering of a musical composition, however excellent the performance might be, for his performance requires only talent. There is a talent for writing verse, but if entirely unsupported by any poetical genius it does not constitute a poet; it only constitutes a rhymester. There is a talent for speech, but it does not always make people orators; it sometimes makes them talkers. Any faculty of the human mind has, so to speak, two poles, one turning towards the production of new ideas—genius; and the other turning towards the reduction of the idea into form—talent; the form being a poetical impersonation or a scientific proposition or a useful contrivance or a political measure. But these two poles are not, like the magnetic poles, necessarily connected with each other. Whether genius can exist without talent is a question whose solution depends upon the final definition of what genius is; but it is indisputable that talent can exist without genius. There are thousands of men of talent at this minute in New York, but perhaps not ten geniuses.

It is evident, however, that this distinction between genius as a natural power of creation, and talent as an acquired faculty of formation, does not fully answer the question, What is genius? One hundred years ago, when there still lingered in the word *genius* a remembrance of the tutelary god, of the Socratic dæmon, and creation simply meant production of something from nothing, the definition comprised within the above distinction was sufficient. Genius was considered an organ of the human mind, like memory and imagination—the organ of creation. But modern psychology has failed to find this organ, and modern metaphysics has destroyed the definition of creation as a production of something from nothing. "Of nothing comes nothing" is a rule not only in nature, but also in the mind, and wheresoever science can reach. What, then, does it mean to produce new and perfect ideas? Or, in other words, what is genius? Samuel Johnson said, "Genius is large general powers turned in a particular direction;" and with a little explanatory addition this definition agrees with the results of the latest psychological researches. How "large general powers," by being concentrated on one particular point, can produce ideas which, in this field, are new and perfect, is a question capable of being satisfactorily answered, but the definition seems to imply that a man of "large general powers" might turn these powers in any direction he liked, and thus become a military, mathematical, musical, or poetical genius, just as he chose; and such an inference would be very wrong. It is not the man who turns his "large general powers" in a particular direction and makes himself a genius; it is the presence of a particular talent. If a man of "large general powers" finds in his bodily and mental organization a natural disposition for a particular kind of exercise, which by training and education can be developed into a talent, and if he merges his "large general powers" into this particular talent, he is a genius. But if he turns them in some other direction, where he has no talent, or if he neglects to educate a talent of adequate proportions, he scatters them to the wind or breaks them. With this addition the definition explains the existence of talent without genius—of talent for legerdemain; and it also explains the existence of genius without talent—of scattered, broken, impotent, or, as Jean Paul called it, female genius. But even without any addition Samuel Johnson's definition shows a wonderful intuition. It alone can explain how new and perfect ideas are created, and it alone agrees with actual experience. No one ever met with a great genius in a small man. A painter who talks nonsense in politics is sure to paint nonsense on his canvas; a statesman who has no appreciation of art is sure to take imperfect measures in practice. "Large general powers" is the fundamental element of genius. CLEMENS PETERSEN.

Genlis, de (STÉPHANIE FÉLICITÉ DUCREST DE ST. AUBIN), COUNTESS, b. near Autun, France, Jan. 25, 1746; in 1761 was married to the count de Genlis; in 1770 became attached to the household of the duke de Chartres (afterwards the citizen Égalité); in 1782 became governor to his children, and, according to the popular opinion, was his mistress. In 1793 she was obliged to leave France. From Napoleon and Joseph Bonaparte she subsequently received liberal pensions. Among her best writings are the educational works designed for her young pupils, the Orleans princes, and *Mademoiselle de Clermont*, a short novel of great excellence. Her personal *Mémoires*, in ten large volumes, abound in scandal, and are full of malignant attacks upon the prominent persons of her time. D. at Paris Dec. 31, 1830. It is believed that Pamela, wife of Lord Edward Fitzgerald (1763–98), was her daughter by Philippe Égalité. It is noteworthy that when six years old the future Madame de Genlis entered the Church as canoness of Alix, with the title of countess of Lancy.

Gennes'aret, Lake of [now called *Bahr Tabarîyeh;* mentioned only four times in the Old Testament, where it is called *the Sea of Chinnereth* or *Chinneroth;* in the Apocrypha called *the Water of Gennesar;* by Josephus called *the Lake of Gennesar*, or *Tiberias;* in the New Testament called once *the Lake of Gennesaret*, but oftener *the Sea of Galilee*, or *Tiberias*], in Palestine, between lat. 32° 42′ and 32° 54′ N., is found by recent measurement to be 12¼ miles long and 6¾ miles wide. Its surface is 653 feet below the level of the Mediterranean. Its greatest depth is 165 feet. Its waters are clear, cool, and sweet, abounding with fish. Drs. Tristram and Günther report seventeen species of seven families, including an eel, a catfish, four species of perch, and several chubs and minnows. The perch, the most important of all, are *Hemichromis sacra, Chromis Andreæ, Chromis Simonis*, and *Chromis nilotica*. Its whole eastern side is bounded by a steep mountain-wall, rising nearly 2000 feet, and spreading off into the table-land of Bashan. On the western side there is a similar, though less lofty, wall along the southern half of the lake. The Plain of Gennesaret, famed in ancient times for its fertility, begins about 2½ miles N. of Tiberias, is about 3 miles long, and more than a mile wide. The upper part of this plain was watered by means of an aqueduct from Bethsaida, brought around the head of the promontory which forms the northern boundary of the plain. N. of this promontory the shore of the lake has a broad and gentle slope. Mount Hermon is in full view from every point. The climate is almost tropical. Though not wholly wanting in grandeur and beauty, the lake is noted rather for its historic associations. It was the centre of our Lord's ministry and the scene of many miracles. Nine cities then stood upon its shores; only two of which (Tiberias, with its 2000 inhabitants, and Magdala, with its 20 mud hovels) now remain. Dr. Robinson reports only one boat on the lake in 1838, but in 1870 the writer of this article found four. The chief unsettled question is in regard to the site

of Capernaum. Some identify it with *Tell Hûm*, about 2 miles from the head of the lake; others with *Khan Minyeh*, under the promontory on the northern edge of the Plain of Gennesaret. Accepting this identification, *Tâbighah*, about three-fourths of a mile N. of *Khan Minyeh*, is Bethsaida, and *Tell Hûm*, about 1½ miles farther on, is Chorazin.

R. D. Hitchcock.

Gennesee′, tp. of Kandiyohi co., Minn. Pop. 361.

Geno′a, province of the kingdom of Italy, extending along the Gulf of Genoa. Area, 1250 square miles. Pop. 716,759.

Genoa, a large maritime and commercial town of Italy, on the gulf of the same name, in lat. 44° 21′ 18″ N., lon. 8° 54′ 24″ E. The whole Gulf of Genoa is more or less sheltered on the N. by the Apennines, which here approach the sea so boldly as to leave room for towns only at the openings of the mountain valleys; and the port of the city is formed by a small bay, receding inland, between the torrents of Polcevera and Bisagno. The harbor, further sheltered by two piers—the Molo Vecchio, running from the E. side in a westerly direction, and the Molo Nuovo, from the W., south-easterly—is in no danger of being shoaled up, as are so many Italian seaports, for the shore-current is diverted from it by the headland of Portofino, and the little promontories of the Lanterna and the Carignano protect it from the torrent-wash. Still, this harbor, though safe and commodious for its size, is too small for the growing commerce of the town, and the great depth of the water makes its artificial enlargement, now a subject of discussion, very difficult. A railway connects Genoa with Turin (four hours distant), and a littoral line—opened in 1872-74, and running nearly parallel with the Corniche—affords easy communication with Nice and Marseilles on the W., and with Spezia, Florence, Rome, etc. on the S. Steamers run regularly to different Italian ports and to Marseilles and Tunis. The city presents an enchanting view from the water as it rises, amphitheatre like, towards the summit of verdant and richly cultivated hills, overtopped by a strong city wall; while the turreted forts of a second line of defence crowning the barren heights beyond add greatly to the picturesque effect. Genoa contains many grand churches and palaces, with some fine streets, though, from the unfavorable form of the hills upon which it is built, the city communication is chiefly carried on by means of narrow, ill-lighted, sometimes stair-like thoroughfares, scarcely passable for mules. Many of the proud structures which once justified the haughty title of "La Superba," have fallen more or less into decay, and are now used as hotels or for other public purposes; but some of the old palaces are still occupied by descendants of the "merchant princes" who built them, and possess choice treasures of Italian art. The most noteworthy churches are: S. Maria di Carignano, of remarkable architecture; SS. Andrea and Ambrogio, begun in the sixth century; SS. Annunziata, very gorgeous; S. Lorenzo, the cathedral, built in 1100, and containing, among other curious relics, the glass cup, with its improbable traditions, brought from Cæsarea by the crusaders, and long believed to be an emerald. The Carlo Felice is the finest and most spacious of the several theatres. In the Piazza d'Acqua a monument has been erected within a few years to Christopher Columbus, who was born at Cogoleto, near Genoa. The favorite promenade is the elevated park called Acqua Sola, at the N. E. end of the city, behind which, through the Villa Negro, a winding ascent leads to a bastion 150 feet above the park itself, and commanding a noble view.

The traditional history of Genoa is very obscure, but Livy mentions it as adhering to Rome against Carthage, by which it was destroyed 204 B. C., and soon after rebuilt by its allies. An ancient bronze tablet, found in the Polcevera in 1506, commemorates the settlement, by Rome, of a dispute between Genoa and a neighboring town (187 B. C.). In the sixth century it fell into the hands of the Lombards, who in turn were dispossessed by Charlemagne. After the dissolution of the empire of the Franks it passed through much the same vicissitudes as other large Italian towns, suffering more, however, from the Saracens, whose depredations forced Genoa to strengthen her navy, thus laying the foundation of her great maritime power. For further security against the Mohammedans she formed an alliance with Pisa, but conflicts were afterwards frequent between the two commonwealths. With Venice also Genoa carried on wars disastrous to both, the Levant trade being the subject of their mutual jealousies, and the hostile galleys of the two republics encountered each other, with changing fortune, in all the waters of the Mediterranean. In 1260 Genoa was able to place the emperor of her choice, Michael Palæologus, on the throne of Constantinople, and received from him, in addition to her already extensive Eastern possessions, the cession of Galata and Pera, suburbs of Constantinople, which she retained till 14[illegible]3, and of the port of Smyrna, so that for a time she controlled the commerce of India through the Black and Caspian seas. Corsica, Minorca, Almeria, Tortosa, Marseilles, Nice, etc. successively fell into the hands of the Genoese, and their dominion might have extended still wider but for their internal dissensions. The early government of Genoa, democratic in form, was very turbulent until 1270, when the famous Guelph "captains of liberty" assumed the control of the commonwealth under pretext of restoring order; and they retained their power about twenty years. The first doge was elected in 1339. In 1399, France obtained possession of Genoa, and the adventurous Marshal Boucicault was made governor of the city; but in 1528 the renowned Andrea Doria restored his country to independence. The conspiracy of Giovanni Fiesco, which has furnished the theme of so many dramas, occurred in 1547. In 1656 Genoa lost 70,000 of her citizens by the plague. In 1746 the Austrians made themselves masters of the city, but were driven out after holding it three months. The victorious Bonaparte in 1796 gave Genoa the title of the Ligurian Republic, but in 1802 he annexed both town and province to France. By the peace of 1815 the Genoese territory became a part of the kingdom of Sardinia, and is now a most important province of united Italy.

The Genoese are now, as they have always been, a bold, independent, energetic, and industrious people. Their commerce is wide and important; their manufactures are very considerable. Shipbuilding is carried on extensively, and this business has greatly increased during 1873 and 1874, many ships being built on commission for foreign countries. Elegant objects of household furniture in wood, such as chairs, tables, cabinets, etc., are manufactured on a large scale, and the silks, velvets, and laces, as well as the coral and silver filigree-work of Genoa, have a wide reputation. Among the coarser manufactures should be mentioned cotton goods, soap, candles, etc.; the extraction of oil is also an important industry. Recent changes in the methods of keeping the custom-house accounts lead to some confusion when comparisons are made with previous years, but the sums-total in 1873, as appear from the records of that year, are—exports (velvets, silks, laces, jewelry, gloves, etc.), $15,590,000; imports (raw cotton, cotton and woollen cloths, hides, dyestuffs, etc.), $63,9[illegible],000. The construction of the St. Gothard Railway, with the intended improvements in the railway connection with Genoa, will make this city the nearest Mediterranean port for Western and Central Germany, and consequently tend greatly to increase its commercial prosperity. The schools and charitable institutions of Genoa are numerous and well sustained. The municipality proposes to form a museum in the Villa Negro, now town property, by placing there the rich collections of the late prince Otho, of the marchese Lorenzo Pareto, and of the marchese Giacomo Doria, and to invite the last-named distinguished citizen to assume its direction. A princely gift has been recently made to the municipality of Genoa by the duke and duchess di Galliera. The duchess, being the only child of the Brignole-Sale house, has, with the consent of her husband and their son, bestowed the magnificent Brignole-Sale palace, with its superb collection of pictures and its rich and rare library, upon the city of Genoa, "for the promotion of the study of the fine arts and of classical literature." A large sum of money accompanied this munificent donation. Pop. in 1873, 161,669.

Geo. P. Marsh.

Genoa, post-tp. of De Kalb co., Ill. Pop. 993.

Genoa, post-v. of Monroe tp., Wayne co., Ia. Pop. 87.

Genoa, post-tp. of Livingston co., Mich., on the Detroit Lansing and Lake Michigan R. R., 16 miles W. N. W. of Detroit. Pop. 992.

Genoa, post-v., cap. of Douglas co., Nev., on Carson River, 14 miles S. by W. of Carson City. It is pleasantly situated in a pine-region. Pop. of tp. 482.

Genoa, flourishing post-v. and tp. of Cayuga co., N. Y. It has several manufactories. Pop. of tp. 2295.

Genoa, tp. of Delaware co., O. Pop. 1050.

Genoa, post-v. of Ottawa co., O., on the Lake Shore R. R., 15 miles S. E. of Toledo. It is noted as a great lime-manufacturing town, and has lumber, washboard, wooden bowl, wagon, barrel, stove, hoop, and other manufactures. It has 5 churches, a superior graded school, and a German school. It is located in a [illegible] Pop. 558.

Wm. H. [illegible] "Examiner."

Genoa, post-v. of [illegible] tp., [illegible] co., O. P. 1[illegible].

Genoa, post-tp. of Vernon co., Wis. Pop. 6[illegible].

Genoa, a v. of Walworth co., Wis., on the Illinois State line, at the crossing of the Kenosha and the Fox River branches of the Chicago and North-western R. R., 27 miles W. by S. of Kenosha.

Genoa, Gulf of, is the name generally given to the Mediterranean N. of Corsica, where between Spezia and Oneglia the coast of Italy retreats with a large curve. It is a bay, however, rather than a gulf.

Genre Paint'ing [Fr. *genre*, a "kind" or "sort;" that is, painting of a special kind] occupies an intermediate position between the historical picture and the landscape, and is composed of elements borrowed from those two fields. It may accentuate these elements differently, and thus become subdivided itself into several branches. The historical character may predominate, and produce what is generally called the historical genre picture. The Berlin painter Adolph Mentzel's representations of the life and time of Frederick the Great, the Belgian painter Wapper's representation of Charles I. taking leave of his children, or Nicaise de Keyser's of the emperor Max visiting Memling; the numerous pictures in which the topics are taken from works of poetry, such as Ary Scheffer's *Faust and Marguerite*, from Goethe's *Faust;* Eugène Delacroix's *The Murder of the Bishop of Liège*, from Walter Scott's *Quentin Durward*, or his *Shipwreck*, from Byron's *Don Juan;* Gustave Doré's illustrations to Dante and Cervantes; W. Mulready's representation of scenes in Shakspeare and Molière;—all such pictures are not exactly historical painting, and yet they are so near to it that they cannot well be called simply genre painting. Or, on the other hand, the landscape character may be the predominant element, and produce what is generally called still-life painting. A great number of pictures by masters of the elder Dutch school, representing perhaps a decayed doorsill, on which a cat basks in the sunlight, or the interior of a poor room, where one single sunbeam steals in and reveals all the charms of cleanliness and neatness, are not exactly landscape pictures, but they approach so near to that branch of painting as to form a sort of transition to it. But as soon as one of these elements is entirely lost sight of, either that of history or that of the landscape, genre painting becomes flat or it approaches caricature.

The relation between genre painting and historical painting is clear, though the dividing line between them may sometimes be difficult to draw correctly. Historical painting represents historical reality; genre painting represents only the spirit of history. In an historical picture either the character or the situation must be real. One of them only can be fiction. In biblical representations the characters are invented, the events are real. In Paul Delaroche's *Cromwell at the Coffin of Charles I.* the situation is invented, the character is real; it is Cromwell's portrait. If both character and event are fiction, the picture may belong to what is called historical genre painting, but it is not an historical picture. In genre painting both character and situation may be invented, but, although without historical reality, they must have historical significance. Whether the subject be a popular custom, a procession, a ceremony, a festival, or a mere individual habit; whether it represent a business, sailors, soldiers, quack doctors, or merely an incident; whether it express passion, gambling, fighting, flirtation, or merely play,—whatever it may be, it must tell something about life in general, such as it is led in this country, by this class, in this age. The charm of the Dutch genre painting of the sixteenth and seventeenth centuries does not consist only in the marvellous accuracy and minuteness with which nature is observed and imitated, but one can see that these clumsy peasants become heroes on the dyke when the wall is broken and the waters come—that these tipsy soldiers are unconquerable when they fight for their freedom and their religion. One can study the climate and soil of the country, the character and history of the people, in these pictures; and were they all gathered together in one gallery, Homer would not be more eloquent or more complete than they are. But without any historical signification genre painting becomes utterly flat. It may still be interesting as imitation of nature, as a study, but it is not art. A smoked herring suspended on a wooden peg and dangling in the air, with a piece of board for its background, is not a genre picture.

Less clear but no less important is the relation between genre painting and landscape painting. Critics often overlook this relation entirely, in spite of the fact that genre painting originated from the introduction of the landscape into the historical picture. In the Netherlands, Joachim Patenier (1490–1550) first began to work out the background on which the Holy Family was placed, into an elaborate landscape; and this novelty found so much favor that in the next generation Henri de Bles could place an unbiblical event in the middle of the landscape and yet sell the picture. In Italy a similar transition took place at about the same time. In the pictures of Paul Veronese (1528–88), especially in the *Marriage at Cana* and the *Finding of Moses*, the accessories, the locality, the landscape are developed to an extent and with an independence hitherto unknown; and with Jacopo da Ponte (1510–92), like Veronese a disciple of Titian, genre painting was born with all its principal characteristics. Among these, critics often mention representation of low life, or, better, of the life of the lower classes. But this is as erroneous as if one should say that it is a characteristic of historical painting to represent kings. Historical painting describes the relations of man to his fellow-man, and in order to be interesting it must consequently paint powerful men. Genre painting describes the relations of man to nature, and in order to be true it must consequently paint men who converse intimately with nature. It is not low life, but life in nature, which is characteristic of genre painting. The intermixture of nature is as necessary as historical significance. If nature is too harshly shut out, genre painting approaches to caricature. It is well known that Hogarth did not exaggerate. On the contrary, he delineated the vices of his time with the accuracy of a sober realist. And yet he impressed most people as a caricaturist. The reason is, that in his anxiety for psychological precision and completeness he forgets that with the medium which he uses psychological precision and completeness are not enough to express psychological truths. According to its own nature, the medium asks for something which only the admission of nature into the composition can give—the picturesque. Without this element the medium is as sure to caricature any idea which is seen through it as a globular mirror is sure to distort any face which looks into it.

The origin of genre painting has been mentioned. Information concerning its development and brilliant culmination in the sixteenth and seventeenth centuries can be found in the biographies of the individual artists. After a somewhat irregular course through the last century, it has made a new departure in this, and seems destined to become once more a grand art. Almost every country has one or more excellent, and quite a number of able, genre painters. The most celebrated names in France are Gérôme, Hebert, and Jules Breton; in Germany, Adolph Schrödter, Jacob Becker, Karl Hübaer, Rudolph Jordan, and Henry Ritter, all belonging to the school of Düsseldorf, and evincing its faults in their art of coloring; in Spain, Escosura and Luis Ruiperez; in America, Winslow Homer; in Belgium, Alfred Stevens; in Denmark, Carl Block; in the Netherlands, Israels; in England, Thomas Faed; in Russia, Peroff. CLEMENS PETERSEN.

Gens. See TRIBE, by HON. L. H. MORGAN, LL.D.

Gens d'Armes, a title in France anciently applied to the whole body of men liable to military service. From the twelfth to the sixteenth century it designated the body of nobles and gentry serving under the kings of France. In the present century it denotes the armed and mounted rural police, generally soldiers detailed from the army.

Gen'seric, king of the Vandals, was the natural son of a Vandal king in Spain, and joint heir of the kingdom with Gonderic, his brother, whom he succeeded in 428 A. D.; crossed to Africa in 429 with 50,000 men, who were joined by the savage native tribes and the Donatists; sacked and burned Hippo in 431; banished the Catholic bishops 437; captured Carthage in 439, and dismantled all the African towns except Carthage; terrified the Mediterranean coasts; overran Sicily 440; took and sacked Rome for fourteen days and nights 455, carrying off the empress and her daughters, and robbing the city of its most valued treasures of art; remained master of Carthage and the terror of both the Eastern and the Western empire, successfully repelling all attacks. D. in 477. He was the most terrible of the barbarian invaders of Rome, an Arian, and a fierce persecutor of orthodoxy, an able general, and a cruel and rapacious man.

Gen'tian, a genus of plants of the natural order Gentianaceæ, of which the most important species is the yellow gentian (*Gentiana lutea*), growing on the mountainous meadows of Central and Southern Europe. This is a perennial plant, with a thick, long, branching root, erect stem three or four feet high, broad, ovate, bright-green leaves, and rather large, bright-yellow flowers. The name is said to be derived from Gentius, an ancient king of Illyria, who introduced yellow gentian into medicine. The dried root is an important drug. It is of spongy texture, faint odor, but intensely bitter taste. Its active principle is probably a bitter crystallizable neutral substance, the *gentiopicrin* of Ludwig and Kromayer, a body belonging chemically to the glucosides. This, like other simple vegetable bitters, when taken internally tends to increase the appetite and promote digestion by gentle irritation of the mucous membrane of the stomach. The root is accordingly used medicinally as a stomachic tonic in simple digestive debility, being given in the form of solid and fluid extract, compound infusion, or tincture. The roots of the several perennial species of the U. S. have similar medical prop-

erties. Many species have very beautiful flowers, as, for instance, our fringed gentian (*G. crinita*), an autumnal biennial. EDWARD CURTIS.

Gentiana'ceæ [from *Gentiana*, one of the genera], a natural order of exogenous herbs, rarely shrubs, with a watery, bitter juice, and mainly opposite and entire leaves, without stipules. They are found in nearly every part of the world, mainly, however, in the temperate and frigid zones. A few are climbing. They have, as a rule, the tonic properties alluded to in the article GENTIAN. Many have beautiful flowers. There are 60 genera and 450 species.

Gen'tile [from the Lat. *gens*, *gentis*, a "people;" Heb. *goyim*; Gr. ἔθνη, "nations"], one not a Jew; a name applied by the Jews to all who were not of their own nationality. Between Jews and Gentiles there was a profound mutual aversion, the intensity of which it is hard for us to conceive, although the feeling itself is not yet quite obsolete. The Mormons in recent times apply the term Gentile to those who are neither Mormons, Jews, nor aboriginal Indians, for they regard the latter as a remnant of the ten lost tribes of Israel.

Gentilly, a v. of France, in the department of Seine, is by the walls of Paris, divided into two parts, Great and Little Gentilly, and contains the famous hospital of Bicêtre and numerous manufactories, of which those of chemicals are quite extensive. Pop. about 15,000.

Gen'tleman [Lat. *vir gentilis*, or *generosus*; that is, a "man of family," a "man of good birth"], in Great Britain, a man of a rank above that of yeoman. The term *gentry* in a large sense includes the nobility, but in popular use often excludes them. Thus, British society is divided into nobility, gentry, and yeomanry, and families are either *noble*, *gentle*, or *simple*. Some of the Plantagenet kings gave patents of gentility. Sir Thomas Smith (1514–77) says, ". . . Whosoever studieth the laws of the realm, who studieth in the universities, who professeth the liberal sciences, and (to be short) who can live idly and without manual labor, and will bear the port, charge, and countenance of a gentleman, he . . . shall be taken for a gentleman." Later authorities make the bearing of coat armor the test of gentility, but Chaucer, an older authority than any we have cited, puts it on a better ground: "He is gentil that doeth gentil dedes." The French *gentilhomme* was properly a title belonging to those of noble birth.

Gen'tlemen-at-Arms (or, more fully, "Her Majesty's Body Guard of the Hon. Corps of Gentlemen-at-Arms," formerly called "Gentlemen Pensioners"), in the court of Great Britain, one of the divisions of the royal body-guard, the others being the "Yeomen of the Guard" (Beef-eaters) and the Royal Archers (for Scotland). The Gentlemen-at-Arms consist of one captain (Gold Stick), one lieutenant (Silver Stick), one standard-bearer (Silver Stick), one clerk of the cheque, adjutant and harbinger, one sub-officer, and forty gentlemen, for the most part retired officers of the army. They are present only on occasions of state ceremony. Instituted 1509 by Henry VIII.; received the present name in 1834.

Gen'try, county of Missouri, in the N. W. part of the State. Area, 504 square miles. It is watered by Grand River and its numerous branches. Cattle, grain, wool, tobacco, and sawed lumber are the principal products. Cap. Albany. Pop. 11,607.

Gen'tryville, post-tp. of Gentry co., Mo. Pop. 255.

Genuflec'tion [Lat. *genu*, "knee," and *flecto*, to "bend"], the act of kneeling in prayer and worship. Kneeling has been the general attitude of supplication in all times and regions. Christ himself knelt in prayer. In the liturgies and rubrics of nearly every ritual there are directions given indicating the proper times for genuflection.

Ge'nus [Lat. *genus*, *generis*, a "kind"], plu. **Gen'era,** in zoology and botany, a group of closely allied animals or plants, distinguished from others by the possession of numerous characters in common with each other, indicating a closer relationship than that of families, and yet not indicating identity of species. Some genera, such as *Felis* (the cats), *Quercus* (the oaks), etc., are so plainly marked as to be recognized in popular language by a common name; and yet in many instances generic distinctions are and must be partly arbitrary and artificial, because the genera often overlap and run into each other. The rule or statement laid down by high authorities, that the genus indicates ultimate structural identity, the various species being marked off by variations in the proportion of parts, is a very useful one, affording a standard or ideal according to which to construct genera; but practically it is almost nowhere possible to apply this or any other absolute rule for the construction of the genus. (See APPENDIX.)

Genza'no, town of Italy, about 16 miles S. E. from Rome. Little is known of its history before the thirteenth century, after which it passed successively from the dominion of one great mediæval family to that of another. It contains some fine buildings, but it is chiefly known by its yearly festival of the Infiorata, on which occasion (the Sunday of the Corpus Domini) the streets are covered with flowers, so arranged as to produce a kind of floral mosaic—a show which attracts many strangers. Pop. about 5000.—Also, town in Southern Italy, in the province of Potenza.

Ge'ode, a roundish hollow concretion, sometimes having the cavity lined with crystals, sometimes filled with ochre, and sometimes quite empty.

Geod'esy [Gr. γεωδαισία, from γῆ, "earth," and δαίω, "I divide"]. Geodesy is the higher science of surveying, in which the magnitude and figure of the earth are taken into account. The size and form of the earth are such that no areas of any considerable extent can be correctly admeasured and mapped without due regard to its curvature. Due N. lines, ten miles apart, deemed parallel in plane surveying, have, in fact, such a convergence in middle latitudes as to approach each other 150 feet in ten miles. The operations of a geodetical survey divide, therefore, into two principal parts: First, the measurement of the distances and angles on the surface of the earth, to determine the geometrical figure of the area surveyed; secondly, the determination of the position of this figure with regard to the astronomical meridian, latitude, and longitude, or, in other words, its situation on the surface of the globe.

The first operation, which is that of trigonometrical surveying, requires the lineal measurement of base-lines and the observation of horizontal angles in the triangulation. The lineal measurement of a line consists in the continued repetition of some unit of length, which operation may be performed either by optical means or by actual contact. The optical mode of measurement consists in bringing into coincidence, side by side, lines drawn on two measuring-bars; or, where a greater degree of precision is desired, in the employment of a micrometric microscope, mounted on a very solid support, which is pointed on the forward end of one bar, and with which the rear end of the next bar is brought into coincidence; the ends being defined either by a fine line or other suitable optical means. In the method of measuring by contact care must be had not to disturb the position of the bar which remains in place, and against which the next succeeding one is made to abut. It is therefore admissible only to touch it with a very light pressure. To this end, Bessel used a slender glass wedge divided along its parallel sides, which was inserted between two bars purposely left a short distance apart, the width of the wedge at the points of contact being added each time to the length of the bar. Repsold's level of contact was first employed in the measurement of base-lines by Struve in Russia, and was subsequently adopted by Bache in the U. S. in a measuring apparatus which may be considered as the most perfect hitherto employed, and which will serve here to illustrate the principles involved in the delicate operation of the precise measurement of a distance of several miles. The apparatus consists of two measuring-bars, each supported on two massive tripod stands, placed respectively at one quarter from each end, and provided with mechanical means for adjusting the bars sidewise, lengthwise, and in height. Each measuring bar is a compensating combination of an iron and a brass bar, so adjusted as not only to have the same length at different temperatures, but also to preserve an invariable length through changes of temperature, by means of a suitable adaptation of the cross-sections of the bars to their respective specific heat and conductivity. These compound bars are protected from the direct influence of the sun by double tubes of tinned sheet iron, within which they are movable on rollers by means of a differential screw, admitting of the contacts being made within $\frac{1}{10000}$ of an inch. The abutting piece acts upon a lever of contact which is attached to the fixed end of the compound bar, and carries a spirit-level of great sensibility, the horizontal position of which defines that length between the two contact pieces of the measuring bar, which has been compared with a standard iron bar of six metres. By means of a circular abutting piece it is made possible to use the apparatus at inclinations ranging to four degrees on each side of a level. For complete description of this apparatus see the report of the U. S. Coast Survey for [illegible].

An accuracy within $\frac{1}{10}$ of an inch in one mile, or the [illegible] of the whole length, is attainable by means of this apparatus. The length of each bar is six metres, or nearly twenty feet. The average length of base-lines to which modern practice has settled is about 10,000 metres, or six miles. The necessity for extreme accuracy in the measure of a base-line becomes apparent when we reflect that whatever be its errors, the same are constantly multi-

plied as the triangulation advances, and an error of a foot in ten miles would produce one of ten feet in a hundred miles.

From such a base-line the triangulation proceeds, by gradually-increasing steps, to sides of as great length as the nature of the country will admit of. The preferred system of enlargement from the base-line is that of forming equilateral triangles on each side of the base, which together compose a lozenge, the long diagonal of which, duly observed from both ends, forms the base for a similar system as the next step. In a country of moderate elevations, sides from 25 to 40 miles are usually attained. In mountainous regions, sides from 60 to 80 miles are common, while 100 miles is very rarely attained.* In work of the first order it is always desirable to obtain quadrilaterals, the diagonals of which are intervisible, which attains the object that each successive base can be derived from a preceding one by two different triangles, and thus affords a continual check upon the precision of the operations. The intervisibility of stations on long lines is effected by means of small mirrors reflecting the solar rays towards the observer, directed by means of an apparatus called a heliotrope, of which there are several forms, all effecting the same purpose with more or less simplicity. Such a signal may be seen in the telescope, showing like a star of the second magnitude, when the outline of the mountain from which it is seen is indistinguishable.

The horizontal angles subtended from the different points of the triangulation are measured by means of theodolites—instruments for angular measurement—the vertical axis of which is placed in the vertical of the station-point occupied, and by means of which are consequently measured the angles between the vertical planes passing through the station-points observed upon. The angles thus measured are, therefore, the spherical—or, more precisely speaking, the spheroidal—angles of the triangle; their sum should exceed two right angles by an amount dependent on the ratio of the area of the triangle to that of the whole sphere; and known as the spherical excess. In an equilateral triangle of sides of 40 miles this amounts to 9″.1, or 1″ to every 76 square miles. The formula for spherical excess is as follows: $E'' = \frac{ab\sin C}{2r^2\sin 1''}$, where a and b are two sides, C the included angle of the triangle, and r the radius of curvature of the earth at the triangle. This radius of curvature varies somewhat with the latitude, and if we call $E = \frac{1}{2r^2\sin 1''}$, and express the distances in mètres, the following values will serve for accurate computation:

Lat. 25	........................log E	1.4060
30	....	1.4056
35	....	1.4051
40	....	1.4046
45	....	1.4041

The size of instruments used for the measurement of angles in geodetic work ranges from circles of 12 inches to 40 inches diameter, with telescopes of from 28 inches to 54 inches focal length, and corresponding apertures, the smaller instruments being of course applicable to the lesser length of sides. The accuracy attained in the mean result of the measurement of an angle should not be less than the nearest half second. When the largest class of instruments is employed the uncertainty of the result may be reduced to 0″.25. Owing to the variability of the directions as seen through the atmosphere, it is necessary to measure each angle at least twenty-five times, employing five or more different positions of the circle in order to eliminate the accidental errors of graduation, which even in the best instruments frequently reach 2″. The readings are usually taken with three micrometer microscopes, attached at equal intervals to the movable plate which carries the telescope. When the circle has been firmly mounted and carefully levelled, the telescope is pointed successively at each station, the corresponding readings on the circle being taken by means of the micrometers; the telescope is then reversed, and another series of observations is taken in the inverse order. The mean of these series forms a complete measure of the relative angles between the stations observed upon. From twenty-five to thirty such measures will generally yield all the accuracy attainable by the means employed.

When we have thus measured all the angles in a system of triangulation with the utmost attainable precision, and proceed to calculate the length of the sides, we shall be met by discrepancies in such lengths as may be independently derived through different series of steps, and by defects or excesses in the theoretical sum of the angles about a given point, or in the several triangles. These discrepancies, due to the residual errors in the angles, require adjustment in order to arrive at some definite geometrical figure. Such adjustment is effected by the application of the method of least squares, which demands that the geometrical conditions of the figure shall be satisfied with the least possible change of the observed angles. Illustrations of this method of adjustment will be found under the head of SQUARES, LEAST, METHOD OF.

Since the triangles are always small compared with the whole sphere, it is extremely convenient to compute the length of the sides as if they were plane triangles, each angle being diminished by one-third of the spherical excess—a method based upon the fact that small arcs are to each other as their sines.† An interesting example of the methods of computation and adjustment will be found in the Coast Survey Report for 1865, giving the results of the primary triangulation extending from the eastern boundary of Maine to New York, and involving three measured base-lines.

All geodetic operations are reduced to the common level of the ocean, and represent the surface of equilibrium at that level—a surface which is affected by the varying densities of the earth's crust, and which therefore will differ in many localities from the closest approximation to an average geometrical figure. It is necessary, therefore, to reduce the length of each base-line to what it would be at the level of the sea, to which end it is only necessary to know its elevation above that level, and allow for the divergence of the radii passing through its ends. The angles of the triangulation, being measured in the horizontal plane of each station, are the same whatever altitude they are measured at. The elevation of each station above the level of the sea, although of no importance in the general plan of a geodetic survey, is nevertheless of great importance in topographical aspects. It is determined by the observation of zenith distances of the several stations as seen from each other; which observations should be reciprocal and simultaneous in order to avoid the great variability of atmospheric refraction. Owing to the uncertainties arising from the latter cause during these measures, the levelling with a spirit-level and at comparatively short sights yields an accuracy far superior to that attainable by trigonometrical levelling.

The computation of difference of height from reciprocal zenith distances observed at two stations is made as follows: Let z, z' be the observed zenith distances, d the distance between the two stations, R the radius of curvature of the arc joining them, c the angle subtended by that arc, expressed in seconds, $h-h'$ the difference of height; then $c = \frac{d}{R\sin 1''}$, $h-h' = \frac{d\sin\frac{1}{2}(z'-z)}{\cos\frac{1}{2}(z'-z+c)}$. The effect of refraction is indicated by the fact that the sum of the two zenith-distances exceeds two right angles by an angle less than c, the angle at the centre of curvature. Designating the ratio of that excess to c as the *coefficient of refraction*, m, we have $m = \frac{c-(z'+z-180^\circ)}{2c}$. This coefficient of refraction is found to vary from 0.078 in moist localities to 0.070, and even less, in dry and elevated regions.

When the value of m may be assumed as known, the difference of elevation may be computed from the zenith-distance measured at one station only, by the formula $h-h' = \frac{d\cos(z+mc-\frac{1}{2}c)}{\sin(z+mc-c)}$.

The geometrical figure and dimensions of a system of triangulation having been determined by the methods heretofore sketched, the next step is to determine its position in azimuth and latitude. The azimuth is determined by observations on the pole-star, preferably at its elongations, when the accurate knowledge of time does not affect the result; by which means the meridian plane is referred to some point included in the system of horizontal angles of the triangulation. In order to check the accumulation of small errors in the measure of horizontal angles, and to take into account the local variations of the direction of gravity, it is now customary to determine the astronomical meridian with reference to the triangulation at a great number of stations, and to take an average of the whole for the orientation of the scheme of triangles. On similar considerations, the latitude is observed at a great number of stations, in order that from their comparison there may

* A very neat rule for the distance of visibility on account of the earth's curvature is this: The distance in miles is 1¼ the square root of the height in feet. Thus, an elevation of 144 feet allows a visibility from the horizon 15 miles distant. This includes an average amount of refraction.

† With the angles so reduced, one side and the three angles being always given, the computation of the other two sides proceeds upon the principle that the sides are to each other in the same ratio as the sines of the opposite angles. It is customary to carry the expression of the angles to hundredths of seconds of arc, and to employ eight places of decimals in the logarithmic computation.

be derived an average value of the earth's curvature in the meridian, less influenced by local attraction than the comparison to two terminal stations would probably be.

The azimuth is usually determined by means of the same theodolite which serves for the measurement of horizontal angles, using the mercurial horizon for direct and reflected observations of the pole-star in preference to the spirit-level on the transit-axis of the instrument. The determination of a meridian-mark by means of a transit-instrument, employing upper and lower passages of circumpolar stars, is to be specially commended.

The determination of latitude is primarily effected by the observation of the zenith-distances at upper and lower culminations of circumpolar stars, or else by the measurement of zenith-distances of stars the declinations of which have been well ascertained at fixed observatories. The most convenient practice for determination of latitude in the field, where the employment of instruments carrying circles of large size is extremely inconvenient, has been found to be that of equal zenith-distances, first suggested by Gauss, and put in practical shape by Talcott. This method consists in selecting from the great number of stars whose positions are now accurately determined, two that follow each other within a few minutes of time, and which have nearly the same zenith-distance at the place of observation, on opposite sides of the meridian. A telescope of considerable power, with attached level and micrometer, serves to measure the differences of zenith-distance. The method thus leaves to the permanent observatories, supplied with instruments of great power, the ascertainment of absolute declinations, and at the field station we only concern ourselves to measure micrometrically the difference of zenith-distance, including, of course, the ascertainment of the level correction. It is evident that the mean of the declinations, corrected for half the difference of zenith-distance, will give the latitude of the place.* By these means it is found practicable to determine the latitude within 0.″1 by observing twenty-five pairs of stars on three nights, occupying about four hours on each.

Another method of determining the latitude is by observing the times of passage of stars which culminate near the zenith over the prime vertical on both sides of the meridian. The difference between the declination of each star and the latitude of the place is then deduced from the difference of time between its two prime vertical transits. This method, first employed by Bessel, is susceptible of great precision, but absorbs much time; having, however, the economical advantage of employing the same instrument which is used for observations of time, the astronomical transit. Observations have been made at the same station by the three different methods, to test their agreement with the following results:

Latitude of Station Mount Agamenticus, Me.

By differences of zenith distance...	43° 13′ 24.″99	±0.″11
By absolute zenith distances.........	25.07	±0.10
By transits in prime vertical........	24.97	±0.14

showing an accordance within the limits of the probable error.

While the astronomical latitude is referred to a determinate plane in space—viz. that of the equator—the longitude is merely relative to some assumed meridional plane of the globe, for which it is customary, for many historic reasons, to take that of the Greenwich Observatory in England. It is obvious that the difference of longitude between two stations can only be determined by corresponding observations at both places. Our only means of measuring such differences being by time, we must note at the outset that the unit employed and perceptible to our senses is much larger than that employed in the co-ordinate of latitude, the second of time being fifteen times as great as the second of arc. Hence the extreme difficulty of precise determinations. The essential mode of obtaining a difference of longitude is that of comparing the accurate local time of each place by means of some instantaneous phenomenon that can be simultaneously observed at both places. A flash of light visible from each station is the type of this mode of determination, but is applicable only for limited distances. Occultations of stars by the moon, although not strictly simultaneous, yet reducible to a common instant, are the next in order of accuracy, but fail in extreme precision, from the fact that the moon's edge presents very sensible inequalities. Solar eclipses have a somewhat greater degree of precision than occultations of stars, but occur at very rare intervals. The transportation of chronometers from one place to another for inter-comparison of local time affords another means of recognized value.†

By far the most precise method of determining differences of longitude is by means of the electric telegraph, by which astronomical clocks at different places are compared with each other chronographically with the utmost precision. The method of recording observations of time on a chronographic register, by means of a galvanic circuit, known in Europe as the *American method*, originated in the U. S. Coast Survey with the first attempts to determine longitude by means of the electro-magnetic telegraph. The *chronographic record* is made on a cylinder, revolving with nearly uniform velocity, covered with a sheet of paper, upon which a pen traces a line, interrupted or deflected for an instant, through the agency of an electro-magnet, every time the pendulum of the clock passes the vertical, and, in doing so, interrupts a galvanic circuit. The pen is at the same time slowly moving lengthwise, so that the line formed is a long spiral, which is thus graduated into spaces corresponding to seconds of time, and described with uniform velocity. When any instant of time is to be recorded the observer strikes a finger-key, which, like the pendulum, breaks the galvanic circuit, and causes a similar mark to be made on the record; the position of which, in reference to the adjacent seconds marks, can be read off with great precision. The method of determining longitudes by means of the electric telegraph is substantially as follows: A transit-instrument, astronomical clock, and chronograph are mounted at each station. After suitable observations for instrumental corrections at each station, which are recorded only at the place of observation, the clock at the eastern station is first put in connection with the circuit, so as to write on the chronographs at both stations. Next that at the western station is made to perform the same service. Now, since these records have been obtained at both stations, it will be easily seen that if there be any sensible interval of time consumed in the transmission of the signals, the difference of longitude obtained from the record at the eastern station will be too great by that interval, and that at the western station will be too small by the same amount. The mean result will give the longitude free from this error, and the difference measures double the time of transmission of the signals through the whole circuit. By this method the longitude of Harvard Observatory from Greenwich has been determined by the U. S. Coast Survey, on three different occasions, with the following highly accordant results:

1866, by Anglo-American cables.........	4h.	44m.	31.05s.
1870, by French cables to Duxbury......			30.99
1872, by French cable to St. Pierre......			30.96

Instructive examples of this method will be found in the Coast Survey Reports for 1848, 1856, 1866, 1867, and 1872.

When, by the operations heretofore indicated, the trigonometrical network of a country has been determined, and its situation in respect to the astronomical meridian, the equator, and the assumed first meridian has been ascertained, it remains to compute for each point of the triangulation its latitude and longitude, in order to project the same upon a map. The latitude and longitude of some point of departure being known, and the distance and azimuth of the next station, we proceed to compute the difference of latitude and longitude and the reverse azimuth by the following formulæ, which take into account the spheroidal figure of the earth, and are those used in the U. S. Coast Survey. Let a be the equatorial radius of the earth, or 6,378,206 mètres; b the polar semi-axis, or 6,356,584 mètres; then $e^2 = \frac{a^2 - b^2}{a^2}$, e being the eccentricity; the radius of curvature in the meridian for any latitude L is $R = \frac{a(1 - e^2)}{(1 - e^2\sin^2 L)^{\frac{3}{2}}}$; the normal to its intersection with the polar axis is $N = \frac{a}{(1 - e^2\sin^2 L)^{\frac{1}{2}}}$. Let, further, K designate the distance between two trigonometrical stations, L, L' their latitude, M, M' their longitude, Z and Z' the azimuths of the line K, counted from S. around by W.; then we have, in the spheroidal triangle formed by the pole and the two stations, by development into series, $L - L' = \frac{K\cos Z}{R} + \frac{K^2\sin^2 Z\tan L}{R\,2N} - \frac{K^3\sin^2 Z\cos Z(1 + 3\tan^2 L)}{R\,6N^2} \ldots - (\delta L)^2 D$.

The last term is a small correction due to the fact that the series is developed for the radius of curvature at the latitude of the given station, instead of the middle latitude, δL being an approximate value of the difference of latitude derived from the first and second terms, and $D = \frac{3e^2\sin L\cos L}{2a(1 - e^2)}$.

* A marked advantage of the method is that refraction enters only differentially into the results.

† Yet the degree of accordance in the results attainable by different chronometers and by repeated transportation falls far short of what would be requisite to make the differences of longitude so obtained comparable in accuracy with differences of latitude.

We have further $M' - M = \dfrac{K \sin Z}{N' \cos L'}$, and $Z' - Z = 180^\circ - (M' - M) \dfrac{\sin \frac{1}{2}(L + L')}{\cos \frac{1}{2}(L - L')}$.

The use of these formulæ is made quite convenient by means of tables of coefficients depending on the latitude, which can be found in the Coast Survey Report for 1860.

With the determination of the latitude and longitude of each triangulation-point, and of their relative distances and bearings, the work of geodesy is concluded. The further operations requisite to the construction of a complete map of a country are set forth in our articles on TOPOGRAPHY and MAP. It remains now to show how the figure and magnitude of the earth may be derived from the results of the geodetic operations that have been reviewed.

The fundamental elements of the earth's magnitude and figure have long been a subject of the highest interest to philosophers. While measures approximating to precision have only been executed within the last 200 years, attempts were made to ascertain the diameter of the globe as early as 200 years before our present era. The sphericity of the earth was fully recognized by the Alexandrian school, and Eratosthenes, by a comparison of the angle of the shadow of a vertical style at Alexandria and at Syene, had estimated the circumference of the earth to be about 252,000 stadia; and, later, Posidonius, by a similar comparison of the altitude of the star Canopus at Rhodes and at Alexandria, derived a value of 240,000 stadia.* Under the auspices of Maimon, caliph of Bagdad, the length of a degree was determined to be between 56 and $56\frac{2}{3}$ Arabic miles, equivalent to 58,400 to 59,000 toises—a result only about $2\frac{1}{2}$ per cent. in excess. Meantime, the Western World had fallen into the night of the Middle Ages, during which the earth was again considered as flat; and it was not until 1800 years after Eratosthenes that Snellius and Musschenbroek, by measures near Leyden in Holland, between 1615 and 1629, determined the length of a degree to be 57,033 toises. Norwood (1633–35) found the length of a degree between London and York to be 57,300 toises.

But these attempts, as well as that of Fernel in France, while they are notable approximations, were not based upon methods of precision. The first application of accurate measurement was made in 1669 by Picard, who first applied telescopes to astronomical observation, between Malvoisin and Amiens, in France, which operation furnished to Newton the data for the demonstration of the law of gravitation. At that era, under the intelligent auspices of Louis XIV., the French continued to lead in geodetic operations, and in connection with the trigonometrical survey of France three arcs were measured by the two Cassinis (1683–1700) between Bourges, Paris, Amiens, and Dunkirk, by trigonometrical operations, avowedly for the purpose of determining the figure and magnitude of the earth. While such measurements, taken in middle latitudes, would well serve to determine the average diameter of the earth, they could throw but little light on the question of its ellipticity, which can be derived only from arcs measured in widely different latitudes. From theoretical considerations, supported by the pendulum observations of Huyghens and Richer, Newton had concluded the polar axis of the earth to be somewhere between $\frac{1}{180}$ and $\frac{1}{500}$ less than its equatorial diameter, while Cassini's measures indicated a slight excess of the polar axis. In order to settle this question, the French determined to measure arcs of the meridian near the equator and near the pole, in addition to those situated within their own country. Accordingly, about 1740 three degrees were measured in Peru, near the equator, by Bouguer and La Condamine, and a corresponding arc in Lapland, near Tornea, by Maupertuis and Clairaut. The results of these operations showed a flattening at the pole of between $\frac{1}{250}$ and $\frac{1}{300}$, and first established the fact of the spheroidicity of the earth.

Since that time all civilized nations have been engaged in making geodetical surveys of their territories, either with the direct object of measuring arcs of the meridian or of a parallel, with a view to the determination of the elements of the earth's figure, or in connection with a complete trigonometrical survey of their respective countries.

The French have covered their entire territory with a network of triangulation, and their meridional arc, of over ten degrees, from Dunkirk to Barcelona, forms a leading element among the existing data, having served, in connection with the arc measured by them in Peru, for the determination of the *mètre* as the ten-millionth part of a meridional quadrant. The value thus obtained has been found somewhat too small when more extended measurements are taken into account, as will be seen below. England has not only covered the British Isles by the geodetic operations of the Ordnance Survey, but has executed still more extensive surveys in India, besides extending at the Cape of Good Hope the arc first measured by Lacaille under French auspices. In Russia the geodetic operations carried on by the Struves cover a range of twenty-nine degrees of latitude. The Scandinavian and German states have contributed their share. In Italy and Spain great activity in the same direction has lately been developed; and an international organization for the complete junction of all European triangulations is actively engaged in bringing the whole network of Europe into one uniform system of geodetic measurement. North America early (*Phil. Trans.*, 1768) furnished a contribution to the general stock of information by Mason and Dixon's measurement of the line between Maryland and Pennsylvania, and the determination of latitude at its terminal points. But since the increase of precision demanded in the latter element this datum has lost its place among the valid measures. Trigonometrical operations of the U. S. Coast Survey have, however, furnished up to this time an addition of eight degrees of the meridian—namely, $3\frac{1}{2}^\circ$ in New England and $4\frac{1}{2}^\circ$ from the head of Chesapeake Bay to Ocracoke Inlet; and much larger contributions to the admeasurement of the earth's figure are accruing from the further prosecution of the work.

It will be readily seen, without going into mathematical developments, that the measure of the length of a degree in different latitudes on the same meridian will give us the measure of the earth's ellipticity; and if in different meridians we should find a different degree of ellipticity, the inference would obtain that the equator itself is not a circle, and the earth's figure therefore not precisely a spheroid of revolution about its polar axis, but more nearly an ellipsoid of three axes. There is a small preponderance of evidence in favor of the latter supposition; but as by far the larger proportion of meridional arcs have been measured in nearly the same longitude, while the total aggregate does not yet reach a quarter of a circle, the conclusion as to the ellipticity of the equator is at present within the uncertainties of the data.

It will not be out of place here to show the method of finding the semi-axis and ellipticity, when the lengths, amplitudes, and middle latitudes of two arcs are known. Let s, λ, m, and s', λ', m' represent those data respectively, and a, b, as heretofore, the equatorial and polar semi-axes; then,

$$\frac{a-b}{2} = \frac{1}{3} \, \frac{\frac{s}{\lambda} - \frac{s'}{\lambda'}}{\cos 2m' - \cos 2m}$$

$$\frac{a+b}{2} = \frac{\frac{s}{\lambda}\cos 2m' - \frac{s'}{\lambda'}\cos 2m}{\cos 2m' - \cos 2m};$$

from which a and b are readily found, as well as the ellipticity, which is $\epsilon = \dfrac{a-b}{a}$.

Bessel has shown how measurements made in different parts of the earth, comprising not only those of meridional arcs, but also arcs of the parallels or geodetic arcs measured in any direction, may be combined, by the method of least squares, to give the most probable elements of the earth's figure; and in 1841 (*Ast. Nach., No.* 438), he derived, from the data existing at that time, the following values: a = 6,377,397 mètres, b = 6,356,079 mètres, and hence $\epsilon = \frac{1}{299}$, and the length of a meridional quadrant = 10,000,856 mètres.

The latest general combination of the various meridional arcs with a view to the determination of the figure of the earth has been made by Clarke, of the British Ordnance Survey, published in 1866. It does not comprise the results of the American measures, which were only published in 1868, but these so closely agree with the general result that their introduction would not sensibly modify the elements. It is based, like all previous discussions, upon the supposition that the uncertainty of the measured lengths of the arcs is extremely small, compared with that of their amplitudes or differences of latitude; since the latitudes are affected by the irregularities of local attraction to an amount generally between one and two seconds of an arc, attaining in mountainous regions even ten seconds. Stations exhibiting extraordinary discrepancies in latitude are of course excluded from the discussion, which was preceded by a minute comparison of all the standards of length that had served in the several operations. The following arcs, entitled to equal consideration by their superior precision, have entered into the comparison: (1) The French arc, from Formentera (lat. 38° 40′) to Dunkirk (lat. 51° 2′), having an amplitude of 12° 22′, and comprising six latitude-stations. (2) The British arc, from Greenwich (lat.

* We lack the means of making an approximate comparison of these estimates with modern measures, but they show that the problem was well understood by the ancients.

51° 28′) to Saxavord (lat. 60° 49′); amplitude 9° 21′, with six latitude-stations. (3) The Indian arc, between Punnae (lat. 8° 10′) and Koliana (lat. 29° 31′); amplitude 21° 21′, with eight latitude-stations. (4) The Russian arc, from Staro Nekrassowska (lat. 45° 20′) to Fugleness (lat. 70° 40′): amplitude 25° 20′, thirteen latitude-stations. (5) The Cape of Good Hope arc, from North End (lat. 29° 44′) to Cape Point (lat. 34° 21′); amplitude 4° 37′; five latitude-stations. (6) The Peruvian arc, from N. lat. 0° 2′ to S. lat. 3° 4′; amplitude 3° 6′; two latitude-stations. These six groups, aggregating an arc of over 76°, and comprising 40 latitude-stations, when treated with reference to a spheroid of rotation, yield the following results:

Equatorial semi-axis = 20,926,060 feet = 6,378,206 mètres.
Polar semi-axis = 20,855,120 " = 6,356,584 "
Ellipticity = $\frac{1}{295}$.

When the latitudes of the several stations are computed from the mean of each arc upon these elements, the difference between the computed and observed latitudes is on the average ± 1″.8, a degree of discordance fairly ascribable to local deviations of the plumb line. The same data, treated with reference to an ellipsoid of three axes, indicate an ellipticity of the equator of 1 : 3270, while the average error of the latitudes is only reduced to ± 1″.4, which small improvement gives no great support to that assumption. A quadrant of the meridian on the spheroid (of rotation, the elements of which are above given) is equal to 10,001,887 mètres, showing that the mètre falls short of its presumed value by its $\frac{1}{5310}$th part.

It appears that this figure may be taken as the most probable that can be deduced from the geodetic measurements published at the present time; nor is it likely that it will be materially changed by the operations now in progress in Central Europe. The following table, derived from the same elements, embodies the data which are most likely to be useful to the American reader:

Latitude.	Length, in metres, of one degree— on the meridian	on the parallel
23°	110,739	102,524
24	110,753	101,754
25	110,768	100,952
26	110,783	100,119
27	110,799	99,257
28	110,815	98,364
29	110,831	97,441
30	110,848	96,488
31	110,865	95,506
32	110,883	94,495
33	110,901	93,455
34	110,919	92,387
35	110,937	91,291
36	110,956	90,166
37	110,975	89,014
38	110,994	87,835
39	111,013	86,629
40	111,033	85,396
41	111,052	84,137
42	111,072	82,853
43	111,091	81,543
44	111,111	80,208
45	111,131	78,849
46	111,151	77,465
47	111,170	76,058
48	111,190	74,627
49	111,210	73,174
50	111,229	71,698

Besides geometrical admeasurements of the earth, there are physical considerations which lead to an estimate of its form and ellipticity which it is of interest to compare here with the above results. Upon the hypothesis of the earth having the form which a fluid mass of its dimensions would assume rotating with the same velocity, it was shown by Clairaut in 1743 that the increase of gravity in passing from the equator to the poles varies as the square of the sine of the latitude, and that a certain relation must necessarily exist between the ellipticity and the amount of gravity—namely, that $\frac{g}{G} = 1 + (\frac{5}{2}m - \epsilon) \sin^2 L$, where G is the force of gravity at the equator, g that at any latitude L, m the ratio of centrifugal force at the equator to gravity, and ϵ the ellipticity.

The force of gravity has been determined at a great number of stations by pendulum experiments, an exhaustive discussion of which is to be found in Airy's treatise on the figure of the earth. (*Encyc. Metrop.*, 1830. See also PENDULUM EXPERIMENTS.) The general result of these observations is that the difference between the equatorial and polar diameters, or the ellipticity of the earth, is $\frac{1}{289}$ of the former. This is somewhat larger than the ellipticity deduced from the geodetic measures above recited—namely, $\frac{1}{295}$. The difference between the two results, partly attributable to the unequal distribution of land and water on the surface of the earth, is so small as to show that the distribution of the earth's mass is very nearly that which would result from the supposition that its form is due to an anterior fluid condition, or that if its interior be now fluid the hardened crust is very closely adapted to the form of fluid equilibrium.

The standard works to which the student of geodesy may be referred, in addition to those already cited, are Delambre and Méchain, *Base du Système Métrique*; Puissant, *Traité de Géodésie* (1842); Bessel's *Gradmessung*; Fischer's *Geodasie*; James and Clarke, *Ordnance Trigonometrical Survey of Great Britain*, etc. (1858); Pratt, *Figure of the Earth* (1871). No systematic treatise on geodesy is at the present time (1875) extant in the English language.

J. E. HILGARD.

Geoffrey of Mon′mouth (JEFFREY AP ARTHUR), a Welsh chronicler, became bishop of St. Asaph in 1152, and probably d. in 1154. His most important work, *Chronicon sive Historia Britonum*, is probably a paraphrase of some older work, and so abounds in fables as to have small historic value.

Geoffroy St.-Hilaire (ÉTIENNE), b. Apr. 15, 1772, at Étampes, France; distinguished himself by his brave rescue of Haüy from the Terrorists 1792; became professor of zoology in the Jardin des Plantes 1793; was actively engaged in the Egyptian exploration 1798–1802; was chosen to the Legion of Honor, 1803, to the Institute, 1807; became professor of zoology in the Faculty of Sciences 1809. In 1829 his famous controversy with Cuvier broke out, regarding the unity of plan lying at the basis of the philosophic or transcendental system of comparative anatomy; the soundness of which system Cuvier denied. He wrote much and ably regarding philosophical anatomy and other biological subjects; was late in life blind and paralytic, and d. June 20, 1844.

Geoffroy St.-Hilaire (ISIDORE), M. D., son of the foregoing, b. at Paris Dec. 16, 1805; became his father's assistant 1824; took his degree 1829; entered the Institute 1833; became inspector in the Academy of Paris 1840; professor of zoology in the Museum 1841, and in the Faculty of Science 1854; professor in the Société d'Acclimatation 1854. D. Nov. 10, 1861. Author of the *Life* of his father, and of good treatises on teratology, acclimatization, hippophagy, and various biological subjects.

Geographical Distribution of Diseases. It has long been known that certain diseases are endemic, or peculiarly prevalent at all times, or at certain seasons of the year, in particular countries and regions. The ancients knew this, and recorded many interesting facts in relation to it; but the idea of a generalization of the known facts, and of a systematic and thorough search after new and unknown ones, is a thing originating in the present century. Scientific nosogeography is a newly-born and as yet a comparatively undeveloped branch of knowledge. The geographical distribution of disease is largely dependent upon the *physical conditions* of the various countries of the globe. The topics which physical geography considers are the great facts which bear upon the health of man and the lower animals. Latitude, elevation, surface of country, climatic zones and isothermal lines, variations of temperature, the geological and chemical character of soils, water distribution in air and soil, the vital characters of different races, the injurious and salutary influences of vegetation,—these are some of the topics which nosogeography considers.

Latitude and Climatic Zones.—These are intimately associated in their influences upon disease. Thus, the intertropical zone is the home of the worst forms of malarious fevers, cholera, and hepatic diseases. Not alone the influences just indicated, but other conditions, tend to this result. Damp soils and the presence of decaying vegetation especially assist, particularly in low-lying regions like river-deltas. The yellow fevers of the Mexican Gulf, the dreadful remittent fevers of Western Africa, and the ever-present cholera of the lower Ganges are examples of the evil effects of a combination of unfavorable conditions. Farther N. and S. are the zones of typhus, typhoid, and intermittent fevers, scarlatina, and the like. These zones are nowhere clearly marked off from the tropical on the one hand or the cold zones on the other. Except intermittent fevers, few of their diseases are endemic. But they are peculiarly subject to epidemics or occasional severe visitations of some prevalent disease. If the intertropical region is the abode of dreadful endemic diseases, then is this the peculiar field of great epidemics, for many of the epidemic diseases are truly endemic in the intertropical regions. In this connection it may be noted that the plague, once the great epidemic scourge of Europe, is now strictly localized, and known only in the Levant. In the northern hemisphere we find northward of the zone last mentioned the great zone of catarrhal diseases of the air passages—a zone which has no southern representative, for all the habitable land in the southern hemisphere is remarkably free from catarrhal diseases of any kind. Catarrhal diseases prevail also to a

great extent in portions of the intertropical and warm zones, but their seat is (though not exclusively) the alimentary canal, rather than the respiratory mucous surfaces. The zone of catarrhal disease extends northward as far as the human race is found. It is to be noted that certain diseases seem not to be affected by any of the conditions hitherto considered. Thus, leprosy is endemic in Greenland, Norway, and Iceland, as well as in the valleys of the Niger and the Amazon, in the high Deccan, the volcanic Sandwich Islands, and the low Philippines. Rheumatism prevails in the warm and dry Queensland and in the cold and wet Newfoundland.

Elevation above the sea-level is another important point to be considered. In cases of emphysema and heart disease it may have a direct effect upon the patient's comfort and the duration of his life. The barometrical pressure in cases of thoracic disease is a question little studied as yet, but most inviting to the student and the philanthropist. Hypsometrical conditions also affect health through the temperature, the vegetation, and the hygrometry of any region. Thus, in Italy the higher hills about the Maremma are comparatively free from the prevalent fevers. Some hill-regions, however, are habitually ravaged by fevers, while the intervening valleys are free from the endemic. Researches regarding geology, the character of soils, vegetation, and drainage may explain these apparent anomalies.

Drainage.—The importance of this topic, considered with relation to the prevalence of disease, is well illustrated in the history of the Campagna, the Maremma, and the Pontine Marshes. The destruction of the rude drainage systems of antiquity during the Gothic wars was a great blow to Rome and to Italy, for it reconverted the once fruitful region just indicated into an almost useless waste, whose exhalations infect a large area. Of late years, the relation of soil-moisture to the prevalence of consumption, enteric and other fevers, dysentery, and scarlatina has attracted much attention. Dry soils, it must be conceded, are the healthiest by far, other conditions being equal.

Geological and Chemical Characters of Soils.—That goitre, calculus, and cretinism prevail upon calcareous soils, and that the inhabitants of alluvial tracts are peculiarly liable to fevers, have long been known. But that a high and dry region with a porous soil, like that of Gibraltar, and in general the dry volcanic regions, should be the homes of acute diseases, such as fevers, is by no means easy to explain. It has been suggested that some dry soils may be peculiarly receptive and retentive of the organic germs upon the presence of which many diseases are supposed to depend. The subject is by no means well understood at present. It is certain that cultivation of the soil may favorably modify the character of malarial diseases, and even banish the endemic influence; but these effects are not universal, for some of the longest-settled and best-cultivated regions of Europe are subject to intermittent fevers.

Vegetation.—The influence of vegetation upon general health is sometimes injurious and sometimes beneficial. The belief that microscopic plant-germs are the direct cause of many diseases is becoming a general one, but the known facts with regard to the question are as yet few. On the one hand, the beneficial influence of trees and herbs in warding off diseases is clearly established. The destruction of large forests, especially in wet and warm countries, is often followed by deadly epidemics. On the other hand, it has been held that the mangrove-belts of tropical regions breed fevers, but the facts collected go to show that the fevers prevail in spite of the protection exercised by the mangroves; or, rather, that the flux and reflux of tides deposits decaying organic matter among the roots of the mangroves, and that this decaying matter is the source of the disease, for there is no question that if living vegetation wards off disease, decaying vegetation is a most fruitful source of it. Facts are not wanting which tend to show that the cholera may have its origin from minute vegetation. Certain it is that its worst ravages in the Ganges Valley have been in years when the rice was mildewed or rusted extensively; and there are observers who believe that the rust of barley-straw gives origin to the measles; but it is generally regarded as probable that neither cholera nor measles are originated in this way.

Animal life affects the distribution of disease much less directly than vegetable. Egypt has an endemic dysentery, and the Cape Colony an endemic hæmaturia due to entozoa. Guinea-worm prevails in the tropical parts of the Old World, and tape-worm about the Gulf of Bothnia, to an astonishing degree. Certain epizoötic diseases are also to some extent communicable to man.

Races, Acclimation.—That there is a difference in the vital character of the different races is now generally conceded. The Polynesian race seems dying out, not simply from degrading habits, but even in islands seldom visited by sailors, and in places where the former conditions of their life seem to be maintained. In many instances it appears that strong emotional excitement has caused the death of persons of this feeble race. The rapid destruction of the American Indians illustrates the same probable truth, that the vital force of some races is becoming exhausted. The mixed races, as seen in India, South America, South Africa, and the U. S., are generally inferior, physically, to both parent stocks. People of the different races generally thrive best upon their own soil. In Bengal it is declared that British troops never become acclimated, but become feebler the longer they stay. In Australia, however, the British emigrant is far healthier and stronger than the aboriginal native. The French have crossed the Mediterranean and settled Algeria, but, says Boudin, its colonization has been proved to be impossible. Nevertheless, the Phœnicians and Romans long ago colonized the same region with success. These points show that man's constitution is one of the factors in vital statistics.

The prevailing *personal habits* of any people materially affect the public health. Certain endemic diseases, like the *beri-beri* of Ceylon, appear to depend largely upon the widely-prevailing abuse of alcoholic stimulants. The avoidance of an unmixed fish-diet has extinguished the leprosy once endemic in the Faröe Islands, and the unhealthy Mauritius has a hardy peasantry of French descent whose poverty has kept them abstemious, and consequently healthy.

The Continents.—No part of the world seems so well adapted to human health and development as *Europe*. Here the conditions of temperature, soil, and moisture seem almost perfect; and with increased attention to public health the future will, it may be hoped, be far more free than the past from pestilences, famines, and the ravages of endemic disease. The diseases of *Asia* much resemble those of Europe, except that in the intertropical regions the diseases have that peculiar character already indicated. Japan and China have more cholera and remittent fevers than might be looked for. North-eastern Asia has a North American climate and disease-character. *Africa* is the home of acute and deadly diseases of the intertropical type, yet Morocco and the Cape of Good Hope are remarkably healthful. *Australia* has almost no widely prevailing diseases, except rheumatism in the N. E. and fevers in the extreme N. *North America* appears less congenial to human health than Europe. In the U. S. fevers prevail in the S., pneumonia and ague in the central, and consumption in the N. E. portion. The Pacific coast and the Western plains and mountains are, however, exceptionally healthful. There is no civilized country where the conditions requisite to public health require more careful attention than ours. The tables of the vital statistics of the ninth U. S. census are prepared from the very imperfect death-returns of the U. S. census-takers. They are illustrated by carefully prepared maps, showing the relative proportion of deaths in the various parts of the U. S. from each of several important classes of disease. The general results of the investigation of the census returns may be stated as follows: (1) Other things being equal, there is more mortality from lung diseases in a northern than in a southern latitude; in a wet than in a dry region; at a low than at a high level, the pine regions of the South being, however, remarkably free from pulmonary disease, though low and having a large rainfall. (2) Malarial fevers are most fatal, *cæteris paribus*, in southern latitudes and in wet and low regions, but are also for the most part comparatively insignificant in the great pine forests. (3) The continued fevers and intestinal catarrhs are most deadly in the South, but prevail to a formidable degree throughout the land.

The science of the geography of disease requires, first, careful collection of more facts by competent observers, and, next, wise generalizations and thorough discussion of the gathered facts. No branch of science can be more important, and few will be found more difficult to master, than this. (See the treatises of MÜHRY and of BOUDIN on nosogeography, and SIR R. MARTIN *On the Influence of Tropical Climates.*) CHAS. W. GREENE.

Geog'raphy [Gr. γῆ, the "earth," and γράφω, to "write" or "describe"], literally, a description of the earth. A simple description, including the nature of the land and waters, of the climate and natural productions, of the various countries of the globe, together with an account of the people and nations inhabiting them, and of their social and political condition, was the substance of the first geographical writings transmitted to us by the ancients. Though our information on all parts of the earth is now far more extensive and reliable, geography has, to this day, necessarily retained its descriptive character; for an accurate description of the phenomena observed in nature and in human societies is the only foundation for a scientific knowledge of our planet. It is therefore quite natural that most of the geographical treatises confine themselves to the task of drawing such pic-

tures as will seem to most readers sufficient for practical purposes. This is *General Descriptive Geography.* But the great progress of physical and natural sciences, as well as of the science of man in all his conditions, has awakened a desire for a higher, more comprehensive, and intelligent knowledge of our earth. To describe without rising to the causes and descending to the consequences of the phenomena is not science. The reflective mind craves more. While studying the earth in its natural aspects, it wishes to learn *why* these natural phenomena are as they appear, *how* they are produced, and what *laws* govern them. It seeks to understand the relations of mutual dependence which bind them together, as causes and effects, into a vast system, into one great individual mechanism, which is the terrestrial globe itself, with all it contains. Such a science must endeavor to discover those incessant mutual actions of the different portions of physical nature upon each other, of inorganic nature upon organized beings—upon man in particular—and upon the successive development of human societies; in a word, to study the reciprocal action of all these forces, the perpetual play of which constitutes what might be called the life of the globe. This is *Scientific Geography*, which may be defined as the science of the general phenomena of the present life of the globe in reference to their connection and mutual dependence.

It may be asked whether a science which thus embraces the whole domain of nature and man has a claim to an individual existence; but when geology has taught us the composition of the earth's crust and the history of its gradual formation, physics, the laws which govern matter—when botany and zoology have classified the plants and animals according to their affinities and differences in a grand system of life; when ethnography and history have done their special work,—it still remains for geography to trace out the relations of these various orders of things to each other. Geography needs the results of all these sciences, but is not to be confounded with them.

Geography, as the science of the earth, is naturally divided into three great departments, corresponding to three orders of facts: the earth considered as a planet, a part of the solar system, or *Astronomical Geography;* the earth considered in itself, the *Geography of Nature*, or *Physical Geography;* the earth considered as the abode of man, the *Geography of Man.* These three departments are usually called *Mathematical, Physical*, and *Political* Geography.

MATHEMATICAL GEOGRAPHY embraces two distinct sciences, both of which need mathematics as their principal instrument: *a. Astronomical Geography*, which treats of the position of the earth in the solar system, of its general form, its movements of rotation and revolution around the sun as causes of the daily and annual changes in the distribution of solar light on the surface of our planet, or the succession of days and nights and seasons. *b. Mathematical Geography* proper includes Geodesy (from γῆ, the "earth," and δαίω, to "divide"—viz. in mathematical figures), which teaches the scientific methods of ascertaining the exact form of the earth, and of all portions of its surface, and their precise location in longitude and latitude; *Topography* (τόπος, a "place," and γράφω, to "describe"), which surveys the minor features of relief and position of land and water, the location of mountains, rivers, and places; and *Cartography*, which teaches how to represent the same on maps and globes.

PHYSICAL GEOGRAPHY is the geography of nature. Physics, or natural philosophy, is its principal helpmate. When it confines itself to a simple description of the natural features of the land, climate, plants, and animals, it is called *Physiography* (from φύσις, "nature," and γράφω, to "write"), a term which is fast coming into use. When applied to the waters, it is *Hydrography* (from ὕδωρ, "water," and γράφω, to "write").

Physical Geography proper, however, goes farther, and seeks by careful comparison to discover the laws which regulate the structure and distribution of the land-masses and oceans. It shows how the relief of the continents controls their drainage and shapes the vast river-systems, so useful and so characteristic of each of them; how the very forms of the lands, together with their size and relative situation, modify the climate, the productions, and therefore the capacity of each country for commerce and civilization. It not only describes the great marine currents which circulate in the bosom of the oceans, but seeks to discover their causes, trace their connection, and the vast influence they exert upon climate, either by heating or cooling the superincumbent atmosphere. It is not enough for it to find that the temperature is highest in the equatorial regions of our globe, and gradually decreases toward the poles; it inquires into the causes of that fundamental law of the distribution of heat. But, while the general law is well established, why is it that mountains which rise from the burning, tropical plains of the Amazon and the Ganges are capped with everlasting snow? that in January snow obstructs the streets in New York City, while in the same latitude the orange tree flourishes under a genial sun and in a mild atmosphere in Naples, and flowers and perpetual verdure grace the gardens in the islands of the Azores in the midst of the Atlantic? that on the E. of the American continent Labrador is but a frozen peninsula, where no tree can grow, no agriculture is possible, in the same latitude where in Europe, on the other side of the Atlantic, the cities of Christiania, Stockholm, St. Petersburg flourish in the midst of cultivated fields? Looking at the distribution of rain-water, that other element of climate indispensable for all that has life on earth, why is it that it is so unequal, varying from a complete or almost total absence in the deserts to an amount which would cover the ground with a layer of fifty feet of water? Why are the sunny regions of the tropics blessed with a quantity of rain-water several times greater than that which falls in our temperate regions, while the foggy regions toward the poles receive as many times less? Why are the rains periodical in the warm regions, and more and more equally distributed throughout the year as we recede from them toward the poles?

To answer all such questions, suggested at every step to the reflecting observer of nature's phenomena, physical geography has to find out the laws which govern the distribution of heat and of the rains. It has to study the course of the winds, which are the carriers of warm and cold air from one place to another, and of the rains from the common reservoir of the ocean to the interior of the continents. It thus shows that upon all these elements, properly combined, and modified in their action by the forms, extent, and situation of the land-masses and oceans, depend the distribution of life, vegetable and animal, on the surface of the globe, and the degree of usefulness to man of each portion of his domain.

The scientific treatment of every portion of this vast field of research expands into a science. The study of the globe as a unit, irrespective of its surface, involving that of its general form, as given by geodesy, its density, its magnetism, its specific temperature, forms a group to which may fitly be applied the name of *Physics of the Earth*, already much in use among French scientists, though in a less defined meaning. Taking up the surface, *Geomorphy* (from γῆ, the "earth," and μορφή, the "form") studies the forms, horizontal and vertical, the relief, of the solid land, including the basin of the oceans, and endeavors to find out the laws of their physical structure and peculiar arrangement; *Hydrology*, those which regulate the land and oceanic waters, and their movements. *Climatology*, or the science of climates, aided by meteorology, inquires into the nature and character of those combinations of physical agencies, especially of heat and moisture, which, acting through the atmosphere, foster nature's life. The *Geography of Plants*, raised by Humboldt's researches to the dignity of a science, and the *Geography of Animals*, treated in the same spirit, make it a special object to ascertain the mode of association of plants and animals, in each natural region, in characteristic groups called *floras* and *faunas*, and to discover their relation with the special climatic influences under which they are found and sustained.

THE GEOGRAPHY OF MAN, Political Geography, or the globe as the abode of human races and societies, can be viewed under different aspects. It may be a simple description of the various races and nations of men as found in their present dwelling-places; *Ethnography* (ἔθνος, "nation," and γράφω, to "write"), the scientific form of which, inquiring into the principles underlying their nature, relations, and formation, is *Ethnology.* To give a description of the civilized nations, their characteristics, their boundaries and extent, their territories, an enumeration of their cities, an account of their constitution and government, of their population and resources, is the object of *Political Geography* proper, while *Statistics* gives the numerical data relating to these various branches of the subject.

But aside from this descriptive part, a multitude of questions arise. We see that each large portion of the earth is tenanted by a peculiar race—the black in Africa, the yellow in Eastern Asia, the white in Western Asia and Europe, the so-called red in both Americas, etc. Is there any physical peculiarity of relief or climate in each of these natural regions which can account for these deep modifications of the human type? What influence have these continents exerted, with their plateaus, plains, and mountains, on the formation of nations and languages—on the course of the migrations which have spread them over the whole face of the earth? The history of mankind shows that each individual continent has performed a different part in the progress of civilization. Asia, the great parent continent, is also the mother of the races and civilization; in Europe and North America man's development has attained its

highest pitch. Is there in their structure, climate, situation, and geographical properties anything which fits them better than others for such functions? Were there special geographical features which enabled Palestine, Greece, and Italy to play on the theatre of history the brilliant parts for which they have been conspicuous? All these and similar questions are to be answered by what we may call *Historical* or *Philosophical Geography*, the sister and indispensable handmaid of the Philosophy of History.

A. Guyot.

Geo'logy [from the Gr. γῆ, the "earth," and λογος, "discourse"] is that branch of natural science which treats of the structure of the crust of the earth and the mode of formation of its rocks, together with the history of physical changes and of life on our planet during the successive stages of its history. It depends upon mineralogy for its knowledge of the constituents of rocks, and upon chemistry and physics for its knowledge of the laws of change; and in its study of fossil remains it is closely connected with the sciences of zoology and botany. A knowledge of geology lies at the base of physical geography, and is essential to the skilful prosecution of mining and other useful arts. A subject so vast and so complicated in its relations requires a special treatise for its discussion. We shall merely attempt here to give a sketch of the results as yet attained by geological investigation, leaving the reader to consult such works as Dana's *Manual* for details and methods of research.

The geological history of the earth is ascertained by a study of the successive beds of rock which have been deposited on its surface, and of the masses which have been forced up in a liquid state from within its crust, together with the fossil remains of animals and plants which certain of the beds contain. As thus established, it is usually divided into four great periods, the names of which are taken from the progress of animal life, as this at present affords one of the best criteria for geological classification. They are—

I. The Eozoic, or "period of the dawn of life."
II. The Palæozoic, or "period of ancient life."
III. The Mesozoic, or "middle period of life."
IV. The Neozoic, or "recent period of life."

Each of these admits of subdivisions; which may stand as follows, beginning with the oldest:

Eozoic,	*Laurentian.*	Mesozoic,	*Triassic,*
	Huronian.		*Jurassic,*
Palæozoic,	*Cambrian, or Primordial;*		*Cretaceous.*
	Siluro Cambrian,	Neozoic,	*Eocene,*
	Silurian,		*Miocene,*
	Devonian,		*Pliocene,*
	Carboniferous,		*Post pliocene and Recent.*
	Permian.		

I. Primitive Condition of the Earth.—In the oldest condition of the earth, shown by the most ancient of the rock-formations above referred to, its surface was covered with water more generally than at present, and sediments were then, as now, being deposited in the waters. The earth must, however, have an earlier history than this, though not represented by distinct geological monuments. This primitive condition of the earth is a subject of inference and speculation, rather than of actual knowledge; still, we may begin with a consideration of a fact bearing upon these questions which has long excited attention. It is the observed increase in temperature in descending into deep mines and in the water of deep artesian wells—an increase which may be stated in round numbers at 1 degree of heat of the centigrade scale for every 100 feet of depth from the surface. These observations apply, of course, to a very inconsiderable depth, and we have no certainty that this rate continues for any great distance towards the centre of the earth. If, however, we regard it as indicating the actual law of increase of temperature, it would result that the whole crust of the earth is a mere shell covering a molten mass of rocky matter. Thus, a very slight exercise of imagination would carry us back to a time when this slender crust had not yet been formed, and the earth rolled through space an incandescent globe, with all its water and other vaporizable matters in a gaseous state. Astronomical calculation has, however, shown that the earth, in its relation to the other heavenly bodies, obeys the laws of a rigid ball, and not of a fluid globe. Hence, it has been inferred that its actual crust must be very thick, perhaps not less than 2500 miles, and that its fluid portion must therefore be of smaller dimensions than has been inferred from the observed increase of temperature. Further, it seems to have been rendered probable, from the density of rock-matter in the solid and liquid states, that a molten globe would solidify at the centre as well as at the surface, and consequently that the earth must not only have a solid crust of great thickness, but also a solid nucleus, and that any liquid portions must be a sheet or detached masses intervening between these. Still, this would merely go to show that the earth has advanced far toward the entire loss of its original heat. Other considerations, based on the form of the earth and the distribution of variances, lead to similar conclusions. It must be observed, however, that, as Dr. Hunt has well shown, there are good reasons for the belief that the products of volcanoes arise chiefly from the fusion of portions of the stratified crusts. Such considerations, however, lead to the conclusion that the former watery condition of our planet was not its first state, and that we must trace it back to a previous reign of fire. The reasons which can be adduced in support of this are no doubt somewhat vague, and may in their details be variously interpreted, but at present we have no other interpretation to give of that chaos formless and void, that state in which "nor aught nor naught existed," which the sacred writings and the traditions and poetry of ancient nations concur with modern science in indicating as the primitive state of the earth.

II. Eozoic Time (Archæan of Dana).—Here we have actual monuments to study. The Laurentian rocks, more especially, occupy a very wide space in the northern part of America, the name being derived from the vast belt of these rocks stretching across the northern part of Canada and constituting the Laurentide hills of the old French explorers. These rocks stretch along the N. side of the St. Lawrence River from Labrador to Lake Superior, and thence northwardly to an unknown distance, constituting a wild and rugged district, often rising into hills 4000 feet high, and in the deep gorge of the Saguenay forming cliffs 1500 feet in sheer height from the water's edge. S. of this great ridge the isolated mass of the Adirondack Mountains rises to the height of 6000 feet, rivalling the newer (though still very ancient) chain of the White Mountains. Along the eastern coast of North America a lower ridge of Laurentian rock, only appearing here and there from under the overlying sediments, is seen in Newfoundland, in New Brunswick, and perhaps in Nova Scotia, and farther S. in Massachusetts, and as far as Maryland. In the Old World rocks of this age do not, so far as known, appear so extensively. They have been recognized in Norway and Sweden, in the Hebrides, and in Bohemia, and may no doubt be yet discovered in other localities. Still, the grandest and most instructive development of these rocks is in North America, and it is there that we may best investigate their nature and endeavor to restore the conditions in which they were deposited. Though originally sedimentary, they are very different in their external aspect from the silt and mud, the sand and gravel, and the shell and coral rocks of the modern sea or of the more recent geological formations. Yet the difference is one in condition rather than in composition. Deeply buried in the earth under newer sediments, they have been baked until sandstones, gravels, and clays have become crystalline, as gneiss, mica-schist, hornblende-schist, and quartzite, showing at first sight no resemblance to the original material, except in the regularly stratified and bedded arrangement which serves to distinguish them from igneous or volcanic rocks. In like manner, certain finer calcareous sediments have been changed into Labrador feldspar, and what were once common limestones appear as crystalline marbles. If the evidence of such metamorphoses is asked for, this is twofold. In the first place, these rocks are similar in structure to more modern beds which have been partially metamorphosed, and in which the transition from the unaltered to the altered state can be observed. Secondly, there are limited areas in the Laurentian itself in which the metamorphism has been so imperfect as to permit traces of the original character of the rock to remain. In North America these Laurentian rocks attain to an enormous thickness. This has been estimated by Sir W. Logan at 30,000 feet, so that the beds would, if piled on each other horizontally, be as high as the highest mountains on the earth. They appear to consist of two great series, the Lower and the Upper Laurentian. Even if we suppose that in the earlier stages of the world's history erosion and deposition were somewhat more rapid than at present, the formation of such deposits, probably more widely spread than any which succeeded them, must have required an enormous length of time.

Geologists long looked in vain for evidences of life in the Laurentian period, but its probable existence was inferred from such considerations as the abundance of carbon, limestone, iron, etc.—materials known to be accumulated in the newer formations by the agency of life. In addition to this inferential evidence, however, one well-marked animal fossil has at length been found in the Laurentian of Canada—*Eozoön Canadense*, a gigantic representative of one of the lowest forms of animal life, that of the Protozoa, and of a type still extant in the ocean,

and remarkable for its power of collecting and secreting calcareous matter. The existence of such creatures sup-

FIG. 1.

Eozoön Canadense.

poses that of other organisms, probably microscopic plants, on which they could feed. No traces of these have been observed, though the great quantity of carbon in the beds probably implies the existence of the larger sea weeds. Of life on the Laurentian land we know nothing, unless the great beds of iron ore already referred to may be taken as a proof of land vegetation.

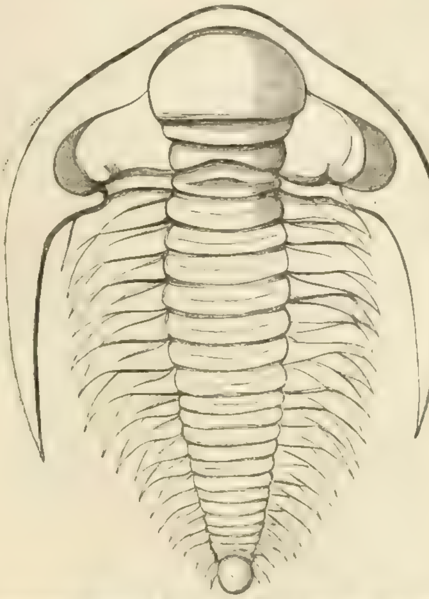
III. THE PALÆOZOIC TIME.—(1) *The Cambrian, or Primordial.* Between the time when *Eozoön Canadense* flourished in the seas of the Laurentian period, and the age which we have been in the habit of calling Primordial, or Primordial Silurian, a great gap evidently exists in our knowledge of the succession of life on both the continents, representing a vast lapse of time, in which all the beds of the Upper Laurentian were deposited, in which the Laurentian sediments were altered, contorted, and upheaved, and in which another immense series of beds, the Huronian and Lower Cambrian, were formed in the bottom of the sea. The western hemisphere, where the Laurentian is so well represented, is especially unproductive in fossils of the immediately succeeding period. Worm-burrows and remains of *Eozoon*, however, occur in beds of this age in Canada. Here, however, the European series comes in to give us some small help. Gümbel has described in Bavaria a great series of gneissic rocks corresponding to the Laurentian, or at least to the lower part of it. Above these are what he calls the Hercynian mica-slate and primitive clay slate, probably equivalent to the Huronian, in the latter of which he finds a peculiar species of *Eozoön*, which he names *Eozoön Bavaricum.* In England, also, the Longwynd group of rocks in Shropshire and in Wales, and their equivalents in Ireland, appear to be the immediate successors to the Huronian, and have afforded some obscure worm-burrows, or perhaps casts of sponges or fucoids, with a small shell of the genus *Lingulella*, and also fragments of crustaceans (*Palæopyge*). If these rocks are really the next in order to the Eozoic, they show, even in their few fossils, a marked advance in life immediately on the commencement of the Primordial period. In Ireland the curious *Oldhamia* appears to occur in rocks equally old. In the Middle Cambrian, however, various forms of marine life abound, for to this age we may refer the Menevian beds of Wales and the Acadian group of New Brunswick; and the Upper Cambrian may be held to include the rich lingula flags of Wales and the Potsdam and Calciferous groups of American geologists. The beds of the Middle and Upper Primordial are especially rich in crustaceans of the order Trilobites. The Primordial sediments must have at one time been very widely distributed, and must have filled up many of the inequalities produced by the rending and contortion of the Laurentian beds. Their thicker and more massive portions are, however, necessarily along the borders of the Laurentian continent; and as they in their turn were raised up into land, they became exposed to the denuding action first of the sea, and afterwards of the rain and rivers, and were so extensively wasted away that only in a few regions do large areas of them remain visible. That of Bohemia has afforded to Barrande a great number of most interesting fossils. The Shropshire districts in England, and those of Wicklow in Ireland, are also of great interest: and next to these in importance are perhaps the Acadian and Potsdam groups of North America, in which these formations, with characteristic fossils, occupy wide areas, and in some parts—as, for example, in Nova Scotia and in New England—there are extensive areas of old metamorphic rocks whose age has not been determined by fossils, but which may belong to this period.

FIG. 2.

Lingula Matthewi. *Discina Acadica.* *Orthis Billingsi.*

Brachiopods from the Primordial of New Brunswick.

FIG. 3.



Paradoxides Micmac, a Primordial Trilobite from New Brunswick; restored by G. S. F. Matthew.

(2) *The Siluro Cambrian, or Lower Silurian.* In North America this is represented by the great Trenton group of limestones, with the Utica shale and Hudson River group above. In Britain, the Bala and Caradoc groups are its representatives. In America it is remarkable for its extensive distribution and the thick limestones which it contains, and it exhibits a greatly increased and more varied marine fauna. The Trenton limestone in North America can be traced over forty degrees of longitude, and throughout this space it is composed almost entirely of comminuted corals, crinoids, and shells. The muddy and sandy deposits of the Utica and Hudson periods which succeed are almost as extensive. It will be convenient to notice under this head the leading marine animals of the Lower Palæozoic, so as to avoid repetition.

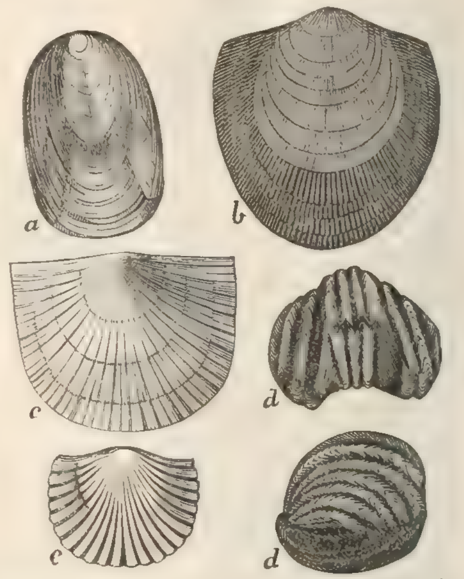
The Siluro Cambrian presents us with a definite physical geography, for the northern hemisphere at least; and this physical geography is a key to the life conditions of the time. The North American continent, from its great unbroken area, affords, as usual, the best means of appreciating this. In this period the northern currents, acting

perhaps in harmony with old Laurentian outcrops, had deposited in the sea two long submarine ridges running to the southward from the extreme ends of the Laurentian nucleus, and constituting the foundations of the present ridges of the Rocky Mountains and the Alleghanies. Between these the extensive triangular area now constituting the greater part of North America was a shallow oceanic plateau, sheltered from the cold polar currents by the Laurentian land on the N., and separated by the ridges already mentioned from the Atlantic and Pacific. It was on this great plateau of warm and sheltered ocean that what we call the Silurian fauna lived, while of the creatures that inhabited the depths of the great bounding oceans, whose abysses must have been far deeper and at a much lower temperature, we know little. During the long Silurian period, it is true, the great American plateau underwent many revolutions, sometimes being more deeply submerged, and having clear water tenanted by vast numbers of corals and shell fishes; at others rising, so as to become shallow and to receive deposits of sand and mud; but it was always distinct from the oceanic area without. In Europe, in like manner, there seems to have been a great internal plateau bounded by the embryo hills of Western Europe on the W., and harboring a very similar assemblage of creatures to those existing in America. Further, during the two Silurian periods themselves there were great changes, from a fauna of somewhat Primordial type up to a new order of things in the Upper Silurian, tending towards the novelties which were introduced in the succeeding Devonian and Carboniferous. We may, in the first place, sketch these changes as they occurred on the two great continental plateaus, noting as we proceed such hints as can be obtained with reference to the more extensive oceanic spaces.

Previous to the beginning of the age both plateaus seem to have been invaded by sandy and muddy sediments, charged at some periods and places with magnesian limestone; and these circumstances were not favorable to the existence or preservation of organic remains. Such are the Potsdam and Calciferous beds of America and the Tremadoc Llandeilo beds of England. The Potsdam and Tremadoc should be included in the Cambrian, and the succeeding Chazy limestone may be regarded as the transition group to the Silurian. It is further to be observed, in the case of these beds, that if we begin at the W. side of Europe and proceed easterly, or at the E. side of America and proceed westerly, they become progressively thinner, the greater amount of material being deposited at the edges of the future continents, just as on the sides of a muddy tideway the flats are higher, and the more coarse sediment deposited near the margin of the channel, and fine mud is deposited at a greater distance and in thinner beds. The cause, however, on the great scale of the Atlantic was somewhat different, ancient ridges determining the border of the channel. This statement holds good not only of these older beds, but of the whole of the Silurian and of the succeeding Devonian and Carboniferous, all deposited on these same plateaus. Thus, in the case of the Silurian in England and Wales the whole series is more than 20,000 feet thick, but in Russia it is less than 1000 feet. In the eastern part of America the thickness is estimated at quite as great in amount as in Europe, while in the region of the Mississippi the Silurian rocks are scarcely thicker than in Russia, and consist in great part of limestones and fine sediments, the sandstones and conglomerates thinning out rapidly eastward of the Appalachian Mountains.

In the animal life of this period we may remark the vast abundance and variety of corals. The polyps were represented in the Silurian seas by a great number of allied yet different forms, equally effectual with those of the modern ocean in the great work of secreting carbonate of lime in stony masses, and therefore in the building up of continents. The animals themselves must have differed somewhat from their modern successors. This we gather from the structure of their stony cells, which present points of difference indicating corresponding difference of detail in the soft parts. Zoologists thus separate the rugose or wrinkled corals and the tabulate or floored corals of the Silurian from those of and prevailing in the modern seas. Next to the corals we may place the crinoids, or stone-lilies, creatures abounding throughout the Silurian seas, and realizing a new creative idea, to be expanded in subsequent geological time into all the multifarious types of the star-fishes and sea-urchins. A typical crinoid, such as the *Glyptocrinus* of the Lower Silurian, consists of a flexible jointed stem, sometimes several feet in length, composed of short cylindrical disks curiously articulated together, a box-like body on top, made up of polygonal sides attached to each other at the edges, and fine radiating jointed arms furnished with branches and branchlets, or fringes, all articulated and capable of being flexed in any direction. Such a creature has more the aspect of a flower than an animal; yet it is really an animal, and subsists by collecting with its arms and drifting into its mouth minute creatures floating in the water. Another group less typical, but abundantly represented in the Silurian seas, is that of the Cystideans, in which the body is sack-like and the arms few, and sometimes attached to the body. They resemble the young or larvæ of crinoids. Among shellfishes, of which vast multitudes of all grades existed in the Silurian, we may select the representatives of the highest group. In

FIG. 4.



Brachiopods from the Silurian: *a*, Lingula; *b*, Atrypa; *c*, Leptæna; *d*, Rhynconella; *e*, Orthis.

the Silurian period there were not only nautili like ours, but a peculiar kind of straight nautilus, the Orthoceratite, which sometimes attained to a gigantic size. The shells of these creatures may be compared to those of nautili straightened out, the chambers being placed in a direct line in front of each other. A great number of species have been discovered, many quite insignificant in size, but others as much as twelve feet in length and one foot in diameter at the larger end. Indeed, accounts have been given of individuals of much larger growth. These large Orthoceratites were the most powerful marine animals known to us in the Silurian, and must have been in those days the tyrants of the seas.

Among the crustaceans or soft shell-fishes of the Silurian we meet with the Trilobites, continued from the Primordial in great and increasing force, and represented by many and beautiful species; while an allied group of shell-fishes of low organization but gigantic size, the Eurypterids, came in with the Upper Silurian, and were provided with powerful limbs, long flexible bodies, and great eyes in the front of the head, and were sometimes several feet in length.

No remains found in the Silurian rocks have been more fertile sources of discussion than the so-called *Grapholites*, a name given long ago by Linnæus, in allusion to the resemblance of some species, having rows of cells on one side, to minute lines of writing. These little bodies, which are characteristic of some portions of the Siluro-Cambrian, usually appear as black coaly stains on the surface of the rock, showing a slender stem or stalk, with a row of little projecting cells at one side, or two rows, one at each side. The more perfect specimens show that in many of the species, at least, these fragments were branches of a complex organism spreading from a centre; and at this centre there is sometimes perceived a sort of membrane connecting the bases of the branches, and for which various uses have been conjectured.

(3) *The Silurian proper, or Upper Silurian.*—The central mass of this formation in Eastern America is the great Niagara limestone, almost equal to the Trenton in extent and thickness, and constituting by its outcropping edge the abrupt escarpment over which Niagara pours its waters. Under the Niagara limestone are the sandy and pebbly beds of the Medina and Oneida formations, and above it, in the typical New York regions, are shallow water sandstones, marls, and magnesian limestones, constituting the Salina group, supporting a mixed calcareous and argillaceous series, the Lower Helderberg group. The life of the Upper Silurian is not markedly distinct from that

of the Lower Silurian group, except in some general specific types, and we have already anticipated most of its great dynasties of life in describing the Siluro-Cambrian. In its upper member, however, we find the first appearance of fishes and of land plants. The land plants of the Upper Silurian as yet known are confined to a few species, representing members of the family of club mosses, or Lycopodiaceæ. They belong to the genera *Lepidodendron* and *Psilophyton*, to be noticed in the sequel. In Great Britain the Wenlock limestone and shale, so rich in beautifully preserved marine organisms, are the equivalents of the Niagara of America, and the Ludlow formations represent the Lower Helderberg. As already stated, we find in the Upper Silurian the first vertebrate animals, represented by several species of shark like fishes, which come in here as forerunners of the dynasty of the Vertebrates, which from that day to this have been the masters of the world. These earliest vertebrates are especially interesting as the first known examples of a plan of structure which culminates only in man himself. They appear to have had cartilaginous skeletons, and in this, and their shagreen-like skin, strong bony spines, and trenchant teeth, to have much resembled our modern sharks, or rather the dog-fishes, for they were of small size. One genus (*Pteraspis*), apparently the oldest of the whole, belongs, however, to a tribe of mailed fishes allied to some of those of the old red sandstone. In both cases the groups of fishes repre-

FIG. 5.

Pteraspis, a mailed fish of the Upper Silurian, as restored by Powrie and Lankaster.

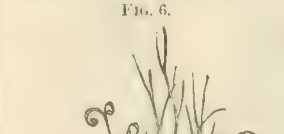
senting the first known appearance of vertebrates were allied to tribes of somewhat high organization in that class; and they asserted their claims to dominancy by being predaceous and carnivorous creatures, which must have rendered themselves formidable to their invertebrate contemporaries.

(4) *The Devonian, or Erian.** —In this age our knowledge of land-plants greatly increases, and we have evidence that our continents were more definitely assuming their present forms. The lowest Devonian beds in the Pennsylvania and New York series are sandy deposits, the Oriskany and Schoharie sandstones. These are succeeded by a great oceanic limestone rich in corals, and named, from its concretions of hornstone, an impure flint, the Corniferous limestone. Associated with it are the Hamilton and Genesee shales. Above these are the sandy and muddy beds known as the Portage and Chemung groups, still rich in marine fossils, but holding also many fossil plants. In the more eastern part of America, as along the Appalachian ridges and in Gaspé and New Brunswick, the great marine limestone is absent, and shallow water and littoral beds, in some places rich in land-plants, are alone developed. In like manner, in Europe the marine limestones of the Eifel and of Devonshire are represented in Central England and Scotland by the "old red sandstone," containing remains of fishes and of land-plants. When we read Hugh Miller's graphic descriptions of the old red sandstone of Scotland, with its numerous and wonderful fishes, we have before us a formation altogether distinct from that of Devonshire or the Eifel. But the one represents the shallow, and the other the deeper, seas of the same period. We learn this by careful tracing of the beds to their junction with the corresponding series, and by the occasional occurrence of the characteristic fishes of the Scottish strata in the English and German beds. In like manner a geologist who explores the Gaspé sandstones or the New Brunswick Devonian shales has under his consideration a group of beds very dissimilar from that which he would have to study on the shores of Lake Erie. But here, again, identity of relations to the Silurian below and the Carboniferous above shows the contemporaneousness of the beds; and this is confirmed by the occurrence in both series of some of the same plants and shells and fishes. It will further be observed that it is in the Middle that the greatest difference occurs. Sand and mud and pebble banks were almost universal over our two great continental plateaus in the Older and Newer Devonian. But in the Middle there were in some places oceanic areas with coral reefs, in others, shallow flats and swamps rich in vegetation. Herein we see the greater variety and richness of the Devonian. Had we lived in that age, we should not have seen great continents like those that now exist, but we could have roamed over lovely islands with breezy hills and dense lowland jungles, and we could have sailed over blue coral seas, glowing below with all the fanciful forms and brilliant colors of polyp-life, and filled with active and beautiful fishes. Especially did all these conditions culminate in the Middle Devonian, when what are now the continental areas of the northern hemisphere must have much resembled the present insular and oceanic regions of the South Pacific.

From the abundant life of the Devonian period we may select, as specially characteristic, its corals, its fishes, and its land-plants. The central limestones of the Devonian may be regarded as the head-quarters of the peculiar types of corals characteristic of the Palæozoic age. Here they were not only vastly numerous, but present some of their grandest and also of their most peculiar forms. Edwards and Haime, in their *Monograph of British Fossil Corals* (1851), enumerate 150 well developed species, and the number has since been largely increased. The reign of fishes began in the Upper Silurian, for in the rocks of this age, more especially in England, several species have been found. They occur, however, only in the newer beds of this formation, and are not of large size nor very abundant. It is to be observed that, in so far as the fragments discovered can be interpreted, they indicate the existence of two distinct types of fishes—the Ganoids, or gar fishes, protected with bony plates and scales, and the Placoids, or shark-like fishes—and that in the existing world these fishes are regarded as occupying a high place in their class. Further, these two groups of fishes are those which through a large portion of geological time continue to prevail to the exclusion of other types, the ordinary bony fishes having been introduced only in comparatively recent periods. With the Devonian, however, there comes a vast increase to the finny armies; and so characteristic are these that the Devonian has been called the Age of Fishes *par excellence*. But we have not space here to give details as to these old inhabitants of the waters, and Agassiz, Hugh Miller, and Dr. Newberry have described all the more important forms in the Devonian of Europe and of the U. S.

We may now briefly sketch some of the more prominent features of the Devonian vegetation. The plants of the genus *Psilophyton*, of which there are several species, probably grew on swampy flats liable to inundation. They constitute the most characteristic and abundant members of the Lower Devonian flora, and appear to have been equally abundant in Europe as in America, though when occurring in fragments they have often been mistaken for Algæ and for roots. More distinctly allied to the modern club-mosses were the *Lepidodendra*, *Leptophlæa*, and similar plants of the Devonian, which may be defined to be gigantic arborescent club-mosses or Lycopodiums. These also are widely diffused in the Devonian of all parts of the world; and some of the genera, especially *Lepidodendron*, are still more abundant and attain to greater dimensions in the Carboniferous period. Still another feature of this ancient vegetation was the occurrence of dense brakes of *Calamites*, plants which were exaggerations of the modern Equisetums, attaining to a diameter of several inches, and to a great height, and in some cases with strong and woody stems. The Calamites of the Devonian much resemble those of the Carboniferous, and two of the species are found also in the latter system. Probably allied to the Calamites were the beautiful star leaves of the genus *Asterophyllites*, which occur spread out on the Devonian shales of St. John, N. B., as if prepared by a careful botanist.

FIG. 6.



Psilophyton princeps, the oldest known plant of America restored. *a*, fruit; *b*, stem; *c*, scalariform tissue of the axis highly magnified. In the restoration one side is represented in vernation, and the other in fruit.

* The name *Erian* is derived from the Erie division of the State survey of New York, and from the extensive distribution of this formation around the shores of Lake Erie.

The ferns are among the most beautiful plants of the modern world in point of foliage, and they are very ancient in regard to geological time, making their appearance abundantly in the Middle Devonian. Of the Devonian species, few extend into the Carboniferous; and some forms, like that of the well-known *Cyclopterus* (*Archaeopteris*) *Hibernicus* of the Upper Devonian of Ireland, are quite peculiar to that system. This type of ferns is represented in America by *Cyclopterus Jacksoni* and others.

There seems to have been in the Devonian a prevalence of forms of ferns allied to the modern genera *Hymenophyllum* and *Trichomanes*. There were also tree-ferns, large trunks of which, of the genera *Psaronius* and *Caulopteris*, have been found by Prof. Newberry in Ohio and by Prof. Hall in New York. Those of the former genus had the same habit found in the modern ferns, of sending out masses of aërial roots which, stretching into the soil like cords, supported the stem. In Scotland a small trunk, approaching to a tree-fern, has been found. It is the *Caulopteris Peachii* of Salter. Of all the plants of the Palæozoic forests, the most singular are the *Sigillaria*.

Fig. 7.

Sigillaria and *Lepidodendron*, restored. (*Dawson's Acadian Geology.*)

The head-quarters of this genus, or family, are in the Carboniferous, but several species occur in the Devonian, though they are of comparatively small stature, as far as yet known. The Sigillariæ had tall slender stems, with vertical rows of narrow two-nerved leaves, and their structures present remarkable points of resemblance to those of modern Gymnosperms, though there is reason to suspect that some trees included in the group may have been Cryptogams of high organization. The Sigillariæ were the trees most important in the accumulation of coal in the Carboniferous, but in the Devonian we have no evidence that their remains accumulated to so great an extent. In the Lower Devonian especially the rhizomata of *Psilophyton* appear to take the place which the stigmaria roots of *Sigillaria* hold in the Carboniferous. Rising still higher in the vegetable kingdom, we reach unquestionable Gymnosperms in the pine trees of the genus *Dadoxylon*, whose drifted trunks, preserved in stone by the infiltration of siliceous or calcareous matter, occur in the sandstones of New York, Ohio, and New Brunswick, and also in Scotland and Germany. The most noteworthy point with reference to these trees is that, while specifically distinct from those of the Carboniferous, they resemble them precisely in the structure of the woody fibres, and more especially in the beautiful bordered pores of the cell-walls—a structure fitted to promote the more free flow of the sap, and in which they agree with the fossil conifers of the coal formation, and also with the modern Araucarian pines of the southern hemisphere, but differ in detail from the modern pines of the northern hemisphere. With these Araucarian trunks are others showing structures which may have appertained to a rudimentary type of conifers, and which are known by the generic name *Prototaxetes*.

The oldest known remains of insects were found by Prof. Hartt in the Devonian rocks of New Brunswick, associated with some of the above-mentioned fossil plants.

(5) *The Carboniferous.*—That age of the world's history which, from its richness in accumulations of vegetable matter destined to be converted into coal, has been named the Carboniferous, is in relation to living beings the most complete and noble of the Palæozoic periods. In it those varied arrangements of land and water which had been increasing in perfection in the previous periods attained to their highest development. In it the forms of animal and plant life, that had been becoming more numerous and varied from the Eozoic onward, culminated. The Permian, which succeeded, was but the decadence of the Carboniferous, preparatory to the introduction of a new order of things. Thus, the Carboniferous was to the previous periods what the modern is to the preceding Tertiary and Mesozoic ages—the summation and completion of them all, and the embodiment of their highest excellence. We may take as a type of the Carboniferous the development of this system in Nova Scotia, where it attains a thickness and completeness in its several members not surpassed in any other part of the world. The complete Carboniferous series may be arranged in the following subordinate groups or formations, the limits of which are, however, in most cases not sharply defined: (1) *The Upper Coal Formation*, containing coal-formation plants, but not productive coals. (2) *The Middle Coal Formation*, or coal formation proper, containing the productive coal-beds. (3) *The Millstone-grit Series*, represented in Nova Scotia by red and gray sandstone, shale, and conglomerate, with a few fossil plants and thin coal-seams, not productive. (4) *The Carboniferous Limestone*, with the associated sandstones, marls, gypsum, etc., holding marine fossils, recognized by all palæontologists who have examined them as Carboniferous. (5) *The Lower Coal Measures*, holding some, but not all, of the fossils of the Middle Coal Formation, and thin coals not productive, but differing both in flora and fauna from the Upper Devonian, which they overlie unconformably. The most remarkable facts in connection with the Carboniferous period are the land-life of the period, the introduction of reptiles, and the culmination of the Palæozoic flora, accompanied with vast accumulations of vegetable matter in the form of coal.

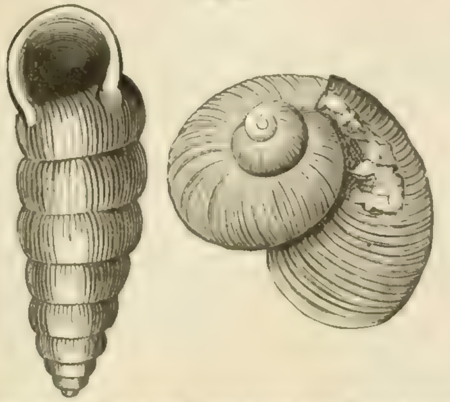
In the Carboniferous, as in the Devonian age, insects existed, and in greater numbers. The winged insects of the period, so far as known, belong to three of the nine or ten orders into which modern insects are usually divided. Conspicuous among them are representatives of our well-known domestic pests the cockroaches, which thus belong geologically to a very old family. Another group, represented by many species in the coal forests, was that of the may-flies and shad-flies or ephemeras, which spend their earlier days under water, feeding on vegetable matter, and affording food to many fresh-water fishes—a use which they no doubt served in the coal period also. Another group of insects was that of the weevils, a family of beetles, whose grubs must have found plenty of nuts and fruits to devour, without attracting the wrathful attention of any gardener or orchardist. A curious and exceptional little group of creatures in the present world is that of the gally-worms or millipedes — wingless, many-jointed, and many-footed crawlers, resembling worms, but more allied to insects. These animals seem to have swarmed in the coal forests, and are represented by *Xylobius* and other genera. It is not wonderful that animals like these, feeding on decayed vegetable matter, should have flourished in the luxuriant Sigillaria swamps. A few species of scorpions and spiders, very like those of the modern world, have been found in the coal-measures both in Europe and America.

In the coal-measures we also meet, for the first time, in our ascending progress, the land-snails, so familiar now in every part of the world, and which are represented by two little species found in the coal formation of Nova Scotia.

Perhaps the most fish-like of the reptilian animals of the Carboniferous are the curious creatures from the coal-measures of Saarbrück, first found by Von Dechen, and which constitute the genus *Archegosaurus*. Their large heads, short necks, supports for permanent gills, feeble limbs, and long tails for swimming, show that they were aquatic creatures, presenting many points of resemblance

to the ganoid fishes with which they must have associated; still, they were higher than these in possessing lungs and

FIG. 8.



The two oldest Land-Snails, *Pupa Vetusta* and *Conulus priscus.*

true feet, though perhaps better adapted for swimming than even for creeping. From these creatures the other coal reptiles diverge, and ascend along two lines of progress, the one leading to gigantic crocodile like animals, provided with powerful jaws and teeth, and probably haunting the margins of the waters and preying on fishes: the other leading to small and delicate lizard-like species, with well-developed limbs, large ribs, and ornate horny scales and spines, living on land and feeding on insects and similar creatures. In the first direction we have a considerable number of species found in the Jarrow coal field in England, and described by Prof. Huxley. Some of them were like snakes in their general form, others more like lizards, and at the top stand such animals as *Baphetes* and *Eosaurus* from the Nova Scotia coal field, and *Anthracosaurus* from that of Scotland. The style and habits of these creatures are easy to understand, however much haggling the comparative anatomists may make over their bones. They were animals of various size, varying from a foot to at least ten feet in length, the body generally lizard-like in form, with stout limbs and a flattened tail useful in swimming. Their heads were flat, stout, and massive, with large teeth strengthened by the insertion and convolution of plates of enamel.

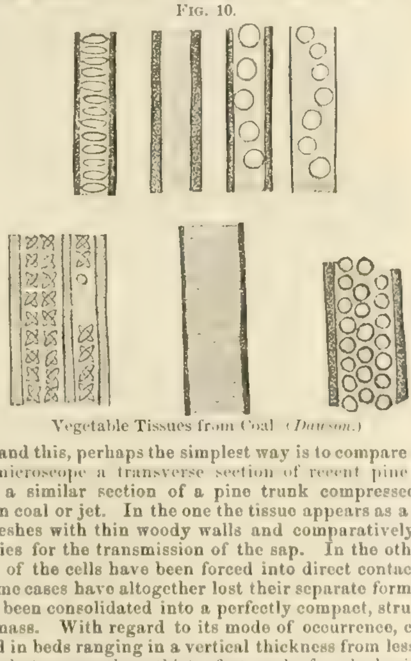
FIG. 9.

Reptiles of the Carboniferous Period, restored. Those on the land belong to the genera *Dendrerpeton* and *Hylonomus.*

The fore limbs were probably larger than the hind limbs, the better to enable them to raise themselves out of the water. The belly was strengthened by bony plates and closely imbricated scales, to resist, perhaps, the attacks of fishes from beneath, and to enable them without injury to drag their heavy bodies over trunks of trees and brushwood, whether in the water or on the land. In the other direction we find several animals of small size, but better developed limbs, leading to a group of graceful little animals quite as perplexing with regard to affinities as those first mentioned, but tending towards the smaller lizards of the modern world. At the top of these we may place the genus *Hylonomus* from hollow fossil trees of Nova Scotia.

In the present condition of our civilization, coal is the most important product which the bowels of the earth afford to man. And though there are productive beds of coal in most of the later geological formations, down to the peats of the modern period, which are only unconsolidated coals, yet the coal of the Carboniferous age is the earliest valuable coal in point of time, and by far the most important in point of quantity. Mineral coal may be defined to be vegetable matter which has been buried in the strata of the earth's crust, and there subjected to certain chemical and mechanical changes. The proof of its vegetable origin will grow upon us as we proceed. The chemical changes which it has undergone are not very material. Wood or bark, taken as an example of ordinary vegetable matter, consists of carbon or charcoal, with the gases hydrogen and oxygen. Coal has merely parted with a portion of these ingredients in the course of a slow and imperfect decay, so that it comes to have much less oxygen and considerably less hydrogen than wood, and it has been blackened by the disengagement of a quantity of free carbon. The more bituminous flaming coals have a larger amount of residual hydrogen. In the anthracite coals the process of carbonization has proceeded farther, and little remains but charcoal in a dense and compact form. In cannel coals and in certain bituminous shales, on the contrary, the process seems to have taken place entirely under water, by which decomposition has been modified, so that a larger proportion than usual of hydrogen has been retained. The mechanical change which the coal has experienced consists in the flattening and hardening effect of the immense pressure of thousands of feet of superincumbent rock, which has crushed together the cell-walls of the vegetable matter, and reduced what was originally a pulpy mass of cellular tissue to the condition of a hard laminated rock. To un-

FIG. 10.



Vegetable Tissues from Coal (*Dawson.*)

derstand this, perhaps the simplest way is to compare under the microscope a transverse section of recent pine wood with a similar section of a pine trunk compressed into brown coal or jet. In the one the tissue appears as a series of meshes with thin woody walls and comparatively wide cavities for the transmission of the sap. In the other the walls of the cells have been forced into direct contact, and in some cases have altogether lost their separate forms, and have been consolidated into a perfectly compact, structureless mass. With regard to its mode of occurrence, coal is found in beds ranging in a vertical thickness from less than an inch to more than thirty feet, and of wide horizontal extent. Many such beds usually occur in the thickness of the coal formation, or "coal-measures," as the miners call them, separated from each other by beds of sandstone and compressed clay or shale. Very often the coal occurs in beds of several, somewhat close to each other, and separated from other groups by "barren measures" of considerable thickness. In examining a bed of coal where it is exposed in a cutting or shore cliff, we nearly always find that the bed below it, or the "under-clay," as it is termed by miners, is a sort of fossil soil, filled with roots and rootlets. On this rests the coal, which, when we examine it closely, is found to consist of successive thin layers of hard coal of different qualities as to lustre and purity, and with intervening laminæ of a dusty fibrous substance, like charcoal, called "mother coal" by miners, and sometimes mineral charcoal. Thin partings of dark shale also occur, and these usually present marks and impressions of the stems and leaves of plants. Above the coal is its "roof" of hardened clay, limestone, or sandstone, and this generally holds great quantities of remains of plants, and sometimes large stumps of trees with their bark converted into coal, and the hollow once occupied with wood filled with sandstone, while their roots spread over the surface of the coal. Such fossil forests of erect stumps are also found at various

levels in the coal-measures, resting directly on under-clays without any coals. A bed of coal would thus appear to be a fossil bog or swamp.

Of the trees of the Coal period, we may first notice that which is the most conspicuous and abundant tree in the swampy levels—the *Sigillaria*, or seal tree, so called from the stamp-like marks left by the fall of its leaves—a plant which has caused much discussion as to its affinities. Some regard it as a Gymnosperm, others as a Cryptogam. Most probably we have under this name trees allied in part to both groups, and which, when better known, may bridge over the interval between them. These trees present tall, pillar-like trunks, often ribbed vertically with raised bands, and marked with rows of scars left by the fallen leaves. They are sometimes branchless, or divide at top into a few thick limbs, covered with long, rigid, grass-like foliage. On their branches they bear long, slender spikes of fruit, and we may conjecture that quantities of nut-like seeds scattered over the ground around their trunks are their produce. If we approach one of these trees closely, more especially a young specimen not yet furrowed by age, we are amazed to observe the accurate regularity and curious forms of the leaf-scars, and the regular ribbing, so very different from that of our ordinary forest trees. If we cut into its stem, we are still further astonished at its singular structure. Externally it has a firm and hard rind. Within this is a great thickness of soft cellular inner bark, traversed by large bundles of tough fibres. In the centre is a core or axis of woody matter very slender in proportion to the thickness of the trunk, and still further reduced in strength by a large cellular pith. Thus, a great stem four or five feet in diameter is little else than a mass of cellular tissue, altogether unfit to form a mast or beam, but excellently adapted, when flattened and carbonized, to blaze upon our winter hearth as a flake of coal. The roots of these trees were perhaps more singular than their stems; spreading widely in the soft soil by regular bifurcation, they ran out in long snake-like cords, studded all over with thick cylindrical rootlets, which spread from them in every direction. They resembled in form, and probably in function, those cable-like root-stocks of the pond-lilies which run through the slime of lakes, but the structure of the rootlets was precisely that of those of some modern Cycads. It was long before these singular roots were known to belong to a tree. They were supposed to be the branches of some creeping aquatic plant. Along with the trees last mentioned we observe others of a more graceful and branching form, the successors of those Lepidodendra already noticed in the Devonian, and which still abound in the Carboniferous, and attain to larger dimensions than their older relations, though they are certainly more abundant and characteristic in the lower portions of the Carboniferous. Relatives, as already stated, of our modern club-mosses, now represented only by comparatively insignificant species, they constitute the culmination of that type, which thus had attained its acme very long ago, though it still continues to exist under pauperated forms. In the Coal period there were several generic forms of these plants, all attaining to the dimensions of trees. Like the Sigillariæ, they contributed to the materials of the coal; and one mode of this has recently attracted some attention. It is the accumulation of their spores and spore-cases, already referred to in speaking of the Devonian, and which was in the Carboniferous so considerable as to constitute an important feature locally in some beds of coal. A similar modern accumulation of spore-cases of tree-ferns occurs in Tasmania; but both in the modern and the Carboniferous such beds are exceptional, though whereever spore-cases exist as a considerable constituent of coal, from their composition they give to it a highly bituminous character—an effect, however, which is equally produced by the hard scales supporting the spores, and by the outer epidermal tissues of plants when these predominate in the coal, more especially by the thick, corky outer bark of *Sigillaria*. In the wide, open forest glades tree-ferns almost precisely similar to those of the modern tropics reared their leafy crowns. We have only time to glance at the vast brakes of tall Calamites which fringe the Sigillaria woods, and stretch far seaward over tidal flats. They were allied to modern mares-tails or Equisetums, but were of gigantic size, and much more woody structure of stem. The Calamites grew on wet mud and sand-flats, and also in swamps; and they appear to have been especially adapted to take root in, and clothe and mat together, soft, sludgy material recently deposited or in process of deposition. Rarely in the swampy flats, perhaps more frequently in the uplands, grew great pines of several kinds—trees capable of doing as good service for planks and beams as many of their modern successors, but which lived before their time, and do not appear to have aided much in the formation of coal.

(6) *The Permian.*—This formation does not occur in Eastern America, unless perhaps some of the upper beds of the Carboniferous of Nova Scotia should be referred to it. This period is, however, that when the greatest foldings and elevations of our rocks occurred, and in the West it is represented by limestones and sandstones of considerable thickness and extent. In Europe the magnesian limestone (the *Zechstein* of the Germans) is its principal deposit, though accompanied by sandstones and shales of considerable thickness. With respect to the first point above named, the earth's crust was subjected in the Permian period to some of the grandest movements which have occurred in the whole course of geologic time, and we can fix the limits of these, in Europe and America at least, with some distinctness. If we examine the Permian rocks in England and Germany, we shall find that everywhere they lie on the upturned edges of the preceding Carboniferous beds. In other words, the latter have been thrown into a series of folds, and the tops of these folds have been more or less worn away before the Permian beds were placed on them. But if we pass on to the eastward, in the great plain between the Volga and the Ural Mountains, where, in the "ancient kingdom of Perm," the greatest known area of these rocks is found—an area equal in extent to twice that of France, and which Sir R. I. Murchison, who first proposed the name, took as the typical district—we find, on the contrary, that the Permian and Carboniferous are conformable to one another. If, now, we cross the Atlantic and inquire how the case stands in America, we shall find it precisely the same. Here the great succession of earth-waves constituting the Appalachian Mountains rises abruptly at the eastern edge of the continent, and becomes flatter and flatter, until, in the broad plains W. of the Mississippi, the Permian beds appear, as in Russia, resting upon the Carboniferous, so quietly that it is not always easy to draw a line of separation between them. As Dana has remarked, we find at the western side of Europe and the eastern side of America great disturbances, inaugurating the Permian period; and in the interior of both, in the plains between the Volga and the Ural in one, and between the Mississippi and Rocky Mountains in the other, an entire absence of these disturbances. The Permian fauna may be, in the main, regarded as an imperfect continuation of that of the Carboniferous period.

The Palæozoic period includes the thickest and most widely distributed formations of our continents.

IV. THE MESOZOIC TIME.—(1) *The Trias.*—The red sandstones and their associated beds, which in Prince Edward's Island, Nova Scotia, Connecticut, and Pennsylvania overlie unconformably the Carboniferous and all the older formations, are the best known American representatives of these rocks. They are remarkable for their fossil footprints of gigantic bird-like reptiles, and also for the ejections of volcanic or trappean rocks which have been poured through them, and of which the Palisades on the Hudson and the North Mountains of Cornwallis and Annapolis in Nova Scotia are eminent examples. In Virginia, and also in North Carolina, this formation includes plant-bearing shales and thick beds of coal, resembling those of the Carboniferous period, but the fossil plants are of different species. With reference to life, the Trias is remarkable for the introduction of many forms of reptilian life, heralding the Age of Reptiles, which culminates in the succeeding period, and for the first appearance of the Mammalia, or ordinary quadrupeds, of which one small species has been found in North Carolina and another in Germany. In Europe the Trias is more complete in its development than in America, and may be represented by the following table:

German Series.	French Series.	English Series.
Keuper sandstone and shale.	Marnes irisées	Saliferous and gypseous shales and sandstones.
Muschelkalk, limestone, and dolomite	Calcaire coquillier.	Wanting.
Bunter sandstone and conglomerate.	Grès bigarré	Sandstone and conglomerate.

(2) *The Jurassic*—The Trias is succeeded by a great and complex system of formations, usually known as the Jurassic from its admirable development and exposure in the range of the Jura, but which the English geologists often name the "Oolitic," from the occurrence in it of beds of oolite or roe-stone. This rock, of which the beautiful cream-colored limestone of Bath in England is an illustration, consists of an infinity of little spheres, like seeds or the roe of a fish. Under the microscope these are seen to present concentric layers, and often to have a minute grain of sand or fragment of shell in the centre. They are, in

short, miniature concretions, produced by the aggregation of the calcareous matter around centres by a process of molecular attraction to which fine sediments, and especially those containing much lime, are very prone. This style of limestone is very abundant in the Jurassic system, but it is not confined to it. The writer has seen very perfect oolites in the Silurian and the Carboniferous. The Jurassic series, as developed in England, may be divided into three triplets or cycles of beds, in the following way:

Upper Jurassic ...	Purbeck and Wealden, Portland limestone, Portland sand.
Middle Jurassic...	Kimmeridge clay, etc., Coral rag, limestone, Lower calcareous grit, Oxford clay.
Lower Jurassic* ..	Aenbrad and forest marble, Great and inferior oolite, limestone, Lias clays and limestones.

These rocks occupy a large space in England, and are also largely distributed over the continent of Europe and Asia, which had evidently three great and long-continued dips under water, indicated by the three great limestones. In America the case was different. The Jurassic has not been distinctly recognized in any part of the eastern coast of that continent, which then perhaps extended farther into the Atlantic than it does at present, so that no marine beds were formed on its eastern border. But in the West, along the base of the Rocky Mountains, and also in the Arctic area, there were Jurassic seas of large extent swarming with characteristic animals. The Jurassic was emphatically the Age of Reptiles. Among the most remarkable of these were the great terrestrial group of Dinosaurs, many of them huge in bulk, some of them biped, and combining the characters of the modern Reptilia with features now restricted to birds and mammals. The flying reptiles of the Pterodactyl group were not less marvellous. Species of these creatures from Western America, recently described by Cope, must have been bat-like reptiles, with wings more than twenty feet in expanse; and equally gigantic species occur in Europe, while others were no larger than pigeons or snipes. Some of these, like *Plesiosaurus*, had short

Fig. 11.

Plesiosaurus rostratus, from the Lower Lias of Charmouth, Dorset. (In the British Museum.)

bodies and long, swan-like necks; others, like *Ichthyosaurus*, had gigantic heads and long, flexible bodies; others, like *Mosasaurus*, rivalled the fabled sea-serpent in the immense extension of their bodies. Our limits do not permit us to attempt the description of these creatures, notices of which will be found in most books of geology. The Jurassic period also presents numerous small mammals allied to the humbler marsupials of New Holland, and one very re-

Fig. 12.

Skeleton of *Hadrosaurus* (tallest figure in cut), a giant reptile found in Cretaceous strata in New Jersey, North Carolina, etc. From the Central Park Museum, New York.

markable type of bird, the *Archæopteryx*, which, with the feet and general form of a modern percher, combined peculiarities of tail and wings which tend toward the reptiles.

The Jurassic shores were clothed with an abundant flora, which changed considerably in its form during the lapse of this long time; but yet it has a character of its own distinct from that of the previous Palæozoic and the succeeding Tertiary. Perhaps no feature of this period is more characteristic than the great abundance of these

* This last group is very complex, and might perhaps admit of subdivision, locally at least, into subordinate cycles.

singular plants, the Cycads, which in the modern flora are placed near to the pines, but in their appearance and habit more resemble palms, and which in the modern world are chiefly found in the tropical and warm temperate zones of Asia and America. No plants certainly of this order occur in the Carboniferous, where their nearest allies are perhaps some of the Sigillariæ; and in the modern time the Cycads are not so abundant, nor do they occur at all in climates where their predecessors appear to have abounded. In the quarries of the island of Portland we have a remarkable evidence of this in beds with numerous stems of Cycads still *in situ* in the soil in which they grew, and associated with stumps of pines which seem to have flourished along with them. In further illustration of this point, we may refer to the fact that Carruthers, in a recent paper, catalogues twenty-five British species belonging to eight genera—a fact which markedly characterizes the British flora of the Mesozoic period.

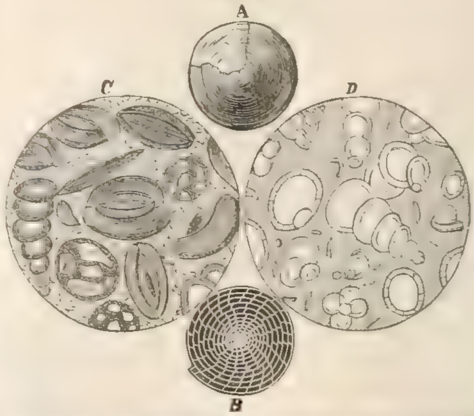
(3) *The Cretaceous.*—At the close of the Triassic the eastern and western continents seem to have been as extensive as at present. The Cretaceous began with a great subsidence, more complete in the eastern than in the western hemisphere, but very widespread in both. This led to the deposition over the Jurassic rocks of the chalk of Western Europe—a very remarkable rock, produced only in the abysmal depths of the ocean; and associated with this are extensive deposits of greensand, made up largely of grains of the mineral glauconite. In America pure chalk does not appear, but the greensand is extensively developed on the eastern coast, especially in New Jersey, and wide regions of the West are covered with limestones and marls of this period, while in Vancouver's Island it contains beds of coal and fossil plants, the latter presenting many generic forms still represented on the earth, as the oaks, plane trees, etc.

IV. Tertiary, or Neozoic Time.—Both in Europe and America there is evidence of great changes of level at the beginning of the Tertiary. In the west of Europe beds often of shallow water or even fresh-water origin fill the hollows in the bent Cretaceous strata. This is manifestly the case with the formations of the London and Paris basins, contemporaneous but detached deposits of the Tertiary age, lying in depressions of the chalk. Still, this does not imply much want of conformity, and, according to the best explorers of those alpine regions in which both the Mesozoic and Tertiary beds have been thrown up to great elevations, they are in the main conformable to one another. Something of the same kind occurs in America. On the Atlantic coast the marine beds of the Older Tertiary cover the Cretaceous, and little elevation seems to have occurred. Farther W. the elevation increases, and in the upper part of the Valley of the Mississippi it amounts to 1700 feet. Still farther W., in the regions of the Rocky Mountains, there is evidence of elevation to the extent of as much as 7000 feet. Throughout all these regions scarcely any disturbance of the old Cretaceous sea-bottom seems to have occurred until after the deposition of the Older Tertiary, so that there was first a slow and general elevation of the Cretaceous ocean-bottom, succeeded by gigantic folds and fractures, and extensive extravasations of the bowels of the earth in molten rocks in the course of the succeeding Tertiary age. These great physical changes inaugurated the new and higher life of the Tertiary, just as the similar changes in the Permian did that of the Mesozoic. The classification of the Tertiary given by Sir Charles Lyell is represented in the following table, the percentage of fossils being taken from marine forms, and mainly from mollusks, and the system having in some cases been modified by stratigraphical evidence:

Tertiary, or Neozoic Time.	Post-pliocene, including that which immediately precedes the Modern. In this the shells, etc., are recent, the Mammalia in part extinct.
	Pliocene, or more recent age. In this the majority of the shells found are recent in the upper beds. In the lower beds the extinct become predominant.
	Miocene, or less recent. In this the large majority of the shells found are extinct.
	Eocene, the dawn of the recent. In this only a few shells occur.

(1) *The Eocene.*—This has been very thoroughly studied in the Tertiary basins of Paris and London, and also in the Southern States of the Union, where it constitutes the Claiborne, Jackson, and Vicksburg groups of Dana. We may content ourselves with a review of its formations as exposed in the localities first mentioned. The London clay is Lower Eocene, but in the beds of the Isle of Wight and neighboring parts of the south of England we have the Middle and Upper members of the series. They are not, however, so largely developed as in the Paris basin, where, resting on the equivalent of the London clay, we have a thick marine limestone, the *calcaire grossier*, abounding in marine remains, and in some beds composed of shells of Foraminifera. The sea in which this limestone was deposited, a portion, no doubt, of the great Atlantic area of the period, became shallow, so that beds of sand succeeded those of limestone, and finally it was dried up into lake-basins, in which gypsum, magnesian sediments, and siliceous limestone were deposited. These lakes or ponds must at some periods have resembled the American "salt-licks," and were no doubt resorted to by animals from all the surrounding country in search of the saline mud and water which they afforded. Hence there occur vast numbers of bones of Mammalia, and in some marly beds intervening between the layers of gypsum numerous footprints occur, exactly like those already noticed in the Trias. The mammals were largely pachyderms of extinct genera, but Carnivora and Marsupials are also represented.

Fig. 13.



Foraminiferal Rock-builders: A, *Nummulites lævigata*, Eocene; B, the same, showing chambered interior; C, Miliolite limestone, magnified, Eocene, Paris; D, chalk, section magnified, Cretaceous.

(2) *The Miocene.*—In France and elsewhere on the continent of Europe marls and sands of this age succeed to the Eocene beds, and in America beds of similar age occur along the Atlantic coast from Gay Head southward, and they are extensively developed in the West. Confining ourselves mainly to the mammalian life of the Miocene, we find three remarkable points of difference as compared with the Eocene: (1) Whereas the Eocene mammals are remarkable for adherence to one general type—viz. that group of pachyderms most regular and complete in its dentition—we now find a great number of more specialized and peculiar forms. (2) We find in the latter period a far greater proportion of large carnivorous animals. (3) We find much greater variety of mammals than either in the Eocene or the Modern, and a remarkable abundance of species of gigantic size. The Miocene is thus apparently the culminating age of the Mammalia, in so far as physical development is concerned; and this, as we shall find, accords with its remarkably genial climate and exuberant vegetation. In Europe the beds of this age present for the first time examples of the monkeys, represented by two generic types, both of them apparently related to the modern long-armed species, or gibbons. Among carnivorous animals we have cat-like creatures, one of which is the terrible *Machairodus*, distinguished from all modern animals of its group by the long, sabre-shaped canines of its upper jaw, fitting it to pull down and destroy those large pachyderms which could have easily shaken off a lion or a tiger. Here also we have the elephants, represented by several species now extinct; the mastodon, a great, coarsely-built, hog-like elephant, some species of which had tusks both in the upper and lower jaw; the rhinoceros, the hippopotamus, and the horse, all of extinct species. We have also giraffes, stags, and antelopes, the first ruminants known to us, and a great variety of smaller and less noteworthy creatures. Here also, for the first time, we find the curious and exceptional group of Edentates, represented by a large ant-eater. Of all the animals of the European Miocene, the most wonderful and unlike any modern beast is the Dinothere, found in the Miocene of the Epplesheim in Germany, and described by Kaup. Some doubt rests on the form and affinities of the animal, but we may reasonably take it, as restored by its describer and currently reproduced in popular books, to have been a quadruped of somewhat elephan-

tine form. Some years ago, however, a huge haunch bone, supposed to belong to this creature, was discovered in the south of France, and from this it was inferred that the Dinothere may have been a marsupial or pouched animal, perhaps allied in form and habit to the Kangaroos. The skull is three feet four inches in length, and when provided with its soft parts, including a long snout or trunk in front, it must have been at least five or six feet long. Such a head, if it belonged to a quadruped of ordinary proportions, must represent an animal as large in proportion to our elephant as an elephant to an ox. In Asia the Siwalik Hills afforded to Falconer and Cautley one of the most remarkable exhibitions of Miocene animals in the world.

FIG. 14.

Sivatherium giganteum, Falconer, from the Miocene of India. (From a restoration by Dr. D. Murie of London.)

These hills form a ridge subordinate to the Himalayan chain, and rise to a height of 2000 to 3000 feet. In the Miocene period they were sandy and pebbly shores and banks lying at the foot of the then infant Himalayas, which, with the table lands to the N., probably formed a somewhat narrow E. and W. continental mass or large island. As a mere example of the marvellous fauna which inhabited this Miocene land, it has afforded remains of seven species of elephants, mastodons, and allied animals—one of them, the *Elephas Ganesa*, with tusks ten feet and a half long and twenty-six inches in circumference at the base. Miocene America is scarcely behind the Old World in the development of its land animals. From one locality in Nebraska, Leidy described in 1852 fifteen species of large quadrupeds, and the number has since been considerably increased. Among these are species of *Rhinoceros*, *Palæotherium*, and *Machairodus;* and one animal, the *Titanotherium*, allied to the European Anoplothere, is said to have attained a length of eighteen feet and a height of nine, its jaws alone being five feet long.

The Miocene is also remarkable for its flora, which is of very modern type, but presents the remarkable peculiarity that plants now confined to the more temperate regions extended N. to Greenland and Spitzbergen. The Miocene flora of these Arctic regions, as described by Heer, constitutes one of the most marvellous revelations of modern geology. To this or to the Eocene belongs the remarkable accumulation of the siliceous crusts of the humble plants known as Diatoms, which extends through parts of Maryland and Virginia, with a thickness in some places of thirty feet, and is celebrated among microscopists as the "Richmond infusorial earth."

(3) *The Pliocene.* Beds of this age occur along the coast of North and South Carolina, containing from 40 to 60 per cent. of living species of shells. It is probable that wide areas on the plains of the West are occupied by deposits of the same period, and the calcareous and sandy beds known in England as clay may be regarded as a representative in that country. With regard to animal life, the Pliocene continues the conditions of the last age, but with signs of decadence. Many of the old gigantic pachyderms have disappeared, and in their stead some familiar modern genera were introduced. The Pliocene was terminated by the cold or Glacial period, in which a remarkable lowering of temperature occurred over all the northern hemisphere, accompanied, at least in a portion of the time, by a very general and great subsidence, which laid all the lower parts of our continents under water. This terminated much of the life of the Pliocene, and replaced it with boreal and arctic forms, some of them, like the great hairy Siberian mammoth and the woolly rhinoceros, fit successors of the gigantic Miocene fauna. How it happened that such creatures were continued during the Post-pliocene cold we cannot understand till we have the Tertiary vegetation before us. It must suffice now to say that as the temperature was modified and the land rose, and the modern period was inaugurated, these animals passed away, and those of the present time remained. Perhaps the most remarkable fact connected with this change is that stated by Pictet, that all the modern European mammals are direct descendants of Post-pliocene species, but that in the Post-pliocene they were associated with many other species, and these often of great dimensions, now extinct. In other words, the time from the Pliocene to the Modern has been a time of diminution of species, while that from the Eocene to the Miocene was a time of rapid introduction of new species. Thus the Tertiary fauna culminated in the Miocene. Yet, strange though this may appear, man himself, the latest and noblest of all, would seem to have been a product of the later stages of the time of decadence. We propose, however, to return to the animals immediately preceding man and his contemporaries after we have noticed the Glacial period.

(4) *The Post-pliocene, or Glacial.* The warm climate and rich vegetation of the Miocene extended far into the Pliocene, with characters very similar to those already stated; but as the Pliocene age went on, cold and frost settled down upon the northern hemisphere, and a remarkable change took place in its vegetable productions. For example, in the somewhat celebrated "forest bed" of Cromer, in Norfolk, which is regarded as Newer Pliocene, we have lost all the foreign and warm-climate plants of the Miocene, and find the familiar Scotch firs and other plants of the modern British flora. The animals, however, retain their former types; for two species of elephant, a hippopotamus, and a rhinoceros are found in connection with these plants. This is another evidence, in addition to those above referred to, that plants are better thermometers to indicate geological and climatal change than animals. This Pliocene refrigeration appears to have gone on increasing into the next or Post-pliocene age, and attained its maximum in the Glacial period, when, as many geologists think, our continents were, even in the temperate latitudes, covered with a sheet of ice like that which now clothes Greenland. Then occurred a very general subsidence, in which they were submerged under the waters of a cold icy sea, tenanted by marine animals now belonging to boreal and arctic regions. After this they rose to constitute the dry land of man and his contemporaries.

Our next topic for consideration is one of the most vexed questions among geologists—the Glacial period which immediately preceded the advent of man. In treating of this it will be safest first to sketch the actual appearances which present themselves, and then to draw such pictures as we can of the conditions which they represent. The most recent and superficial covering of the earth's crust is usually composed of rock-material more or less ground up and weathered. This may, with reference to its geological character and origin, be considered as of three kinds. It may be merely the rock weathered and decomposed to a certain extent *in situ;* or it may be alluvial matter carried or deposited by existing streams or tides or by the rains; or lastly, it may be material evidencing the operation of causes not now in action. This last constitutes what has been called drift or diluvial detritus, and is that with which we have now to do. Such drift, then, is very widely distributed on our continents in the higher latitudes. In the northern hemisphere it extends from the Arctic regions to about 50° N. lat. in Europe, and as low as 40° in North America; and it occurs S. of similar parallels in the southern hemisphere. Farther towards the equator than the latitudes indicated we do not find the proper drift deposits, but merely weathered rocks or alluvia, or old sea-bottoms raised up. This limitation of the drift at the very outset gives it the character of a deposit in some way connected with the polar cold. Besides this, the general transport of stones and other material in the northern regions has been to the S.; hence in the northern hemisphere this deposit may be called the *Northern* Drift. If now we take a typical locality of this formation—such, for instance, as we may find in Scotland, or Scandinavia, or Canada—we shall find it to consist of three members, as follows:

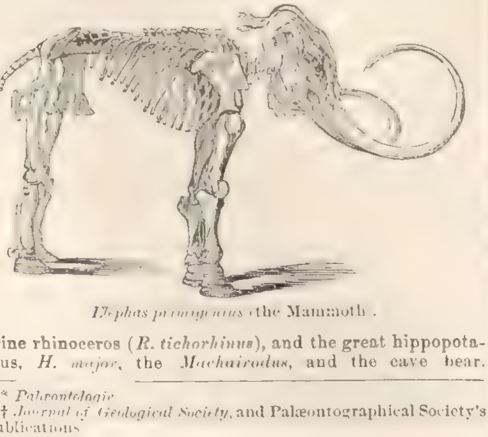
3, Superficial sands or gravels;
2, Stratified clays;
1, Till or boulder clay.

This arrangement may locally be more complicated, or it may be deficient in one of its members. The boulder clay may, for example, be underlaid by stratified sand or gravel, or even by peaty deposits. It may be intermixed with layers of clay or sand; the stratified clay or the boulder clay may be absent, or may be uncovered by any upper member. Still, we may take the typical series as above

stated, and inquire as to its characters and teaching. The lower member, or boulder clay, is a very remarkable kind of deposit, consisting of a paste which may graduate from tough clay to loose sand, and which holds large angular and rounded stones or boulders confusedly intermixed; these stones may be either from the rocks found in the immediate vicinity of their present position or at great distances. This mass is usually destitute of any lamination or subordinate stratification, whence it is often called *Unstratified* Drift, and is of very variable thickness, often occurring in very thick beds in valleys, and being comparatively thin or absent on intervening hills. Further, if we examine the stones contained in the boulder clay, we shall find that they are often scratched and striated and grooved; and when we remove the clay from the rock-surfaces on which it rests, we find these in like manner scratched and grooved and polished. These phenomena—viz. of polished and striated rocks and stones—are similar to those produced by those great sliding masses of ice, the glaciers of alpine regions, which in a small way and in narrow and elevated valleys act on the rocks and stones in this manner, though they cannot form deposits precisely analogous to the boulder clay, owing to the wasting away of much of the finer material by the torrents, and the heaping of the coarser detritus in ridges and piles. Further, we have in Greenland a continental mass with all its valleys thus filled with slowly-moving ice, and from this there drift off immense ice-islands, which continue at least the mud-and-stone-depositing process, and possibly also the grinding process, over the sea-bottom. So far, all geologists are agreed, but here they diverge into two schools. One of these, that of the Glacier theorists, holds that the boulder clay is the product of land-ice; and this requires the supposition that at the time when it was deposited the whole of our continent N. of 40° or 50° was in the condition of Greenland at present. This is, however, an hypothesis so inconvenient, not to say improbable, that many hesitate to accept it, and prefer to believe that in the so called Glacial period the land was submerged, and that icebergs then as now drifted from the N. in obedience to the Arctic currents, and produced the effects observed. It is probable that the truth lies in a combination of both causes, and that the appearances were produced by local glaciers aided by floating ice.

The Post-glacial and Modern.—The rigorous climate of the Post-pliocene gradually softened into that of the Post-glacial, which passes into the Modern, though there seems to have been a subsidence of great extent intervening before the establishment of the actual condition of the earth. In the Post-glacial period, for the first time in the great series of continental elevations and depressions, we find the newly-emerging land peopled with familiar forms. Nearly all the modern European animals have left their bones in the clays, gravels, and cavern deposits which belong to this period, but with them are others either not now found within the limits of temperate Europe or altogether extinct. According to Pictet,* the Post-glacial beds of Europe afford ninety-eight species of mammals, of which fifty-seven still live there, the remainder being either locally or wholly extinct. According to Mr. Boyd Dawkins,† in Great Britain about twelve Pliocene species survived the Glacial period, and reappeared in the British Islands in the Post-glacial. To these were added forty-one species, making in all fifty-three whose remains are found in the gravels and caves of the latter period. Of these, in the Modern period twenty-eight, or rather more than one-half, survive, fourteen are wholly extinct, and eleven are locally extinct. Among the extinct animals are the mammoth, *Elephas primigenius;* the Tich-

Fig. 17.



Elephas primigenius (the Mammoth).

orine rhinoceros (*R. tichorhinus*), and the great hippopotamus, *H. major*, the *Machairodus*, and the cave bear. Among the locally extinct are the reindeer, the lion and the Cape hyæna.

In the Post-glacial and Modern deposits we have remains of man and his works, and in the Modern the geological ages pass into modern history.

(For the more full discussion of geological details and methods, and for the economic relations of the science, the reader is referred to the *Manuals* of Lyell and Dana, and that of Jukes, edited by Geikie.) J. W. DAWSON.

Geology, Chemical. The science of geology is concerned not only with the structure or architecture of the earth, the arrangement and succession of the various rocks which compose its crust, and the physical agencies which have presided over its changes, but with the mineral composition of these rocks, and the chemical agencies which have been at work in past ages arranging from the elements of the globe their present combinations. Chemistry, therefore, finds a wide application in the investigation of the earth, the waters, and the air, and in considering the changes which these have undergone in past ages, and are still undergoing; and to this study we give the name of chemical geology. We may further distinguish between chemical geognosy, or the chemical composition and relations of the various bodies, and chemical geogeny, which concerns itself with the origin and changes of these bodies. Beginning with the rock-masses of the globe, we have to consider first, the mode of their generation, and second, their composition and the relations which they sustain to the atmosphere and the waters. Looking back into the past, we can discern a time when the oldest Palaeozoic rocks were not yet deposited, and when the Eozoic rocks formed the surface, and by their subsequent disintegration and decay gave rise to the Palaeozoic formations. Going still further, we may form some notion of the generation of the Eozoic rocks, and may speculate upon the condition of the earth when even these were not, and when water and air had not yet begun their action on the surface of the globe. The hypothesis of the igneous origin of the earth is now almost universally admitted, and we may fairly accept it as the basis of our sketch of chemical geogeny and geognosy. This hypothesis, as interpreted in the light of modern discoveries, supposes a liquid globe condensing from a vaporous mass in which, as in the sun, the various elements were at first in a state of chemical dissociation, but united, as the temperature of the mass became reduced, in the order of their affinities, and were successively precipitated. From this must have resulted a molten globe of oxidized materials, and an atmosphere in which the chlorine was presumably in the condition of chlorhydric acid, with carbon and sulphur in oxidized forms, watery vapor, nitrogen, and a probable excess of oxygen gas. Starting from this hypothetical condition of things, which is, however, strictly in accordance with what we know of chemical affinities at elevated temperatures, we have the basis of an intelligent scheme of chemical geogeny, which will enable us to understand clearly the order of things as we see it recorded in the earth's crust.

The conclusion now generally received as to the earth's interior is that it is solid to great depths, if not throughout, and there are good reasons for supposing that solidification may have commenced at the centre. The mean density of the earth, which is 5.3, water being unity, is about twice that of the known rocks taken as a whole, leading to a conjecture that denser compounds may have accumulated at the centre. Chemical geology has, however, only to do with the superficial portions, from which, with the elements of the air and the ocean, the whole of the known rocks have been derived. Analogies lead us to conclude that the primitive surface was irregular and accidented, and consisted of a compound of silicates of alumina, lime, magnesia, iron-oxide, and alkalies, besides the rarer bases, resembling perhaps some basic lavas in composition, and therefore very unlike granite, which is generally supposed to be the fundamental rock. Upon this, as cooling went on, there would, in accordance with our hypothesis, be precipitated the acid compounds of chlorine and sulphur from the primeval atmosphere, by which at an elevated temperature and under the pressure of a high barometric column, the silicates would be decomposed, with separation of silica and saturation of the acids by the bases of the primitive silicated mass. This process would soon terminate, and be succeeded by another reaction, the decomposition of portions of the silicates by waters holding in solution carbonic acid, which must have abounded in the early atmosphere. From this process (which still continues to operate on crystalline rocks) would result the separation of silicate of alumina as clay, free silica, and iron-oxide, and the formation of carbonates of lime, magnesia, and alkalies. These being carried down to the sea in solution, the alkaline carbonate would, from the dissolved chloride of calcium, precipitate carbonate of lime, with the production of chloride of sodium;

* *Paléontologie.*

† *Journal of Geological Society*, and Palæontographical Society's publications.

we thus get a conception of the process which may have given rise at once to the formation of limestone, clay, silica, and sea-salt. How near these decompositions, which are now going on, approach to the method of nature in the earlier times we can never determine, for our knowledge of the precise constitution of the primitive crust is too hypothetical. The elements therein may have been arranged in a manner very different from that of any compounds now known to us, and the mode of its decomposition consequently subject to conditions of which we can form but an imperfect notion. It will be found, however, that the above hypothesis gives us a starting point in chemical geology, and is, moreover, in remarkable accordance with the facts to be made known farther on.

Coming now to the chemical composition of the rocks, we distinguish them into so-called crystalline and uncrystalline divisions—terms which are better defined by saying that the first consist chiefly of crystalline silicates, and the second, for the greater part, of the results of the decay of these. Granites, gneisses, and hornblende rocks may be taken as examples of the former, which includes most eruptive and Eozoic rocks, and sandstones and shales of the latter. In this grouping we have excluded such rocks as are composed of carbonate and sulphate of lime, carbon, metallic oxides, and sulphurets, which belong alike to the crystalline and uncrystalline divisions. The minerals of crystalline silicated rocks are, besides quartz, potash-feldspar or orthoclase, the lime and soda-feldspars albite, oligoclase, andesine, labradorite, and anorthite, leucite, nepheline, and other double aluminous silicates, both hydrous and anhydrous, which are related to the feldspars in composition; the various micas and chlorites, garnet, epidote, all of which are moreover double aluminous silicates, and such simple aluminous silicates as andalusite, kyanite, and pyrophyllite. No less important are those which are essentially protoxide-silicates, such as hornblende, pyroxene, chrysolite, chondrodite, serpentine, and talc; and if to these we add carbonates of lime and magnesia, iron-oxides and graphite, we shall have the chief mineralogical elements of the crystalline rocks. Granite consists essentially of quartz and orthoclase, sometimes accompanied by a triclinic feldspar (oligoclase or albite), and holding, as an accidental mineral, a small portion of mica or of hornblende, or both. Trachyte is closely related to granite in composition. The elements of granite, arranged in a banded or stratiform manner, make up gneiss, and this, by a predominance of mica, passes into mica-slate, which itself often includes, as accidental minerals, garnet, staurolite, andalusite, and kyanite, giving rise to compound rocks in which silicates of alumina without alkali replace orthoclase. Passing from the above classes of rocks, in which there is generally an excess of silica in the form of quartz, we come to those in which quartz is rarer or altogether wanting. Hornblende or pyroxene, either alone or mixed with a feldspar, generally labradorite, often accompanied by chrysolite, constitutes the compounds known as dolerite, diabase, diorite, and many related rocks, frequently containing chlorite, garnet, or epidote; while those composed chiefly of serpentine or steatite make up another and closely related class.

To discuss the whole question of the varieties of rocks produced by the admixture of different minerals would exceed the limits of this sketch. It will, however, be necessary to give some notion of the different classes of crystalline silicated rocks, considered geognostically: 1. Those which, like gneiss, mica-slate, and serpentine, are evidently bedded and stratified rocks, are generally supposed to have been deposited from water, and are conveniently designated indigenous rocks. 2. Those which, like granites, traps, and lavas, have been forced in a more or less liquid form from beneath the surface, are regarded as of igneous origin, and are called eruptive or exotic rocks. 3. Those which have been deposited from solution in fissures of previously formed rocks, as the quartz of mineral veins, and likewise many granitic vein-stones, have been called endogenous rocks. Rock-masses of the same mineral constitution may belong to all of these classes; thus, a granitic gneiss, an eruptive granite-dyke, and a granitic vein-stone may be alike composed of orthoclase, quartz, and mica, and difficultly distinguished from each other unless their geognostical relations are taken into account.

The origin and mode of formation of the indigenous crystalline rocks, such as gneiss or hornblende, are involved in much obscurity. By one school they are supposed to be of plutonic origin—that is, to have been formed in some way from the cooling of the primitive crust of the earth, and to have acquired the stratiform arrangement observed in their constituent minerals from movements in the cooling mass. These ancient crystalline rocks are declared by this school to be neither stratified nor eruptive rocks in the accepted sense of these terms, but to partake of the nature of both of these classes. Granite would thus differ from gneiss only in the accident of structure. To this view, which derives these rocks from the cooling mass of the globe, it is objected that the quartz which they contain is not, as far as known, a product of igneous action, but is, on the contrary, changed into a wholly unlike form of silica by a heat even below that required for its fusion, and in most cases is clearly shown by its associations to have been deposited from aqueous solution. Moreover, the microscopic study of the quartz, as well as of other minerals of granitic rocks, has shown them to contain in many cases small cavities partially filled with water or with saline solutions: and from the examination of these at elevated temperatures it has been calculated that the crystallization of such quartz has taken place at a heat much below that of redness. Such are some of the arguments advanced against the purely igneous origin of granite and granite-like rocks, and in favor of the notion that they have at one time been in a softened condition under the combined influence of water and heat, or in a condition of what may be defined as one of aqueo-igneous fusion. Reasons are given for supposing that the presence of a few hundredths of water may produce a softened and plastic condition of the rock at a temperature far below that required for the fusion of its elements. Granite, according to the views of this school, is a softened and modified gneiss which has lost the evidences of its aqueous stratification. The occurrence of the various minerals of granite in vein-stones which are pretty evidently of aqueous origin, gives a further support to this theory; and it has been suggested that the deposition of bedded gneiss at the earth's surface was a process closely analogous to that by which the granitic vein-stones were formed in fissures, in both cases from solutions. A similar view will then be extended to other feldspathic and hornblendic indigenous rocks, which must have been generated under conditions, both physical and chemical, very different from those which have in more recent times prevailed at the surface. A modification of this view is that which holds that the various mineral silicates, such as hornblende and feldspars, which enter into the composition of these rocks were deposited from watery solutions, not in a crystalline form, but as non-crystalline precipitates or magmas, which subsequently assumed a crystalline arrangement, as has evidently been the case in many limestone rocks. It is probable in the present state of our knowledge that each of these latter views is in certain instances true, and that in either case the minerals seen in our crystalline stratified rocks have been generated by aqueous agencies. It has been suggested above that granite is a softened and displaced gneiss from which the evidences of stratification have been obliterated, and a similar view should be extended to other eruptive or exotic rocks, with certain modifications to be considered farther on, in the discussion of volcanic phenomena. Eruptive rocks are seen in many cases to present local variations in their structure, which presents a banded arrangement simulating that of indigenous rocks—a fact which has lent support to the notion that all stratified rocks, such as gneisses, have been derived from granites, rather than all exotic granites from gneisses. Such a view, however, leaves unaccounted for the origin of the exotic rocks themselves, which is the very problem to be explained. These are by this school supposed to have had their origin in the original fluid mass of the globe, of which a portion at least is imagined to have separated into two strata, a lighter and a denser one, which arranged themselves in the order of their specific gravities, and being from time to time ejected, have given rise, the heavier and more basic stratum to the hornblende and pyroxenic rocks, and the lighter and more silicious to the granitic and trachytic rocks, all of which may assume in certain cases a stratiform structure. The variations in the chemical and mineralogical composition of the crystalline rocks are, however, so great as to require a supplementary hypothesis; which is that of a conversion or transmutation of almost any crystalline rock into any other. The rocks are supposed to be permeated by circulating liquids, through which one element may be removed and another substituted in its place, so as to effect a more or less complete transformation of the rock. Thus, in accordance with this view, we are told that granite or gneiss may be changed into serpentine, limestone, or dolomite, and, conversely, limestone may be converted into any one of these, hornblendic rocks being subject to not less remarkable changes; so that, given the two types of igneous rocks already mentioned, it is easy, in accordance with this view, to imagine the conversion of various parts of them into limestones, dolomites, serpentines, chloritic, talcose, and micaceous rocks. This hypothesis, based upon a small number of well recognized facts as to the alteration of certain known species, and upon a much larger number of cases of association or blending of species which have been regarded as evidences of partial alteration, has been very generally

adopted as a means of explaining the origin of the great variety of crystalline rocks.

Related to this view, which supposes the plutonic origin and subsequent aqueous alteration of the crystalline rocks, is another which requires some notice, and which supposes that various crystalline stratified rocks have been formed from the uncrystalline sedimentary sands and clays (themselves the result of the decay of the older crystallines), through the agency of infiltrating waters, which have introduced alkalies, magnesia, etc., and thus effected changes analogous to those supposed to have taken place in the plutonic rocks. Such a process has doubtless in some cases operated on a limited scale, but is of no importance to the inquiry as to the origin of the ancient crystalline rocks themselves. These views of the generation of various crystalline rocks by the alteration either of plutonic rocks or of earthy sediments through the addition or subtraction of foreign matters in solution, are now being supplanted by that above defined, which supposes the direct aqueous origin of those rocks and their constituent minerals.

The relations of the internal heat of the earth, which has been found to increase at the rate of about 1° F. for every 50 feet of depth to more than 3000 feet, are very important in connection with geological chemistry. The earth is slowly cooling, and it can be shown that at an early period in its history, when this process was less advanced, the augmentation of heat in descending must have been much more rapid than it now is, so that atmospheric waters penetrating the crust to no great depth would attain a temperature at which their solvent power would be greatly increased. It has been found that water, either pure or impregnated with the saline matters often met with in mineral waters, such as alkaline carbonates and alkaline or earthy sulphides, has its solvent power greatly exalted when heated under pressure to temperatures above the ordinary boiling-point. Experiments thus conducted have shown that it is possible to crystallize quartz, pyroxene, zeolites, and many other mineral species, including the metallic sulphurets and sulpharseniets, which are our common metallic ores. Pressure alone, moreover, aids the solution of bodies in water by favoring that condensation which is one of the conditions of solution, as has been shown by the experiments of Sorby in operating under great degrees of pressure upon mixtures of water and soluble salts. A vast number of bodies generally classed as insoluble in water, or nearly so, are known to present modifications, often very unstable, under which they are readily soluble in water, and are the soluble forms of colloids. Water seems, in fact, under favorable conditions of temperature, pressure, and saline impregnation, to realize pretty nearly the conception of a universal solvent or menstruum, which, penetrating at considerable depths through highly-heated strata, dissolves from these great quantities of mineral matters. Coming towards the surface again, where both pressure and heat are diminished, it deposits these materials, and thus gives rise to the crystalline fillings of veins or to superficial deposits.

The Eozoic or crystalline stratified rocks consist of several distinct series, deposited, like the later formations, through long ages, and sustaining to each other such relations as to show that one series had been partially broken up or destroyed before the deposition of the succeeding one. Each in its turn consists of feldspathic, hornblendic, and micaceous silicates, with quartz rocks, limestones, iron ores, etc.; and in each series at present known we find some evidences of the destruction of a preceding series, so that the fundamental rock remains as yet undiscovered. The substratum of granite, in the sense generally understood of a first-formed rock, is nowhere known, and it is the granite-like gneiss of the Laurentian or oldest Eozoic series which has given rise to the notion of an underlying granite. A study of the elements of these crystalline rocks shows that essentially the same chemical agencies were at work in those earlier times as at present, and that the differences are rather in kind than in degree. Silicates of magnesia, like serpentine, have been found not only in the Silurian, but as late as the Cretaceous period; sepiolite is found in the Tertiary; triple silicates, related to chlorite, fill the pores of Palæozoic crinoids; and glauconite is found in similar conditions in more recent foraminifera; while the deposition of crystalline zeolites comes down to the historic period; all of which processes show the continuation, though under enfeebled conditions, of processes which were once very active at the earth's surface. Further illustrations of this will be given when we come to speak of mineral springs and of vein stones.

The agencies of organic life are among the most important of those which from a very early age have contributed to changes in the chemistry of the earth. We have seen that there is reason to believe that the condition of the first-formed globe was one of general oxidation, and hence endeavored to show that after the affinities of the stronger acids were satisfied, the whole of the sulphur must have existed as sulphates, all of the carbon either as carbonates or free carbonic acid, all of the hydrogen as water, and all of the iron and other readily oxidable metals as oxides, either combined as silicates or set free by the partial decomposition of these. A great problem to be solved is that of the deoxidation of these elements as a condition preliminary to their entering into new combinations; and this, so far as we know, can be effected in one way only—namely, by the intervention of organic life. It is the function of vegetation under the stimulus of solar light and heat to decompose carbonic acid and water, setting free oxygen, and giving rise to hydrocarbonaceous bodies, both organized and unorganized, which in many cases, after having served the purposes of plants, become in turn a part of living animals. When in the course of nature plants and animals die, their remains, in a dead or disorganized form, constitute what is sometimes comprehensively spoken of as organic matter. This, by taking up oxygen either in the process of combustion or of slow decay, is again transformed into carbonic acid and water, not to speak of the nitrogen which is present in greater or less extent in organisms, and is again liberated either as gaseous nitrogen, as ammonia, or as nitrate. While living, the vegetable organism effects the reduction of carbonic acid and water (and to a less extent of sulphates), and is thus the source of carbon and hydrogen as they appear in the earth in the various forms of graphite, coal, petroleum, and hydrocarbon gases. In addition to this, growing plants and animals reduce sulphates, as appears from the sulphuretted compounds which occur in many of them. These organisms, moreover, by a process of selection, remove from the media in which they live certain mineral elements, which through this intervention become fixed and concentrated. Thus, the phosphates of the soil through vegetation are accumulated in the bones of vertebrate animals. Potash is removed in like manner both by terrestrial and marine vegetation, and by the latter also the metals found in the sea—silver, lead, and copper—are removed from its waters and fixed in the organic tissues, by which means they are removed from the oceanic circulation, and by the decay of these in contact with the ooze of the bottom or the mud of the shore are again restored to the earth, from which they are as constantly dissolved and taken down to the sea, the waters of which, but for the intervention of organic life, would become charged with these mineral elements. But the results of the decay of animal and vegetable organisms are not less important through their reducing action, due to their affinity for oxygen which is demanded in the retrograde metamorphosis by which the elements return to their original highly oxidized condition. In virtue of this power they reduce soluble sulphates, like those of the alkalies and the alkaline earths, to the condition of sulphides; the carbonic acid which results from the oxidation of carbon in this process in its turn decomposes these sulphides, liberating sulphuretted hydrogen gas, the partial oxidation of which, removing the hydrogen, produces deposits of sulphur. The soluble sulphides or the sulphuretted hydrogen resulting from this process of reduction give rise to the insoluble metallic sulphides which are so abundant in the rocks as metallic ores. Native metals like copper are also probably due to the reducing action, either directly or indirectly, of organic matters; and the power of these substances to reduce the insoluble peroxide of iron which abounds in the soils into a protoxide, which is soluble in solutions of carbonic acid or of certain organic acids, themselves the products of vegetable decay, permits the removal of this element from certain beds of rocks, and its accumulation in certain others in the shape of oxidized ores, such as limonite, hematite, or siderite, or, when the decomposition of sulphates concurs, of pyrites.

There is another agency which is not less important in its relations to the chemistry of the rocks, and that is the slow sub-aërial decomposition of the crystalline silicated rocks under the influence of atmospheric agents. In those regions of the earth from which comparatively recent changes have not removed the products of decay this process is seen to have attacked the feldspars, removing from them their protoxide bases, together with a portion of silica, leaving behind a hydrated silicate of alumina or clay. In like manner the protoxide silicates like hornblende and pyroxene have given up in a soluble form the lime and magnesia which they contained, together with a part of the silica, leaving behind with the remaining silica the oxides of iron and manganese raised to a higher degree of oxidation. The decomposition of other silicates, such as mica and chlorite, has been as yet but partially studied, but the quartz remains unchanged. This process of decay is seen to have penetrated to a depth of several hundred feet in many regions, and the beds and veins of metallic sulphides enclosed in the decayed crystalline rocks have

undergone a somewhat similar change, which has resulted in the loss of the sulphur, copper, and zinc in a soluble form, leaving behind a residue of hydrous peroxide of iron, which forms in many of these cases an ore of that metal. This process of decay has doubtless been effected by the action of the carbonic acid and oxygen of the air dissolved in atmospheric waters, which, while oxidizing iron and sulphur, have removed in the form of carbonates, the bases lime, magnesia, and the alkalies, together with a portion of silica, which was liberated from its compounds in a soluble form. Such a process as this was doubtless active from a very early period; and this decay was a preliminary to the process of denudation by the action of water, which removed the clay and separated it from the unchanged quartz; which latter, by its further attrition, gave rise to grains of sand. From the vast quantities of this decaying matter the clays of all the argillaceous strata of the various geological periods have been derived, while from the silica set free in a dissolved form during the process of decay have come the great deposits of flint, chert, hornstone, agate, etc. which abound at many different horizons, and also certain crystalline sands which appear to consist not of the quartz from the decay of ancient granite like rocks, but rather of crystalline quartz directly deposited from solutions.

The carbonates which in a dissolved form have come from the decaying crystalline rocks, and have been conveyed to the sea, have played an important part in the chemistry of its waters. It would appear from *a priori* considerations, in accordance with the views already put forth, that the early sea must have contained a great predominance of lime and magnesia salts relatively to the soda salts; in other words, that a much larger part of the chlorine which the ocean must have from the first contained was combined with earthy bases, and a less portion consequently with sodium, than in the modern ocean. In strict accordance with this is the fact that the saline mineral waters of the older rocks, which may be looked upon as fossil sea-waters imprisoned since a very early date, contain a great predominance of chlorides of calcium and magnesium, while in modern sea-waters, as in the bitterns resulting from their evaporation, there is no chloride of calcium found, the sulphates of the sea being sufficient not only to convert into gypsum the whole of the lime present, but to yield, moreover, a large proportion of sulphate of magnesia. Now, as the proportion of sulphates in the sea has not been augmented in the course of ages, but, on the contrary, has diminished, not only by the gypsum deposited, but also by the sulphur reduced and separated either in a free state or as metallic sulphides, it follows that this changed condition of the sea-water as regards the proportion of the lime to the sulphate must have been brought about by the abstraction of lime in other forms than that of sulphate. No compounds of this base other than sulphate and carbonate being found in the rocks since the beginning of Palæozoic time, it follows that the lime must have been removed as carbonate from the sea in which it must have previously been present in a soluble form. In other words, the bicarbonates of soda and magnesia derived from decaying rocks have the power of decomposing chloride of calcium, with the formation of chloride of sodium and the separation of carbonate of lime which, either directly or indirectly, has been separated in the form of limestone.

Another not less important factor in the chemistry of the sea has been evaporation. Climatic conditions have over large areas favored the evaporation of waters, as is now the case in certain desert regions, and enclosed sea basins have often been subject to this action. The result of this process of evaporation on sea water is to cause the deposit of the sparingly soluble sulphate of lime; and if, as was the case in the early seas, the lime-salts were in excess, the whole, or very nearly the whole, of the sulphates would be removed, sulphate of lime being much less soluble in strong saline liquids than in pure water. A further continuation of the process of evaporation would give rise to the separation of rock-salt, and at a later stage to salts like carnallite, tachydrite, and karstenite, which are found in a solid form in certain saliferous formations, with all the evidences of a slow evaporation of sea-water. In connection with this process of evaporation an important reaction takes place between waters holding sulphate of magnesia and solutions of bicarbonate of lime. This latter compound is found in most river and spring waters, and is either derived from the direct decomposition of rocks containing silicate of lime, or from the solution, by means of atmospheric carbonic acid, of previously formed carbonate of lime. By the reaction between bicarbonate of lime and sulphate of magnesia there are formed sulphate of lime and bicarbonate of magnesia. The latter is much the more soluble of the two, pure water being capable of holding about nine parts of carbonate of magnesia as bicarbonate for one part of sulphate of lime. Thus, from an evaporating sea-basin fed with solutions of bicarbonate of lime, gypsum is deposited, while the more soluble magnesian carbonate, being subsequently thrown down mixed with a variable portion of carbonate of lime, furnishes the material for dolomite and magnesian carbonates of lime. This reaction, then, results in the elimination from the waters subjected to it of both the elements of the sulphate of magnesia. Another not less important reaction in connection with evaporating waters is of even greater significance as regards the formation of magnesian limestones. When waters, charged with carbonates of lime, magnesia, and soda from the decay of rocks, flow into the sea, the latter bases, replacing lime in the soluble salts of the water, give rise to carbonate of lime; but when, in a confined basin, the sulphate and chloride of calcium are at length decomposed, the carbonate of soda attacks the magnesium salts, giving rise to bicarbonate of magnesia, which, added to that accompanying the soda-salt, soon causes the accumulation in the basin of an abundance of magnesian carbonate, which by evaporation is deposited, mingled with lime-carbonate, and is itself a still more frequent source of magnesian limestones. These, resulting from the intervention of carbonate of soda, are distinguished from those produced by the previously described reaction by the absence of associated gypsum. In both cases, however, the great solubility of the magnesian carbonates is such that evaporation is an indispensable condition for the generation of these magnesian deposits, which, from their geological relations, are shown to have been formed in limited basins.

Closely related to this subject is that of saline and alkaline mineral waters: of these the first consist of the elements of the ocean-waters imprisoned in the ancient strata, sometimes as fossil sea-water, and at other times as the bitterns or the solid salts resulting from its evaporation. From these sources, which in fissured and dislocated strata are in communication with atmospheric waters, the saline matters, more or less diluted, are brought to the surface as mineral springs. The source of alkaline springs is to be sought in the slow subterranean decomposition of feldspathic sediments, which yield to infiltrating waters carbonated or silicated alkalies; and from the mingling of these with the saline waters already mentioned various intermediate kinds of waters are produced. The deoxidation of sulphates by organic matters, in the manner already explained by the intervention of decaying organic matters, aided in some cases by the action of carbonic acid, explains the origin of the sulphuretted hydrogen and the soluble sulphides which abound in many mineral waters. Alkaline mineral waters hold in solution large quantities of free silica, but besides that many of them contain dissolved silicates of lime and soda. The reaction of these upon magnesian salts in saline waters gives rise to a very insoluble silicate of magnesia, which in some uncrystalline formations is found accumulated in large beds under the name of sepiolite or magnesian marl. From analogous compounds formed in a like manner in earlier geological periods, it is probable that magnesian silicates like serpentine, chrysolite, and talc have originated. Many neutral and alkaline mineral waters contain, besides silica, a portion of alumina in a soluble form, from which may be generated aluminous silicates. In the deposits from mineral waters we find an explanation of the origin of the minerals of metalliferous and other vein-stones, which are accumulations in fissures that once were channels for aqueous solutions of mineral matters.

The origin of volcanic products is a problem of great interest in geology. The various molten rocks and lavas poured out from beneath the surface of the earth, sometimes imperfectly fused and enclosing crystalline mineral species, sometimes vitreous and homogeneous, embrace great varieties in chemical composition, and are moreover accompanied by watery vapor and several gaseous products, chiefly sulphuretted hydrogen, hydrochloric and carbonic gases. The origin of all these has been sought to be explained by different hypotheses, but the one which seems the most rational is that which ascribes them to the action of heat upon stratified rocks. Whether the source of this heat be conduction from the igneous centre, or, as supposed by others, due to mechanical movements in the earth's crust, or rather to the heat from the one source seconding and supplementing the other, we may conceive that its effect upon heterogeneous strata containing, besides siliceous and argillaceous matters, carbonates, chlorides, sulphates, and organic matters, the whole permeated with water, would be to generate both the gaseous and the stony products of volcanoes.

It is impossible within the limits here assigned to discuss all of the questions which arise in connection with the

chemistry of geology, but we have endeavored in the preceding pages to touch briefly upon some of the more important problems which it presents, and to offer such solutions as seem most in accordance with the present state of geological and chemical knowledge. T. STERRY HUNT.

Geomet'rical Mean, the second of three continued proportionals, or the second of the terms of a geometrical progression containing three terms. The geometrical mean of two numbers is equal to the square root of their product. If we assume two terms, and insert any number of terms, so that the whole forms a geometrical progression, all the inserted terms are called geometrical means to these two.

Geomet'rical Progres'sion is a series of numbers, each one of which is the product of the preceding one multiplied by a common and constant ratio. A geometrical progression may be increasing or decreasing, according as the constant ratio is greater or less than unity.

Geom'etry [Gr., from γῆ, the "earth," and μέτρον, "measure"], that branch of mathematics whose object is to investigate the properties and relations of geometrical magnitudes.

Subject-matter of Geometry.—The subjects treated of in geometry are *volumes*, *surfaces*, *lines*, and *angles*. A volume is a limited portion of space; it has three dimensions—length, breadth, and thickness or height. That which separates a volume from the rest of space is called a *surface*: a surface has length and breadth, but not thickness. If we conceive a surface to be made up of two parts, that which separates these parts is called a *line*; a line has length, but neither breadth nor thickness. If we conceive a line to be made up of two parts, that which separates these parts is called a *point;* a point has position, without length, breadth, or thickness. These are the fundamental concepts of geometry. Considered in a reverse order, we may conceive a line to be generated by a point moving according to some fixed law; a surface to be generated by a line moving according to some fixed law; and a volume to be generated by a surface moving according to some fixed law. (See FLUENTS AND FLUXIONS.) In taking this view of the subject we have the additional concept of *direction*. The difference of direction of two lines, or the inclination of one line to another, is called an *angle*.

Division of Geometry.—Geometry is divided into two branches—*elementary geometry*, and *higher* or *transcendental geometry*. 1. Elementary geometry treats of those magnitudes whose elements are the straight line and the circle. It embraces all propositions relating to plane figures whose elements, or bounding lines, consist of straight lines or arcs of circles; it also embraces all propositions relating to surfaces and volumes whose elements, or bounding surfaces, may be generated by the revolution of a straight line or of an arc of a circle; it also embraces all constructions that can be made by the aid of the straight line and circle. 2. Higher or transcendental geometry embraces those branches in which the elements are more complex than the straight line and circle; as, for example, conic sections, cycloids, and the like. In this branch are included those higher investigations of the ancients which are now more elegantly made by means of analytical geometry and the calculus.

Objects of Geometry.—The object of geometry is to deduce the properties and relations of geometrical magnitudes. A *property* of a geometrical magnitude is an attribute that is common to every individual of the class to which the magnitude belongs; thus, it is a property of a triangle that the sum of its three angles is equal to two right angles. A property may be *characteristic*, or *secondary*. A characteristic property is one that is peculiar to a particular class of magnitudes, but is not possessed by any other class; thus, it is a characteristic property of a triangle that it has but three angles. A secondary property is one that is shared by magnitudes of other classes; thus, it is a property of a square that its area is equal to the product of its perimeter by the radius of the inscribed circle. This property is secondary, because it is a property common to all regular polygons. The enunciation of a characteristic property is a sufficient definition of a magnitude. In fact, the definition of a magnitude usually consists of a statement of one or more of its characteristic properties; thus, we say that a triangle is a polygon having three angles: it might also be defined as a polygon of three sides. Since the same magnitude may have several characteristic properties, it follows that the same magnitude may have several definitions.

The *relations* deduced by geometrical reasoning are of two kinds: those of equality or inequality, and those of proportionality. As an example of the first kind of relation we may instance the following: any side of a triangle is less than the sum of the other two, and greater than their difference. As an example of the second kind of relation we may instance the following: similar triangles are to each other as the squares of their homologous sides.

Methods of Investigation.—The truths of geometry form a chain of dependent propositions which may be divided into three classes. The *first* class of truths are those implied in the definition; for example, when we say that a quadrilateral is a polygon of four sides, we imply that such a figure may exist. The *second* class of truths are self-evident or intuitive; these are called axioms; thus, the proposition that a whole is greater than any of its parts is self-evident—that is, its truth is universally admitted. The *third* class of truths are those which are inferred from definitions, axioms, and truths already established; these are called demonstrative truths. The train of reasoning by which a geometrical truth is inferred from truths already established is called a demonstration. Two methods of demonstration are employed—the *direct* and the *indirect*. The direct demonstration consists of a train of logical arguments in which the successive premises are definitions, axioms, and truths previously demonstrated, and in which the final conclusion is the truth to be established. Thus, the method of demonstrating Prop. v. book iii. *Davies' Legendre*, that "two triangles which have two sides, and the included angle of the one, equal to two sides, and the included angle of the other, each to each, are equal in all their parts," is direct. In the indirect method at least one of the premises is an hypothesis, that is, a supposed truth. There are two species of indirect demonstration. In the *first* species there may be several hypotheses, of which one, and only one, can be true; in this case we show that all of these hypotheses except one are false, and then we infer the truth of this one. This is the method by *exclusion*. The demonstration of Prop. xvii. book iii. *Davies' Legendre*, in which it is shown that "in equal circles, incommensurable angles at the centre are proportional to their intercepted arcs," belongs to this species. In the second species of indirect demonstration an hypothesis is made which is contradictory to the proposition to be demonstrated; this hypothesis is then treated as though it were true, and the reasoning is carried on, using no other propositions except those that are known to be true, until a conclusion is reached that contradicts some known truth; the contradictory of the assumed hypothesis is then inferred to be true. This species of demonstration is called the *reductio ad absurdum*. The demonstration of Prop. iv. book i. *Davies' Legendre*, in which it is shown that "if a line meets two other lines at a common point, making the sum of the contiguous angles equal to two right angles, the two lines met form one and the same straight line," belongs to this species of demonstration.

Besides the methods of investigation already given, there is a mode of demonstration which was much used by the ancients in their higher investigations, known as the *method of exhaustions*. This method is closely connected with the modern *method of limits*. As an example of this method we may instance the mode of determining the area of a circle in plane geometry. It is first shown that two regular polygons, having the same number of sides, can be constructed, the one inscribed within, and the other circumscribed about, a given circle whose areas differ from each other by less than a given area. By continually increasing the number of sides, this difference is continually diminished or *exhausted;* as the two polygons approach each other in area, each becomes more nearly equal to the circle; finally, when the number of sides is made infinitely great—that is, when the limit is reached—the two polygons become equal to each other and to the circle. This method of proceeding enables the geometer to find an approximate value for the area of the circle true to within any desired degree of accuracy. The ancients applied the method of exhaustions to a great variety of propositions both in elementary and in higher geometry.

History of Geometry.—The following sketch of the history of geometry has been compiled, mostly from Rouché and De Comberousse. Ideas of form and extension are as old as the human race, but the first attempts to co-ordinate and systematize them were made by the Egyptians and Chaldæans. Geometry, as a science, was introduced into Greece by Thales of Miletus (637–548 B. C.); he founded the Ionian school, and is said to have demonstrated many propositions which were afterwards incorporated with Euclid's *Elements*. It was Thales who discovered the properties of similar triangles. Pythagoras of Samos, a disciple of Thales (580 B. C.), founded in Italy the celebrated school which bore his name. He demonstrated the relation between the three sides of a right-angled triangle, and showed that the circle contains a greater area than any plane figure having the same perimeter, and that the sphere contains the greatest volume bounded by a given surface. He also investigated the properties of regular polyedrons, and established those

relations which formed so conspicuous an element in the cosmogonies of the Middle Ages. Plato (430–347 B. C.) laid the foundation of the analytical method; he investigated the nature of the conic sections and developed the fundamental principles of geometrical loci. It was in the school which he established that the noted problems of the *duplication of the cube* and the *trisection of an angle* were first discussed. It is said that Plato himself gave a solution of the first of these problems. Euclid, who belonged to the famous school of Alexandria, flourished about the year 285 B. C. He wrote on various mathematical subjects, but he is especially noted as the author of the *Elements of Geometry*, in which he collected and systematized all the truths and principles of elementary geometry that were known before his time, and to which he added many new ones. It is in Euclid's *Elements* that the method of proof known as the *reductio ad absurdum* first appears. Many of his works have been lost, the most important of which is his treatise on porisms. His *Elements of Geometry* have been translated into all civilized tongues, and to the present day form a favorite text-book for elementary instruction. Immediately after Euclid came Archimedes and Apollonius, two of the most distinguished geometers of the most brilliant era of the Alexandrian school. The attention of Archimedes (287–212 B. C.) was specially directed to metrical geometry. He determined the ratio of the diameter of a circle to its circumference, and also investigated the areas of the circle and parabola. He discussed the properties of spirals, the relation of the sphere to its circumscribed cylinder, and the cubature of spheroids and conoids. The writings of Apollonius (247 B. C.) relate to the geometry of form. He composed a treatise on conic sections, in which he developed the properties of asymptotes, foci, conjugate diameters, and normals. He also wrote on the subject of maxima and minima, and it is to him that we owe the theory of cycles and epicycles, which was employed for so long a time in explaining the apparent motion of the bodies of the solar system. The successors of Archimedes and Apollonius directed their studies towards those branches of geometry which have a particular bearing on the science of astronomy. Hipparchus (150 B. C.) discovered the method of projecting the sphere stereographically, also the properties of transversals in both rectilineal and spherical triangles. Pappus discovered the principle of the theorem now known as Guldin's; he also discovered the fundamental principle of the anharmonic relation and the properties of a hexagon inscribed in a conic section. The school of Alexandria was destroyed when that city was taken by the Arabs about 640 A. D. During the following centuries there sprung up in the school of Bagdad a few able commentators on those writings of the Greeks that had escaped the disasters incident to the Arabian conquest, but throughout the rest of the world a profound stagnation took place, which remained unbroken for nearly 1000 years, and clearly marked the line of division between ancient and modern geometry. The ancients were in full possession of the two great methods, geometrical synthesis and geometrical analysis, and by their aid "they built up a grand and symmetrical fabric of geometrical truth, which certainly may contest the palm with the achievements of any age, and whose positive value has only been surpassed by the acquisitions of our own." It was not till the middle of the sixteenth century that geometry showed any signs of revival. Vieta (1540–1603) developed the science of symbolical algebra, and applied it to the solution of problems in geometry. He constructed graphically the roots of equations of the second and third degrees, and was the first to solve the problem of drawing a circle tangent to three given circles. In the writings of Kepler (1571–1631) and of Fermat (1570–1633) we have the first germs of the method of infinitesimals. Pascal (1623–62) and Desargues (1593–1663) extended and improved the ancient methods of geometrical analysis, and laid the foundation of that new geometry which has received such a wonderful development during the present century. The ancients studied the properties of conic sections on the cone itself, and often made use of tedious demonstrations, differing in method for each of the three classes of curves. Desargues, whom Poncelet calls the Monge of his age, generalized the methods of investigation, and by an extension of the properties of the circle which forms the base of the cone he reached demonstrations that were equally applicable to all of the classes. Descartes (1586–1650) created the science of analytical geometry, which produced a complete revolution in the method of geometrical investigation, and for a time checked the progress of pure geometry. A few eminent writers, amongst whom may be named Huyghens and La Hire, resisted the change, and worthily sustained the character of the ancient methods. The discovery and development of the infinitesimal calculus by Newton and Leibnitz gave an additional check to the progress of pure geometry. The ease with which this new branch of mathematics could be applied to geometrical investigation and the study of natural phenomena caused it to absorb almost exclusively the labors of the most illustrious geometers of the age. There were, however, a few exceptions. Newton showed in the *Principia* that the ancient methods could be employed in researches of the highest order. Cotes and Maclaurin applied their methods to the study of geometric curves. Halley and Simpson also strove to revive a taste for the ancient geometry, but no decided advance was made till the time of Monge and Carnot. At the beginning of the nineteenth century the creation of descriptive geometry by Monge marked a new era. This new science was of immense assistance in studying the properties of bodies. It showed the intimate relation between plane figures and figures in space, and at once enriched the science of geometry by many new and elegant methods of investigation; by permitting the deduction of properties of figures of three dimensions from those of two dimensions, it contributed in no small degree to the revival of pure geometry. The appearance of Carnot's *Geometry of Position* and his essay on transversals still further directed the attention of mathematicians to the possibility of obtaining, by the principles of pure geometry, all the results that had been reached by the analytical methods of Descartes. To the labors of Carnot and Monge must be added those of Poncelet, who, in his treatise on the properties of projections of figures, was able, by a skilful employment of the principle of continuity and the beautiful theories of reciprocal polars and of homological figures, to deduce all the known properties of lines and surfaces of the second order. Passing over numerous writers on the recent geometry, mention must be made of Chasles, whose great works are his higher geometry, his treatise on porisms, and his memoir on duality and homography. These developments of the recent geometry are a continuation of the methods of geometrical analysis of the ancients, as revived by Pascal and Desargues, but they possess an immense advantage over those methods in their generality and systematic uniformity of proceeding. W. G. PECK.

Geoph'agism [Gr. γῆ, "earth," and φαγεῖν, to "eat"], or **Dirt-eating,** a habit which prevails in many parts of the earth among uncivilized nations, who often, even when the supply of food is good, resort to this habit. The Ottomacs of South America eat upon an average, we are informed, a pound and a half of ferruginous clay daily. Clay for eating is a regular article of merchandise in Bolivia; and the negroes and lower classes of whites in some of the U. S. have a similar practice. In Lapland and Northern Scandinavia bergmehl is mixed with flour in making bread, but it is by no means unlikely that the diatoms it contains are nutritious to some extent. From Lollhagysyön alone hundreds of cartloads of bergmehl are sold yearly. Dirt-eating is a common habit among the West Indian blacks, and in the Hudson's Bay country among the Indians, where a soft steatite is eaten, probably to allay hunger. Dirt eating is also one of the forms of the *pica*, *malacia*, or depraved appetite, common among chlorotic young women, in whom it is not improbable that some stomachic uneasiness of local or reflex origin may be relieved by it.

George, duke of Saxony, the second son of the late King John of Saxony, was b. Aug. 8, 1832. He received a military education; entered early into the artillery, and gave the first proofs of his ability in the campaign of 1866, during which he commanded a brigade of cavalry as major general. In the beginning of the Franco-German war of 1870 he commanded the first division of the Saxon army corps, but after the battle of Metz, when his elder brother was appointed commander-in-chief of the fourth army, he received the command of the whole army corps, and led it with distinction in the encounters of Nouart and Beaumont, in the battle of Sedan, and during the siege of Paris. After the war he retained his command, with the rank of general. AUGUST NIEMANN.

George I., the first Hanoverian king of Great Britain, b. at Osnabrück May 28, 1660, was the son of Ernst August, elector of Hanover, and great grandson, on his mother's side, of James I. of England. In 1682 he married his cousin, known as Sophia of Celle, from whom in 1694 he was divorced on account of her adulterous intrigue with Philip, Count Königsmark. In 1698 he became elector; served against the Danes and Swedes 1700; and held a high command in the war of the Spanish succession 1701–09; succeeded Anne as sovereign of Great Britain in 1714 in consequence of the exclusion of the Stuarts; was never popular in England, which he in turn disliked, although he served British interests faithfully and, for a king, with more than ordinary ability; but his private character was thoroughly bad. Memorable events of his reign were the first Jacobite rebellion (1715–16); the failure of the South Sea Company (1720); the restoration of the Order of the Bath

(1725); the Spanish war of 1726. D. near Osnabrück June 10, 1727.

George I., king of Greece, with the title "king of the Hellenes," was b. at Copenhagen Dec. 24, 1845, second son of the king of Denmark. In 1863 he accepted his present position, King Otho having been deposed. The Cretan war (1866–69) and the troubles with brigands have caused some complications with foreign powers, but thus far (1875) his reign has been somewhat prosperous and tolerably quiet. In 1867 he married a niece of the Russian czar. His children are to be bred in the Greek faith, but the king is a Lutheran.

George II., of Great Britain, b. at Hanover Oct. 30, 1683; was throughout life an object of dislike to his father, in consequence of which his education was slighted, and his intellect, not naturally brilliant, suffered from this neglect; married in 1705 the princess Wilhelmina Carolina of Brandenburg-Anspach, whose remarkable abilities for many years made good the defects of her husband; fought with conspicuous valor at Oudenarde 1708; succeeded his father in 1727. His English reign was singularly adorned by men great in art, letters, war, and diplomacy. The king's fondness for war led him to take command at the battle of Dettingen (1743), where by good luck he won a victory in spite of tactical blunders. Other great events of his reign were the battle of Minden 1739; of Fontenoy 1745; the second Stuart invasion 1745–46; the wars of Clive in India; and the conquest of Canada. The king was a man of obstinate temper and of vicious habits, and was far more fond of Hanover than of Great Britain, where he was personally unpopular; but he advocated liberal public measures, by means of which England made great material and industrial progress. D. at Kensington Oct. 25, 1760.

George III., of Great Britain, son of Frederick, prince of Wales, was b. in London June 4, 1738, and succeeded his grandfather, George II., in 1760. He was the first Hanoverian king who had a British education and a deep regard for his country, but his patriotism proved a far worse thing for his subjects than the neglect and open dislike shown by his predecessors. He was a man of conscientious principles, and felt a high regard for religion and morals, which contrasted strangely with the lewdness of the two preceding as well as the two succeeding monarchs; but this was neutralized by his intellectual sluggishness, his blind obstinacy and craft, his revengeful and long-remembering hostility to those who opposed his reactionary policy, and his equally blind partiality to his political friends. The annals of his reign of sixty years, the longest in English history, are replete with great events, among which are the Spanish war of 1762–63; the Wilkes controversy 1762–82; the passage of the American Stamp Act 1765; the publication of the Junius letters 1769–72; the American Revolution 1775–83; the Fox and North coalition 1783; the French Revolution 1789 *seq.*; the Irish Rebellion 1798; and the Napoleonic wars. (See NAPOLEON I.) The king's mind was naturally infirm, and in 1810 a fifth attack of insanity came on and proved incurable. Blindness also supervened, and in 1811 the prince of Wales became regent. The Tory foreign policy of the king was continued until Napoleon's power was finally crushed. D. at Windsor Jan. 29, 1820. His reign is memorable as a time of great literary and industrial activity.

George IV., king of Great Britain, b. Aug. 12, 1762; received a careful training, but became early conspicuous for loose moral habits, which he never abandoned; in 1781 joined the Whig opposition to his father's public policy; in 1791, in consequence of misconduct on the turf, he got into trouble with his Whig friends, and then became, and ever after remained, a Tory; married Caroline Amelia of Brunswick 1795, and in 1796 separated from her on the ground of her supposed adultery, for which she was, however, not brought to trial until 1820, and was then acquitted. In 1811, George became regent, and in 1820 king. The wars with Napoleon, that of 1812–15 in North America, the Catholic emancipation, the conquest of Aracan and the Tenasserim provinces, the slow but healthy advance of liberal ideas in Great Britain, so vigorously and constantly opposed by able Tory leaders, and, above all, the progress of the physical sciences, pure and applied, in England, make the reign of George IV. one of the most interesting periods of British history. (See THACKERAY, *The Four Georges*, 1860; *The Greville Memoirs*, 1874.) D. at Windsor June 26, 1830.

George V., ex-king of Hanover. See CUMBERLAND AND TEVIOTDALE, DUKE OF.

George, SAINT, patron of England and of Russia, is reputed to have been b. in Palestine in the third century. According to the legend, he became a prince in Cappadocia, and was distinguished for his exploit of rescuing a king's daughter from a dragon. He was a Christian, and suffered martyrdom at Nicomedia Apr. 23, 303, for having torn down the edict of Diocletian against Christians, the emperor himself being then in the city. Saint George is venerated in the Eastern and Latin churches, and even by the Mohammedans is regarded with great reverence. Gibbon and others identify him with George of Cappadocia, a fuller, who in 356 A. D. was made bishop of Alexandria by the Arians, and in 361 was killed by the pagans, whom he grievously oppressed. But the latest authorities decide that Saint George is not identical with the Cappadocian fuller.

George (ENOCH), b. in Lancaster co., Va., in 1767; entered the Methodist Episcopal ministry as an itinerant in 1790, while residing in North Carolina; was made presiding elder in the Charleston (S. C.) district 1796, where his powerful eloquence and great zeal led to a large increase in the numbers and effectiveness of his denomination. In 1816 he was chosen a bishop, after which his usefulness was still more conspicuous. He was a man of rare native abilities, and was widely known and beloved. D. at Staunton, Va., Aug. 23, 1828. ABEL STEVENS.

George (WILLIAM S.), b. in Derby, Vt., Mar. 3, 1825; removed to New Hampshire, and attended the common schools; at thirteen years of age commenced learning the trade of a printer; at twenty removed to Massachusetts; became foreman, printer, and editor; in 1862 removed to Michigan; won his chief success in journalism on the Detroit *Tribune;* since 1868 has been publisher and editor of the Lansing *Republican*, and head of the firm of State printers and binders by contract.

George, Lake, a beautiful sheet of water in the State of New York, extending N. N. E. and S. S. W., and having Warren co. on the N. W. and Washington co. on the greater part of its S. E. border. Its length is 36 miles; its breadth, from 1 to 3 miles. Lake George was the scene of important military operations during the French-and-Indian war of 1755–59. Here stood Fort George, Fort William Henry, and other works. The lake is 310 feet above tide. Its outlet flows into Lake Champlain. The lake contains some 300 islands. Its waters are clear, and are, in some places, 400 feet deep. Steamboats ply upon it in summer. It is sometimes called Lake Horicon, but its Indian name was Caniaderioit.

Geor'ges, tp. of Fayette co., Pa., in an important coal and iron region. Pop. 2544.

George's Creek, tp. of Barnwell co., S. C. P. 1295.

Georgetown, the capital of British Guiana, at the mouth of the Demerara. It is neatly built, but very unhealthy. Its exports of sugar, rum, and coffee are considerable. It is the seat of an Anglican bishop. P. 25,508.

Georgetown, port of entry, cap. of King's co., Prince Edward Island, on the eastern coast, has an excellent harbor and exports provisions. Shipbuilding is carried on. It has one weekly newspaper. Pop. 760.

Georgetown, post-v. of Equessing tp., Halton co., Ont., Canada, on the river Credit, has good water-power, large paper-mills, a brisk trade, and one weekly paper. Pop. of sub-district, 1282.

Georgetown, maritime county of South Carolina. Its surface is level, and mostly covered by pine forests and by swamps, where rice is produced. The Santee River flows along its S. W. border, and the Waccamaw traverses the county, and discharges its waters into Winyaw Bay. The county has suffered much in consequence of the civil war. Cap. Georgetown. Pop. 16,161.

Georgetown, post-tp. of El Dorado co., Cal. Pop. 1023. It contains rich gold-mines.

Georgetown, post-v., capital of Clear Creek co., Col., in the heart of the Rocky Mountains in a beautiful valley. Two branches of Clear Creek run through the town. It has a national bank, a newspaper-office, a number of hotels, business-houses, and shops. It is the centre of the great silver-region, and contains several large reduction-works.
E. H. N. PATTERSON, ED. "MINER."

Georgetown, post-v., cap. of Sussex co., Del., on the line of the Junction and Breakwater R. R., and the northern terminus of the Breakwater and Frankford R. R. It has 1 bank, 1 newspaper, mills, shops, 4 churches, and 2 hotels. Pop. of v. 710; of hundred, 1863.
W. F. TOWNSEND, ED. "SUSSEX JOURNAL."

Georgetown, District of Columbia, situated at the head of navigation on the Potomac, 125 miles from its mouth, lies W. N. W. of Washington, from which it is separated by Rock Creek. In 1871 its autonomy was merged in the territorial form now governing the entire district; and as we write (first session 43d Congress) a bill is pending to abolish the name and designate it a part of Washington. Founded in 1751, or nearly half a century before

the seat of government was located on the left bank of the river, Georgetown has not advanced like the rest of the country; *e. g.* its population, which in 1830 was 8441, diminished in the next decade of years 1129; and, though the following census showed an increase over the preceding one of 1000, the generation between 1830 and 1860 augmented only 292 souls. Its business has also fallen away, the construction of railroads N. W. and S. W. having diverted its former brisk trade to other places. Georgetown is the terminus of the Chesapeake and Ohio Canal, which extends 185 miles to the bituminous coal-fields in the Alleghany Mountains, and divides with the Baltimore and Ohio R. R. the transportation of coal, an average of 600,000 tons being annually received and shipped on board vessels of from 300 to 400 tons each for Northern and Eastern markets. The flour manufactured here is of first quality and highly prized, it being of the "fancy" brand, and therefore outside the regular market quotations. Six large flour-mills operate constantly; there are besides 2 corn-mills, 1 bone-mill, 1 paper manufactory, several large lumber-yards, 1 saw-mill, 2 tanneries, 2 iron-foundries, 11 churches, 3 cemeteries, 3 hotels, 2 banks, 2 street railways, 2 breweries, 1 vinegar factory, and 1 weekly paper. The facilities for education are nowhere excelled in places of the size, Georgetown College and the Academy of the Visitation, under Catholic auspices, antedating the present century, and having long enjoyed an enviable reputation for imparting knowledge of the higher branches of learning. This place also boasts of two seminaries for young ladies and several private academies for youth, while the public schools are in an excellent condition. The Peabody Library and Linthicum Institute (founded by former residents) are located in the N. wing of a large and elegant school-building. The Aged Women's Home, a new brick edifice, is maintained by voluntary contributions of the charitably disposed, as is the parochial school attached to Trinity (Catholic) church. Water is copiously supplied by a conduit from the Great Falls of the Potomac, 11 miles distant, the works, which are of a most enduring character, having cost the general government $3,500,000, and the authorities of the District cities $1,500,000 additional for mains, pipes, etc. Georgetown is situated on a succession of heights, and fine residences abound, the place being salubrious and commanding a prospect of the Capitol, the river, Arlington, and other interesting localities. Pop. 11,384.

J. D. McGill, Ed. "Georgetown Courier."

Georgetown, post-v., cap. of Quitman co., Ga., on the Chattahoochee River and on the South-western R. R., 112 miles S. W. of Macon and 2 miles E. of Eufaula, Ala. Pop. of tp. 263.

Georgetown, post-tp. of Vermilion co., Ill. Pop. 2237.

Georgetown, post-tp. of Floyd co., Ind. Pop. 1424.

Georgetown, post-v., cap. of Scott co., Ky., on the turnpike leading from Lexington, Ky., to Cincinnati, O., 12 miles N. of the former place, and on the proposed railroad from Cincinnati to Chattanooga. It has a college, 2 female seminaries, a number of private schools, 2 banks, 2 hotels, 1 newspaper, several stores, etc. It has a fine water-power, but no manufacturing establishments. Principal business of surrounding country, farming and stock-raising. Situated in the heart of the "Blue-grass country," it is admirably adapted to the latter purpose. Pop. 1570. John A. Bell, Ed. and Pub. "Times."

Georgetown, post-tp. of Sagadahoc co., Me., consisting of Parker's Island, E. of the mouth of the Kennebec River, and 12 miles S. of Bath. Pop. 1135.

Georgetown, post-v. and tp. of Essex co., Mass., on the Newburyport R. R., 31 miles N. of Boston. It has 3 churches, one of which was built by the late George Peabody of London, a fine library and building given to the town by the same benefactor, and is the seat of the Perley Institute. Boot and shoe making and agriculture are the chief industrial pursuits. Pop. 2088.

Georgetown, post-tp. of Ottawa co., Mich. Pop. 1474.

Georgetown, tp. and post-v. of Madison co., N. Y., has 3 churches and manufactures of leather, etc. Pop. 1423.

Georgetown, post-v., cap. of Brown co., O., 42 miles E. of Cincinnati and 7 miles from the Ohio River. It has 3 churches, a large school house, a fine court house, a woollen-factory, steam flour-mill, a bank, 2 newspapers, 2 hotels, and 17 stores. Agriculture, and especially tobacco-raising, are leading interests. Pop. 1037.

L. B. Leeds, Ed. "Brown Co. News."

Georgetown, v. of Clermont co., O. Pop. 65.

Georgetown, v. of Coleraine tp., Hamilton co., O. Pop. 172.

Georgetown, post-v. of Greene tp., Beaver co., Pa. Pop. 297.

Georgetown, post-v. and tp., cap. of Georgetown co., S. C., on Winyaw Bay. It has 3 lumber-mills, several rice-mills, 2 newspapers, about 35 stores, and a "Winyaw Indigo Society" hall. It is a great turpentine section. It has direct communication with New York by several lines of schooners. Pop. of v. 2080; of tp. 3520.

Josiah Doar & Co., Pubs. "The Times."

Georgetown, post-v. and tp., cap. of Williamson co., Tex., 25 miles N. of Austin, in a healthy section and surrounded by picturesque scenery. It is the seat of the "Texas University," has several churches, 2 schools, and 1 newspaper. Principal business, agriculture. Pop. of tp. 479. Wm. K. Foster, Ed. "Williamson Co. Record."

Georgetown College, D. C., founded in 1789, when the first building was erected; classes begun in 1792; chartered by Congress as a university 1815; medical department organized 1851; law department 1870; buildings were added from time to time, the last in 1854. Students can enter the college at any age, though young children are not admitted, and no previous scholastic attainments are required beyond the mere rudiments of knowledge. The applicant is examined, and placed in the class for which he is fitted by his previous course of study. For those who begin at the lowest point a seven years' course is required; this term may be shortened by extraordinary diligence or proficiency, but promotions are rarely made except at the close of the scholastic year. Each student undergoes a careful examination twice a year in all his studies. Marks are kept in each class; the general result is read publicly every month, and tickets of excellence are awarded to the most meritorious. Those who fall below a certain standard are punished by the withdrawal of certain privileges, or by being sent to a lower class, or, if persistently idle, they are dismissed from the college. Quarterly reports of each student's literary progress and moral conduct are sent to parents. Rewards are distributed in medals or books, or by honorable mention, at the close of the year. The studies of each class and the books used are prescribed in the annual catalogue. The class-titles used here are also explained by the class-titles employed in other colleges for the same grade. No departure from the regular course is permitted. At a future day the college may provide an extended commercial course and another course of science, but it has not been found expedient, or even possible, to inaugurate these departments as yet. The standard of the classes is rigorously kept up to the point the character of each class requires, so that the graduate of Georgetown is fully the equal in scholastic attainments of the graduate of any other American college. Graduates of these other colleges, owing to their more advanced age, may have more finish of literary culture, but can hardly be as deeply grounded in the studies which belong to their course as the students of Georgetown, owing to the close and constant supervision exercised here over every student in his studies, and the responsibility under which the student lies towards his teachers, individually and collectively. Nearly all the students board in the college. Those who do not, live with their parents. One-fourth or one-fifth of the students are non-Catholics. Students attend from all portions of the Union, but the greater portion are from the Southern States. The schools of law and medicine are conducted in Washington, and neither the professors nor the students of these schools live within the college or form any part of the community directed by its superiors. The college is, and always has been, directed by the Jesuits. It has no endowments, and is supported by the fees paid for tuition. No school of theology is carried on in connection with it.

J. S. Sumner.

Georgeville, port of entry of Stanstead tp. and co., Quebec, Canada, on the E. side of Lake Memphremagog, 13 miles from Derby Line, Vt. Pop. about 250.

George White, tp. of Blount co., Ala. Pop. 232.

Geor'gia [Russ. *Grusia*] has now no geographical signification, being divided into the Russian governments of Tiflis, Kutais, Elizabetpol, Baku, and Erivan; but it was formerly a kingdom, comprising the territory S. of the Caucasian Mountains, between the Black and the Caspian seas, and bounded S. by Asiatic Turkey and Persia. After the death of Alexander the Great the Georgians succeeded in establishing themselves as an independent people with a government of their own; and although they were conquered and made tributary several times by the Arabian caliphs, by Timoor, and by Persia, they maintained a political position as a state until the beginning of this century, when Georgia was merged into the Russian empire. Early in the fourth century (318 A. D.) the Georgians were converted to Christianity, but at present many of them are Mohammedans. Their language forms a very interesting intermediate link between the Aryan languages and the

monosyllabic ones of Eastern Asia. Georgian women are, like the Circassians, celebrated for their personal beauty.

Georgia, one of the Southern Atlantic States of the American Union, lying between the parallels of 30° 20′ and

Georgia Seal.

35° N. lat., and between the meridians of 80° 48′ and 85° 38′ W. lon. from Greenwich. It is bounded on the N. by North Carolina and Tennessee; on the E. by South Carolina, from which it is separated by the Savannah River and by the Atlantic Ocean; on the S. by Florida; and on the W. by Alabama. Its extreme length from N. to S. is 320 miles, and its extreme breadth from E. to W. 254 miles. Its area is estimated at 58,000 square miles, or 37,120,000 acres.

Face of the Country.—Georgia is well watered. The course of its rivers in the eastern half of the State is S. E., gradually turning to the S. The Savannah, which separates the State from South Carolina, is about 450 miles in length, and is navigable for large vessels to Savannah, 18 miles, and for steamboats to Augusta, 230 miles from its mouth. It has three or four considerable affluents—viz. the Brier and Broad rivers and Beaverdam Creek—and is itself formed by the union of the Tugaloo and Kiowee rivers. Like most of the rivers entering the Atlantic, it forms a considerable delta, and discharges its waters by several mouths. The Ogeechee, about 250 miles in length, rises in Greene co., and runs nearly parallel with the Savannah, discharging its waters into Ossabaw Sound; the Cannouchee is its principal affluent. The Altamaha is formed by the junction of the Oconee and the Ocmulgee; the former of these rises in Hall, and the latter in Gwinnett co., and after flowing in nearly parallel courses for about 250 miles, the latter turns eastward, and the two join to form the Altamaha. The Little Ocmulgee and the Appalachee are the principal branches of these rivers. The Ocmulgee is navigable for steamers to Macon, and the Oconee to Milledgeville. The Satilla and St. Mary's drain the south-eastern corner of the State. Between them lies the great Okefinokee Swamp. The Withalacoochee and the Allapaha, which unite in Florida to form the Suwanee, and the Ochlochonee, which falls into the Gulf in Florida, drain its southern counties. In the S. W. the Flint and the Chattahoochee, the former rising in Campbell co., and the latter in the Blue Mountains, are the principal streams. They unite at the Florida line to form the Appalachicola River. The Chattahoochee has a course of 550 miles to the Gulf, of which 350 are navigable; the Flint has a course of 300, and is navigable for steamboats to Albany in Dougherty co. In the N. W., to the N. of the Chattahoochee, which turns eastward at the 33d parallel, the Tallapoosa, one of the rivers which unite to form the Alabama; the Chattooga River and Chickamauga Creek, branches of the Coosa; and the Etowah and Oostenaula, which, uniting, form the Coosa, the other tributary of the Alabama; the Tacoah, Notley, and other affluents of the Hiawassee, and the Chattanooga, both tributaries of the Tennessee, are the principal streams which drain the hill-country. The sea-coast, extending in a direct line about 100 miles from St. Mary's to the mouth of the Savannah River, is bordered with islands, between which and the mainland are seven sounds, connected with the ocean by numerous inlets. These sounds are—St. Andrew's, St. Simon's, Altamaha, Doboy, Sapelo, St. Catharine's, and Ossabaw. The whole coast-line formed by the islands and sounds is said to be about 480 miles. The islands are of alluvial soil, very fertile, and yield considerable rice and sea-island cotton.

Surface.—The Atlantic coast, for a distance of about 20 miles inland, is low and swampy, spreading out in the extreme S. into the great Okefinokee Swamp. Where it is cleared, this land is adapted to the cultivation of rice. Where not cleared, this swampy lowland is covered with the saw-palmetto and some other semi-tropical trees. A little farther back, on the sandy lands and dunes, pines and scrub-oaks are the principal trees. About 20 miles inland the land suddenly rises, by a terrace formation, about 70 feet, and continues at the level of about 100 feet above the sea for nearly 20 miles farther, when another terrace, 70 or 75 feet high, appears, and a second table-land extends with a gradually ascending grade not far from 160 miles to the centre of the State, where, in Baldwin co., the elevation is about 575 feet above the level of the sea. At this point, about 200 miles from the sea, the foot-hills begin, and rise in the northern and north-western portions of the State to the height of 2500 to 4000 feet above the sea. These hills, which run in nearly parallel ranges to each other, though with outlying spurs, cover a breadth of nearly 150 miles. Between the eastern Appalachian chain and the Blue Mountains the country is broken up into valleys with a rocky, broken surface and short ranges of hills; between the Blue Mountains and the Cumberland the valleys are narrower, but less broken. This mountain-district covers 25 counties, lying mostly N. W. of the Chattahoochee River. Throughout this region, as well as in the counties of Middle Georgia, there are many cataracts and waterfalls of great beauty. Toccoa Falls and the cataracts of Tallulah in Habersham co., Estatoia Falls in Rabun co., Hiawassee Falls on the Hiawassee, the falls of Amicalula in Lumpkin co., and the falls of the Towalaga in Butts co., are the most celebrated.

Geology and Mineralogy.—In the varied surface of Georgia we have examples of almost every known geological formation. For about 20 miles from the coast, and including the great Okefinokee Swamp and the valley of the Savannah River for nearly 100 miles, we have alluvium rich in vegetation, but level, though with numerous sand-dunes, except where there are marshes. From the first terrace to a line running almost straight from Augusta on the Savannah River to Georgetown on the Chattahoochee, the Eocene, with its sands, clays, calcareous and siliceous strata, overlies the Metamorphic slates and gneiss. For a short distance in Jefferson co., on both sides of the Ogeechee, the Cretaceous formation appears at the surface, and seems to have pushed the Eocene rocks from their position. W. of the Eocene, beginning at Knoxville in Crawford co., running nearly due W. to and across the Chattahoochee, and along that river to Eufaula, and thence back to Knoxville, we have a Cretaceous deposit extending over a part of nine counties. N. of the Eocene and Chalk stretch the Metamorphic, Palæozoic, and Eozoic rocks of the Appalachian range, covering nearly half the territory of the State. On the Savannah River above Augusta, for a distance of 25 miles, the Silurian strata from North-western South Carolina come to the surface, and from the point in Union co. where the Notley River passes out of the State, to the foot of Dugdown Mountain in Haralson co., on the W. line of the State, the north-western counties are overlaid with Silurian rocks, with occasional outcrops of Devonian; while in the north-western corner the coal-measures belonging to that great coal deposit which occupies Central and North-eastern Alabama yield an excellent quality of bituminous coal. Immense deposits of iron ore are found at the junction of the limestone and metamorphic rocks in Bartow and Cherokee cos. In the N. W. part of the State, for 40 miles, a small mountain called Shinbone Mountain, which is simply a mass of fossiliferous iron ore, runs parallel with Lookout Mountain, less than a mile distant, in which are beds of coal. Every facility for the production of the best quality of iron at the cheapest possible rate, and under the most favorable circumstances, is found here. On the E. side of Taylor's Ridge this fossiliferous iron ore is so abundant and in such large blocks that the people near the ridges saw it into blocks to put in the backs of their chimneys, as it stands fire well. Gold is found in almost every county N. of the central line of the State. It was first discovered in Habersham co. in 1831, and is most plentiful in Cherokee, Carroll, Cobb, and Lumpkin cos. A branch mint was established at Dahlonega, Lumpkin co., in 1837, and coined in the next 24 years $6,121,919, mostly of Georgia gold. The mint was discontinued in 1861, and the buildings have been given by the government to the North Georgia Agricultural College. Efforts are now making to renew the gold-mining by the hydraulic process on a large scale. There are veins of copper ore in Gilmer co., a continuation of those which have been worked so productively in Polk co., Tenn. Silver is combined with the gold, and is also found with lead in the argentiferous galena. There is a very good building limestone in the central portion of the State, and marls and burrstones in the Eocene

region. The usual minerals found in connection with gold and silver—manganese, titanium, antimony, zinc, and graphite—also exist, but are not largely worked. Granite of good quality, marble (that of Cherokee co. being statuary marble of excellent quality), gypsum, sienite, talc, soapstone, asbestos, slate, shale, tripoli, petroleum, fluor-spar, barytes, and hydraulic cement in Bartow co., white in color and of excellent quality, are among the minerals of economic value; and among the choicer minerals and gems have been found the more precious varieties of the quartz-crystal, beryls, garnets, agates, and, it is asserted, diamonds, though not of clear water or perfect color. There are several deposits of fossils, mostly in the alluvium, which have enlisted much attention. Among the most remarkable of the fossil animals of these deposits are skeletons of the mastodon, mylodon, megatherium, one (if not two) extinct species of elephant, an extinct species of the ox, and numerous fossil species of turtles and mollusks. There are numerous mineral springs in the State, mostly chalybeate in the N. and sulphurous in the central portion of the State. The Indian Springs in the N. of Forsyth have a high reputation.

Vegetation.—The vegetation of the alluvial lands near the coast is semi-tropical. The cypress, cedar, live-oak, magnolias, the gum trees, liquidambar, sweet bay tree, palmetto, canes, etc. abound, and the orange grows wild. The live-oak timber exported from Brunswick and its vicinity is the most valuable grown in the U. S. On the sandy lands pines and scrub-oaks are plentiful. The Georgia yellow pine grows over a somewhat extensive but distinctly defined district, and commands a high price. The central and northern portions of the State have large tracts of forest, and among the trees of these sections are black walnut, chestnut, tulip tree, hickory, poplar, sycamore, beech, maple, ash, elm, fir, spruce, birch, and bay-laurel. The broad-leaved *Kalmia* adorns the wild lands with its beautiful blossoms, and other flowering shrubs are abundant. Still more varied are the cultivated agricultural products of the State. In South-eastern Georgia the orange, lemon, banana, olive, and other tropical fruits come to perfection, while rice, sugar-cane, sea-island and some short-staple cotton, sweet potatoes, and some corn are the principal crops. In the extensive flatlands of Southern Georgia there is considerable cotton, and rich and excellent grasses both for pasture and hay. Stock and swine are largely pastured in the pine woods. Middle Georgia is an admirable fruit-region. The peach tree is hardier, subject to fewer diseases, and yields more than almost anywhere in the U. S. Apples and pears of native seedling varieties are of excellent quality and yield abundantly. Cherries and some of the small fruits do not thrive so well in this section. The Catawba grape has been found a failure, but the scuppernong, herbemont, post-oak, and other Southern varieties more lately introduced, are proving successful. Melons of the finest quality abound, and the trade in market vegetables is growing rapidly, and has already become very large. This section is largely devoted to cotton, but clover, wheat, and Indian corn are also grown, as well as oats and a small amount of rye and barley. Tobacco is also a crop of some importance. Sorghum and pea-nuts (or ground-nuts, as they are called in the South) are grown in considerable quantity. The sweet potato and the Irish potato are both cultivated, the latter not so largely as in the northern counties. North-eastern Georgia is mountainous, some of the mountains being 5000 feet above the sea; its geological structure is Azoic; it has fine scenery, a healthy and delightful climate, heavy timber, and good crops of grass and grain in the creek and river lands, small farms; and in the uplands a thin, poor soil. North-western Georgia, the region N. and W. of the Chattahoochee, is a blue limestone region, has numerous fine navigable streams, and is the connecting link between the great West and the Atlantic ports of the South. This section has a rich and fertile soil in the river and valley lands, but requires manure and deeper ploughing to realize its full advantages. All the Northern fruits do well here, and are from four to five weeks earlier than in New York. The principal crops are wheat, Indian corn, clover and other grasses, and in the river-valleys, which contain sand, cotton. South-western Georgia is in the Tertiary formation. It is the great cotton-region of the State, and cotton is there a very sure crop. It is also well adapted to the culture of the sugar-cane and of rice in the bottom-lands. Sweet potatoes are grown in immense quantities by the freedmen, and a commencement has been made in the tea culture. The climate of this portion of the State is sickly, and perilous to the unacclimated in summer, especially in the river-valleys, though the old inhabitants enjoy fair health. In the whole State 51.6 per cent. of its area was in forest woodland in 1870. A wide field of enterprise may be found in converting the products of these forests to economical uses.

Zoology.—The wild animals of the State are tolerably numerous, especially in the densely wooded portions. The black or dark-brown bear, and probably both, are not unfrequent in North-eastern and North-western Georgia. The panther and wild-cat are occasionally seen, and the fox, raccoon, opossum, and woodchuck (or ground hog) are tolerably plentiful; deer and smaller game, rabbits, squirrels, etc., abound. In the southern section alligators are to be found in the rivers, estuaries, and bayous, the sea-turtles on the coast and about the mouths of the rivers, and a variety of reptiles more displeasing to the sight than positively harmful. The only poisonous serpents are the cotton-mouth, the moccasin, and the rattlesnake. The insect pests are numerous in the lowlands, the most annoying being the chigoe or tick, the sandflies and mosquitoes. The northern portion of the State is comparatively free from these annoyances.

Climate. Having spoken in general terms of the climate and healthfulness of the different sections when describing the vegetation of each, we now proceed to give the average monthly temperature, the maximum and minimum for each month, the monthly rainfall, and the yearly average and rainfall at Atlanta, lat. 33° 42′, W. lon. 84° 20′; Macon, lat. 32° 45′, W. lon. 83° 32′; and Berne about lat. 30° 55′, W. lon. 81° 45′:

Places.	January.			February.			March.			April.			May.		
	Highest temperature.	Lowest temperature.	Rainfall for month.	Highest temperature.	Lowest temperature.	Rainfall for month.	Highest temperature.	Lowest temperature.	Rainfall for month.	Highest temperature.	Lowest temperature.	Rainfall for month.	Highest temperature.	Lowest temperature.	Rainfall for month.
	°	°	in.	°		in.	°	°	in.			in.			in.
Atlanta	63	25	5.86	67	16	9.93	76	16	5.85	85	29	8.67	94	44	1.75
Macon	69	28	5.70	70	26	6.48	78	25	2.13	86	36	4.9	89	51	.60
Berne	..	..	....	..	..	..	..	..	..	83	38	4	95	53	2.21

Places.	June.			July.			August.			Sept.			October.		
	Highest temperature	Lowest temperature	Rainfall for month.	Highest temperature.	Lowest temperature.	Rainfall for month	Highest temperature.	Lowest temperature	Rainfall for month	Highest temperature	Lowest temperature	Rainfall for month	Highest temperature	Lowest temperature	Rainfall for month.
			in.	°		in.	°		in.		°	in.	°		in.
Atlanta	93	52	2.48	...	..	..	98	50	2.12	86	44	2.30	75	27	1.87
Macon	98	64	3.58	103	70	3.34	104	64	2.85						..
Berne	92	65	6	93	70	9.17	92	64	3.90	84	58	4.50	80	36	...

Places.	November.			December.			Year.			Year.	Remarks.
	Highest temperature.	Lowest temperature.	Rainfall for month.	Highest temperature.	Lowest temperature.	Rainfall for month.	Highest temperature.	Lowest temperature.	Mean temperature.	Annual amount of rainfall.	
	°	°	in.			in.	°			in.	
Atlanta	69	26	5.95	60	23	6.67	98	16	55.9	53.7	For 11 months
Macon	75	31	0.51	60	13	5.32	103	13	61.3	38.45	For 10 months
Berne	76	29	0.75	76	27	4.99	94	27	60	35.53	For 9 months.

Agricultural Products.—The two great agricultural staples of Georgia are Indian corn and cotton. Previous to the late war cotton was its great crop, yielding in 1859–60, 701,840 bales, or more than one-sixth of the whole cotton crop. Since the war the cotton crop has never attained the same magnitude, and in 1873 there were nearly 100,000 acres more in corn than in cotton. The product of cotton in 1873 is officially reported at 614,039 bales, about 19,000 bales more than in 1872. The corn crop of 1873 was about 23,500,000 bushels, raised from about 2,000,000 acres. Its money value was about $20,410,000, or somewhat less than that of 1872. The wheat crop amounted to about 3,125,000 bushels, from 349,000 acres, and was estimated worth $5,490,000. The wheat of South-western Georgia is of remarkably fine quality, and averages 64 pounds to the bushel. The acreage of oats in 1873 was about 400,000, yielding over 5,000,000 bushels, valued at $4,160,000. Of rye only 190,000 bushels were raised in 1873, from 18,887 acres, value $285,000. Very little barley is raised, and not much tobacco—only 600 acres in 1873, yielding about 300,000 pounds, valued at $82,000. The sweet potato crop occupied about 45,000 acres in 1873, yielding 4,050,000 bushels, worth nearly $4,000,000. There were only about 2500 acres of Irish potatoes, yielding perhaps 250,000 bushels. These are largely shipped North, and, being very early, bring a high price, reported in 1873 at $261,000. Over 20,000 acres

are devoted to the pea nut or ground-nut: the greater part of the crop is sent North. There are over 100,000 acres of orchards, and the fruit crop is becoming very valuable. There were nearly 10,000 acres of sugar-cane, and almost 5000 of sorghum; the production of sugar increases with great rapidity, and may soon supply the southern counties. There were in 1873 about 30,000 acres in rice; the production of this staple in the State in 1870 was 22,277,380 pounds, worth about $1,650,000. The culture of the vine for wine is not extensive, the scuppernong, herbemont, Norton's Virginia, and post-oak being the varieties most cultivated. The number of acres of land in farms in 1870 was 23,647,941 acres, not quite two-thirds of the area of the State; the value of the farms, $94,559,468. In 1873 the number of acres of improved land in farms had increased to 27,762,445 acres, and the value to $99,125,591; of farming implements and machinery, $4,614,701; the amount of wages paid to farm-hands, including board, $19,787,086; the estimated value of farm products was $80,390,228; of orchard products, $352,926 (evidently an under-estimate); of the produce of market-gardens, $193,266; of forest products, $1,281,623; of home manufactures, $1,113,080; of animals slaughtered or sold for slaughter, $6,854,382. There were reported as produced that year 21,927 gallons of wine; 4,499,572 pounds of butter; 4292 pounds of cheese; 109,139 gallons of milk sold; 10,518 tons of hay; 31,233 pounds of beeswax and 610,877 pounds of honey. The census of 1870 reports but 846,947 pounds of wool as produced in Georgia in 1869–70, and 410,020 bushels of peas and beans. The numbers of live-stock, except horses, etc., do not seem to be increasing very rapidly. In 1870 there were 81,777 horses and 87,426 asses and mules in the State; in Jan., 1873, the Agricultural Department estimated the number of horses at 117,300, and of mules at 92,700; in Dec., 1873, the State comptroller, from incomplete returns, gave the number of horses and mules as 139,672, but stated that the real number was almost double. The census gave the number of cattle, including milch cows, working oxen, and other cattle, as 697,903; the Agricultural Department in Jan., 1873, makes the number 658,700, while the imperfect returns of the comptroller give 559,340. The census report is probably not far from the truth. Of sheep, the census reports 419,465; the Agricultural Department in Jan, 1873, 253,500—evidently a blunder; Rev. Mr. Howard in 1867 thought there were not less than 500,000, while the imperfect returns of the comptroller in Dec., 1873, give 369,012, with six important counties and parts of others omitted. The true estimate is probably not below 500,000. In 1870 the census reports 988,566 swine; the Agricultural Department in Jan., 1873, 1,559,400, and the comptroller's report, 758,935. There are probably not less than 1,200,000 in the State.

Manufactures.—The manufactories are increasing, both in numbers and extent. From 1860 to 1870, Georgia had more than doubled the number, and nearly doubled the product, of her manufacturing establishments, and since 1870 manufactures have received a new and powerful impetus. In 1870 there were 3836 manufacturing establishments, using 405 steam-engines of 10,826 aggregate horse-power, and 1729 water-wheels of 27,417 horse-power, employing 17,871 persons, of whom 15,078 were males over 16 years of age, 1498 females above 15, and 1295 children. The reported capital of these establishments was $13,930,125; the wages paid, $4,844,508; the raw material used, $18,583,781; the manufactured products were valued at $31,196,115. The most important of these were—cotton manufactures, of goods and yarns, which employed in 34 establishments, 2920 persons, and capital to the amount of $3,433,265; paid $611,868 in wages; used $2,504,758 worth of raw material; and produced goods to the amount of $3,648,973; flouring and grist-mill products had 1097 establishments, employing 17,887 persons, $3,103,918 capital, paid $337,864 wages, used $9,189,578 of raw material, and produced goods to the value of $11,202,029. Iron manufactures were produced in 30 establishments, employing 492 persons and $407,810 of capital, paying $389,896 wages, using raw material to the value of $705,598, and producing iron to the value of $1,346,365. The 187 carpentering and building establishments employed 624 hands, and produced buildings valued at $1,007,623; the 513 blacksmithing establishments, employing 1080 hands, produced articles valued at $630,445; boots and shoes, in 244 establishments, were produced to the value of $493,862; and brick, in 41 kilns, to the amount of $420,109; carriages and wagons in 178 factories were produced to the value of $664,512; leather tanned and curried, in 186 tanneries, was produced to the value of $572,306; lumber planed and sawed, in 557 saw and planing mills, was produced to the value of $4,615,575; machinery, in 42 machine-shops, to the value of $1,624,622; printing and publishing, in 45 printing-offices, was done to the value of $931,672; woollen goods were manufactured and dressed in 46 factories, employing 563 persons, $936,585 capital, and producing goods valued at $471,523 (in 1873 the number of these establishments had increased to 81); tobacco was manufactured in 20 factories to the amount of $465,874; car-building and car-repairing were prosecuted in 180 car-shops to the amount of $366,790; clothing, in 38 establishments, to the value of $213,072. The manufactures of cotton, wool, iron, and tobacco have increased materially since 1870. The consumption of cotton in the cotton-mills in the State in 1870 was 24,820 bales; in 1873, 39,122 bales.

Mining.—The census of 1870 reported 10 mining establishments, employing 126 hands and $145,800 capital, and producing $49,280. These, too, have since been greatly increased. The products of the fisheries were very imperfectly reported, only one fishing-station, yielding but $200, being noticed. The shad fisheries of the Savannah River and the Ogeechee, which send the first shad to the Northern markets, are very profitable, as are many of the fisheries of Brunswick, St. Mary's, and other points on the coast.

Railroads.—There were in Jan., 1874, 2388 miles of completed railroads in Georgia. The principal railroads are trunk roads, now or in the near future forming connecting links in some one or other of the great systems of N. and S. or E. and W. lines of the country. Lines radiate from Chattanooga, Tenn., just at the N. W. corner of the State, connecting Atlanta, and through other radiations Augusta, Savannah, and Brunswick, with Chicago, Cincinnati, Louisville, St. Louis, and Memphis. Other lines stretch toward Selma, Ala., Montgomery, Mobile, and New Orleans; and others still aim to connect with Pensacola and Cedar Keys, Fla., and thus secure outlets on the Gulf. From Brunswick and from Savannah railroads are pushing westward to make a connection with the proposed Pacific road on the 32d parallel, and furnish that future thoroughfare with eligible termini on the Atlantic coast. Numerous branches are also already built or projected to connect enterprising villages with these trunk roads. The Georgia, the Central of Georgia, the Atlantic and Gulf, and the new Atlanta and Richmond have leased many of the minor lines, and are running them as feeders to their main roads. The Central has, including its leased lines, 660 miles of road, the Atlantic and Gulf 347, and some of the others nearly as much. The cost of the railroads already constructed in the State exceeds $43,000,000, or one-sixth of the entire valuation of the State.

Finances.—The public debt of the State Jan. 1, 1874, was $8,342,500. This is entirely a bonded debt, all the bonds falling due within eighteen years, and most of them in annual sums which can readily be paid from the current revenues. There is besides this a contingent indebtedness arising from the endorsement of railroad bonds amounting to $7,033,400, most of which will be met by the railroads themselves, and for all of which the State holds securities more or less ample. The credit of the State is good and improving. The amount received into the treasury from all sources during the year 1873, including the proceeds of the sale of bonds and the balance on hand from the previous year, was $3,172,788.74. The disbursements for the same period, including the payment of $1,335,767.73 of the principal and interest of the public debt, were $2,250,232.49, leaving a balance in the treasury Jan. 1, 1874, of $922,556. The estimated receipts for 1874 from all sources (mainly from taxes) were $2,722,856, and the disbursements, after paying $823,460 on interest and principal of public debt, $1,563,660, leaving a balance in the treasury of $1,159,196, a part of which would be applied to a sinking fund to reduce the State debt. The bonds issued in 1873, $1,200,000, were taken at par, and mostly by citizens of the State. The assessors' valuation of real and personal property in the State in 1873 was $242,687,382. It is probable that the true valuation, which in 1870 was $268,169,207, now exceeds $300,000,000.

Commerce and Trade.—The assessed value of merchandise in the stores and warehouses of the State in 1873 was $14,781,024, the assessed value being probably from one-third to one-half the true, as is usual. The aggregate value of wild and improved land was $101,805,039, these also being assessed at much less than their true value; the amount of money and solvent debts, $26,585,350; and the assessed value of city and town property, $58,891,268. This last is probably on the basis of 40 to 50 per cent. of the true value. The capital reported as invested in shipping and tonnage in the State in 1873 was $207,895; in cotton manufactories, $1,908,095; in iron-works, $766,405; in mining, $22,770. All these amounts, being for assessment purposes, are probably less than half of actual values. The official report of the imports and exports from the three ports of the State, Savannah, Brunswick, and St. Mary's, for the year ending Dec. 31, 1873, does not fully represent the commerce of the State, since a considerable portion of the exports from the

north-eastern portion of the State are made through Charleston, those from the southern counties through Fernandina, Appalachicola, and Pensacola, Fla., and those from the W. and S. W. through Mobile, Ala.: yet the imports of the three ports were $845,693, and the exports, in which cotton was much the largest item, $31,199,183.

Banks.—In Jan., 1873, there had been 13 national banks organized in Georgia, of which two were closed or closing, and 11 in operation. The capital of these banks, paid in, was $2,620,000; the bonds on deposit, $2,356,400; the circulation issued, $2,340,050; the amount of actual circulation, $2,129,301.75. There were also the Georgia Railroad and Banking Co., operating under the State charter of the Georgia R. R., with $300,000 capital, and located at Augusta; the Central Georgia Bank, connected with the Central Georgia R. R., located at Macon, and having a capital of $200,000; and the Savannah Banking and Trust Co., at Savannah, with $100,000 capital. There are saving banks at Augusta and Macon, and about 40 private banking-houses, some of them very large.

Insurance.—In July, 1873, there were 5 fire insurance companies in the State, all stock companies except that at Athens, which is mutual. The capital of the stock companies was $825,000, and the assets of all in July, 1873, were $1,483,275. There were at the same date two life insurance companies, one having a capital of $150,000, assets, $542,302; and the other a capital of $120,000, assets not reported.

Population.—The following table exhibits the population of the State at each census, with its classification, until that of 1870, when slavery had ceased:

Census.	White	Free Colored	Slave.	Total.	Remarks.
1790	52,886	398	29,264	82,548	
1800	102,261	1,019	59,406	162,686	
1810	145,414	1,801	105,218	252,433	
1820	189,566	1,763	149,656	340,985	
1830	296,806	2,486	217,531	516,823	
1840	407,695	2,753	280,944	691,392	
1850	521,572	2,931	381,682	906,185	
1860	591,550	3,500	462,198	1,057,286	38 Indians.
1870	638,926	545,142	None	1,184,109	40 Indians, 1 Chinese.

The density of the population in 1850 was 15.62 to the square mile; in 1860, 18.23; in 1870, 20.42. The population of Georgia is almost wholly of native birth: of its 1,184,109 inhabitants in 1870, 1,172,982 were born in the U. S., and only 11,127 in foreign countries; of the native population, 572,126 were males and 600,856 females; of the foreign-born, 6829 were males and 4298 females; of the 638,926 whites, 311,171 were males and 327,755 females; of the 628,173 native whites, 304,562 were males and 323,611 females; of the 10,753 foreign-born whites, 6609 were males and 4144 females. Among the 545,142 colored (267,765 males and 277,377 females), there were but 372 (219 males, 153 females) of foreign birth. Of these people of color, 501,814 were blacks, and only 43,328 mulattoes; of the 40 Indians, 18 were males and 22 females. Of the population in 1870, 407,516 (namely, 206,026 males and 201,490 females) were of school age, or between 5 and 18 years; 202,573 males (of whom 108,711 were whites and 93,852 colored) were of the military age, from 18 to 45; and 237,640 males (of whom 129,665 were whites and 107,962 colored) were of the voting age, 21 years old and upward: of these 234,919 were male citizens.

Education.—According to the report of Hon. G. J. Orr, State school commissioner of Georgia, presented to the legislature in Jan., 1874, there were at that date 349,161 children of school age (between 6 and 18 years) in the State. Of these, 198,516 were white and 150,198 colored. By act of the legislature the benefit of the school moneys was also to be extended to all Confederate soldiers under 30 years of age who chose to avail themselves of this opportunity of acquiring an elementary education. Of these, there were 8704. According to the same report, there were in the State 1379 schools for white children and 356 for colored children, which were sustained wholly or in part by the school moneys. In the white schools there were 58,499 children (32,502 boys and 25,997 girls); in the colored schools there were 17,658 children (8945 boys and 8713 girls): in all, white and colored, 76,157 scholars, or about one-fifth of the school population. These were, however, divided somewhat unequally, two sevenths of the white children and but little more than one ninth of the colored being in school. The average attendance was but 32,221 in all. The monthly cost of tuition was $1.65. The schools of the cities of Savannah, Atlanta, Macon, and Brunswick, and of the counties in which they are situated, are organized under special laws. In these schools there are about 5000 children in attendance, though the number enrolled is somewhat more than 7000. In addition to these public schools there are 576 private elementary schools which have reported to the State commissioner, partially sustained by the Peabody and other charitable funds, having 713 teachers and instructing 23,597 children, of whom 22,363 were white and 1234 colored. There are thus about 107,000 children, white and colored, who attend the schools, public and private, some portion of the year, out of 358,000 of school age, though not more than 54,000 attend regularly. According to the census of 1870, 418,553 persons over ten years of age in the State could not read, and 468,593 over ten years of age could not write. There are also 101 high schools which have reported to the commissioner (the whole number of these schools is supposed to be about 140). The 101 reporting had 167 teachers and 5450 scholars (3228 males and 2222 females). They are mostly schools of really high grade, and some of them of established reputation. There are also 18 or 20 (so-called) female colleges, which are really only academies or seminaries of high grade, very few, if any of them, we believe, possessing the power of conferring degrees: these have 91 teachers or professors, 1476 students, and an average tuition fee of about $50 per annum. In the true sense of the term there are not more than one or perhaps two universities in the State. The University of Georgia, at Athens, which is now also the Agricultural and Scientific College, and has the North Georgia Agricultural College at Dahlonega as one of its branches, and a law department also, is an institution which under its present management may become a true university. Mercer University, at Macon, has a theological department. Oglethorpe University, at Atlanta, is simply a college. Atlanta University, for colored students preparing to become preachers, is rather a missionary theological school than either a college or university. The other colleges—Bowdon College, at Bowdon, Carroll co., Emory College, at Oxford, Newton co., the Masonic College, at Covington, Marshall College, at Griffin have a fair measure of support. These universities and colleges have about 45 professors and 1446 students. The State University is scantily endowed, and the others need further endowment. In the matter of special education there is an academy for the blind at Macon, with 35 pupils and 8 instructors and employés, which receives about $10,000 annually from the State; an institution for the deaf and dumb at Cave Spring, with 5 instructors and 61 pupils, which receives $15,000 per annum from the State; but no normal school, no reformatory for either boys or girls, no asylum for idiots or inebriates, and but one hospital for the insane, that at Midway. The State-prison labor is farmed out, and the prison is certainly not abreast of the age in the character of its discipline. It had Jan. 1, 1874, 664 convicts, of whom 93 were white and 571 colored; there were 1 white and 19 colored females in the number.

Newspapers and Periodicals.—In 1870, Georgia had 110 newspapers and periodicals of all kinds, with an aggregate circulation of 150,987, and an annual issue of 15,039,724 copies. In 1872 the number had increased to 125, though the aggregate circulation was not greatly enlarged. There were 15 dailies, 5 tri-weeklies, 7 semi-weeklies, 86 weeklies, 2 semi-monthlies, 9 monthlies, 1 bi-monthly; of these, 6 were agricultural and horticultural; 8 literary and miscellaneous; 95 were political, embracing two-thirds of the entire circulation; 4 were religious; 3 technical and professional.

Churches.—There were in Georgia in 1870, 2873 churches of all denominations, 2698 church edifices, with 801,148 sittings, and church property valued at $3,561,955. Of these, the regular Baptists had 1364 churches, 1308 church edifices, 388,265 sittings, and $1,123,950 of church property. (At the close of 1873, according to the *Baptist Year Book*, there were 2112 churches, 1217 ordained ministers, 7015 baptisms, and 149,636 communicants. There were also 500 Sunday schools and 28,125 teachers and scholars.) Of the minor Baptist denominations there were in 1870, 5 churches, 4 church edifices, 900 sittings, and $1700 church property. Of the Christian Connection there were in 1870, 34 churches, 33 church edifices, 10,285 sittings, $60,050 church property. In the census of 1870 there are reported (erroneously) 10 Congregationalist churches, 10 church edifices, 2800 sittings, $16,550 of church property. (The *Congregational Quarterly* in 1873 reports only 4 churches, 2 constituted that year, 6 ministers, and 420 members.) The census reported in 1870, 35 Protestant Episcopal churches, 27 church edifices, 8975 sittings, $246,850 of church property. (The *Protestant Episcopal Almanac* for 1874 reports 1 bishop, 78 churches, 73 parishes and missions, 37 clergymen, [illegible] communicants, 379 confirmations, 3103 Sunday-school teachers and scholars, $86,761 contributions for church support and benevolent institutions.) The census reports 6 Jewish congregations, 5 synagogues, 1400 sittings, $52,700 of church property. In 1870 there were 11 Lutheran churches, 10 church edifices.

3000 sittings, $57,100 of church property. (The *Lutheran Almanac* for 1874 reports that in 1873 there were in the synod of Georgia 9 ministers, 14 churches, 980 communicants.) In 1870 there were of Methodists of all descriptions 1248 organizations, 1158 church edifices, 327,343 sittings, $1,073,030 of church property. (There are so many kinds of Methodists in Georgia that it is impossible to obtain the statistics of all for 1873 or 1874, but there has undoubtedly been a considerable increase over the census figures.) There is one New Jerusalem (Swedenborgian) church in the State. There were in 1870, 121 regular Presbyterian (*i. e.* Presbyterian Church South) churches in Georgia, 114 church edifices, 45,275 sittings, $545,450 church property. (In 1872 this church reported but 75 ordained ministers in Georgia.) The other Presbyterian bodies had in 1870, 13 churches, 9 church edifices, 4300 sittings, and $8075 of church property. The Associate Reformed Synod of the South had in 1872, 1 presbytery, with 3 churches and 3 ministers in the State; and Cumberland Presbyterians had 4 ministers and 8 churches in the State in 1872. The Roman Catholic Church had in 1870, 14 congregations, 11 church edifices, 5500 sittings, $294,550 of church property. (In 1875 the *Catholic Directory* reports 14 churches and 7 others building, 30 chapels, and out-stations, 19 priests, 1 monastery, 5 convents, 4 academies, 6 free schools, 1 college.) The Roman Catholic population does not exceed 25,000. Of Universalists there were in 1870, 5 congregations, 3 church edifices, 900 sittings, and $900 of church property. (In 1873 their official *Register and Almanac* reported 16 parishes and 12 congregations, with 271 members.) There were also in 1870, 6 union congregations, with 6 church edifices, 1100 sittings, and $20,700 of church property.

Constitution, Courts, Representatives in Congress, etc.—The present constitution of the State was adopted in convention in Mar., 1868, and ratified by the people in April of the same year. It declares all citizens of the U. S. residing in the State to be citizens thereof, and that no laws shall be made or enforced which shall abridge the privileges or immunities of citizens of the U. S. or of the State, or deny to any person within its jurisdiction the equal protection of its laws. The governor is chosen by the people for four years; and for the same period are elected by the general assembly the following officers: the secretary of state, comptroller-general, treasurer, and surveyor-general. The senate consists of 44 members, one-half elected biennially for four years, and the house of representatives of 168 members, elected biennially for two years. The judiciary of the State comprises a supreme court, a superior court for each judicial district, courts in ordinary, and justices of the peace. The supreme court has appellate jurisdiction only. The superior courts have exclusive jurisdiction in cases of divorce, in criminal cases, where the penalty is death or confinement in the penitentiary, in cases respecting titles to land, and in equity cases. It has also power to correct errors in inferior judgments, and to issue writs that may be necessary for carrying into effect their powers. The judges of the supreme and superior courts, the attorney-general, solicitor-general, and the district judges and attorneys are appointed by the governor and confirmed by the senate. Under the apportionment of 1872, Georgia has 9 representatives in Congress (a gain of 2 on her previous representation).

Counties.—Georgia had in Jan., 1874, 136 counties, which had the following population in 1870: Appling, 5086; Baker, 6843; Baldwin, 10,618; Banks, 4973; Bartow (formerly Cass), 16,566; Berrien, 4518; Bibb, 21,255; Brooks, 8342; Bryan, 5252; Bullock, 5610; Burke, 17,679; Butts, 6941; Calhoun, 5503; Camden, 4615; Campbell, 9176; Carroll, 11,782; Catoosa, 4409; Charlton, 1897; Chatham, 41,279; Chattahoochee, 6059; Chattooga, 6902; Cherokee, 10,399; Clarke, 12,941; Clay, 5493; Clayton, 5477; Clinch, 3945; Cobb, 13,814; Coffee, 3192; Columbia, 13,529; Colquitt, 1654; Coweta, 15,875; Crawford, 7557; Dade, 3033; Dawson, 4369; Decatur, 15,183; DeKalb, 10,014; Dodge*; Dooly, 9790; Dougherty, 11,517; Douglass*; Early, 6998; Echols, 1978; Effingham, 4214; Elbert, 9249; Emanuel, 6134; Fannin, 5429; Fayette, 8221; Floyd, 17,230; Forsyth, 7983; Franklin, 7893; Fulton, 33,446; Gilmer, 6644; Glascock, 2736; Glynn, 5376; Gordon, 9268; Greene, 12,454; Gwinnett, 12,431; Habersham, 6322; Hall, 9607; Hancock, 11,317; Haralson, 4004; Harris, 13,284; Hart, 6783; Heard, 7866; Henry, 10,102; Houston, 20,406; Irwin, 1837; Jackson, 11,181; Jasper, 10,439; Jefferson, 12,190; Johnson, 2964; Jones, 9436; Laurens, 7834; Lee, 9567; Liberty, 7688; Lincoln, 5413; Lowndes, 8321; Lumpkin, 5161; Macon, 11,458; Madison, 5227; Marion, 8000; McDuffie*; McIntosh, 4491; Meriwether, 13,756; Miller, 3091; Milton, 4284; Mitchell, 6633; Monroe, 17,213; Montgomery, 3586; Morgan, 10,696; Murray, 6500; Muscogee, 16,663; Newton, 14,615; Oglethorpe, 11,782; Paulding, 7639; Pickens, 5317; Pierce, 2778; Pike, 10,905; Polk, 7822; Pulaski, 11,940; Putnam, 10,461; Quitman, 4150; Rabun, 3256; Randolph, 10,561; Richmond, 25,724; Rockdale*; Schley, 5129; Scriven, 9175; Spalding, 10,205; Stewart, 14,204; Sumter, 16,559; Talbot, 11,913; Taliaferro, 4796; Tatnall, 4860; Taylor, 7143; Telfair, 3245; Terrell, 9053; Thomas, 14,523; Towns, 2780; Troup, 17,632; Twiggs, 8545; Union, 5267; Upson, 9430; Walker, 9925; Walton, 11,038; Ware, 2286; Warren, 10,545; Washington, 15,842; Wayne, 2177; Webster, 4677; White, 4606; Whitfield, 10,117; Wilcox, 2439; Wilkes, 11,796; Wilkinson, 9383; Worth, 3778.

Principal Cities and Towns.—There are six cities in the State: Atlanta, the capital, pop. in 1870, 21,789, and rapidly growing; Augusta, county-seat of Richmond co., on the Savannah River, pop. in 1870, 15,389; Macon, county-seat of Bibb co., pop. in 1870, 10,810; Columbus, county-seat of Muscogee co., on the Chattahoochee, pop. in 1870, 7401; Athens, in Clarke co., on the Oconee, pop. in 1870, 4251; and Savannah on the Savannah River, county-seat of Chatham co., pop. in 1870, 28,235. Aside from these cities, the only towns having a population between 3000 and 5000 in 1870 were Griffin and Americus; between 2000 and 3000, Milledgeville, Cartersville, Cuthbert, Albany, and La Grange.

History.—Though one of the thirteen colonies which united in the Declaration of Independence in 1776, Georgia was settled much later than any of the rest. Before the year 1733 it was a wilderness, a doubtful border-land, claimed both by Great Britain and by Spain. By a patent dated June 9, 1732, George II., king of Great Britain, from whom the colony was subsequently named, granted the territory to a company designated as the "Trustees for settling the Colony of Georgia." Among the parties interested in obtaining this grant, were Gen. James E. Oglethorpe (who was subsequently the leader and governor of the colony), Whitefield, and the Wesleys, the founders of Methodism and the eloquent and noted preachers of that period. The objects of this colonization were twofold—to provide a refuge for the needy and destitute, especially for poor debtors, orphans and friendless children and youth, and to establish a barrier against Spanish and Indian encroachments and aggressions upon the British possessions in North and South Carolina. The charter and grant being duly executed, Gen. Oglethorpe sailed from Gravesend late in the autumn of 1732 with a colony of 120 persons, and landed at Charleston in Jan., 1733, and at once proceeded to the new territory, and shortly, after some explorations, founded the city of Savannah. The colony was at first a military one, the colonists holding the lands parcelled out to them on the condition of military service. This condition involved so many hardships that many of the emigrants deserted the new colony and settled in North Carolina, where the land was held in fee-simple. The trustees then changed their policy, offering 50 acres to each settler, and as a consequence a considerable number of immigrants, mostly Scotch and Germans, flocked to the colony. Mr. Whitefield was very active in establishing his home for orphans at Bethesda, near Savannah, and crossed the Atlantic many times for this purpose, bringing with him a considerable number of settlers at each voyage. In 1739 war was declared between Great Britain and Spain, and Gen. Oglethorpe was appointed to command the colonial troops of Georgia and South Carolina, and marched with 1000 troops and Indian allies into Florida, but this expedition proved a failure. In 1742 the Spaniards returned the compliment of Oglethorpe's visit with an expedition of 36 ships and 3000 men. The fleet appeared in the Altamaha River, took Fort Frederica, on St. Simon's Island, when, by a stratagem conceived by Oglethorpe, they became alarmed, retired to their ships, and sailed for Florida. Peace was subsequently restored. The people of Georgia became discontented on account of the prohibition of negro slavery, which was tolerated in other sections. In 1752 the trustees surrendered their charter to the Crown, and the colony became a part of the royal government, enjoying the same privileges as to land, trade, and negro slavery as the other colonies. The general assembly was established in 1755, and in 1763 all the land between the Altahama and St. Mary's rivers was added to the province. From this date the progress of the colony was rapid. The fertile lowlands were brought into cultivation as the immigration increased, and in the ten years from 1753 to 1763 the exports had risen from £3059 = $15,300, to £14,469 = $72,350. In 1773 they amounted to £85,391 = $426,955. The imports of 1773 were £62,932 = $314,660. In 1775 the population had increased to 75,000, the exports were £103,477 = $517,385, and the imports £113,777 = $568,885. Of all the colonies, Georgia was in the most prosperous condition, and had the fewest inducements to take part

* Those having no population specified are new counties organized since 1870.

with the other colonies in the Revolution. But the colonists felt that the cause was one, and they lost no time in manifesting their sympathy with the other colonies, and in preparing to take an active part in the coming struggle. In Mar., 1775, they appointed a delegate to Congress, and in July of the same year a convention of the colonists met and gave their sanction to the measures adopted by Congress. During the war which followed Georgia suffered severely. The State was overrun by British troops, and the principal citizens were compelled to fly for their lives. In 1778, Savannah was captured, and in 1779, Augusta and Sudbury. The Americans, aided by the French, attempted to retake Savannah in 1779, but without success. Georgia formed her first constitution in 1777, her second in 1785, and her third in 1798, which, with some amendments, continued in force till 1861. The constitution of the U. S. was ratified by the State Jan. 2, 1788. For some years after the close of the Revolutionary war the Creeks and Cherokees made frequent forays into the frontier settlements of Georgia, but in 1790 and 1791 treaties of peace were concluded with the chiefs of these nations, and the western boundaries of the State were established. In 1802, by the treaty of Fort Wilkinson, the Creeks ceded to the U. S. a large tract of land, which now comprises the rich and fertile counties of S. W. Georgia. These lands were subsequently assigned to Georgia, and the State in 1802 ceded to the U. S. all its claims to the lands W. of its present boundaries, now forming the greater part of the States of Alabama and Mississippi. From 1830 to 1838 there were constant collisions between the State government and the Cherokees, who occupied a large and valuable tract in N. W. Georgia. The citizens of the State were determined to drive out this intelligent and formidable tribe, and at one time there seemed a probability that the national and State governments would be arrayed in hostility against each other. In 1838 the removal of the Indians to the Indian Territory W. of Arkansas put an end to the strife, and the people of Georgia speedily entered into possession of their valuable lands. Growing rapidly in wealth and political influence, Georgia became within the next twenty years the leading State of the Southern tier. Her influence was naturally thrown in favor of slavery; and when South Carolina determined (Dec. 20, 1860) to secede, Georgia followed with an ordinance of secession Jan. 19, 1861, although a minority, strong in talent and influence, opposed it. Once enlisted in the Southern Confederacy, the State was very active in furnishing material aid to the war. At first, her citizens had but little personal experience of suffering from its ravages, though many of her sons had fallen in the field or had been taken prisoners; but in the autumn of 1863, beginning with the battle of Chickamauga Creek and the conflicts which followed, partly in East Tennessee and partly in Georgia, she first tasted its horrors on her own soil. Cavalry raids of considerable extent visited several of her cities and larger towns; but it was not until May, 1864, when Gen. Sherman set his face towards Atlanta, that there were any great number of severe conflicts on her soil. The campaign, of four months' duration, which culminated in the capture and occupation of Atlanta, was one of great losses, both of life and property; much of her territory was traversed more than once by the contending armies; this was followed in the autumn and winter of 1864–65 by Sherman's "march to the sea," his army spreading over a breadth of 50 miles, and finishing by the capture and occupation of Savannah. Humbled and helpless in the hands of the conquerors, the citizens of the State were not slow to accept the situation under the proclamation of Pres. Johnson. On Oct. 25, 1865, a convention elected by the people assembled, and on the 30th of that month they repealed the act of secession, repudiated the Confederate debt, and adopted a new constitution, in which slavery was for ever prohibited in the State. The legislature which soon after met under this new constitution also ratified the Thirteenth Amendment to the Constitution of the U. S. This new constitution of the State so made, with the entire State government so put in operation, was set aside by the Reconstruction act of Congress in Feb., 1867. All the State officers, executive, legislative, and judical, were deposed. Another provisional governor (Gen. Ruger, U. S. A.) was assigned to Georgia, and the State was included with Alabama and Florida in the third military district then created. A new election was ordered for another constitutional convention. At this election all persons were disfranchised who had ever held civil office of honor or profit in the State. Several thousand white men were thus excluded from the polls, while all colored male residents of twenty-one years of age and upward were permitted to vote. The second convention so ordered met in the winter of 1867–68, and formed the constitution under which the State is now organized. A legislature elected under it met early in July, 1868, and ratified the Fourteenth Amendment to the Constitution of the U. S., and the State thus passed out of military rule to self-government, and was admitted again to the Union. A Senator and several members of the House were permitted to take their seats in Congress, but on the failure of the legislature to ratify the Fifteenth Amendment the State was again put under military rule until this additional exaction was complied with. Since that period Georgia has been peaceful, and has occupied itself with the restoration of its material resources and its financial position, in which it has been in a marked degree successful. For a time there was a very general complaint of the maladministration of some of the State officers, but a peaceful political revolution seems to have resulted in an honest and well-administered government.

The *Governors* of the State since the adoption of the U. S. Constitution have been:

Governors.	Term of service.	Governors.	Term of service.	Governors.	Term of service.
George Walton	1789–90	David B. Mitchell	1815–17	George W. Crawford	1843–47
Edward Telfair	1790–93	William Rabun	1817–19	George W. B. Towns	1847–51
George Matthews	1793–96	Matthew Talbot (acting)	1819–19	Howell Cobb	1851–53
Jared Irwin	1796–98	John Clarke	1819–23	Herschell V. Johnson	1853–57
James Jackson	1798–1801	George M. Troup	1823–27	Joseph E. Brown	1857–65
David Emanuel (acting)	1801–1801	John Forsyth	1827–29	James Johnson (provisional	1865–65
Josiah Tatnall	1801–02	George R. Gilmer	1829–31	Charles J. Jenkins	1865–67
John Milledge	1802–06	Wilson Lumpkin	1831–35	Gen. T. H. Ruger (provisional	1867–68
Jared Irwin	1806–09	William Schley	1835–37	Rufus B. Bullock	1868–72
David B. Mitchell	1809–13	George R. Gilmer	1837–39	James Milton Smith	1872–76
Peter Early	1813–15	Charles J. McDonald	1839–43	Alfred H. Colquitt	1876

Electoral and Popular Votes for President and Vice-President.—The vote for President and Vice-President in Georgia was cast by the legislature, who chose the Electoral College, until 1828. Since that time the presidential electors have been chosen by the people, so that there has been both an electoral and popular vote since that time, except in 1864, when the State was regarded as out of the Union.

Elect. Year.	Candidates voted for President and Vice-President.	Elect. Vote.
1789	P. George Washington	5
	V. P. four candidates	5
1792	P. George Washington	4
	V. P. Geo. Clinton, N. Y.	4
1796	P. Thomas Jefferson	4
	V. P. George Clinton, N. Y.	4
1800	P. Thomas Jefferson	4
	V. P. Aaron Burr, N. Y.	4
1804	P. Thomas Jefferson	6
	V. P. George Clinton, N. Y.	6
1808	P. James Madison	6
	V. P. George Clinton, N. Y.	6
1812	P. James Madison	8
	V. P. Elbridge Gerry, Mass.	8
1816	P. James Monroe	8
	V. P. D. D. Tompkins, N. Y.	8
1820	P. James Monroe	8
	V. P. D. D. Tompkins, N. Y.	8
1824	P. William H. Crawford, Ga.	9
	V. P. M. Van Buren, N. Y.	9
1828	P. Andrew Jackson	9
	V. P. John C. Calhoun, S. C.	2
	V. P. William Smith, S. C.	7

Elect. Year.	Candidates for President and Vice-President.	Elect. Vote.	Popular Vote.
1828	P. Andrew Jackson	...	18,709
1832	P. Andrew Jackson	11	20,750
	V. P. Martin Van Buren	11	20,750
1836	P. Hugh L. White, Tenn.	11	24,930
	V. P. John Tyler, Va.	11	24,930
	P. Martin Van Buren	...	22,126
	P. Three other candidates	...	not reported
1840	P. Wm. H. Harrison, O.	11	40,261
	V. P. John Tyler, Va.	11	40,261
	P. Martin Van Buren	...	31,933
1844	P. James K. Polk	10	44,177
	V. P. Geo. M. Dallas, Pa.	10	44,177
	P. Henry Clay, Ky.		42,100
1848	P. Zachary Taylor, La.	10	47,544
	V. P. Millard Fillmore, N. Y.	...	47,544
	P. Lewis Cass, Mich.		44,80[illegible]
	P. Martin Van Buren, N. Y.	10	not reported
1852	P. Franklin Pierce, N. H.	10	34,705
	V. P. William R. King, Ala.	10	34,705
	P. Winfield Scott, N. Y.		16,660
1856	P. James Buchanan, Pa.	10	56,578
	V. P. J. C. Breckinridge, Ky.	10	56,578
	P. Millard Fillmore	...	42,228
	P. John C. Fremont	...	not reported

Elect. Year.	Candidates for President and Vice-President.	Elect. Vote.	Popular Vote.
1860	P. John C. Breckinridge	10	51,889
	V. P. Joseph Lane, Or.	10	51,889
	P. Stephen A. Douglas, Ill.		11,590
	P. John Bell, Tenn.		42,886
	P. Abraham Lincoln, Ill.		not reported
1864	No vote		no vote
1868	P. Horatio Seymour, N. Y.	9	102,722
	V. P. Francis P. Blair, Jr., Mo.	9	102,722
	P. Ulysses S. Grant, Ill.		57,134
1872	P. Horace Greeley, N. Y.	3	76,356
	P. B. Gratz Brown, Mo.	6	
	P. Charles J. Jenkins, Ga.	2	
	V. P. B. Gratz Brown, Mo.	5	76,356
	V. P. Alfred H. Colquitt, Ga.	5	
	V. P. Nat'l P. Banks, Mass.	1	
	P. Ulysses S. Grant	...	62,550
	P. Charles O'Conor, N. Y.		4,000
1876	P. Samuel J. Tilden, N. Y.	11	130,088
	P. Rutherford B. Hayes, O.		50,446
1880	P. Winfield S. Hancock, Pa.	11	102,470
	P. James A. Garfield, O.		54,086

We are indebted for statistical and other information to His Excellency James Milton Smith, governor of Georgia, to Rev. C. W. Howard of Kingston, Ga., and to the editors of the *South*, New York. L. P. BROCKETT.

Georgia, tp. of Limestone co., Ala. Pop. 958.

Georgia, tp. of Columbia co., Ark. Pop. 783.

Georgia, tp. of Jasper co., Mo. Pop. 948.

Georgia, tp. and post-v. of Franklin co., Vt., 52 miles N. W. of Montpelier, and on the Vermont Central R. R., has 3 churches and an academy. Pop. 1603.

Georgia, Gulf of, the body of water between the mainland of British Columbia and Vancouver Island. It may be regarded as a northward extension of Puget Sound. The Strait of San Juan de Fuca is the southern entrance to the gulf and to Puget Sound. Queen Charlotte's Sound is the northern entrance. The Gulf of Georgia is a sound or channel, rather than a gulf, is 100 miles long, and in some places 20 miles broad.

Georgia'na, post-v. of Butler co., Ala., on the Mobile and Montgomery R. R., 16 miles S. S. W. of Greenville, has a weekly newspaper.

Georgiana, tp. of Sacramento co., Cal. Pop. 1056.

Geor'gian Bay, the easternmost portion of Lake Huron, lying within the province of Ontario, Canada, and separated from the rest of the lake by the Great Manitoulin Island and by a peninsula (Cabot's Head) which extends N. from Bruce co., Ont. The bay was formerly called Lake Manitoulin. Length, 120 miles; breadth, 50 miles.

Geor'gian Lan'guage and Lit'erature. The Georgian language is placed by Latham in his Dioscurian group, which includes the other languages of the Caucasus, which have been variously classed as either Turanian or Dravidian, or as related to the monosyllabic tongues of South-eastern Asia, but some authorities state positively that it is quite distinct from the other languages of the Caucasus, and assign to it an Indo-European origin; and some make it a link between the monosyllabic and the Aryan tongues. Though harsh in sound, the language has many merits. The old alphabet of forty letters is giving place to the Russian. Some of the literature is of high antiquity. It consists chiefly of romances, histories, pseudo-histories, poetry, and church literature. The Georgian Bible is of the tenth century. The golden age of Georgian letters was the seventeenth and eighteenth centuries, but in 1807 the Russians carried to St. Petersburg an important part of the literature of the country, and a process of Russianization is now going on in the schools of Transcaucasia. (See BROSSET, *Éléments de la Langue Géorgienne*, 1837, and the *Lexicon* of PRINCE SULKHAN SABA ORBELIAN.)

Geor'giaville, post-v. of Smithfield tp., Providence co., R. I., on the Providence and Springfield R. R., 9 miles N. W. of Providence.

Geor'giesville, post-v. of Pleasant tp., Franklin co., O., on the Columbus Springfield and Cincinnati R. R., 12 miles W. by S. of Columbus. Pop. 22.

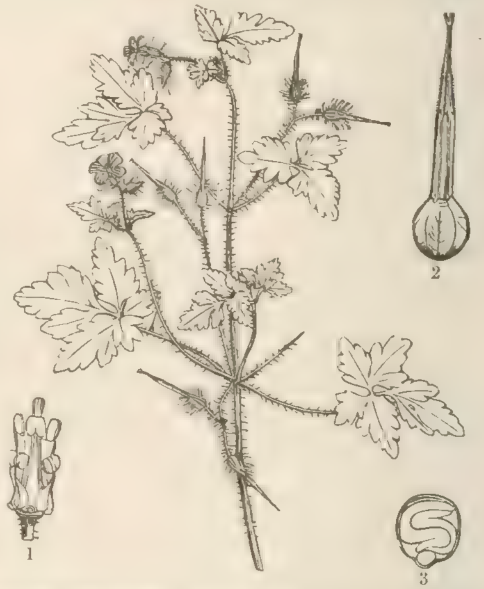
Ge'ra, town of Germany, in Reuss, on the White Elster. It is neatly built and thriving. Its woollen and cotton manufactures are considerable. Pop. 10,036.

Gera'ce, old town of Italy, in the province of Reggio di Calabria, situated 4 or 5 miles from the sea. It has a fine Gothic church and other good buildings, and mines of iron, lead, and zinc are worked in the neighborhood. It is a bishop's see. Pop. 7200.—GERACE SICULO, small town in the province of Palermo, Sicily.

Gérando, de (JOSEPH MARIE), BARON, b. at Lyons, France, Feb. 29, 1772; studied for a priest, but served in the army and the civil service, and in 1812 was made a baron and governor of Catalonia; was 1828–42 professor of public law in the faculty at Paris; was made a peer in 1837. D. at Paris Nov. 11, 1842. Author of *Des signes et de l'art de penser* (4 vols., 1800), which was written while he was in the army, and gained the prize of the Institute; *Génération des connaissances* (1802); *Histoire comparée des systèmes de philosophie* (3 vols., 1803; 4th vol., 1847); *Du perfectionnement moral et l'éducation de soi-même* (1820); *Visiteur du pauvre* (1821); *De l'éducation des sourds-muets* (1827); *Institutes du droit administratif* (1829); *Cours normal des institutions judiciaires* (1839); *De la bienfaisance publique* (4 vols., 1839); and many other works upon philosophy, education, social questions, law, etc.

Gerania'ceæ, a natural order of exogenous plants, mostly herbs, having as many or twice as many stamens (including the sterile ones) as there are sepals; the one or few ovuled lobes of the ovary as many as the sepals; the flowers perfect, and very generally symmetrical; the axis of the dry fruit persisting. Some authorities separate the Limnantheæ, the Tropæoleæ, the Balsamineæ, and the Oxalideæ from the order, but they all possess very nearly the characters indicated above.

Gera'nium [Gr. γεράνιον, "cranesbill"] is the typical genus of the order Geraniaceæ. It has ten stamens with perfect anthers. Five are longer than the others, and have glands at the base alternate with the petals. The persistent sepals are imbricated, and the petals usually convolute in the bud, while the stamens are slightly monadelphous. The receptacle has a very long extension, which gives the name of "cranesbill" to the genus. The five carpels and the styles are adnate to this. When ripe and dry, the pods are torn off and carried away by the styles, which curve elastically and throw out the seeds. Our common wild *Geranium maculatum* well exhibits the characteristics of the genus. It flowers in April or May. The geraniums are herbaceous, with rose-colored, purplish, or white flowers, sometimes variegated. They generally have a strong odor—often agreeable, but sometimes offensive, as in *Geranium Robertianum.* They contain tannin, often in



Geranium Robertianum: 1, the stamens; 2, the ovary; 3, section of seed, showing the curved embryo.

large quantities, and from the astringency which this imparts are used in medicine. *Geranium maculatum* contains very large quantities of it, and is often called *alum-root.* It is used as a remedy for dysentery. The true geraniums are not much used in cultivation, the plants from the Cape of Good Hope, generally known by the name, in fact belonging to the kindred genus *Pelargonium.* Of these there are very many—some valued for their rich scarlet, pink, or white blossoms, and some for the fragrance of their leaves. There are no plants better known in floriculture, or more sought after for in-door or garden ornamentation. As they cross easily, many hybrids have been formed, and it is now often difficult to determine the parentage of an individual. The pelargoniums are mostly shrubby. While the flowers of the geraniums usually are purple or some related color, a species exists in the south of Europe (the *Geranium chrysanthum*) which has yellow flowers. Those used in cultivation are easily propagated by cuttings. The genus contains about 500 species, unequally distributed over the world. W. W. BAILEY.

Gérard (CÉCILE JULES BASILE), b. at Pignans, Var, France, June 14, 1817; went to Algeria as a *spahi* in 1842. His *La chasse au lion* (1855) and *Gérard le tueur des lions* (1856) made him widely known as "Gérard the Lion-killer." In 1863 he set out to explore parts of Western Africa, and after many misfortunes was drowned in the river Jong, Sept., 1864.

Gérard (ÉTIENNE MAURICE), COUNT, b. at Damvillers, France, Apr. 4, 1773; enlisted in the army 1791; had attained a colonelcy 1800; distinguished himself in many of Napoleon's principal battles; was made a general of division and count in 1813; commanded the army of the Moselle 1815, and was with Grouchy in that campaign; returned to France 1817; was made war-minister and marshal 1830; reduced Antwerp 1832; became a peer of France 1832, prime minister 1834; commander of the national guard 1838; senator 1852. D. at Paris Aug. 17, 1852.

Gérard (FRANÇOIS PASCAL SIMON), BARON, b. at Rome,

1770; began to study painting under David 1786; became the first French portrait painter of his time; was patronized by Napoleon and made a baron by Louis XVIII. D. at Paris Jan. 11, 1837. Among his numerous historical paintings are *Belisarius*, 1795; *Cupid and Psyche*, 1797; *The Battle of Austerlitz*, 1810; *The Entrance of Henry IV. into Paris*, 1817, his *chef d'œuvre; Coronation of Charles X.*, 1830; *Thetis with Achilles' Armor*, 1822.

Gerarde (John), b. at Nantwich, Cheshire, England, in 1545; became in 1577 head-gardener to Lord Burghley, and practised as a surgeon in London. Author of *Catalogus arborum*, etc. (1596), and of a very quaint and curious *Herbal*, 1597, which is based on the *Historiæ Stirpium* of Dodæus (Antwerp, 1583). D. about 1607.

Gérardmer, Giromeix, or **Gérômé,** town of the department of Vosges, France, on the beautiful Lake Gérardmer, 21 miles S. E. of Epinal. From this place comes the Gérômé cheese. Pop. 5600.

Gerards'town, post-v. of Berkeley co., West Va., is situated in one of the most fertile portions of the Shenandoah Valley. It has 3 churches, 1 Masonic hall, 1 hotel, 1 weekly news-paper, 2 school-houses, stores, shops, etc. Pop. of tp. 1857. J. B. Morgan, Ed. "Times."

Ger'asa, the name of two places in Palestine: I. Also written **Ger'gesa** and **Ger'sa,** on the E. side of the Lake of Galilee, just opposite Magdala. At this point, and not at Gadara (which is more than three hours from the lake), the herd of swine perished (Matt. viii. 28–32). The ruins which now mark the spot are within a few rods of the shore, and the mountain just behind is pierced with ancient tombs. (See Thomson's *Land and Book*, ch. xxv.) II. (Arabic, *Jerash*), 20 miles E. of the Jordan, in a shallow valley about 5 miles N. of the Zerka (ancient *Jabbok*), and about the same distance N. E. of Dibbin, or Dhibân, where the Moabite Stone was found in 1868. This place is not spoken of in the Bible. It is first mentioned by Josephus (*Jew. War*, 1, 4, 8) as captured by Alexander Jannæus (105–78 B. C.) about 85 B. C. It was one of the ten cities of *Decapolis*. Having been twice destroyed, it was rebuilt with great splendor in the time of the Antonines (138–180 A. D.). Its ruins are the most extensive and beautiful E. of the Jordan. Its walls, in places of the original height, with three of the ancient gateways nearly perfect, enclose a square of about a mile. Inside are ruins of a forum and of baths, theatres, and temples. More than 230 columns still remain upon their pedestals. Among the ruins are the remains of a Christian church. A bishop of Gerasa attended the Council of Seleucia, in 359, another that of Chalcedon, in 451. R. D. Hitchcock.

Ger'bil (*Gerbillus*), a genus of rat-like rodents, found mostly in Asia, Africa, and Eastern Europe. They are all nocturnal, living in burrows, where they store away much grain. They generally secrete an offensive odor. They are elegant and active, and generally of a fawn color.

Gerboa. See Jerboa.

Gerfalcon. See Gyr Falcon.

Ger'hard (Eduard), b. at Posen, Prussia, Nov. 29, 1795; held a professorship at Breslau, where in 1816 he graduated; went to Rome 1822; was 1828–37 director of the Institute of Archæological Correspondence at Rome; was afterwards professor in the University of Berlin and archæologist of the Royal Museum. D. May 12, 1867. Author of works on Italian, Greek, and Etruscan archæology.

Gerhardt (Charles Frédéric), b. at Strasburg, France, Aug. 18, 1816; studied chemistry under Liebig; was a professor at Montpellier 1844–48; pursued chemical investigations in Paris for some years, and was 1855–56 professor of chemistry and pharmacy at Strasburg. His *Traité de chimie organique* (4 vols., 1853–56) is a work of great value. Gerhardt's immortality rests upon the reform in chemical notation inaugurated by him, but his early death left the work incomplete. D. at Strasburg Aug. 19, 1856.

Gericault (Jean Louis Théodore André), b. at Rouen in 1790; studied painting under Carle Vernet and Guerin, and from 1816 to 1819 at Rome; lived for some time in England. D. in Paris Jan. 18, 1824. His *Le Radeau de la Méduse*, exhibited in 1819, was the inauguration of the romantic school of painting in France. Among his other works are numerous horse pictures.

Ger'izim and **E'bal,** mountains of Western Palestine, about halfway between Jerusalem and Nazareth. They face each other across a narrow and exceedingly fertile valley, in which stands the town of Nablous, the ancient *Shechem* or *Sychar*. Gerizim, on the S. side of the valley, is 2650 feet above the sea; Ebal, on the N. side, about 2750. Jacob's Well and Joseph's Tomb are just at the mouth or E. end of the valley. Here was Abraham's first encampment W. of the Jordan. Here the Law was solemnly read in the hearing of the twelve tribes (Josh. viii. 30–35). Gerizim is the sacred mountain of the Samaritans, where the handful that survive (150 persons in all) still observe the three great festivals of the Mosaic ritual. The temple built there, by permission obtained of Alexander the Great in 330 B. C., was destroyed by John Hyrcanus (135–106 B. C.) about 129 B. C. The spot where it stood is now a platform of naked rock surrounded by slight traces of former walls. The massive ruins near by are probably the ruins of Justinian's fortress, built there about 529 A. D. (See Robinson's *Biblical Researches*; also his *Physical Geography of the Holy Land*, 1865.) R. D. Hitchcock.

Ger'ki, town of Central Africa, in the dominion of Saccatoo, is situated in lat. 12° 26′ N., lon. 9° 16′ E., surrounded with walls. Pop. 15,000.

Germ [Lat. *germen*], or **Em'bryo,** is the essential part of the seed of a plant. All the other portions of the flower and fruit serve merely to develop or protect it. It possesses in a rudimentary condition all the essential portions of a mature plant, and varies greatly in size, position, and the quantity of nourishment it requires. Sometimes the embryo occupies the whole seed, but often it is surrounded by albumen or starch, or has similar nutritious matter stored away in its own tissue. It consists of the *cotyledons*, or seed-leaves; the *plumule*, or small leaves of the ordinary kind folded together between the cotyledons; and the *radicle*, or stem from which the true roots afterwards develop. It is from the number of cotyledons that the classes of phænerogamous plants take their names and leading character. The name *germ* is equally applied to any growing point, as of a bud. The embryo is the germ of a seed. Moreover, germ was the name applied by Linnæus and his contemporaries to what is now named the ovary or ovarium; but this use is now completely obsolete. (See Ovule.) The *embryo* must not be confounded with the ovule which contains it. W. W. Bailey.

Ger'man, tp. of Bartholomew co., Ind. Pop. 1302.

German, tp. of Marshall co., Ind. Pop. 2233.

German, tp. of St. Joseph co., Ind. Pop. 551.

German, tp. of Vanderburg co., Ind. Pop. 1683.

German, tp. of Grundy co., Ia. Pop. 839.

German, tp. of Keokuk co., Ia. Pop. 1512.

German, tp. of Bollinger co., Mo. Pop. 1117.

German, tp. of Madison co., Mo. Pop. 868.

German, post-tp. of Chenango co., N. Y. Pop. 712.

German, tp. of Allen co., O. Pop. 1462.

German, tp. of Auglaize co., O. Pop. 1750.

German, tp. of Clark co., O. Pop. 1918.

German, post-tp. of Darke co., O. Pop. 1743.

German, tp. of Fulton co., O. Pop. 2479.

German, tp. of Harrison co., O. Pop. 1227.

German, tp. of Holmes co., O. Pop. 1408.

German, tp. of Montgomery co., O., contains the village of Germantown (which see). Pop. 3197.

German, tp. of Fayette co., Pa. Pop. 1911.

Ger'man Cath'olics, a sect in Germany which in 1844 seceded from the Roman Catholic Church in consequence of the exhibition of "the holy coat" at Treves. Two elements entered into the composition of the sect. The dominant element was rationalistic, represented by Johannes Ronge, a deposed Roman Catholic Silesian priest, then living in retirement, whose letter of Oct. 1, 1844, to Bishop Arnoldi of Treves inaugurated the whole movement. The weaker evangelical element was represented by Johann Czerski, another Roman Catholic priest of Posen, who had left the Church (Aug. 22) some five or six weeks before the appearance of Ronge's letter. These two men came together. The first congregation was that organized in 1844 by Czerski himself at Schneidemühl, under the name of "Christian Catholic." The first Creed put forth was the *Confession of Schneidemühl*, drawn up by Czerski, and differing but little from the Roman Catholic faith. It appealed to Scripture and accepted the Nicene Creed, rejecting indulgences, purgatory, invocation of saints, the Latin mass, communion in one kind, auricular confession, clerical celibacy, the papal supremacy, and some other points. The *Confession of Breslau*, drawn up by Ronge, was less conservative and orthodox. The Creed adopted by the council which met at Leipsic Mar. 22, 1845, was substantially Ronge's *Confession of Breslau*. At this time there were more than 100 congregations, and by the end of the year nearly 300. Meanwhile, another sect, called "Free Congregations" (*Freie Gemeinden*), composed of rankly rationalistic seceders from Protestant churches, and dating from 1841, had been making considerable headway in Germany. Both of these sects were strengthened by the revolution of 1848, and weakened by the reaction that fol

lowed. They came together at Gotha in 1859, under the name of *Bund freireligiöser Gemeinden*, but the vitality of the movement was even then nearly spent. Since then, disintegration and decay have gone steadily on. Governmental hostility (from the start), internal divisions, and, more recently, "Old Catholicism," have worked together against a movement which will stand in history as one of very great promise and of very small performance. (See KAMPE'S *Geschichte der religiösen Bewegungen der neuern Zeit*, 4 vols., Leipsic, 1852-60.) R. D. HITCHCOCK.

German′der, a name given to various labiate herbs of the genus *Teucrium*. The U. S. have one species, *Teucrium Canadense*. Most of the Old World species have been employed in medicine. Of these, the cat thyme (*Teucrium marum*) has a powerful fragrance much liked by cats.

Ger′man Em′pire, established by treaties between the North German Confederation and the South German states in Dec., 1870, and enlarged by the annexation of Alsace and German Lorraine by the peace of Frankfort-on-the-Main, May 10, 1871, is situated in the centre of Europe, and bounded N. by the North Sea, Denmark (Jutland), and the Baltic; E. by Russian Poland and Galicia; S. by Austria from the Vistula to the Lake of Constance, and by Switzerland; and W. by France, Luxemburg, Belgium, and the Netherlands. (See Map of Europe in vol. i. of this work.) Its northernmost point is situated in lat. 55° 52′ 56″ N., at the village of Nimmersatt, N. of Memel; the easternmost in lon. 22° 25′ 25″ E. of Greenwich, at the town of Schirwindt in East Prussia; the southernmost in lat. 47° 15′ 48″ N., at the source of the Stillach in the Algauer Alps; and the westernmost in lon. 5° 24′ 50″ E. of Greenwich at the village of Isenbruch in Rhenish Prussia, only 2½ E. miles from the Meuse. The distance from Tilsit to Metz (from N. E. to S. W.) is 810.9 E. miles; that from Hadersleben to Kempten (from N. to S.), 535.6 E. m.; that from Swinemünde to Bautzen (between the Baltic and Austria), 195.7 E. m.; and that from Trier to Wunsiedel (between Luxemburg and Austria), 247.3 E. m. The total area of the empire amounts to 9896 German square miles (15 to one degree at the equator), or 210,396 English square miles. The area of the several states is given in the following table, with their absolute and relative populations:

	Area. German square miles	Area. English square miles	Population in 1871.	Population. On one German sq. mile	Population. On one English sq. mile
GERMAN EMPIRE	9896	210,396	41,060,695	4,149	195
Kingdoms.					
Prussia	6401.6	136,103	24,643,941	3,850	181
Prov. of Prussia	1179.3	25,074	3,137,545	2,661	125
" Brandenburg	724.5	15,403	2,863,229	3,952	186
" Pomerania	574.9	12,224	1,431,633	2,490	117
" Posen	525.8	11,179	1,583,843	3,012	142
" Silesia	731.7	15,556	3,707,167	5,067	238
" Saxony	458.4	9,738	2,103,174	4,588	216
" Sleswick-Holstein	320.5	6,814	995,873	3,107	146
" Hanover	699.0	14,862	1 963,618	2,809	132
" Westphalia	366.8	7,799	1,775,175	4,839	228
" Rhenish Prussia	489.9	10,415	3,579,347	7,306	344
" Hesse-Nassau	288.7	6,138	1,406,370	4,872	229
" Hohenzollern	20.7	441	65,558	3,161	149
" Lauenburg	21.3	453	49,556	2,327	109
Bavaria	1377.8	29,292	4,863,450	3,530	166
Saxony	272.2	5,788	2,556,244	9,391	442
Würtemberg	354.3	7,532	1,818,539	5,132	241
Grand Duchies.					
Baden	277.1	5,891	1,461,562	5,274	248
Hesse	139.4	2,964	852,894	6,117	288
Mecklenburg Schwerin	241.6	5,138	557,897	2,309	109
Mecklenburg Strelitz	53.2	1,131	96,982	1,823	86
Oldenburg	116.2	2,470	312,778	2,692	127
Saxe Weimar Eisenach	65.8	1,399	286,183	4,349	205
Duchies.					
Saxe-Meiningen	44.8	953	187,957	4,195	197
Saxe-Coburg Gotha	35.7	760	174,339	4,907	230
Saxe Altenburg	24.0	510	142,122	5,922	279
Brunswick	67.2	1,428	311,764	4,739	218
Anhalt	42.6	906	203,437	4,772	224
Principalities.					
Schwarzburg Rudolstadt	17.1	364	75,523	4,417	208
Schwarzburg Sondershausen	15.7	334	67,191	4,288	202
Waldeck	20.4	433	56,224	2,761	129
Reuss—Elder line	5.0	106	45,094	9,037	425
Reuss—Younger line	15.1	320	89,032	5,912	278
Schaumburg Lippe	8.0	171	32,059	3,982	187
Lippe Detmold	20.6	438	111,135	5,395	254
Free Cities.					
Hamburg	7.4	157	338,974	45,951	2,160
Lubeck	5.1	109	52,158	10,167	478
Bremen	4.6	98	122,402	26,437	1,244
Imperial Lands.					
Alsace-Lorraine	263.2	5.596	1,549,587	5,887	277

Surface.—With respect to its surface, Germany consists of three different regions—the alpine region along the southern frontier, the mountain region of Central Germany, and the North German lowland. Of the Alps, only some smaller portions of the northern belt of the central and eastern Alps belong to the German empire: to Bavaria—namely, to the W. the Algauer and Bavarian Alps, and to the E. of the Inn, the Salzburger Alps. All these branches form parts of the northern limestone Alps, which extend to the S. into Tyrol to the Inn, from the entrance of the valley of the Stanzer to Schwaz. The northern spurs of the Alps terminate at the towns of Immenstadt on the Iller, Füssen on the Lech, Tölz on the Isar, Rosenheim on the Inn, and Traunstein on the Traun. The Algauer Alps surround the alpine region around the sources of the Iller, but extend beyond it to the E. as far as the Lech, and send their spurs to the W., through Tyrol (Vorarlberg), to the Lake of Constance. To the W. of the broad Iller valley extend the Rindalpen Horn (1850 mètres), at whose northern termination the Alp Lake is situated, near Immenstadt. Opposite this chain, on the eastern side of the Iller valley, the picturesque Grünten (1733 m.) forms the watchtower of the Alps towards the plateau. But these Alps are grandest near the sources of the Stillach and the Trettach, which form the Iller; here the Bavarian territory stretches far into Tyrol, and on the frontier the Mädeler-Gabel (2637 m.) and the Hoch Vogel (2588 m.) rise. The Bavarian Alps, at whose northern termination several lakes, such as those of Kochel and Tegern, are situated, extend between the Inn and the Lech, and are torn in a peculiar way by the Loisach and the Isar. The west-eastern chains are numerous. The most remarkable of them in the territory of the German empire extend on both sides of the Isar towards the frontier of Tyrol; to the W., the Wetterstein Mountains, whose western termination, the Zug Spitze, is the highest peak of the realm (2957 m.); to the E., the Karhwandel Mountains, which are followed into Tyrol by three parallel chains. Of the border-chains towards the northern plateau, the Benedikten Wand is especially noteworthy; it extends between the Kochel Lake and the Isar, and to the S. W. of it the Walchen Lake is situated, entirely encircled by the Alps. The Salzburger Alps, E. of the Inn, and within the boundaries of the German empire (Bavaria), are most remarkable at Reichenhall and Berchtesgaden, which two places are situated in the vicinity of Salzburg, among magnificent alpine surroundings. To the S. of Berchtesgaden, which lies 580 m. above the level of the sea, the King's Lake, the most beautiful lake of the empire, is situated, 604 m. above the sea, in the centre of a magnificent landscape, in which arise to the W. the Watzmann (2740 m.) and to the S., but within the Austrian frontier, the Stone Sea (2728 m.) and the mountain of Perpetual Snow (2938 m.). Those parts of the Alps which belong to Germany consist of Bunter sandstone, lime, lias, new red sandstone, Jurassic, chalk, and oligoclase. The Alps, lifted by tremendous forces from their originally horizontal position, pressed forward, and sometimes wholly overturned, rise often through perpendicular walls or steep precipices into jagged peaks covered with eternal snow or glaciers. The complete upsetting of the different strata, and the great difference between the Alps and the other mountains of Germany, make it very difficult to arrive at a correct view of their formation. But the principal cause of the immense disturbances in the Alps was no doubt the frequent great sinkings, which even affected the northern plateau. Bunter sandstone and lime are not found in large quantities; red sandstone forms the principal mass, and to it belong the dolomite and rock-salt formations of Berchtesgaden. Lias forms the chief element of the Algauer Alps, at least of the Bavarian part of them. Jurassic and chalk deposits are not very prominent. In the older Tertiary formations some iron ore is found; the Rindalpen Horn at Immenstadt belongs to the oligoclase formation.

Along the northern terminations of the Alps the Suabian-Bavarian plateau extends; to the S. W. it stretches beyond the boundaries of the empire into Switzerland, as far as the Lake of Geneva, and to the E., in Austria, it connects with the plain of the March and the Hungarian lowlands. It is broadest (80.8 E. m.) between Rosenheim, where the Inn issues from the Alps, and Ratisbon, where the Danube pushes farthest to the N. The southern side of the plateau is bounded by a belt of Alps belonging to the older Tertiary formation; the north-western, from the Lake of Geneva to Regensburg (in which region the Rhine-fall at Schaffhausen is found), by Jurassic mountains, and the north-eastern by the Bavarian and Bohemian mountains, consisting of granite and gneiss. Strata of the later Tertiary formation form the foundations of the plateau, on which diluvial strata have been deposited, and through these the volcanic cones of Hegau, consisting mostly of basalt, rise to the E. of Schaffhausen. A fine hilly landscape stretches along the feet of the Alps, dotted over with beautiful lakes (Ammer, Würm, and Chiem in Bavaria); to the S. of the Ammer Lake the Hohe Peissenberg (975 m.) offers a splendid prospect. The river-valleys of the plateau have first a northern and then a north-eastern direction. Otherwise the plateau is uniform, and even more monotonous than many parts of the North German lowland. Large, partly uncultivated swamps are found in several places; that below Munich, which stands 519 m. above the sea; the Da-

chau Swamp extends on the left, and the Erdinger Swamp on the right bank of the Isar; and between Ulm and Ingolstadt the intricate Danube swamps. The fertility of the plateau is very small in the centre, around Munich, where large forests abound, but very great between the Inn and the Danube, especially at Straubing, the granary of Bavaria. Those parts of the plateau which belong to Würtemberg are more varied with hills and vales, but even there the fertility of the soil is not great. The climate is generally rough, and vine-cultivation succeeds only on the opposite side of the plateau, at the Lake of Constance, which communicates with the vine-region of the Rhine, and along the Danube below Regensburg, which communicates with the vine-regions of Austria and Hungary.

The mountains of Central Germany are separated from the Alps by the Suabian-Bavarian plateau, but connected with the Carpathian Mountains between the sources of the Oder and the Vistula. They consist of three systems: the Rhenish-Westphalian slate mountains, or the Batavian system; the Rhenish system; and the Hercynian or Sudetic system. The Jura Mountains do not belong to any of these systems. (1) The Rhenish-Westphalian slate mountains, or the Batavian system, form a plateau of no considerable height, but in many ways torn by deep river-valleys. It occupies parts of Rhenish Prussia, Westphalia, and Hesse-Nassau, is traversed by the Rhine, which between Bingen and Bonn forms a deep and often very narrow valley. It consists chiefly of strata belonging to the Devonian formation, which, like those of the smaller hill-ranges in the vicinity, show an inclination from S. W. to N. E. To the W. of the Rhine the Moselle forms in the slate mountains a deep and very winding valley between Trier and Coblenz, separating Hunsrück from Eifel. S. of the Moselle, Hunsrück extends to the Saar, and contains some hill-ranges, such as Hochwald, with Erbeskopt (814 m.), the highest top of the slate mountains on the left side of the Rhine. The southern boundaries of the system are designated by the coal-hills of Saarbrück, at the southernmost point of Rhenish Prussia, and the beautiful group of the Donners Berg (689 m.) in Rhenish Bavaria. N. of the Moselle, the Eifel forms a plateau without hill-ranges. Especially the eastern part abounds in volcanic products, such as lava and mineral waters, and in extinct volcanoes, craters, and cones of basalt. The western part is very rough and barren. The highest point of Eifel is the Hohe Acht (760 m.). The valley of the Ahr is productive of wine, the districts around the Laacher Lake quite picturesque, and the millstone quarries at Niedermendig noteworthy. The north-western part of Eifel, the Hohe Venn (695 m.), situated S. of Aix-la-Chapelle, is entirely bare, and constitutes the most inhospitable region of the empire. Rich collieries are situated at its northern termination, between Aix-la-Chapelle and Eschweiler. The Ardennes in Belgium form the western part of the slate mountains, but may be left out of consideration here. On the eastern side of the Rhine the hill-ranges of Hunsrück are continued by those of Taunus. They are rich in forests and mineral springs, slope rather abruptly to the S., towards the lowland of the upper Rhine, and to the E., towards the Wetterau, but rise in Great Feld Berg to the height of 881 m., and are celebrated for their magnificent vineyards, especially along the foot of the western part of them, the so-called Rhinegau, at Rüdesheim, Johannisberg, and Assmannshausen. To the N., Taunus slopes gently towards the fruitful valley of the Lahn, on whose northern side the plateau of Westerwald (657 m.) extends, which is strewn all over with basalt, and is rich in forests, iron, and brown-coal, and which sends forth at Königswinter the volcanic Sieben Gebirge as an outpost towards the Rhine and the lowland. Still farther to the N. the mountains of the Sauerland, differently named in their different parts, and traversed by the Lenne and the Ruhr, cover the southern part of Westphalia and extend into the neighboring districts. They are very rough in the plateau of Winterberg, around the sources of the Ruhr, the highest point, Astenberg (842 m.), being entirely barren. Along their northern boundary, bordering on the lowland, Haarstrang extends, connecting to the W. with the coal deposits along the Ruhr. (2) The Rhenish system shows an inclination from S. S. W. to N. N. E., and follows the course of the Rhine from Bâle to Mainz, whence it continues in the same direction, but to the E. of the slate mountains, to the Weser. With its two highest branches, the Vosges and the Black Forest, it encloses the low plain of the upper Rhine, which stretches on both sides of this river from Bâle to Mainz, and which must be considered as the finest region of Germany, on account of the fertility of the soil, the mild climate, the excellent fruit, and the superior wine. The Rhenish system consists in its middle chains and plateaus of sandstone; in its lower parts, which to the E. and to the W. extend towards the Jura Mountains, of lime and red sandstone; in its highest parts, in the S., as also in some points on the border of the low plain of the upper Rhine, of granite and gneiss; and in the northern parts, belonging to the region of the red sandstone, heavy masses of basalt are found. Although the Vosges in Alsace-Lorraine and France, and the Black Forest in Baden and Würtemberg, are separated by the low plain of the upper Rhine, in which the insulated volcanic mountain, the Kaiserstuhl, rises, yet they show many similarities: the same height—Sulzer Belchen in the Vosges is 1432 m., Feld Berg in the Black Forest, 1494 m.; the same abrupt descent towards the plain in the regions of the older formation, and the same gentle declivity in those of the later; the same extension to the S.—the Vosges to the gap at Belfort, the Black Forest to the Rhine at Waldshut; the same construction—granite, gneiss, and Devonian strata in the higher parts, though so that the latter are more prominent in the Black Forest, the former in the Vosges. In both groups small streams descend on the steep side, while large rivers have their sources on the opposite sides, the Moselle in the Vosges in France, and the Neckar and the Danube in the Black Forest. Also the beauties of nature, the traditions, and the ruins are similar, though they certainly are much richer in the Vosges. But the Vosges form a ridge on the watershed between the Moselle and the Ill, and the Black Forest has none; and while the Black Forest entirely disappears between Carlsruhe and Pfordsheim, the Vosges reach to the latitude of Strasburg in their full height, and continue then through lower formations of red sandstone into Rhenish Bavaria, where at Kaiserslauten a connection takes place with the slate mountains. To the E. of the low plain a small range of hills connects the Black Forest with Oden Wald, which, chiefly extending between the Neckar and the Main, encircles Heidelberg, and is separated from Spessart by the Main. Odenwald and Spessart are also very similar, being of the same height (about 620 m.) and same formation, sandstone prevailing, with granite and gneiss on the western side. On the northern sandstone plateau of the Hesse, Vogels Berg arises between Giessen and Hanau, consisting mostly of basalt, covered with forests and 772 m. high (the Taufstein). Along its western slope runs the railway from Frankfort to Bremen; along its eastern slope, that from Frankfort to Berlin. Just E. of Vogels Berg lies the High Rhön (Abtsrhön in Prussia, 950 m.; Kreuzberg in Bavaria, 930 m.), in which group basalt is very prominent. The higher parts, which are treeless and occupied by moorland and grass-fields, are covered during the winter with heavy snow-masses, and resemble the northern countries more than any other part of the empire. Near the point where the Fulda and the Werra unite and form the Weser are the Habichtswald; E. of Cassel, the Meisner; near the Werra, the Sollinger Wald, with its beautiful forests on the right side of the Weser; the Egge and the rather barren plateau of Paderborn W. of the Weser. E. of the sandstone formation follows, from Heidelberg to Nuremberg, a formation of shell-limestone and red sandstone, the Suabian-Franconian terraces, the most remarkable points of which are the Franconian Hills, between the Danube and the Rhine (Wörnitz and Tauber), the Steigerwald, and the beautiful Main valley in Lower Franconia. This region of terraces extends as far as the Jura Mountains, which rise very abruptly from it, while on the other side they slope gently down towards the Suabian-Bavarian plateau. The German Jura is a continuation of the Swiss Jura, but differs very much from it. It has not those parallel edges which characterize the Swiss Jura; it rises in elevated plats, traversed by valleys. At some elevations reigns a general scarcity of water, as the water sinks very rapidly through the Jurassic limestone, and forms rich springs at the foot of the mountains and in the deep valleys. Numerous caves are found, especially in Würtemberg and Franconia, among which that at Muggendorf is famous for the remains it contains of extinct animals. The German Jura is divided into the Suabian and Franconian Jura by a fertile basin, the Nordlinger Ries. The former, situated mostly in Würtemberg, is 1012 m. high, and runs from S. W. to N. E.; the latter, situated between the Danube and the Main, extends into the region of the Fichtel Gebirge, has from Coburg a direction S. and N., and is much lower. To the W. of the Rhine, beyond the shell-lime and red sandstone formation in Lorraine, on the Moselle, another Jura chain rises at Metz, which in Germany is very rich in iron ore, but which chiefly is situated in France. (3) The Hercynian or Sudetic system comprises the north eastern part of the mountains of Central Germany, and has a general direction from S. E. to N. W. It consists of two well marked mountain-lines. The southern contains Böhmer Wald, Fichtel Gebirge, Thüringer Wald, and Teutoburger Wald; the northern, the mountains of Silesia, the Harz, and the Weser Mountains. The ground between the two lines is occupied by the mountain regions of Bohemia and Mo-

ravia, the Erz Gebirge, and the terraces of Thuringia. The largest part of this system, from the sources of the Danube and the Oder to the Thüringer Wald, consists chiefly of granite and gneiss; in the north-western parts influences from the other systems are apparent. The Böhmer Wald forms the boundary between Bohemia and Bavaria. To the S. E. its offshoots reach the Danube between Passau and Linz. It is chiefly composed of gneiss and granite, and consists of several chains, the principal one of which is on the frontier between the two countries, and is, like the chains belonging to Bohemia, entirely covered with forests. The highest points are in the principal chain, the Great Arber (1476 m.) and the Great Rachel (1458 m.); in the Bohemian chain, the Kubany (1357 m.), situated in a wilderness of forests; and in the treeless Bavarian chains on the Danube, the Dreitannen Riegel (1216 m.). On the Bavarian side the Böhmer Wald proper terminates in a deep basin, through which the railway runs from Regensburg to Prague. The Oberpfälzerwald forms the continuation to the N. W., and extends to the plain of Naab Wondreb; it is, in Bohemia, called the Czerkow Mountains. Beyond these rises the Fichtel Gebirge, forming the watershed between the Danube, Elbe, and Rhine. It forms the centre of the German mountains, those of German Austria included, and is about 280 E. miles distant from the beginning of the delta of the Rhine, the mouths of the Weser and Oder, and the cities of Presburg, Trent, Bâle, and Strasburg. From it the Eger flows eastward, and the Saale northward, both to the Elbe; the Main westward to the Rhine, and the Naab southward to the Danube. The highest points are the Schnee Berg (1063 m.) and the Ochsen Kopf (1026 m.). Granite and gneiss form the principal rocks of this group. Gneiss is found especially on the plateau of Frankenwald, which leads from Fichtel Gebirge to the Thüringer Wald, and is covered with magnificent forests. The Thüringer Wald, so important as the boundary which separates the Franconians in the S. from the Thuringians in the N., forms to the S. E. a broad plateau, but to the N. W. a real edge, terminating in a cone at Eisenach on the Werra. In the broader south-eastern part the rocks of the Silurian and Devonian formations are most prominent. The north-western part, beginning at the source of the Werra, consists of porphyry and different kinds of crystalline rocks. The highest points are the Great Beerberg (984 m.) and the Schnee-Kopf (978 m.), both situated on the Schmücke; farther to the N. W., the Inselsberg (914 m.), and at Eisenach the celebrated Wartburg. To the N. of the Thüringer Wald the Thuringian terraces extend to the Harz, the plateau of Eichsfeld forming the watershed between the Weser and the Elbe. The Harz is a group of mountains 56 E. miles long, situated between the Leine and Saale, and sloping abruptly to the N. towards the lowland. Its most beautiful points are found along its northern border, the Selke Valley, Bode Valley, Viktors Höhe, Ilse Valley, and the Brocken, the highest point (1141 m.), from which the plateau of the upper Harz stretches to the W., and that of the lower Harz to the E. The principal rocks of the Harz, along whose northern border chalk formations have assumed wonderful forms, are granite chiefly in Brocken, Silurian rocks in the upper Harz, red sandstone, melaphyre, and, as frame of the whole, zechstein. The north-western part of the Hercynian system, traversed by the Leine and the Weser, and extending nearly to the Ems, consists of numerous ranges, in which are found coal, Jurassic rocks, and chalk. The Teutoburger Wald, wholly to the W. of the Weser, and the Weser Mountains, with the gates of the Weser, beyond Minden, run in the same direction as the two principal lines of the system. Between the Weser and the Leine, Süntel, Deister, and Bückeberg are situated, containing considerable coal deposits; in the N. W., near the Ems, lies the small but important coal mountain of Ibbenbühren. None of all these ranges reaches the height of 500 m. From the Fichtel Gebirge, the Erz Gebirge stretches to the N. E., forming the boundary between Saxony and Bohemia. It is steep towards the valley of the Eger, but slopes gently towards the low plain in the N. along the Mulde. Keil Berg (1235 m.) and Fichtel Berg (1213 m.) are the highest points. The prevailing rocks are gneiss, granite, mica, and clay-slate, to which must be added porphyry and red sandstone, with the cave formations at Zwickau, Chemnitz, and Dresden (Potschappel). At the Elbe above Pirna we meet the sandstone mountains of the Elbe, which, under the name of Saxon Switzerland, have acquired a fame not quite deserved. They are continued to the E. along the boundary of Saxony and Bohemia by the Lausitzer mountains, while to the N. the granite plateau of Upper Lausitz, on which the Spree originates, extends from Dresden to Görlitz. E. of the Lausitzer mountains the Silesian mountains begin, which extend in a south-eastern direction, partly in Silesia, partly in Bohemia and Moravia, to the large basin of the upper Oder, through which the railway leads from Upper Silesia to Vienna, and beyond which the Carpathians begin. Within these boundaries the Silesian mountains are divided twice by cuts running from S. to N., once at the upper Bober, and once at Glatz, through which two depressions the railroads of Silesia connect with those of Austria. In the basin of the upper Bober rises the Riesen Gebirge, on the boundary between Silesia and Bohemia. This group contains the highest mountains of Central Germany, well-marked ridges, covered with forests and beautiful valleys. The highest point is Schneekoppe (1665 m.). Like their western continuation, the Isergebirge, they consist mostly of granite on the Silesian side, and of mica in Bohemia and the Schneekoppe. The beautiful Hirschberger Valley lies at their northern foot. The melaphyre and porphyry formations of the coal mountains of Lower Silesia at Waldenburg, lie to the E. of the upper Bober, and form the transition to the mountain-system of Glatz. This surrounds the kettle-shaped valley of Upper Glatz, and consists of several mountain-ranges, of which the Heuscheuer in the W., with its freestone, belongs to the chalk formation, while the Eulen Gebirge in the N. and on the border of the plain, as well as the Glatzer Schneegebirge (Great Schnee Berg, 1412 m.), consists mostly of gneiss. To the S. E. the Sudetic Mountains (Altvater, 1440 m.) are situated, wholly within the boundaries of Austria.

The North German lowland is only a small part of the great European lowland, which occupies almost the whole of Eastern Europe, and to the W. reaches as far as the Strait of Dover. In Germany that part of the lowland which lies to the W. of the Elbe differs very much from that which lies to the E. Fertile marshes extend along the North Sea, also on the eastern side of the Elbe, along the whole western coast of Sleswick-Holstein. They generally lie so low that they must be protected against the sea and the rivers by dykes. Here, in the western part of the German lowland, large swamps alternate with sand-fields, and real hill-ranges do not appear to any extent, except in the vicinity of the Elbe. The Lüneburger Heide, with their brown heath, can support only coarse sheep and bees. In the eastern part, on the contrary, hill-ranges appear, and stretch eastward to the Ural Mountains. Of special interest is the Baltic-Uralic ridge, which begins in Jutland, curves around the Baltic through Sleswick-Holstein, Mecklenburg, Brandenburg, Pomerania, and Prussia, is traversed by the Oder and the Vistula, and forms in Russia a most important watershed. It consists of a broad, undulating extension, is rich in lakes, and rises in Germany, in the province of Prussia, thrice to the height of 300 m. Another ridge, the Mark-Silesian, stretches through Brandenburg and Silesia from N. W. to S. E., and communicates in Poland with the Polish mountains. Between these two ridges large lowlands extend, especially in Brandenburg, along the Havel, the Spree, and the Oder, and these lowlands have made it easy to establish a communication by canals between the Elbe, Oder, and Vistula. Lowlands and beautiful hill-ranges are also found along the Baltic; as, for instance, on the island of Rügen. Dunes also appear; as, for instance, on the land-strip which separates the Kurische Haff from the Baltic, where they are more extensive than in any other place in Europe. The foundation of the whole North German lowland, at least to the E. of the Elbe, belongs to the Tertiary formation, which, however, is covered on the elevations with diluvial, and in the depressions with alluvial formations. The older rocks appear very seldom on the surface, except on Rügen and in Mecklenburg; chalk and even Jurassic rocks occur in Pomerania; shell-lime at Rüdersdorf, near Berlin; gypsum and extensive rock-salt deposits at Segeberg in Sleswick-Holstein, Sperenberg in Brandenburg, Inowraclau in Posen, and in Hanover. Also other rocks are found along the mountain-land; as, for instance, Devonian at Magdeburg, to the W. of the Elbe; granite and serpentine in the insulated Zobten (728 m.), near Breslau in Silesia; and large coal deposits appear in Upper Silesia, to the E. of the Oder, in spurs of the Carpathians.

Hydrography.—The German empire borders on two seas, the North Sea and the Baltic. In the North Sea the usual tide rises 3, the highest spring-flood 8, mètres. A number of islands are scattered along the coast from the Netherlands to Jutland, among which Borkum, Norderney, and Sylt belong to Germany. The sea between these islands and the mainland is called the Watten Sea, but in many places it is entirely dry at low tide. The Gulfs of Dollart and Jade cut deeply into the mainland; also the mouths of the Weser, Elbe, and Eider expand into a sort of gulfs. The Baltic, which has no tides, forms long, narrow, and deep gulfs in Sleswick-Holstein (Flensburg, Kiel). A remarkable feature are the Haffs, large fresh-water lakes or estuaries of rivers. The Pomeranian Haff in Pomerania is separated from the Baltic by the islands of Usedom and Wollin. In Prussia the Frische Haff, at the mouths of the

Vistula and the Pregel, and the Kurische Haff, at the mouth of the Memel, are separated from the Baltic by narrow land-strips covered with dunes. The German empire owns parts of seven river-valleys and three large coast-streams. Of the latter, the Pregel flows to the Baltic, and the Eider and Ems to the North Sea; of the former, the Memel, Vistula, and Oder flow to the Baltic, the Elbe, Weser, and Rhine to the North Sea, and the Danube to the Black Sea. Of all these rivers, the Weser is the only one which belongs entirely to the German empire—of the Elbe and Oder, the largest part; of the Rhine, the larger half. The Memel (in Russia called Niemen) flows through the north-eastern corner of the empire, and divides into two branches, the Russ and the Gilge, both of which fall into the Kurische Haff. It is 499 m. long, and connects with the Pregel by the Gilge and several canals. The Pregel, the principal river of East Prussia, is formed by the Inster, Pissa, and Angerapp, receives the Alle, sends the Deime to the Kurische Haff, and passes through the Frische Haff to the Baltic. The Vistula (652 E. miles) rises in Austrian Silesia in the Carpathians, and belongs, in a small part of its upper course, to Silesia; it then traverses Galicia and Poland in a great curve, and enters Prussia above Thorn, where in the fertile lowland it divides into several branches. Two of these branches, among which is the Nogat, flow to the Frische Haff—two directly to the Baltic, in the vicinity of Danzic. Its largest feeder in Poland is the Narew, with the Bug; its affluents in Prussia—the Drewenz from the right and the Brahe from the left—are less important, but they have a considerable fall, and form a system of canals, among which the Elbing-Oberländische in East Prussia leads from the Drewenz to the Elbing, which falls into the Frische Haff beside the Nogat, while the Bromberger Canal connects the Brahe with the Netze, an affluent of the Oder. Among the coast rivers of Pomerania may be mentioned the Stolpe, Wipper, Persante, and Rega. The Oder (559 E. miles long) has its sources in Moravia, flows through Silesia, Brandenburg, and Pomerania, becomes navigable in Upper Silesia, forms the Pomeranian Haff, and falls into the Baltic through three branches—the Peene, Swine, and Dievenow. The only important among its affluents from the right side is the Warthe (442 E. miles), which receives from the right the Netze (211 E. miles), which again communicates with the Vistula through the Bromberger Canal. To the left it receives the Glatzer Neisse, the Bober, and the Lausitzer Neisse, which all originate in the Silesian Mountains, but contain very little water during the summer; in the Pomeranian plain it receives the Peene. The Oder is in Brandenburg connected with the Elbe by the Fr. Wilhelm Canal, which leads to the Spree, and the Finow Canal, which leads to the Havel. Between the Oder and the Elbe is a long line of coast land which is cut at Rostock by the Warnow and at Lübeck by the Trave. The Elbe (721 E. miles long) rises in Bohemia in the Riesen Gebirge; flows in a curve through Northern Bohemia, where it receives the Moldau and the Eger; enters the German empire through the sandstone mountains of the Elbe and the lowland at Dresden; traverses the kingdom and the province of Saxony, Anhalt, Hanover, Mecklenburg, and Sleswick Holstein, and falls into the North Sea 81 E. m. below Hamburg, having a breadth of 11 E. m. at its mouth. It is decidedly the most important river of Northern Germany; it opens a navigable water-road far into Bohemia; and through navigable affluents and canals it communicates with all the rivers of the eastern part of the country. Near its mouth stands the most important port of Germany, Hamburg. On the right, the Elbe receives, besides the Elde in Mecklenburg, the Havel (221 E. m.), through whose affluent, the Spree, on which Berlin stands, it connects by canals with the Oder. On the left it receives the Mulde from the Erz Gebirge, the Saale (226 E. m.), which gathers a part of the waters from the Fichtel Gebirge and the Thüringer Wald through the Ilm, on which Weimar stands; from the Thuringian terraces through the Unstrut; from the Harz through the Bode; and from the Erz Gebirge through the White Elster, on which Leipzig stands. The Weser (267 E. m.) is formed by the Werra from Thüringer Wald and the Fulda from the Hohe Rhön; receives on the right the Aller, through the Ocker, and Leine, on the left the Hunte, passes by Bremen, and falls into the North Sea below Bremer Hafen, having a breadth of 7 E. m. at its mouth. The Ems flows through sand fields and moorlands, mostly uncultivated, in Westphalia and Hanover, and falls into the Dollart. The Rhine (948 E. m.), the principal water-road in Western Germany, and from Bâle to the boundaries of the Netherlands wholly within German territory, originates from several sources in the Swiss Alps, and divides in the Netherlands into numerous branches. That part of the Rhine which lies between the Lake of Constance and Bâle belongs partly to Switzerland and partly to Germany. From Bâle to Mainz the Rhine traverses the plain of the upper Rhine; from Bingen to Bonn it breaks through the slate mountains; and at Bonn, opposite the Sieben Gebirge, it enters into the North German lowland. On the right the Rhine receives first several small streams from the Black Forest, among which are the Kinzig and the Murg; then the Neckar (247 E. m.), the principal river of Würtemberg, originating on the eastern side of the Black Forest, and receiving from the left the Enz, and from the right the Kocher and the Jagst; and at last the Main (308 E. m.), which is formed by the White Main from the Fichtel Gebirge, and the Red Main from the Franconian Jura, and which flows through Franconia with a very winding course, joining the Rhine in the northern part of the plain of the upper Rhine, opposite Mainz, and receiving from the left the Regnitz and the Tauber—from the right the Franconian Saale; the Ludwigs Canal connects the Regnitz at Bamberg with the Altmühl, an affluent of the Danube. Other affluents of the Rhine on its right are the Lahn, Sieg, Ruhr, and Lippe. On its left it receives the Ill near Strasburg, the Nahe at Bingen, and at Coblenz the Moselle (314 E. m.), which rises on the French side of the Vosges, traverses Metz, and receives on the right side the Saar, which also comes from the Vosges. At Strasburg the Rhine-Rhône and the Rhine-Marne canals connect the Rhine and the Ill with the Rhône and the Marne. The Danube (1771 E. m.), the principal river of Southern Germany, is formed at Donaueschingen by the Brege and the Brigach, which both rise in the Black Forest. After breaking through the Jura, it flows along the northern border of the Suabian-Bavarian plateau, through Würtemberg and Bavaria, and enters Austria below Passau. It becomes navigable at Ulm, and receives from the left the Altmühl, the Naab, and the Regen, and from the right the Iller, Lech, Isar, and Inn. The last rises in Switzerland, is 317 E. m. long, the principal stream of the Northern Tyrol, and joins the Danube at Passau, after receiving from the right the Salza.

There are many lakes in Germany, but no great ones. Most of them are situated in the vicinity of the Alps and on the Baltic-Uralic ridge or near the Baltic. In the S. the lakes of Chiem, Würm, and Ammer are the most important; King's Lake is the most beautiful; of the Lake of Constance, parts belong to Austria and to Switzerland. In the N. the most noticeable lakes are Müritz and Schwerin in Mecklenburg, Leba in Pomerania, Geserich on the boundary between East and West Prussia, and Mauer, Löwentin, and Spirding in East Prussia.

Climate.—The German empire is situated in the happy temperate zone. Only a few peaks of the Alps on the southern boundary of Bavaria rise into the snow-region. In the other mountains there are also a few points where the snow may last into the summer, and sometimes the whole year round. But the whole country lies in the region in which the warm and moist winds still have power enough to resist the arctic currents, and in which rain may occur at every season. The lowest annual rainfall, between 12 and 16 inches, has been observed in the centre of the Silesian plain at Polnisch-Wartenberg and Breslau, at Würzburg on the Main, at Sigmaringen on the Danube, at Dürkheim in Rhenish Bavaria, and at Güstrow in Mecklenburg. The largest rainfall has been observed on the North Sea (27–35 in.), and in the mountains—in the Riesen Gebirge, 43; in the upper Harz, 59 in.; in the slate mountains, 40; in the Alps and the Black Forest, 55; and in the Vosges, 43 in. The annual average heat of Germany, exclusive of the mountains, varies from 43° to 51° F. Along the Baltic coast, or in the vicinity of it, the heat rises from 43° F. in the north-eastern part of East Prussia to 47° F. at Kiel, while the North German land-ridge, situated farther back, shows not 43° F. in the province of Prussia, and not 45° in the more elevated portions farther W. The highest annual average heat is found in the plain of the upper Rhine, where it slowly increases from Frankfort-on-Main to the Neckar, and then again decreases towards the S., according to the elevation. On the Main, at Strasburg and Bâle, the annual average heat is a little below 50°; on the lower Neckar and in the immediate surroundings on both sides of the Rhine, more than 51°.

The vine and the maize reach in Germany their northernmost boundary. The former demands, in order to be cultivated with success, an annual average heat of at least 7° R., and the latter even somewhat more. Thus, the maize still ripens in the south-western parts of the country, but in the districts around the Havel, where in Potsdam table-grapes are still produced, it is cultivated only as fodder. On the Rhine the vine stops at Bonn—on the Saale a little below the mouth of the Unstrut. The chestnut has its northernmost boundary between Coblenz and Cologne, but it is still found at Wernigerode in the Harz. The peach ripens still in the open air in Rhenish Prussia, but in Brandenburg only under shelter; the walnut, on the contrary, succeeds

even in West Prussia. The flowering of fruit trees takes place at Memel eight days later than at Königsberg, three weeks later than at Berlin, and four weeks later than on the Rhine. The beet-root succeeds well in the fertile regions between the Oder and the Weser, but in East Prussia it contains very little sugar. Of the forest trees, the red beech stops a little S. of Königsberg. The ice lies generally 26 days on the Rhine, 30 on the Weser, 62 on the Elbe, 70 on the Oder, 86 on the Vistula, and 116 on the Memel. Storms are more numerous and violent in the S. than in the N. Heavy earthquakes, such as occur in Southern Europe, have never been observed in Germany.

Although the climate generally is healthy, yet endemics and epidemics occur, such as fevers in the swamp districts and goitre in some mountain-regions; and among epidemics cholera and smallpox. Cholera appeared for the first time in Germany in 1831; from 1831 to 1874, 420,000 persons died by this disease.

Minerals.—The production of gold is very small, 640 pounds yearly; more important is that of silver, which is seldom found pure, but generally mixed with lead and copper ore; 228,000 pounds were produced in 1872, of which 162,553 pounds in Prussia, chiefly in the Harz, and over 62,000 pounds in the kingdom of Saxony, at Freiberg. At Freiberg and at Klausthal in the Harz are mining academies, of which the former is the centre of the whole science of metallurgy and mining. Lead ore to the amount of 2,500,000 cwts. is annually raised, especially at Aix-la-Chapelle, Oppeln, Wiesbaden, in Harz, and at Freiberg. In 1872 the smelting produced 1,160,000 cwts. of lead and litharge, of which 1,080,144 cwts. were in Prussia alone; one-half at Aix-la-Chapelle. About 5,000,000 cwts. of copper ore are annually raised, especially in the zechstein formations at Merseburg in the province of Saxony, in the eastern Harz, and at Arnsberg in Westphalia. The smelting produces annually about 150,000 cwts. of copper. Germany is very rich in iron ore. The most remarkable strata are found in the Jura Mountains, on the left side of the Moselle in Lorraine, connecting with the rich strata in Luxemburg; in the Lower Devonian, on the right side of the Rhine from the Wied, N. of Coblenz, to Siegen in Westphalia; in the Upper Devonian, on the Lahn in Wiesbaden; and in Fichtel Gebirge, Erz Gebirge, Upper Silesia, and Thüringer Wald. The production of iron ore amounts, at present, to more than 90,000,000 cwts. annually, of which, in 1872, 73,427,353 cwts. were produced in Prussia, and about 14,000,000 cwts. in Alsace-Lorraine. The production of pig iron, surpassed only by England and America, amounted in 1872 to about 36,000,000 cwts.—namely, 29,156,704 cwts. in Prussia, 4,441,401 in Alsace-Lorraine, 1,210,597 in Bavaria, and about 1,500,000 in the other states. At least 160,000 men are employed in Germany in the production of iron. More than 7,000,000 cwts. zinc ore (calamine and zinc-blende) are annually raised: calamine (nearly 6,000,000 cwts.) especially at Leuthen in Upper Silesia; zinc-blende in Westphalia and Rhenish Prussia. The production of zinc in 1872 amounted to 1,163,779 cwts. Manganese ore is chiefly raised at Wiesbaden on the Lahn and in the Thüringer Wald. Bismuth is found in the kingdom of Saxony; antimony in Thuringia and Westphalia; cobalt in the kingdom of Saxony and Hesse-Nassau; nickel and tin in Saxony; quicksilver in Westphalia, but only in small quantities. Coal is the most important mineral which Germany possesses. It is found in seven large and several minor deposits. Of the large deposits, five belong to Prussia, and two to the kingdom of Saxony. The largest of all coal deposits in Germany is that in Upper Silesia. It stretches into Austria and Russia, but is most powerfully developed in Germany in the districts of Tarnowitz, Beuthen, and Zabreg, from which it extends into the neighboring counties of Pless, Rybnik, Tost-Gleiwitz, and Ratibor, comprising an area of 532 E. sq. miles and reaching the surface on an area of 213–234 E. sq. miles. The working of this coal-field began in 1784; at the beginning of this century the production amounted to 400,000 cwts., in 1822 to 4,000,000, in 1864 to 75,000,000, in 1873 to 156,786,309 cwts. The second great coal deposit is situated in Lower Silesia, in the district of Waldenburg, but some of its strata extend into the county of Glatz, and through the district of Landshut into Bohemia. The production of this field amounted in 1787 to 800,000 cwts., in 1838 to 4,000,000, in 1864 to 21,000,000, and in 1872 to 42,351,118 cwts. The third great coal-field in Prussia stretches along the northern border of the slate mountains on the Ruhr, especially in the districts of Dortmund, Bochum, and Hagen in Westphalia, and Essen and Duisburg in Rhenish Prussia. It is 51 E. m. long, and extends on the left side of the Rhine below very recent layers of earth; that part which reaches the surface comprises 170 E. sq. miles, the whole 340. The production of the Westphalian division amounted in 1740 to 600,000 cwts., in 1800 to 4,000,000, in 1854 to 24,000,000, in 1864 to 76,500,000, and in 1872 to 175,710,249 cwts.; that of the Rhenish Prussian division amounted in 1827 to 3,500,000, in 1854 to 27,000,000, in 1864 to 65,500,000, and in 1872 to 105,604,763 cwts. About 200,000,000 cwts. are annually shipped from these coal-fields by rail, and 30,000,000 to 40,000,000 by the Rhine. The fourth coal-field is situated in two separate basins near Aix-la-Chapelle, to the N. of the Hohe Venn; they yielded 20,826,285 cwts. in 1872. The fifth coal-field, on the Saar, at the southern foot of the slate mountains, extends into Bavaria and Alsace-Lorraine; the productions of the Prussian part amounted in 1815 to 2,000,000, in 1854 to 24,000,000, in 1864 to 56,000,000, and in 1872 to 84,444,680 cwts., besides 3,577,278 cwts. in Bavaria and 5,804,110 cwts. in Alsace-Lorraine. Several other minor coal-fields are found in Prussia: at Ibbenbühren in Westphalia (3,074,373 cwts. in 1872), in Hanover and Hesse-Nassau (7,720,896 cwts. in 1872), and at Wettin on the Saale, N. of Halle. Of the two coal-basins in the kingdom of Saxony, the one is situated at Potschappel, near Dresden; the other, and more important, at Zwickau and Chemnitz. They yielded in 1845, 9,000,000, in 1858, 24,000,000, and in 1872, 58,925,228 cwts. Minor coal-fields are worked on the southern side of the Thüringer Wald, at Neuhaus in Meiningen, and at Rockhing in Bavaria, in the Black Forest in Baden, and in the Tertiary formations in Bavaria at the foot of the Alps. The total production of coal in Germany in 1872 was 666,000,000 cwts.—namely, in Prussia 590,475,512; in Saxony 58,925,229; in Bavaria 8,248,237; in Alsace-Lorraine 5,840,511; and in the other states, 2,600,000 cwts. In the same year 40,161,802 cwts. of coal and coke were imported to the German Zollverein; 81,670,481 cwts. exported. Coal is imported from England for the coast-regions, especially to those E. of the Elbe, and exported to Russia, Austria, the Netherlands, and France. The deposits of brown coal are still more extensive, and comprise a western and an eastern division. The western division consists of the basins of the lower Rhine, at the northern border of the slate mountains, and especially to the W. of Bonn and Cologne. The eastern division extends from the Thuringian terraces to the coast-regions of East Prussia, and is strongly developed, especially in the provinces of Saxony and Brandenburg. In 1872, 182,000,000 cwts. of brown coal were produced in Germany—namely, 148,992,730 cwts. in Prussia; 12,028,966 in Saxony; 9,000,000 in Anhalt; 4,500,000 in Thuringia, and 4,500,000 in Brunswick. In 1873, 29,781,435 cwts. were imported into the German Zollverein, especially from Bohemia; 381,393 cwts. were exported. Peat is raised in the extensive moorlands of the North German lowland and the Bavarian plateau. Amber is found on the coast of the Baltic, especially from Pillau to Memel.

Of precious stones only a few inferior species are found, such as the topaz in the kingdom of Saxony, the chrysoprase in Silesia, the agate in Silesia, and different species of rock-crystals. For larger articles of art, serpentine, alabaster, marble of various kinds are used; also the erratic blocks of the North German lowland and the granite from Weissenstadt in the Fichtel Gebirge. Gypsum is found in the zechstein formations, and in insulated spots in the North German lowland; it is of great importance as a fertilizer. Phosphorite, likewise used as a fertilizer, is raised at Wiesbaden; fluor-spar and heavy spar in the mountains of Central Germany; magnesite in Silesia. Limestone is found in many different deposits; building-stone and free-stone everywhere. The sandstone of Saxon Switzerland, Sollinger Wald, and the Weser Mountains is sent even to the coast-regions. About 1,500,000,000 of brick and tiles are annually made of the clay and loam of the lowlands; fireproof brick is made of the clay of the coal formation. Millstones are raised in Eifel at Niedermendig; lithographic stones at Solnhofen on the Altmühl in the Franconian Jura; roofing slate in the slate mountains, but especially at Lahnstein and Gräfenthal in Thüringer Wald; table slate and grapholite in Thüringer Wald; chalk on Rügen; graphite in Böhmer Wald; kaolin especially in Thüringer Wald.

The production of salt increases every year. Many of the salines, however, have ceased to be worked since the discovery of the large strata of rock-salt. Among these, that in the Alps of Salzburg has been in operation for a long time. In 1816 the rock-salt layers were reached in Würtemberg by boring, in 1853 those at Stassfurth in the province of Saxony, and since that time many others in different places around the Thüringer Wald and the Harz. In the North German lowland rock-salt layers of immense volume were discovered by boring, in 1867 at Sperenberg in Brandenburg, in 1868 at Segeberg in Sleswick-Holstein, and in 1871 at Inowraclau in Posen. The total production of salt in Germany amounted in 1872 to 20,225,754 cwts.—namely, 9,441,664 in Prussia, 5,923,098 in Anhalt, 1,641,166

in Würtemberg, 942,290 in Bavaria, 716,187 in Alsace-Lorraine, 612,302 in Thuringia, 495,003 in Baden, and 307,809 in Hesse: 7,637,500 cwts. were crystallized salt; 2,796,418 rock-salt; and 9,789,836 potassic salts (only in Anhalt and Prussia). Iron pyrites are very frequently found, especially on the Linne in Westphalia; about 2,500,000 cwts. are annually raised. Alum is found in the brown-coal formations. Germany is very rich in mineral springs. The most important are Baden-Baden in Baden; Kissingen in Bavaria; Wiesbaden, Homburg, Ems, and Nieder-Selters in Hesse-Nassau; Aix-la-Chapelle in Rhenish Prussia; and Pyrmont in Waldeck.

Agriculture.—Of the total area of the German empire, fields and gardens occupy 48.5 per cent. (102,115 E. sq. miles), meadows and pastures 17.7 per cent. (37,227 E. sq. m.), forests 25.3 per cent. (53,109 sq. m.), and waste land 8.5 per cent. (17,944 E. sq. m.). In the Prussian provinces the largest proportions of fields are found in Sleswick-Holstein (64.1), Posen (59.6), Saxony (59.1), Pomerania (54.7), and Silesia (54.0). Forests are most frequent in the interior. Prussia possesses 23.1 per cent., Mecklenburg 13.3; of the Prussian provinces, Sleswick-Holstein possesses 4 per cent., Hanover, Pomerania, Prussia, and Silesia 18–20 per cent. The central and southern parts of the country, in which the mountain-regions are suited for forest cultivation only, possess 30 per cent., Hesse-Nassau, 40 per cent.

The annual average production of the more important kinds of bread-corn is—34,000,000 hectolitres wheat, 15,000,000 hectol. spelt, 94,000,000 hectol. rye, 30,000,000 hectol. barley, 87,000,000 hectol. oats, and 272,000,000 hectol. potatoes, of which in Prussia 19,000,000 hectol. wheat, 69,000,000 hectol. rye, 12,000,000 hectol. barley, 55,000,000 hectol. oats, and 176,000,000 hectol. potatoes. Agriculture stands highest in the Saxon countries, but on account of the greater proportion of fields, Mecklenburg and the Prussian provinces of Sleswick-Holstein, Prussia, Pomerania, Posen, and Silesia are the richest corn-lands. The cultivation of maize is insignificant; peas are found everywhere, the gray only in East Prussia; lupine is much cultivated on the poorer fields in Northern Germany as a fertilizer. The cultivation of fruit trees demands an annual average temperature of 6° R., and thus it can be carried on with success through the whole country with the exception of the more elevated tracts. It has its principal domain, however, in the south-western parts of Germany, especially in the Neckar Valley in Würtemberg, where, in the vicinity of Stuttgart, 15,200 fruit trees may be counted on one square mile. Apples, pears, plums, and cherries are found everywhere; in the S. W. also apricots, peaches, and in very favorable localities even almonds and figs. The vine-cultivation succeeds only in regions which have an annual average temperature of at least 48° F. Thus, the vineyards are found, together with the orchards, in the south-western part of the country, though most excellent wine is produced in Hesse-Nassau, under the shelter of Taunus and the Rheingau Mountains, and on the northern border of the plain of the upper Rhine (Rüdesheim and Johannisberg). The vineyards occupy in Germany an area of 303,900 acres; the production of wine amounts on an average to 3,800,000 hectol. a year; in Prussia, 49,400 acres, 378,000 hectol.; in Bavaria 54,600 acres, 612,000 hectol.; in Würtemberg, 43,800 acres, 414,000 hectol.; in Baden, 49,400 acres, 1,250,000 hectol.; in Alsace-Lorraine, 78,100 acres, 1,250,000 hectol.; in Hesse, 23,400 acres, 322,000 hectol. Vegetables are grown at Erfurt, Bamberg, and near all the large cities. Flowers are cultivated at Berlin, Potsdam, Erfurt, and Quedlinburg. Landscape-gardening is principally carried on at the princely palaces, with which large hot-houses are generally connected. The cultivation of oil-seeds has much decreased, on account of the large importation of petroleum from America, but a considerable quantity is still produced for exportation. Of dyestuffs are produced madder, safflower, etc., especially in the provinces of Silesia and Saxony. The cultivation of flax, which at one time was decreasing on account of the extensive use of cotton, is now increasing. It succeeds very well in mountain-regions of middle elevation, but also in the northern lowland. The best flax is raised at Bielefeld in Westphalia, where hemp is also cultivated. The cultivation of flax and hemp in Germany occupies at least 494,000 acres. Chicory is cultivated in Baden and the province of Saxony (14,800 acres). The beet root, which since 1836 has been of some importance to Germany, is cultivated at present on more than 175,000 acres, especially in the fertile regions of the province of Saxony. From 2,000,000 to 3,000,000 cwts. of beet root were consumed by the sugar factories in 1837, but in 1874 no less than 70,000,000. Since the potato disease made its appearance beet-root has been much used as fodder. The tobacco cultivation is decreasing; it occupies about 50,700 acres, and succeeds best in the sandy loam of the plain of the upper Rhine; 900,000 cwts. are annually produced. The cultivation of hops occupies 62,000 acres: in Bavaria, 37,000 acres; in Würtemberg and Prussia, 9900. The annual production amounts to 375,000 cwts.

Besides the production of wood, the forests of a country have the office of regulating its climate. They are the keepers of the moisture, and the stand of the water-courses depends on them. The reckless destruction of the forests has had injurious consequences in many parts of the German empire. Thus, the dunes along the ocean, especially on the land-strips which separate the Baltic from the so-called haffs, have increased and covered with sand good agricultural grounds; in many rivers water has become scanty, and they have partly lost their importance for navigation; in others, the laying bare of the mountain-regions has caused frequent inundations. On the Eifel the devastation of the forests impoverished the inhabitants; on the Hohe Venn it turned meadows into swamps, as the absence of trees prevented a sufficient evaporation of the moisture of the ground. In the coast-regions it has been less injurious—with the exception of the increase of the dunes—than in the interior, on account of the moisture of the sea; and, as above mentioned, Germany has much more extensive forests in the interior than on the coast. The forests belonging to the state are generally managed with great care; the same may be said of those belonging to the communes, but not of the private forests. Of 2,017,000 acres of forests in Prussia, 30 per cent. belong to the state, 14 to the communes, 1 to different institutions, and 55 to private persons. In some of the minor principalities more than 50 per cent. belong to the state; in Bavaria 36, in Würtemberg and Saxony about 30. The principal forest trees are the pine, fir, beech, oak, elder, and birch.

The Animal Kingdom.—According to the account taken in 1873, the German empire possesses 3,360,000 horses, 15,800,000 head of horned cattle, 25,200,000 sheep, 7,300,000 swine, and 2,330,000 goats; that is, on 1 geographical square mile 340 horses, 1600 head of horned cattle, 2550 sheep, 740 swine, and 240 goats. Of these, Prussia possesses 2,278,724 horses, 8,612,150 head of horned cattle, 19,624,758 sheep, 4,278,531 swine, and 1,477,335 goats, or on 1 sq. m. 357 horses, 1350 head of horned cattle, 3076 sheep, 670 swine, and 230 goats. The breeding of horses is of importance in East Prussia, Sleswick-Holstein, Mecklenburg, Hanover, Brunswick, and several places in the South German states. For cattle-breeding the marshes along the North Sea (East Friesland, Oldenburg, Sleswick-Holstein) are of great importance; also all the South German states and the western part of the Prussian state, the Rhine region. In 1873, Bavaria possessed 3,066,263 head of horned cattle; Würtemberg, 943,934; Baden, 660,403; the kingdom of Saxony, 647,074. Sheep-breeding has for its purpose the production either of wool or of meat—the former in those parts of the country where there are estates with extensive grounds, in the eastern province of Prussia, and in Mecklenburg; the latter in the more densely-peopled regions. The genuine merino sheep, the Escorial breed, was introduced into Germany in the latter part of the eighteenth century; later on, another breed, also Spanish, the Negretti, spread into Silesia from Bohemia and Moravia; and in 1820 a crossing of these two breeds was effected, and the improved race, the Escorial-Negretti, was introduced generally. Nevertheless, sheep-breeding seems at present to have passed its point of culmination. The number of sheep is decreasing in many districts, on account of the heavy competition with wool imported from Australia and South America. The largest wool-markets in Germany are held at Berlin and Breslau, and in Southern Germany at Kirchheim on the Alb in Würtemberg. In 1873, Bavaria possessed 1,342,190 sheep; Mecklenburg-Schwerin, 1,100,048; the Thuringian states, 599,370; Würtemberg, 575,930; the kingdom of Saxony, 206,850 (in 1834, 604,950). Swine are numerous (1200–1500 on 1 sq. m.) in the province of Saxony, in Thuringia, Hesse, and the northern part of Baden; goats are kept by small householders in the mountain-regions. Of mules and asses there are only a very few. Of useful game, hares are numerous; the alpine hare is found in the eastern part of the country. The red deer does not go farther E. than the province of Prussia; it is raised, together with the fallow deer, all over the country in large parks. The elk is still found in the forest of Ibenhorst at the Kurische Haff. The roe is very frequent, the black roe is scarce, however, and the white roe is extinct since 1845. The chamois is found in the Bavarian Alps; the wild-boar in some of the extensive forests of Northern Germany. The breeding of rabbits is increasing. The marmot is found in some alpine regions; the beaver now and then on the Elbe; the seal at the sea. Among the beasts of prey, the wolf is the most dangerous; in large packs it is found only in the extensive forests to the W. of the Rhine and in the province of Prussia. The fox is very common, also the

marten, weasel, and fitchet. Great care is bestowed on the breeding of poultry; chickens, ducks, and geese are found everywhere; pheasants are also common. Swans are raised in large establishments on the Havel. Partridges are numerous, but grouse rare. Wild-ducks are caught in great number on the islands of the North Sea. Singing birds are protected by law. Fish cultivation, supported by establishments for artificial breeding at Munich in Bavaria and Hüningen in Upper Alsace, is steadily developing. The best fresh-water fishes are the carp, raised in numerous places; the sheat-fish, sometimes weighing 100 pounds, in the Lake of Constance; the bezola, especially found in Pomerania; and the trout in limpid mountain-brooks. Both in fresh and salt water live the perch, eel, pike, and rudd. Among the salt-water fishes the herring and the flounder are the most important; also the salmon in the Rhine, and the sturgeon. Crabs and oysters are consumed in great quantities. Bees are very extensively kept in Silesia; in 1873, Prussia possessed 1,443,764 beehives.

Of the total population, the female sex (50.92 per cent.) exceeds the male (49.08 per cent.); in some regions, however, the male sex exceeds the female; as, for instance, in Westphalia, Rhenish Prussia, and other mining or manufacturing districts. The increase of the population was, up to the year 1840, nearly uniform in all parts of the empire, and showed nearly the same proportions in city and country. But the building of railways and the general increase of manufacturing industry effected a change. Large numbers of the inhabitants left the agricultural districts, especially in the flat lowlands, and gathered in cities or districts favorably situated for manufacturing business. This movement was apparent even before 1867, and after that time it became still more striking. Berlin rose from 200,867 in 1819 to 920,000 in 1874; Breslau from 78,135 to 208,025; Dortmund from 4453 to 55,000; Essen from 4721 to 60,000. The annual average number of births in the German empire is 1,600,000; of deaths, 1,200,000; of marriages, 380,000. Thus, the births annually exceed the deaths by about 400,000. But a great part of this surplus is lost to Germany by emigration: 1,420,464 emigrants were transferred through Bremen from 1832 to 1873; 826,617 through Hamburg from 1836 to 1873; more than 100,000 a year from both places in the years 1854, 1866–69, 1871–73. Of the total number of emigrants, more than 1,700,000 were from the German states. If to this number are added the emigrants before 1832, and those transferred from other places, it appears that in this century more than 2,000,000 Germans have left their native country. Of the births in Prussia, more than 8 per cent. are illegitimate (in Brandenburg, 11.4; in Westphalia, more than 3); in Bavaria, 16 (1835–68, 21–22); in the kingdom of Saxony, 12.5; in Würtemberg, nearly 13; in Baden and Alsace-Lorraine, 9–10; in Thuringia, 16; in Anhalt, 11; in Mecklenburg-Schwerin, 17; in Hamburg, 12.5; and in Bremen, 7. The density of the population is very unequal in the different parts of the empire. The average was 195 on 1 E. sq. m. in 1871. In Prussia it reached 181—namely, in Rhenish Prussia, 344; in Silesia, 238; in Hesse-Nassau, 229; in Westphalia, 228; in Saxony, 216; in Brandenburg, 186; in Sleswick-Holstein, 146; in Posen, 142; in Hanover, 132; in Prussia, 125; and in Pomerania, 117. The density of the population is greatest in the districts of Düsseldorf (629) and Cologne (400); smallest in those of Hanover (102) and Lüneburg (85). The greatest density of population is in the kingdom of Saxony—namely, 442 on 1 sq. m. Of the other German states, it is in Hesse 288 on 1 sq. m.; in Alsace-Lorraine, 277; in Baden, 248; in Würtemberg, 241; in Thuringia, 224; in Anhalt, 224; in Brunswick, 218; in Oldenburg, 127; and in Mecklenburg-Schwerin, 109. The most scattered population is found in the alpine regions of the S., in the heath and moorlands of the N., and in districts with large estates; the densest population is found in regions with small estates and manufacturing industry. In general, however, such a concentration of the population as is found in England is foreign to Germany. Of the 2280 towns of the empire, none has yet 1,000,000 inhabitants; 8 have more than 100,000—namely, Berlin, 920,000; Hamburg, 240,251; Breslau, 207,997; Dresden, 177,089; Munich, 169,693; Cologne, 129,233; Königsberg, 112,092; and Leipzig, 106,925; 24 have between 50,000 and 100,000—namely, Frankfort-on-the-Main, 100,000; Stuttgart, 91,623; Danzig, 88,975; Hanover, 87,616; Strasburg, 85,529; Magdeburg, 84,401; Nuremberg, 83,214; Bremen, 82,969; Stettin, 76,280; Barmen, 74,449; Aix-la-Chapelle, 74,146; Altona, 74,102; Elberfeld, 71,384; Düsseldorf, 69,365; Chemnitz, 68,229; Brunswick, 57,883; Crefeld, 57,105; Posen, 56,374; Mainz, 53,902; Mülhausen, 52,825; Halle, 52,620; Essen, 51,513; and Augsburg, 51,220. Of the remaining towns, 28 have between 25,000 and 50,000 inhabitants; 160 between 10,000 and 25,000; 188 between 6000 and 10,000; 273 between 4000 and 6000; 819 between 2000 and 4000; and 780 below 2000.

With respect to the language, there were in 1871, according to an estimation, 37,832,000 Germans in Germany, and 3,226,000 not Germans—namely, 2,516,000 Poles in the provinces of Prussia, Posen, Silesia, and Pomerania; 136,000 Wends in Brandenburg, Silesia, and the kingdom of Saxony; 51,000 Bohemians in Silesia; 143,000 Lithuanians in the province of Prussia, along the Kurische Haff and the Memel; 150,000 Danes in Sleswick-Holstein; 230,000 Frenchmen in Alsace-Lorraine and Rhenish Prussia; 200 Kassubes in Pomerania, near the city of Stolp; and 400 Kures in the provinces of Prussia, along the Memel, the last remnants of the old Prussians.

Religion.—The Westphalian treaty of 1648 regulated the relations of the confessions, and in general these regulations have not changed, though, in consequence of the greater tolerance of our time, many Roman Catholic congregations have been formed in countries formerly Protestant, and *vice versâ*. In general, the Evangelical Church reigns in Northern Germany, and the Roman Catholic in Southern. According to the census of 1871, there were in the German empire 25,581,676 Evangelicals (62.30 per cent.), 14,867,698 Roman Catholics (36.21 per cent.), 82,156 Christians of other denominations, 512,160 Jews (1.25 per cent.), and 17,156 persons of other religions. There were in the Prussian state 15,987,927 Evangelicals (64.89 per cent.), 8,267,862 Roman Catholics (33.55 per cent.), and 325,540 Jews. Among the minor states of Northern Germany, Oldenburg is the only one which has a considerable Roman Catholic population—namely, 22.49 per cent.; in the other states the Roman Catholic element never exceeds 3 per cent., and in Mecklenburg and Lübeck it falls below 1. In the Thuringian states there are 1,047,941 Evangelicals, 13,041 Roman Catholics, and 3309 Jews. In the kingdom of Saxony, where the court is Roman Catholic since 1697, there were 2,493,556 Evangelicals (97 per cent.), 53,642 Roman Catholics (2.10 per cent.), and 3358 Jews. Of the South German states, Würtemberg and Hesse are principally Evangelical, the former with 68.67 per cent. (1,248,860), the latter with 68.6 per cent. (585,399). Bavaria, Baden, and Alsace-Lorraine are principally Roman Catholic countries; in Baden, however, the court is Evangelical. In 1871 there were in Bavaria 1,342,592 Protestants (27.61 per cent.), 3,464,364 Roman Catholics (71.23 per cent.), and 5066 Jews. In Baden the percentage of Evangelicals rose between 1852 and 1871 from 31.83 to 33.55; in Alsace-Lorraine, between 1866 and 1871, from 15.30 to 17.47. In the latter country the increase is due to immigration from other German countries, while many Roman Catholics have emigrated to France. In Baden there were 491,008 Evangelicals and 942,560 Roman Catholics (64.49 per cent.). In 1871 there were in Alsace-Lorraine 270,752 Evangelicals and 1,235,195 Roman Catholics (79.70 per cent.). In all the South German states, with the exception of Würtemberg, the Jews are very numerous, especially in the towns along the Rhine and in the villages which formerly belonged to the Knights of the Empire. In 1871 there were 50,662 Jews in Bavaria (mostly in Middle and Lower Franconia and in the Palatinate), 40,928 in Alsace-Lorraine, 25,703 in Baden, 25,373 in Hesse, and 12,245 in Würtemberg.

Manufactures.—The manufacturing industry of Germany has been subject to immense fluctuations during the last fifteen years. In 1860 it was influenced by the war in America; later it suffered much from the unsettled state of Europe; after the close of the war against France it rose at once to a height none had ever expected, but from which it fell in 1873, partly in consequence of fraudulent operations. In the territory of the empire there is liberty of carrying on any kind of trade or manufacture, and boards of trade are established to represent the manufacturing and trading interests. The manufacturing industry has its centres in the Prussian provinces of Rhenish Prussia, Westphalia, Brandenburg, Silesia, and Saxony; in the kingdoms of Saxony, Würtemberg, Alsace-Lorraine, and parts of Bavaria, Thuringia, and Baden. Of no consequence in this respect are Sleswick-Holstein, Posen, Mecklenburg, Oldenburg, and Lippe. (1) The manufacture of woollens employs about 250,000 hands. The raw material is partly imported from other countries, especially from Australia; 1,088,700 cwts. were imported in 1873; 249,000 cwts. were exported; 1,500,000 cwts. were worked up. Coarse woollen stuffs are still made by the country population in the north-eastern part of the empire as a secondary occupation, while the making of cloth, which once was very common, has now ceased almost entirely. To provide the cloth-factories with yarn, about 1,750,000 spindles are in operation in different spinning-factories, situated mostly in the cloth-manufacturing districts, but also in Upper Alsace and in the kingdom of Saxony. The


MAP OF THE
GERMAN EMPIRE
Drawn and Engraved on Copper-Plate
EXPRESSLY
FOR
JOHNSON'S UNIVERSAL CYCLOPÆDIA
Scale of Eng Miles
0 50 100
BOHEMIA
MORAVIA
POLAND
GALICIA
VIENNA
DRESDEN
BERLIN
BREMEN
COPENHAGEN
PRAGUE
BERNE
GENEVA
LYONS

cloth-manufacturing industry, has its principal centre in the government of Aix-la-Chapelle, in whose towns, Burtscheid, Duren, Eupen, and Aix-la-Chapelle, it has flourished for many years, and from which it has conquered a market for itself in almost every part of the world. America buys annually cloths and doeskins in Aix-la-Chapelle to the value of 5,000,000 marks. Another cloth manufacturing region exists in Southern Brandenburg, and a third is found in the western part of the kingdom of Saxony. Here, and in the neighboring parts of Thuringia, the manufacture of other kinds of woollen stuffs is also very flourishing: in Greiz and Zeulenroda, the German Thibet (20,000,000 marks annually); in Apolda, hosiery; in Gera, fine woollens. Carpets and shawls are made in Berlin; Turkish carpets in Schmiedeberg in Silesia. (2) The industry in flax and hemp is increasing, but as yet it demands a considerable importation of raw material from Russia, and of yarn from Great Britain and Belgium. The centre of this industry is Bielefeld in Westphalia and its vicinity, where, besides the spinning and weaving factories, 4000 hands are employed in the manufacture of home-made linen. Other centres are at Zittau in the eastern part of the kingdom of Saxony and in the Silesian mountains. In the whole empire there are about 60 flax-spinning factories, with 280,000 spindles, and about 150,000 looms for the manufacture of linen, of which about 200,000 are found in the eastern provinces of the Prussian state, where linen is manufactured by the country population as a secondary occupation. Sailmaking is important in the seaports; cordage is made in Westphalia. (3) Cotton manufactures are important in Alsace-Lorraine (at Mülhausen, Colmar, and in the valleys of the Vosges); in the kingdom of Saxony, especially in the government of Zwickau (Chemnitz), and in Würtemberg, between Reutlingen and Geislingen. In 1872 there were 450 cotton-spinning factories with about 5,000,000 spindles in the empire; in 1834 there were only 600,000 spindles. At the same time the working capacity of the spindles has increased immensely. In 1836 a spindle consumed only 24 pounds daily; in 1870, nearly 70 pounds. The importation of raw cotton rose from 230,000 cwts. in 1836 to 3,578,500 cwts. in 1873; the exportation from 45,000 to 1,163,800 cwts.; the annual consumption from 185,000 cwts. to 2,412,700 cwts. Besides, in 1873 an importation took place of 126,100 cwts. of cotton yarn, and an exportation of 97,500 cwts. In 1836 the German spinning factories produced only 29, but in 1871, 82 per cent. of the yarn demanded. Some years ago there were in the empire 1030 establishments for cotton weaving, with 48,000 mechanical looms. But the total number of cotton looms in the empire now amounts to 225,000. (4) The silk and velvet manufactures have their centre in Rhenish Prussia, in the cities of Crefeld, Elberfeld, Barmen, and Viersen. In 1871 there were in Crefeld 32,000 looms, producing goods to the value of 76,000,000 marks, of which Great Britain received 26,000,000, and countries outside of Europe 13,000,000. Viersen manufactures especially velvet ribbons. In heavy, all-silk goods Germany cannot compete with France, but in lighter kinds of velvet it can, and its half-silk goods are superior to the French. (5) Among the other branches of the weaving industry of great importance are lace-making and embroidery in the kingdom of Saxony, where numerous power looms are used; embroidery in Southern Würtemberg; the manufactures of galloons and fringes in Berlin and Barmen; of umbrellas in Berlin and Frankfort-on-the-Main; of ready-made clothes in all large cities; of corsets in Würtemberg; of oilcloth in Leipsic and Berlin. (6) Auxiliary branches of the yarn and cloth manufacturing industry are the dyeing and printing establishments. For silk dyeing Crefeld is the most important place; for Turkey red, Elberfeld and Barmen in the valley of the Wupper. For calico printing there are celebrated establishments at Berlin and Mülhausen in Alsace, at Augsburg in Bavaria, at Säckingen, Lörrach, and Constance in Southern Baden, etc. (7) The manufacture of leather is important in the southern and western states. Excellent leather is produced at Mainz and Worms in Rhenish Hesse, at Malmedy in Rhenish Prussia, in the Siegensche Land in Westphalia, and at Eschwege in Hesse-Nassau. Fine boots are made for exportation in Rhenish Bavaria and at Mentz, and leather goods of excellent quality at Berlin, Nuremberg, Offenbach, Hanau, etc.; gloves for exportation in Würtemberg. (8) For the manufacture of paper there are 950 establishments in the empire, employing more than 25,000 hands. The most important are those in the districts of Duren and Jülich, near Aix-la-Chapelle in Rhenish Prussia, and on both sides of the Lenne in the government of Arnsberg in Westphalia, though many of the factories in these regions produce only wrapping and straw paper. In the other parts of the empire the paper factories are more isolated. (9) Among the other branches of industry in animal and vegetable materials, the manufactures of straw goods in the Black Forest and the Vosges, and at Dippoldswalde in the kingdom of Saxony, are important, and of basket-work in Upper Franconia in Bavaria. There are 10,000 saw-mills in the empire; the largest are those at the Finow Canal in Brandenburg, and on the Memel in East Prussia, where they are worked by steam. The manufacture of furniture for exportation is also important, especially at Mainz, of turnery ware in wood, amber, meerschaum, and mother-of-pearl; of carved work, both in wood and bone, in the Alps and at Nuremberg; of hats, which branch is steadily increasing; of gum and gutta-percha goods, especially at Harburg in Hanover and at Berlin. (10) The manufacture of tobacco and cigars is carried on in 3600 establishments, which employ about 70,000 hands. Bremen is its centre (200 establishments with 8000 hands), and it prevails in the adjacent Hanoverian districts. (11) For the manufacture of food there are 65,000 corn-mills in the empire, of which 1000 are worked by steam, 2500 by animal power, and the rest by water or wind. The number of beet-root sugar factories in the empire amounted in 1874 to 336, employing 55,000 hands; 5,640,700 cwts. of raw sugar were produced. Magdeburg is the principal sugar-market. There are besides 45 sugar-refineries in the empire, in Hamburg, Bremen, Cologne, Brunswick, and Magdeburg. Meat is salted in large establishments in Hamburg, Bremen, and Danzig, and preserved at Gütersloh in Westphalia and Gotha; famous are the *pâtés de foies gras* of Strasburg, the Westphalian hams, the smoked beef of Hamburg, and the Pomeranian goose-breasts. (12) In the manufacture of beverages, Bavaria occupies the first place in beer-brewing in the world; in 1872 it produced in 5127 establishments nearly 11,000,000 hectolitres of beer. The most important places are Munich, Regensburg, Nuremberg, Augsburg, Erlangen, Kulmbach, and Hof. Bavarian beer is now made throughout the whole of Northern Germany, but it cannot compete with the genuine Bavarian product. There are in Northern Germany 10,220 beer-breweries, and in Southern Germany, besides those of Bavaria and Alsace-Lorraine, 3490. The brandy-distilleries of Germany number 25,000, of which many, however, are only worked by the country population as a secondary occupation. The distilleries of Northern Germany consume annually 3,500,000 hectolitres of barley, 20,000,000 hectolitres of potatoes, 180 hectolitres of juniper-berries, 1,000,000 cwts. of molasses, and 230,000 hectolitres of fruit and grapes. Of special importance in this respect is Nordhausen in the province of Saxony. Sparkling wines are manufactured in the Rhine regions. Of vinegar-factories there are 1600 in the empire. (13) There are 650 factories for the manufacture of chemicals and dyestuffs. The former are principally situated at the large salt-works, and it is especially the potassic salts of Stassfurth in the province of Saxony, and of Leopoldshall in Anhalt, which have given rise to immense factories for chemicals which export their products to every country of Europe. There are color manufactories in Thuringia and in Bavaria, at Nuremberg, Schweinfurt, and Amberg; ultramarine is made at Nuremberg and in Rhenish Prussia; aniline at Elberfeld, Ludwigshafen, Mannheim, and Crefeld. There are 180 factories for perfumery, among the products of which is the eau de cologne; 7000 oil-mills and oil-refineries; 350 candle and soap factories; 1200 potash factories. (14) There are 18,000 brickkilns in Germany. They are largest and most frequent along the navigable streams of the province of Brandenburg (the Havel, Finow Canal), where they furnish the building materials for the rapidly growing capital of the empire. For the manufacture of pottery and other earthenware there are 600 establishments. There are 110 porcelain factories; that of Meissen (now in the adjacent Triebsche Valley)—is the oldest in Europe (1710). (15) For the manufacture of glass and glassware there are 300 establishments in the empire, employing 35,000 hands. They are numerous in the forest regions of Eastern Bavaria, Thuringia, and Lorraine, and in the coal-regions on the Ruhr; in the North German lowland they are found only in remote forest districts, where a more profitable use of the wood seems impossible. (16) Of other manufactures of stone and earth, there are in Germany 1200 limekilns and 400 gypsum mills; the manufacture of Portland cement is increasing. Slates and slate pencils are made in Thüringer Wald and Franconia; marble articles in the Bavarian Alps, especially at Berchtesgaden, in the slate mountains in Westphalia, and in the Harz at Rübeland. (17) The first steam engine in Germany was put in operation Apr. 4, 1788, at Friedrichshütte, near Tarnowitz, in Upper Silesia. Twenty-five years ago the most of the locomotives and machines were imported from foreign countries, but since that time the German machine-works have improved so much that they are capable not only of satisfying all domestic wants, but even of exporting. Since 1867 the exportation of machinery from the German Zollverein has

exceeded the importation. In the whole empire there are at present 750 machine-works, employing 90,000 hands. The most prominent places are Berlin (locomotives and sewing-machines), employing more than 15,000 hands; Chemnitz, with more than 10,000 workmen; Mülhausen in Alsace; and various towns in the kingdom of Saxony. (18) The manufacture of railway cars has large establishments at Berlin, Aix-la-Chapelle, Breslau, Görlitz, Cologne, Cassel, Munich, Stuttgart, Carlsruhe, Mainz, and Brunswick. The expulsion in 1870 of all Germans from France was advantageous to the manufacture of carriages. Shipbuilding is carried on in Hamburg, Bremen, at different places on the Oder below Stettin, at Danzig, and Lübeck. War vessels are built at Kiel, Danzig and Wilhelmshaven on the Jade. Large iron-clads, however, are bought from foreign countries, as also a considerable number of merchant vessels. (19) Pianofortes are made with great perfection at different places; organs at Dresden; harmoniums at Gera in Thuringia; string instruments of different kinds at Mittenwald in Upper Bavaria, Cassel, and Adorf in Saxony; musical boxes in the Black Forest. The manufacture of watches employs about 10,300 hands in the Black Forest. Munich is the centre for the manufacture of scientific and optical instruments; other important places are Nuremberg and Rathe, now in Brandenburg. (20) The manufacture of iron and steel goods is the chief industrial pursuit in large parts of Westphalia, Rhenish Prussia, and Lorraine. For the production of raw iron (more than 36,000,000 cwts. in 1872) there are large works in the coal-regions. The production of steel and rolled iron amounted in 1872 to 24,300,000 cwts. (in Prussia to 19,482,599 cwts.), of iron rails to 8,600,000 cwts. (in Prussia to 7,221,632 cwts.), of raw and cast steel of different kinds to 6,250,000 cwts. (in Prussia to 5,758,098 cwts.), of iron and steel plate to 2,300,000 cwts. (in Prussia to 2,180,408 cwts.), of iron and steel wire to 2,050,000 cwts. (in Prussia to 1,854,348 cwts.), and of castings to 8,500,000 cwts. (in Prussia to 6,479,529 cwts.). For iron and steel goods the Prussian governments of Düsseldorf (Rhenish Prussia) and Arnsberg (Westphalia) are the centres; for arms, Solingen; for cutlery, Remscheid. The largest establishment for the manufacture of cast steel, and generally the largest industrial establishment of the empire, is that of Krupp at Essen in Rhenish Prussia, celebrated for its cannon. It employs 16,000 hands, covers an area of 400 hectares, uses 270 boilers, 286 engines of 9230 horse-power, and 71 steam-hammers, weighing 4340 cwts. (21) The manufacture of other metals is important—of silver ware at Berlin; of gold and silver ware at Stuttgart, Pforzheim in Baden, and Hanau in Hesse-Nassau; of gold and silver thimbles at Schorndorf in Würtemberg; of gold and silver leafs and wire at Nuremberg and Fürth in Bavaria; of bronzes in Frankfort-on-the-Main; of brass, bronze, and German silver ware at Nuremberg, Fürth, and Augsburg in Bavaria, Gmünd and Ulm in Würtemberg, Pforzheim in Baden, Offenbach in Hesse, Iserlohn and Altena in Westphalia; and of tinware at Lüdenscheid in Westphalia.

Commerce.—The Zollverein, established in 1833 by the acceptance by Bavaria and Würtemberg of the commercial agreements existing between Prussia and the Hessian countries, and now comprising all the German states, has exercised a large and beneficial influence on the commerce of the empire by abrogating injurious restraints and destroying many unnatural barriers. To the Zollverein belong the grand duchy of Luxemburg and an Austrian parish to the S. of Kempten in Bavaria, but not the free ports of Hamburg, Altona, Bremen and Bremer Hafen, Geretemünde, and some districts in Southern Baden. The German custom law dates from July 1, 1869; a new tariff was introduced Oct. 1, 1873. All duties on export and transit are abolished, and the duty on imports is very reasonable. The value of goods imported to the German Zollverein in 1872 amounted to 3,468,480,000 marks; that of exports to 2,494,620,000 marks. The principal items of importation were—spinning materials, 588,900,000; timber and wood, 297,000,000; corn and milling products, 279,300,000; animals and animal food, 230,700,000; precious metals, 206,400,000; yarns, 194,700,000; felt, hair, feathers, hides, and leather, 193,500,000; sugar, coffee, and spices, 192,600,000; woven fabrics and cloths, 187,000,000; fats, oils, and soaps, 178,000,000; drugs, chemicals, and dyestuffs, 172,680,000; raw metals, 140,000,000. The principal items of exportation were—woven fabrics and cloths, 450,300,000; corn and milling products, 215,100,000; spinning materials, 199,900,000; precious metals, 174,000,000; animals and animal food, 173,400,000; timber and wood, 115,800,000. The value of the importations in 1872 through the two free ports Bremen and Hamburg was—for Hamburg, 2,017,222,875 marks (by sea, 1,297,722,805; by land, 720,500,070); for Bremen, 496,197,211 marks (by sea, 316,602,622; by land, 179,594,509).

The commercial fleet of Germany occupies the third place, and follows immediately after those of Great Britain and North America. It consisted in 1873 of 5082 vessels, of 1,308,988 tons burden; of these, 3401 vessels of 650,951 tons, belonged to Prussia; 257 vessels of 231,805 tons, to Bremen; 408 vessels of 199,839 tons, to Hamburg; 426 vessels of 142,954 tons, to Mecklenburg; 542 vessels of 71,547 tons, to Oldenburg; 48 vessels of 11,892 tons, to Lübeck; or to the North Sea fleet, 2672 vessels of 689,557 tons, and to the Baltic fleet, 2410 vessels of 619,431 tons. Of the vessels, 219 were steamers of 165,178 tons burden and 29,139 horse-power. In 1871 there entered 69,710 vessels of 8,542,000 tons; in 1872, 71,907 vessels of 8,994,000 tons. In 1871 there cleared 69,138 vessels of 8,447,000 tons; in 1872, 69,829 vessels of 8,855,000 tons. Among the seaports of the empire, Hamburg and Bremen occupy the first places. The tonnage of entering vessels rose in Hamburg, between 1841 and 1872, more than 500 per cent.—namely, from 520,000 to 2,775,000; and in Bremen, between 1847 and 1872, more than 350 per cent.—namely, from 312,000 to 1,136,000. It is principally these ports which carry on the traffic with England and the Transatlantic countries. They maintain numerous steamship lines, and the main stream of emigration passes through them. For inland navigation there are 16991.2 E. miles of water-roads, of which 8140 are in Prussia and 1155 in Bavaria. In 1872 there were 21,364 coasters, river-craft, and canal-boats in the empire, with a carrying capacity of 31,036,550 cwts.; of these, 20,901 were sailing vessels and 463 steamers.

The first railway in Germany, the Ludwigsbahn, from Nuremberg to Fürth, 3.7 E. m. long, was opened Dec. 7, 1835; the first long line was contracted for between 1837 and 1839, from Dresden to Leipzig. The total length of the railways in Germany was 3.7 E. m. in 1836, 13 in 1837, 86.4 in 1838, 149 in 1839, 291 in 1840, 1332 in 1845, 3638 in 1850, 4863 in 1855, 6890 in 1860, 8637 in 1865, 11,379 in 1870, and 15,158 in 1874; so that there is at present an average of 1.6 E. m. to each E. sq. m. In 1874, 6726 E. m. belonged to the government roads, 1598 E. m. to private roads managed under the superintendence of the state, and 6828 to other private roads. More than 5000 E. m. have double tracks. The total cost of construction amounted in 1874 to 5,000,000,000 marks. The cheapest were the Kottbus-Grossenhain and Nuremberg-Fürth lines, averaging 100,000 marks per mile; the most expensive were those of Rhine-Nahe and Zittau-Reichenberg, averaging more than 666,000 marks per mile, and those of Hausach-Villingen in the Black Forest and Cologne-Minden, averaging between 600,000 and 666,000 marks per mile. There are at present 65,200 miles of highways in the country.

The post and telegraphs are uniformly organized throughout the empire, though in Bavaria and Würtemberg they have separate administrations. Between the German empire and Austro-Hungary there exists a postal convention of May 7, 1872, and a telegraph convention of Oct. 5, 1871. In 1873 the number of post-offices amounted to 7600, of which 1600 were in Bavaria and Würtemberg. The entire length of the post-routes of the empire was in 1873—on railways, 11,903 m., on highways, 37,926 miles. There were delivered 454,554,920 letters, 26,948,267 postal cards, 69,056,824 printed articles, 248,154,482 newspapers, 49,004,406 packages (weighing 289,957,140 pounds, and valued at 4,016,149,326 thalers). In Bavaria and Würtemberg were delivered about 80,000,000 of letters and as many newspapers. At the end of 1872 the entire length of telegraph-lines in Germany was 23,345 m., of which 4265 m. were in Bavaria and 1380 m. in Würtemberg; that of the wires, 77,858 m. The number of stations was 4038; the number of despatches—private, 7,086,579: official, 451,403; international sent out, 1,894,402; international received, 2,022,329; transit, 711,241; total 12,165,954.

In the middle of 1874 there existed in Germany 195 stock institutions for deposits and industrial credit, with an issue of 2,180,000,000 and a capital of 1,700,000,000. There were also, for the same purpose, 40 state and communal institutions. The most important banking institution is the Bank of Prussia, founded in 1765, and in 1846 transformed into a stock institution. Very common are savings banks and the Deutsche Genossenschaftswesen, founded in 1850 by Schulze-Delitsch, and since 1873 existing in Austria and Luxemburg, and now (1874) numbering 1,300,000 members.

Education.—For general education the German people are deeply indebted to Pestalozzi and his disciples, who, aided by political circumstances during the early part of the present century, succeeded in reforming the whole school-system of Prussia. This reform received a hard blow, however, from the reaction which in Prussia began after 1840 with Eichhorn. The retrograde movement was at first hardly apparent; in many points it worked even beneficially, but it became very evident after the introduction of the new school regulation of 1854, and in 1872 it

was generally acknowledged that school matters in Germany had fallen into a sort of dissolution. The regulation of 1854 left the course of the national German development, and hoped to quench the ideas of the revolution and of modern times by an ecclesiastical reaction and a narrow patriotism. At the head of the ecclesiastical reaction stood the Ultramontane party, and it pursued its plans in every direction. But, fortunately, the successful wars of 1866 and 1870 and the foundation of a Protestant empire formed an effective opposition to the Ultramontane party, and made the mistakes of the reaction apparent. The normal schools suffered still more than the primary schools in this period, both from a vicious system and from insufficient teachers. Improvements have certainly taken place since 1872, but a thorough reform of the matter is demanded, and for it a liberal grant of money is necessary. The education is lowest in the eastern provinces, in which a not inconsiderable percentage of the annual levy of recruits appears to have received no school education at all; thus, in 1873 in the governments of Marienwerder, Posen, and Bromberg 18–20 per cent., in Gumbinnen and Danzig 10–13, and in Königsberg 9. According to the census of 1871, there were in Prussia (exclusive of Rhenish Prussia) 13,494,932 persons above ten years of age who could read and write, but 2,061,176 persons, or 13 per cent. of the whole population above ten years of age, had no school education at all. In other German states school matters have been subject to similar fluctuations. The period of reaction was generally shorter, however, and thus the schools of several countries—Baden, Würtemberg, and Saxony—are superior to those of Prussia. In 1873, 7.3 per cent. of the recruits from Bavaria had no school education. The primary schools are generally divided according to religion, but ecclesiastics have been removed as school directors in Prussia, Alsace-Lorraine, and several other countries. Germany has about 60,000 primary schools, with 75,000 teachers (male and female), and 6,000,000 pupils. The proportion between the number of inhabitants and that of school-attending children is as 1000 to 150. Each teacher has on an average 80 pupils. A transition from the primary schools to the higher is formed by the middle schools, institutions of different names and of various organization. The higher school institutions are divided into *Realschulen* and gymnasiums. The Realschulen, subdivided into a first and second order and higher burgher schools, give the foundation of a technical education. Among foreign languages, the living ones have the preference; in the Realschulen of the second order Latin is not taught. In 1874 there were in the empire 106 schools of the first, 42 of the second order, and 107 higher burgher schools, containing 82,000 pupils. The gymnasiums aim at the development of mental productivity (science and art), and prepare for the higher government offices and for the universities. Among foreign languages, the ancient have the preference. In 1874 there were 333 gymnasiums in the empire—183 Evangelical, 57 Roman Catholic, and 93 mixed. Together with the 170 progymnasiums, or so-called Latin schools, they contained 108,000 pupils. For the education of teachers for the primary schools there are 156 seminaries—110 Evangelical and 40 Roman Catholic; furthermore, 9 for teachers for the Latin schools in Prussia; 1 for preachers at Wittenberg; 4 for Evangelical theology in Würtemberg, and for Roman Catholic theology in the dioceses of the archbishops. The 22 universities consist, generally, of 4 faculties—divinity, law, medicine, and philosophy. The faculty of divinity is generally Evangelical; Roman Catholic in Munich, Würzburg, Freiburg, and Münster. The universities of Bonn, Breslau, and Tübingen have both an Evangelical and Roman Catholic faculty of divinity; the last university has seven faculties—namely, besides the five above mentioned, one of political economy and one of natural philosophy. The universities of Munich and Würzburg have also five faculties—namely, one of political economy, besides the four common ones. The academy of Münster ranks with universities, though it has only two faculties (Roman Catholic divinity and philosophy). The oldest university of the empire is that of Heidelberg, founded in 1386; the youngest, that of Strasburg, founded in 1872. These universities contained in the winter of 1873–74, 1675 professors and 17,737 students. As technical high schools are considered the Academy of Architecture in Berlin, the polytechnic schools of Aix-la-Chapelle, Darmstadt, Dresden, Hanover, Carlsruhe, Munich, and Stuttgart, and the Collegium Carolinum, in Brunswick. The number of special schools is very great: for architecture and mining, the mining academies at Berlin, at Freiberg in Saxony, and at Clausthal in the Harz; for forest cultivation, the academy at Neustadt-Eberswalde in Brandenburg, at Münden in Hanover, at Tharand in Saxony; for commerce and the science of war, the military academies at Berlin and Munich; for agriculture, music, and navigation. There are also 63 asylums for the deaf and dumb, and 28 for the blind; numerous learned societies and associations, libraries, museums, zoological and botanical gardens. In 1873 the total number of literary productions amounted to 11,315 (in 1871, 10,669)—namely, collected works, science of literature, bibliography, 258; theology, 1239; law, politics, statistics, 1051; medical and veterinary science, 514; natural philosophy, chemistry, pharmacy, 600; philosophy, 157; pedagogical science, German school-books, 1711; books for the young, 337; classical and Oriental languages, antiquities, mythology, 438; modern languages, Old German literature, 346; history, biography, memoirs, correspondence, 690; geography, travels, 503; mathematics, astronomy, 162; science of war, 314; science of commerce and trade, 402; building, machinery, railways, mining, navigation, 331; forest, hunting, 59; agriculture and horticulture, 310; romances, poems, theatre, 918; fine arts, 391; books for the people, 205; Freemasonry, 19; miscellaneous writings, 590; maps, 220. The German Zollverein imported 54,349 cwts. of books in 1873, and 107,000 cwts. were exported.

Church Matters.—The constitution of the Evangelical Church is different in the different states. In Prussia the highest church authority is the ecclesiastical council; a general synod for the eight old provinces is under consideration. The synodal system is developed in Bavaria, Saxony, Würtemberg, Baden, and Hesse. In most states a presbyterian system exists; in others, the constitution of the Evangelical Church rests on a consistorial system. The highest ecclesiastics are the general superintendents and the superintendents; in Alsace-Lorraine the church inspectors. The Evangelical Church in the German empire has 16,000 ecclesiastics. For the Roman Catholics there are 5 archbishoprics (Cologne, Gnesen-Posen, Munich-Freising, Bamberg, and Freiburg), 20 bishoprics, and 3 vicariates apostolic. There are in the whole empire about 20,000 Roman Catholic priests, and more than 800 monasteries. The Jesuits were excluded from the territory of the empire by the law of July 4, 1872.

Constitution.—The constitution of the empire dates from April 16, 1871, with some modifications made in 1873. It consists of 14 articles and 78 paragraphs. Article I. defines the territory of the confederation. Article II. treats of its government, which is exercised by the federal council, *Bundesrath*, and the diet, *Reichstag*. Article III. discourses on the federal council, which consists of delegates from the federal states—17 from Prussia, 6 from Bavaria, 4 from Saxony, 4 from Würtemberg, 3 from Baden, 3 from Hesse, 2 from Mecklenburg-Schwerin, 2 from Brunswick, and 1 from each of the other states, with the exception of Alsace-Lorraine. Article IV. confers the presidency of the confederation on the king of Prussia, who bears the title of *Deutscher Kaiser*. Article V. treats of the diet, which is constituted by general and direct election by ballot, and consists of 397 members (1 representative for every 100,000 inhabitants)—235 from Prussia, 1 from Lauenburg, 48 from Bavaria, 23 from Saxony, 17 from Würtemberg, 15 from Alsace-Lorraine, 14 from Baden, 9 from Hesse, 6 from Mecklenburg-Schwerin, 3 from Saxe-Weimar, 3 from Oldenburg, 3 from Brunswick, 3 from Hamburg, 2 from Saxe-Meiningen, 2 from Saxe-Coburg-Gotha, 2 from Anhalt, and 1 from each of the other states. The legislative period lasts three years when no dissolution of the diet takes place. All German states, except the two Mecklenburgs, in which feudality still exists, possess constitutions more or less in harmony with modern views; the controversy, however, between the old and the new is not yet closed at every point. The greater number of mediatized princes have seats in the upper houses of the southern states and in the Prussian *Herrenhaus*. At the head of the administration of the empire stands the chancellor of the realm, with offices for the post, telegraphs, railways, and statistics of the empire, and a separate office for the affairs of Alsace-Lorraine. The chancellorship is at present connected with the ministry of foreign affairs. Under the minister of foreign affairs stand the ambassadors and consuls of the empire. Besides the ambassadors of the empire, the different states may represent themselves at foreign courts by special ambassadors. For the whole empire there are furthermore a common school committee for all the higher schools, and a common board of trade in Leipzig, the highest authority in all matters of commerce or trade. The federal council forms standing committees for the army and fortresses, navigation, toll and taxes, commerce and trade, railways, post and telegraph, and for the affairs of Alsace-Lorraine. In the administration of justice the German empire exhibits still the same want of uniformity it formerly showed in political and military affairs. When smaller differences are overlooked, Germany consists of five different jurisdictions. The Prussian common legal law is valid in the largest part of those countries which belonged to Prussia before 1866 and before 1806. The Roman law is predominant in the new Prussian provinces, the Saxon

civil law in Saxe, the common law of Baden in Baden, and the French code on the left side of the Rhine, and on the right in the former grand duchy of Berg (the governments of Düsseldorf, Elberfeld, and Barmen).

Finances.—The revenues of the empire are derived from toll, excise of consumption, post, and telegraph, or, if necessary, they are levied from the several states according to the number of inhabitants. A common imperial income-tax will be introduced. In 1873 the receipts and expenses of the empire amounted to 444,470,325 marks. The receipts were—toll and excise, 198,716,150; stamp-tax, 4,969,800; post, 14,749,634; telegraph, 471,969; government railways in Alsace-Lorraine, 7,637,979; of the French war-indemnity, 57,594,876; surplus from 1872, 38,552,073; interest on capital, 4,201,200; levies from the states, 67,144,251. The standing expenses are—the imperial chancery, 4,114,764; the diet, 202,077; the ministry of foreign affairs, 4,980,495; the army, 278,499,627; the navy, 13,834,674; interest on the debt, 7,290,000; the court of accounts, 294,600; the supreme board of trade, 301,800; rent-allowance to the officers of the army and navy, 16,084,260, and to the officers of the imperial railways, 121,050; total, 363,720,225 marks. The extraordinary expenses amounted to 81,008,100 marks—namely, for the army, 28,989,966; for the navy, 39,534,510; the railway of St. Gotthard, 2,105,064; the mint, 8,400,000. The empire has now no debt. Paper money to the amount of 120,000,000 will be put into circulation in 1876, instead of the present paper money of the separate states.

Army and Navy.—The present military system of Germany was established by Articles IX. and XI. of the constitution of Apr. 16, 1871, by the law of Nov. 9, 1867, concerning the duty of military service, and by the laws of May 2, 1874, and Mar. 26, 1868. The armed power consists of the army, the navy, and the *Landsturm.* The army is divided into the standing army and the *Landwehr.* The navy consists of the fleet and the *Seewehr.* The standing army and the fleet are always ready for war. The Landwehr and Seewehr serve as their support. The Landsturm becomes active only when an enemy invades the territory of the empire. The duty of military service is universal throughout the empire, and substitution is not allowed. Only the members of the reigning or mediatized princely families are exempted from military service. The duty commences with the twentieth year, and lasts for three years at the standard, for four in the reserve, and for five in the Landwehr. To the Landsturm belong all between the seventeenth and the forty-second year who are capable of bearing arms. The volunteer who passes through a certain scientific examination, and proves himself in possession of a certain amount of knowledge, remains only one year at the standard, but pays for his equipment and provision. Teachers from the primary schools have only to go through an exercise of six weeks in an infantry regiment. The military nurses give an active service of eighteen months. The period of service in the active marine is one year for sailors and machinists. The commander-in-chief of the whole army is the emperor, though in times of peace with some restrictions from the side of Bavaria and Würtemberg. Officers are appointed in the different contingents by the different states; to the appointment of generals, however, the consent of the emperor is necessary, except in Bavaria. The emperor also appoints all commanders-in-chief of the contingents and of the fortresses, again with the exception of Bavaria; and he can build fortresses and declare any part of the empire in a state of siege. To a declaration of war in the name of the empire the consent of the federal council is necessary. By the law of May 2, 1874, which is valid to Dec. 31, 1881, the strength of the army of the empire in time of peace is determined to be—401,659 rank and file; 17,036 officers and 3647 physicians, farriers, etc.; in all, 422,342 men—namely, infantry and chasseurs, 280,824; cavalry, 68,922; artillery, 48,291; pioneers and railway troops, 10,137; train, 5354; special formations, 3565; guns, 1200. The war-force is as follows: infantry, 908,346; chasseurs, 42,224; cavalry, 111,839; artillery, 152,205; pioneers and railway troops, 34,649; train, 45,671; staff and administration, 19,114. The respective contingents of the different states are—Prussia, 961,280 men and 2064 guns; Bavaria, 149,307 men and 300 guns; Saxony, 75,762 men and 156 guns; Würtemberg, 62,914 men and 126 guns; in all, 1,249,263 men and 2646 guns.

The development of a navy first began in 1848 as a merely Prussian concern. It is now a force of the empire, under the command of the emperor. It has a flag in common with the merchant fleet—black, white, and red. It consists of 74 vessels, with 528 guns, of which 106 are in iron-clads, 257 in other steamships, and 165 in sailing vessels. It numbers in time of peace 8124 men; in time of war, more than 15,000.

History.—In pre-historic times Germany was inhabited by tribes belonging perhaps to the Celtic family. They built their houses on piles in the lakes, and possessed tools and instruments of stone—later, of bronze and iron. Comparatively late, not until a few centuries before Christ, did the German races, coming from the East, reach the present boundary of the empire, but in the fourth century A. D. they had driven the Celtic tribes over the western frontier into the Vosges Mountains. Meanwhile, they had also met with the Romans—the first time in 113 B. C.—in Noricum, which comprised the present Styria and the adjacent Austrian districts; and although the German tribes which appeared at this occasion—the Cimbrians from the Danish peninsula of Jütland, and the Teutons—were defeated and destroyed by Marius, still the danger which threatened Rome from the North was by no means removed. Cæsar, although he crossed the Rhine twice, did not attack the Germans, and when the emperor Augustus—or, rather, his general Varus—tried to bring the German race under the Roman yoke, the German tribes gathered together in large masses on the call of Hermann (Arminius), the chief of the Cherusci. The Roman legions, the best Rome ever had had, were trampled down in the battle of Teutoburger Wald (9 A. D.), and the liberty and independence of the German race were established for ever. The Romans tried repeatedly to subjugate the Germans, and Thusnelda, Hermann's wife, spent the last years of her life in Roman slavery; yet as a race the Germans remained free, and soon overthrew the fortresses which the Romans built on the frontier between the Rhine and the upper Danube. Their power grew as they united into large national formations, of which the Saxons lived between the Baltic and Harz, the Franks between the lower Rhine and Fichtel Gebirge, the Alemanni along the upper Rhine, and the Goths along the lower Danube. In those days of the first wars with Rome all Germany was covered with forests and swamps. The Hercynian forest spread over all the mountains and plateaus of Central Germany. The coasts of the North Sea were formed otherwise than at present. Large islands, which later floods have submerged, were situated at the mouths of the rivers and stretched along the coast. The climate was rougher than at present. Animals which are now found only in the northernmost regions roamed in the forests. The inhabitants, like all primitive people, were fond of hunting and war. Magnificent hospitality was their pride. Many vices, such as drunkenness and gambling, darkened their lives, but they were, on the other hand, possessed of many virtues which distinguished them above other races. They were chaste, they respected woman, and they kept their word. The Romans brought the vine and the finer sorts of fruit to the Rhine, but they could not withstand the pressure of the Germans. Soon after 300 A. D. the Alemanni pushed forward into Switzerland and Alsace, and although they were defeated in 357 at Strasburg by the Roman emperor Julian, they succeeded in settling in these regions. In 375 the Huns burst into Europe, and then began the migration of nations, which caused great changes in Germany. German tribes from the Vistula, Oder, and Elbe moved farther to the West, even to Africa (the Vandals), while Slavonian tribes (the Wends) advanced from the East into the depopulated regions. Other German tribes went to Italy and destroyed the West Roman empire in 476, while in Gaul, the present France, Clovis founded the powerful empire of the Franks, to which he added the dominions of the Alemanni after the battle of Zülpich in 496. Under the descendants of Clovis, the Merovingians, the strength of the empire was much impaired, however, by being divided, until at last the Carolingian family arose and grasped the reins under the hereditary title of *major-domus.* A member of this family, Pepin le Bref, dethroned the last Merovingian and declared himself king of the Franks in 752, with the consent of the pope. A contemporary of Pepin was the Anglo-Saxon Winfried (Bonifacius), the first archbishop of Mainz, who converted a large part of the German tribes E. of the Rhine to Christianity, but was killed in 755 by the Frisians. With Charlemagne (768–814) the empire of the Franks and the power of the Carolingians reached their highest point. Long wars with the pagan Saxon duke Wittekind, and in Italy, Spain, and Bavaria, extended the empire from the Ebro in Spain to the Raab in Hungary, and from the Eider in the N. to the Tiber in the S. But in spite of the imperial crown bestowed in 800 by Pope Leo III., and in spite of the wise policy pursued in the interior, these conquests caused a weakness which was generally felt even under Louis the Pious (814–840), and which led to the famous treaty of Verdun between his sons. Germany (Eastern Franconia) became now separated for ever from France (Western Franconia), and Lorraine (Middle Franconia) was thrown between them as the apple of discord. Ludwig the Child, the last Carolingian in Germany, died in 911. At

this time the Germans were threatened by the Norsemen from the N., by the Wends on the Elbe and the Havel, and especially by the Hungarians in the E., while in the interior a sort of national or tribal division became more prominent; so that at the extinction of the Carolingian house Germany was divided into five large dukedoms—Saxony (with Thuringia), Franconia, Suabia (formerly Alemannia), Bavaria, and Lorraine. The Franks elected their own duke, Conrad, king of Germany, and he was acknowledged by the other tribes with the exception of Lorraine, which fell to Western Franconia (France). Conrad, however, did not succeed in consolidating the empire internally or strengthening it outwardly, but after his death the Franks and the Saxons chose the mighty Saxon duke Henry for king. Henry I. (911–918) is the founder of the German empire. He vindicated the royal authority against the dukes; he acquired Lorraine for Germany; he fought with success against his foreign enemies, the Wends on the Havel and the Hungarians, whom he defeated at Merseburg in 933. In the interior he improved military affairs by developing a new system of cavalry; built numerous towns, and laid the foundation of the kingdoms of Saxony and Prussia by establishing against the Wends the margraviates of North Saxony and Meissen. Of still greater consequence was the reign of his son, Otho I. the Great (936–973). He crushed the rising opposition of the princely aristocracy; gave the dukedoms to friends and relatives; acquired the crown of the Lombards in 951; defeated the Hungarians at Augsburg on the Lech in 955; and assumed in 962—not to the advantage of Germany—the imperial title, which from that time, and up to 1806, remained with the German kings. After him followed three emperors of the Saxon house, Otho II., Otho III., and Henry II. But under them the royal authority lost very much; the princes and the ecclesiastical dignitaries became very bold; and the popes, hitherto always submitting to the strong emperor, began now to aspire to the empire of the world. With Conrad II. (1024–39) begins the Franconian or Salic dynasty, under which the royal power culminated in Germany; so that, if Henry III. (1039–56) had lived longer, not only would the imperial dignity have become hereditary in his family, but an end would have been put to the injurious interference of the pope in German affairs. His government was severe but just in the interior, and it was respected in foreign countries; in papal affairs he was generally referred to as arbiter. But he died only thirty-nine years old, and all the fruits of his policy were lost for centuries under his son Henry IV. (1056–1106). Henry was well gifted by nature, but having been educated by priests, he suffered very much from their influence. Under him the feudatory princes, the Church, and the Saxons took back what they had lost under his father, and the Church compelled him to perform the famous humiliation at Canossa (1077), by which he, in a manner, acknowledged the supremacy of the Church over the Crown. Henry, however, supported by the burghers, continued to struggle against the Church with various fortune. At one time he even expelled the pope, Gregory VII., from Rome. But his last days were much embittered by his own son, Henry V. (1106–25), who was won over to the papal party and rose against him. As soon, however, as Henry V. came to power himself, he followed the example of his ancestors, but was compelled by the papal party to conclude the concordat of Worms in 1122; with him the Franconian dynasty became extinct. The Saxon Lothaire followed (1125–37); he yielded to the princes and the Church, and by marrying his daughter to Henry the Proud, duke of Bavaria, he left his possessions to the house of the Guelphs. On his death the powerful house of Hohenstauffen ascended to the German crown (1138–1254). Conrad III. (1138–52) confined himself to German affairs, but his successor, Frederick I. Barbarossa (1152–90), tried to extend his power beyond the boundaries of the empire. In Italy he was not successful against the Lombard cities and the pope, but when his son married the heiress of the Norman empire in Lower Italy, he gained new influence, while in Germany he succeeded in curbing Henry the Lion of the powerful house of the Guelphs. He died in Asia on a crusade. His son, Henry VI. (1190–97), ruled with vigor and severity, but died very early; and on his death a contest began between Philip of Suabia, of the house of Hohenstauffen, and Otho, of the house of the Guelphs. The latter was supported by the pope, Innocent III., and Philip was killed; but when Otho IV. became sole emperor he could not satisfy the papal demands, and a son of Henry VI., Frederick II. (1212–50), was elected king by the papal party in opposition to him. Frederick gained the superiority, but as the popes soon became his most inveterate enemies, and were supported by the Lombard cities, he had to fight against the Church during his whole life; and although his adversaries did not succeed in placing another king of any power against him in Germany, still the empire suffered frightfully. During his reign the Germans succeeded in breaking the power of the Danes in the battle of Bornhöved (1227), and in 1230 the Teutonic Order conquered the country of Prussia to the E. of the Vistula. But after his death the house of Hohenstauffen declined rapidly. Conrad IV. died in 1254, and his son, Conradin, the last of the family, was beheaded at Naples in 1268, while trying to reconquer his heritage in Lower Italy from the invader, Charles of Anjou. In Germany, William of Holland reigned to 1256, but then followed an interregnum to 1273. Neither of the two foreign princes who were elected German emperors had any authority at all. On the election of Rodolph I. the house of Habsburg ascended the German throne. Rodolph restored general tranquillity to the empire, which during the interregnum had fallen under club-law, and by the battle on the March in 1278, in which Othokar II. of Bohemia was killed, he acquired the duchy of Austria, and laid the foundation of the Austrian state. After Adolph of Nassau (1292–98) followed Rodolph's son, Albert I. (1298–1308), under whose reign the Swiss Confederation was formed, which later was vindicated so gloriously against Austrian pretensions in the battles of Morgarten (1315) and Sempach (1386). With Henry VII. (1308–13) the house of Luxemburg acquired the German crown; its members held Bohemia, Moravia, and Silesia in their possession. After him, Ludwig of Bavaria (1314–47) and Frederick of Austria contended for the German crown. The former was victorious in the battle of Mühldorf (1322), and by the establishment of the electoral body of the empire in 1338 he made the election of the German emperor independent of the papal confirmation. With Charles IV. (1347–78) of the house of Luxemburg, Bohemia reached its point of culmination. He founded the University of Prague in 1348 (the first university in Germany) and in 1356 published the Golden Bull, by which the election of the German king by seven electors (four secular and three ecclesiastical) became finally settled. His son, Wenceslaus (1378–1400), was too weak for the difficult circumstances. The mischief of club-law increased; associations of princes and lords originated; the Holy Fehme extended its authority beyond Westphalia; the Hansa, founded in 1241 by the maritime cities of the realm, acquired the dominion over the northern seas. Wenceslaus was deposed, and Ruprecht of the Palatinate was elected 1400–10. Then followed Wenceslaus' brother, Sigismund (1410–37), under whose reign the Councils of Constance (1414–18) and Bâle (1431–43) were held, in order to effect a reformation of the Church, which, however, did not take place. On the contrary, the result of the Council of Constance was the burning of Huss, and that of the Council of Bâle a compromise which ended the war of the Hussites. During the reign of Sigismund the house of Hohenzollern first came to Brandenburg in 1411. With Albert II. (1438–39) the house of Austria once more ascended the German throne, which it afterwards held till 1806, with a short interruption. Frederick III. (1440–93) was a feeble ruler. In his time Gütenberg invented the art of printing (1450), which exercised an immense influence on life in general, as the invention of gunpowder a century earlier (1350) by Berthold Schwartz had transformed the whole military system. Bohemia and Hungary were at this time governed by the celebrated kings George Podiebrad and Matthias Corvinus. Frederick's son, Maximilian I. (1493–1519), brought the period of club-law to an end by the declaration of the public peace of the country in 1495, and by the establishment of the imperial chamber or supreme court of the empire. By marriage he acquired Burgundy, to which the Netherlands belonged, and he witnessed the beginning of the Reformation by Martin Luther in Wittenberg (Oct. 31, 1517). The reign of his grandson, Charles V. (1519–56), was one of the most remarkable periods in the history of Germany, especially on account of the rapid development of the Reformation. At the Diet of Worms (1521) Luther defended himself with undaunted courage; at that of Speyer (1529) his adherents formally protested against decisions which were unfavorable to them; and at that of Augsburg (June 25, 1530) they publicly set forth their creed. Other remarkable events of his reign are the peasants' war (1524–25); the appearance of the Anabaptists at Münster (1535); the Schmalkaldian war (1546–47); the Agreement of Passau (1552); the Peace of Augsburg (1555); his several wars with France; and the counter Reformation which took place within the Roman Catholic Church, partly through the establishment of the order of Jesuits, partly through the Council of Trent (1545–63), whose decisions have ruled the Roman Catholic Church up to our days. The empire of Charles V. comprised Germany, Austro-Hungary, the Netherlands, Belgium, Spain, and large portions of Italy. In 1556 he retired, leaving Spain and the Netherlands to his son Philip, and Germany and Austria

to his brother, Ferdinand I. (1556–64). Maximilian II. (1564–76) was rather indifferent with respect to religious matters, but under his son, Rudolph II. (1576–1612), the confusion increased, and under Matthias (1612–19) the Thirty Years' war broke out (1618–48). In the beginning the Roman Catholics gained such great advantage, through the emperor, Ferdinand II. (1619–37), the duke (later elector) Maximilian of Bavaria, and the generals Tilly and Wallenstein, that about 1630 it seemed as if the total fall of the Protestant cause was at hand. But the courageous interference of the Swedish king, Gustavus Adolphus, saved Protestant freedom in Germany: Tilly and Wallenstein died in 1632 and 1634, and the intermeddling of France after 1635 changed the whole character of the war, and transformed it from a religious to a merely political contest. By the Peace of Westphalia (1648) the Lutherans and the Reformed (adherents of the Swiss Reformers, Zwingli and Calvin) obtained free exercise of religion, but large tracts of land were lost to France and Sweden, the German countries were to a great extent withdrawn from the influence of the emperor, and Switzerland and the Netherlands were acknowledged as independent states. After Ferdinand III. (1637–57) followed the slow and hesitating Leopold I. (1657–1705), under whom Germany sank to the lowest stage of degradation. Louis XIV. of France pursued at that time a policy of aggrandizement. In the midst of peace he took (1687) the free imperial city of Strasburg, and with unheard-of cruelty devastated (1689) by fire and sword the Palatinate, the most beautiful part of Germany. And yet the Germans did not rise to resistance. At the diet, which from 1663 to 1806 was always held at Regensburg (Ratisbon), the princes were represented only by deputies. The most important business was delayed and procrastinated, while personal interests were pursued with great eagerness. The immorality and prodigality of the French court were imitated by every petty court in Germany; the French language was adopted in court circles; and German princes allied themselves with France against the emperor and the empire. And it was of very little comfort to the national feeling that the Turks, who in 1683 laid siege to Vienna, were thrown back by the Hungarians and vanquished by Prince Eugène of Savoy. Neither was the victory which the elector of Brandenburg, Frederick William, gained over the Swedes at Fehrbellin (June 28, 1675) so very impressive, though thereby he became the founder of the Prussian state. His country did not assume the name of Prussia, however, until Jan. 18, 1701, when Frederick I. was crowned king. At the same time as Prussia grew into a kingdom two great wars devastated Europe. The one, the Northern war, which raised Russia at the expense of Sweden, and introduced her among European states, touched the German empire only on its north-eastern boundary; while the other, the war of the Spanish succession (1701–14), was fought chiefly in Germany. As the English and the Germans, allied against France and led by Marlborough and Prince Eugène, won victory after victory (Hochstädt 1704, Turin 1706, Malplaquet 1709), it seemed as if Germany would rise again under the reign of Joseph I. (1705–11) and reconquer a large part of the territory which she had lost to France. But with the fall of Marlborough (1711) a reverse of fortune took place, and under the emperor Charles VI. (1711) she was compelled to make an unfavorable peace with France. While, at this time, the prodigality of most German courts had reached an unexampled height, and while Saxony had lost her prominent position among the Protestant states of Germany by the conversion of the dynasty to the Roman Catholic confession in 1697—in order to get possession of the crown of Poland—the king of Prussia, Frederick William I. (1713–40), laid a solid foundation by parsimony, careful administration, and the establishment of an excellent army; and on this foundation his son, Frederick the Great (1740–86), built up a state which soon ranked among the great powers. When, in 1740, the male line of the house of Habsburg became extinct, Frederick II. laid claim to some parts of Silesia. By the first Silesian war (1740–42) he took them; by the second (1744–45) he kept them. Also Bavaria, whose elector was emperor of Germany, under the name of Charles VII., from 1742 to 1745, demanded certain territories of the Austrian countries. Bavaria was supported by France, and the war of the Austrian succession began (1740–48). But Bavaria soon retired from the war; Saxony and the maritime powers allied themselves with Maria Theresa; and in 1747 the first Russian army, also in aid of Austria, reached the Rhine. By the Peace of Aix-la-Chapelle (1748) France gave up all her conquests in the Netherlands. Three years earlier the husband of Maria Theresa, Francis I. of Lorraine, had been elected emperor of Germany (1745–65). Meanwhile, Frederick the Great of Prussia had used the eleven years of peace to prepare himself for the Seven Years' war (1756–63), in which Austria, allied with Russia, France, Sweden, and most of the smaller German states, tried to humiliate Prussia, whose only ally was England, and make her an insignificant state. But Frederick proved himself superior in the field to all his enemies, and although he lost many battles, and more than once brought Prussia to the very verge of ruin, yet he was not to be crushed. The defeat at Kollin (June 18, 1757) was followed by the victories at Rossbach (Nov. 5, 1757) and at Leuthen (Dec. 5, 1757); the defeat at Kunersdorf (Aug. 12, 1759) was followed by a series of marches and strategical camps which reduced almost to nothing the advantages the enemy had gained over him. Russia, Sweden, and France retired from the field, one after the other, and at last Austria herself was compelled to make peace at Hubertsburg (Feb. 15, 1763). From that moment there existed in Germany a destructive dualism, until in 1866 Prussia acquired a decided superiority. The emperor, Joseph II. (1765–90), a son of Maria Theresa, tried by education, religious freedom, and political reforms to bring his people up to the standard of the age. But he was less successful in this respect than the Prussian king had been, partly because he introduced his reforms with some violence, partly because he was thwarted by the Roman Catholic clergy, but more especially because in Austria no preparations had been made by his ancestors. Nevertheless, his reforms were of great importance to Austria, and in spite of a violent reaction they still form the foundation of Austrian life. Both Frederick the Great and Joseph II. took part in the first division of Poland (1772), in which, however, as in the two following (1793 and 1795), Russia received the lion's share. But the attempts of Joseph II. to annex Bavaria to Austria were frustrated by Frederick the Great. In Prussia the weak Frederick William II. (1786–97) followed Frederick the Great, but, although the country was much enlarged by the division of Poland, yet it was brought near to ruin by interior mismanagement, by prodigality, intolerance, and false administrative measures. After the short reign of the emperor Leopold II. (1790–92), Austria, under the emperor Francis II. (1792–1835), and Prussia united into a war against France when the Revolution of 1789 had brought all the states of Europe into fermentation. Royalty, which was in danger in France, and which was to be helped by the allies, was finally overthrown by the first small successes of the Prussian arms. A republic was declared, and Louis XVI. was beheaded. In the field fortune changed. The Prussians had to leave France, the Austrians Belgium, and the jealousy between them prevented any energetic action. Meanwhile, the Reign of Terror in France had passed away, and Prussia made peace with the French republic, while Austria and England continued the war. But after the victories of Napoleon Bonaparte in Italy in 1796, which opened the way for him into Styria, Austria concluded peace at Campo Formio in 1797, and gave up Lombardy, for which it received Venice. In 1799, however, Austria again began war against France, this time in connection with Russia and England. The French were repeatedly defeated both in Italy and Germany, but, on account of a quarrel between Austria and Russia, the Russian troops under Suwaroff were withdrawn, and soon after Napoleon Bonaparte returned from Egypt and became first consul. By the battle of Marengo (June 14, 1800) Austria lost Italy, and after the disaster at Hohenlinden (Dec. 3, 1800) she was compelled to conclude the Peace of Lunéville (1801), by which the Rhine became the boundary of France. Several German princes lost their possessions on the left side of the Rhine, but they received ample indemnification on the right—together with some former Italian princes—by the mediatization of the ecclesiastical states and the imperial cities. In 1804, Napoleon became emperor of France. A third coalition against France was dissolved by the defeat of Russia and Austria at Austerlitz (Dec. 2, 1805), and Austria lost large territories by the Peace of Presburg; Bavaria and Würtemberg were made kingdoms. In 1806, Napoleon united all the South German states into the Rhenish Confederation, under his own protectorate. Numerous mediatizations of minor states took place, and (Aug. 6, 1806) the emperor Francis abdicated his dignity as chief of the empire and assumed the title of emperor of Austria. Prussia, under Frederick William III. (1797–1840), had hitherto lived in peace with France—not to her own advantage—but in 1806 she felt compelled to declare war, and before the Russians could come to her support she was completely defeated at Jena and Auerstädt (Oct. 14, 1806), and thoroughly subdued, owing to the unexampled cowardice and treachery of many of her generals. After the battles of Eylau and Friedland (Feb. 8 and June 14, 1807) peace was concluded at Tilsit, by which Prussia lost one-half of her possessions, and only kept the other half on very hard conditions. After the peace, however, Baron von Stein effected a thorough regeneration of social

and political life in Prussia, and Scharnhorst, supported by Blücher and Gneisenau, became the founder of a new military system. In 1809, Austria ventured once more on a war with France. The archduke Charles won the battle of Aspern (May 21, 1809), but at Wagram he was defeated (July 5, 1809), and by the Peace of Schönbrunn, Austria lost other territories and became totally excluded from the sea. In 1810, Napoleon incorporated the Hanseatic cities of Bremen, Hamburg, and Lübeck into his empire, but on the retreat from Russia, after the burning of Moscow, in 1812, he lost his whole army, and then began the German War of Deliverance. In the beginning, Prussia and Russia fought alone against Napoleon, and they were not successful. They lost the battles at Grossgörschen (May 2, 1813) and Bautzen (May 20, 1813), and Davoust maintained himself in the important city of Hamburg up to 1814. But during the armistice from June to Aug., 1813, Austria and Sweden joined the coalition of the three armies—the chief army, under the Austrian Schwarzenberg in Bohemia; the army of the North, under the Swedish crown prince, the former French marshal, Bernadotte; and the Silesian army, under Blücher in Silesia: the last, though the smallest, turned the fortune of the war. Silesia was delivered by the battle on the Katzbach (Aug. 26). The French force pushed towards Berlin was defeated by Bülow and Tauentzien at Grossbeeren (Aug. 23) and Dennewitz (Sept. 6), and on Oct. 3, Blücher crossed the Elbe at Wartenberg, following the movements of the army of the North, while the main army, after the defeat at Dresden (Aug. 26) and the victory of Kulm (Aug. 29), pushed forward from Bohemia towards Leipsic. The battle of Leipsic (Oct. 16-19, 1813) decided the destiny of Germany and Napoleon. The allies followed the fleeing emperor into France, and after entering Paris (Mar. 31, 1814) they compelled him to abdicate the crown of France and retire to the island of Elba. By the Treaty of Paris the Bourbons returned to France, and German affairs were regulated, after a plan of Metternich, by the Congress of Vienna (1814–15). From this time, and up to 1848, the influence of Metternich, the Austrian minister, was predominant in Europe. The German Confederation developed no life. The diet, sitting at Frankfort-on-the-Main, suppressed every free movement. The promised constitutions were never given. By the establishment, however, of the Zollverein in 1833, Prussia laid the foundation of united Germany, at least with respect to political economy. In Austria, Ferdinand I. ruled from 1835 to 1848. In Prussia, Frederick William IV. inaugurated a powerful ecclesiastical reaction, which, after the transient success of the revolution of 1848, extended also to political affairs, and placed Prussia under the influence of Russia and the Ultramontanes. In 1848, Prussia had become a constitutional state, but its constitution was later altered under the influence of the reaction. The national constitution of the German empire, which in 1849 was planned in Frankfort-on-the-Main, was never introduced into real life. Revolutions in several places of the empire in 1848 and 1849 were subdued by the aid of Prussia. The war with Denmark about Sleswick-Holstein ended favorably to Denmark. In 1851 it seemed as if Germany would glide quietly back into the old track. In Prussia, William I. governed from 1857 as prince-regent instead of his brother —from 1861 as king. He first tried to return to constitutional views, but when the government would not carry the army law, he appointed, in 1862, Bismarck minister of state, and a violent reaction took place in Prussia. In 1863, however, Bismarck found an opportunity of showing his foreign policy. When the Danish dynasty became extinct he disputed, together with Austria, the claims of Denmark on the duchies of Sleswick and Holstein, and by the war of 1864 he acquired these two countries for Germany. Then there arose a quarrel between Prussia and Austria, as Prussia wished to annex the two duchies, while Austria favored the claims of a collateral branch of the Danish dynasty (Augustenburg). In June, 1866, the war broke out, and after routing the Austrian army under Benedek at Königgrätz or Sadowa (July 3), the Prussian armies appeared before Vienna. By the Peace of Prague (Aug. 23, 1866) Austria retired altogether from the German Confederation, and acknowledged the changes and annexations which Prussia had made in Germany. Prussia now established the North German Confederation, whose constitution later was extended, with some modification, to the whole German empire, and concluded treaties with the South German states. But while in the interior the contest between the representation and the government became settled, the relations to France became every day more difficult. In July, 1870, France declared war (see FRANCO-GERMAN WAR), but the surprising success of the Prussian arms brought about, what the war from the French side was intended to prevent, the unity of Germany. In Dec., 1870, treaties were concluded between Northern and Southern Germany by which the new German empire was founded, and (Jan. 18, 1871) the king of Prussia, then residing at Versailles, was proclaimed emperor of Germany, under the name of William I.

GUSTAV NEUMANN.

Ger'man Flats, tp. of Herkimer co., N. Y., has 11 churches and 3 cheese-factories, and contains the important villages of ILION and MOHAWK (which see). It was settled by Germans in 1722. Pop. 5718.

Germa'nia was used by the Romans as the common name for the vast but half-unknown regions extending between the Rhine and the Vistula, and from the Danube to the North Sea and the Baltic. The first time they made any real acquaintance with the inhabitants of this territory was through Cæsar's campaign in Gaul. Several Germanic tribes, the Triboci, Nemetes, and Vangiones, had at that time crossed the Rhine and settled in the district between that river and the Vosges Mountains, while the Marcomanni, Tencteri, and Usipetes pushed forth through Belgium. Cæsar subdued the former, together with the Gauls, and the latter he drove back on the other side of the Rhine. The Usipetes, however, soon returned, followed from the E. by the Catti and Cherusci, and from the N. by the Frisii, Batavi, and Chauci. A new series of campaigns, directed solely against the Germanic tribes, was then undertaken by Drusus (from 16 to 9 B. C.), and the result was that the Roman conquests in Germania were extended N. to the Elbe and E. to the Taunus Mountains. Forts were erected, canals dug, roads constructed, bridges built, and Roman civilization began to make great strides into Germania; but when, a few years later, Varus tried to subject the inhabitants of these newly-conquered regions to the forms of Roman provincial administration, they rose at once in a terrific rebellion. Arminius, the chief of the Cherusci, defeated Varus and his legions at the Teutoburger forests, and the whole northern portion of the Roman possessions in Germania, from the Elbe to the Weser, made itself independent. Although Germanicus was very successful in his attempts at restoring the Roman authority in Germania, yet after the defeat of Varus, the Roman policy became defensive in Germania. The Germanic tribes began to associate, and the Marcomanni and Quadi of the second century, the Alemanni and Franks of the third, the Vandals, Suevi, and Heruli of the fourth, and the Goths and Longobards of the fifth, were not small tribes, but large nations. And when the Germanic tribes, pressed from the E. by the Slavi, went westward and southward, the Romans were incapable of withstanding them. The Roman empire was dissolved, and Germanic states established in its provinces. The ideas which the Romans had formed of these neighbors of theirs, whom they generally considered as mere barbarians, and which are known to us through the writings of Cæsar and Tacitus, seem to have been pretty nearly correct. Tacitus noticed that they erected no temples and had no idols, but believed in a future life and in eternal justice—that they built no cities, and had no manufactures or trade, but held their women and households in deep respect; and indeed these four points are the foundation of the character and history of the ancient inhabitants of Germania.

CLEMENS PETERSEN.

Germanic Union. See GERMAN EMPIRE, by G. NEUMANN; PRUSSIA.

Ger'man I'vy, a climbing plant often seen in parlor culture, and popular for its rapid growth and ivy-like leaves, is in reality not an ivy at all. It is the *Senecio scandens* (order Compositæ), a native of South Africa. Out of doors it is very handsome, but will not stand the lightest touch of frost. It occasionally puts forth clusters of yellow flowers.

Ger'man Lan'guage and Lit'erature. The German language belongs to the Teutonic branch of the Indo-European family, and is a sister of the Gothic, which possessed literary monuments in the fourth century, but died out entirely in the ninth; and of the Icelandic, whose oldest literary production, the elder Edda, dates from the end of the eleventh century, but which is still spoken in its original form in Iceland, and is the mother of modern Danish and Swedish. The German language consisted, and consists still, of two dialects—High German, spoken in Suabia, Bavaria, Austria, and parts of Franconia; and Low German, spoken in the northern and north-western parts of Germany. The latter, which developed into the Anglo-Saxon, the Dutch, the Flemish, etc., has produced one remarkable literary monument, the *Heliand* (*heiland*, "saviour"), a Christian epos from the ninth century, written in alliterative verses, and still existing in two manuscripts—one in Munich, and one in the British Museum. It was published in 1830 by A. Schmeller in Munich. But besides this one production, the Low German dialect has left only feeble traces of itself in the German literature. It had to submit very early to its nobler and more powerful brother-dialect,

the High German. High German, in its second form (known as Middle High German), was used by the Minnesingers in the twelfth and thirteenth centuries, by the Meistersingers in the fourteenth and fifteenth, and in the sixteenth century Luther's translation of the Bible (1534) made it, in its third form (known as New High German), the literary language of the German people, the medium of German civilization. In the oldest shape under which we know it, belonging to the period between the ninth and the twelfth centuries, it differs considerably from the Gothic and Icelandic, both in its grammatical forms and in its phonic method. It has no passive, no dual, and no vocative, but a bewildering exuberance of diphthongs. One of the most characteristic elements, however, of the phonic system of the German language, the famous *sch*, did not appear until the following period, between the twelfth century and the Reformation, when "slagen" became *schlagen*, and "swimmen," *schwimmen*. In the shape in which it was finally fixed by Luther and the other Reformers, it was not founded on any local or individual variety. Luther started from that form of the language which was used at the court of electoral Saxony and by the people of the district of Meissen, but to this he added from other sources whatever his great logical acuteness, powerful poetical intuition, and vivid musical sense told him could and would be generally understood. It was considered necessary to translate the translation into Low German, and in the first spurious reprints of the original edition many expressions are either altered or explained in notes. But hardly one hundred years elapsed before both the explanatory notes and the translation into Low German wholly disappeared. In its present shape the German language is exceedingly rich both in materials and in forms. In the latter respect it is perhaps somewhat encumbered, but with respect to materials it contains more words than either the English or the French language, and it possesses what those two languages have lost, or, at least, only retain in a very meagre state—the power of forming new words. A new idea must in French and English generally be expressed by a word borrowed from another language; a new shade of an old idea by a periphrasis. The German language can coin new words in its own mint, and be sure to have them accepted—that is, understood—by all its citizens. In its speech the German language is rather hard, but manly, energetic, and dignified. It has a great pathetic power, though it is somewhat liable to become harsh and guttural in the expression of passion, and sentimental or wailing when it tries to be sweet. Its style—although the German literature contains examples of style unsurpassed in any other literature, dead or living—is nevertheless, in its general standard, inferior to that of most other European languages. Its richness in grammatical forms makes an intricate and highly artificial construction of sentences possible; and that imitation of Latin eloquence which under Dr. Johnson's leadership passed through the English literature as a temporary aberration, seems in the German language to have become the fixed character of its style. Schiller's prose is often monstrous; Richter's is generally intolerable. And this false tendency was furthermore aided by the German philosophy. As a too pedantic application of the logical forms of thinking generally ends in the most ridiculous logical blunders, so a too minute reflection on the wording of an idea generally makes the expression vague and verbose. This fate has befallen the German style since it ceased to write in German words, and began to write in Latin definitions.

The history of the German literature begins with, or shortly after, the Reformation. Before that time there was a literature, but it had no history. It was produced by sporadic efforts, and it consisted of isolated attempts. During the first period, from Charlemagne to the house of Hohenstauffen—that is, from the ninth to the twelfth century—it was the Church that made the literature; during the second, from the twelfth to the fourteenth, it was the court; and during the third, before and under the Reformation, it was the middle class, the burghers, the workshop. But the literature of the Church had no influence on that of the court, and the literature of the court none on that of the shop. There is no continuity. The true literary spirit, which creates a literature because it has made a literature necessary, and which lives on uninterruptedly as long as the people live, did not awaken until the Reformation. Many of the preliminary attempts are interesting, however, at least in an historical respect, and so is the whole literary life which sprang up under the Reformation. Charlemagne took some interest in the popular songs and mythological lore of the German nations, and had a collection made. But his principal task was to introduce Christianity into the country, and to produce order by curbing that spirit of turbulence which had produced the songs he collected. And to his successors these remnants of paganism and barbarism were objects of utter abhorrence. It was translations of Latin prayers and hymns which were needed, and this literature the monks undertook to furnish. The highest they contrived to produce was a paraphrase in German verses by Ottfried of the Gospels, which is remarkable because the Old German versification, with alliteration, has here given place to the mediæval fashion of making verses with end-rhymes, which was a Roman invention. Much more original life was shown by the Minnesingers between the twelfth and fourteenth centuries. With them the national spirit of the German people breaks forth for the first time in spontaneous poetical inspiration. The personal characters of the emperors of the house of Hohenstauffen, proud, daring, and adventurous; their wars in Italy and the Orient, often victorious and always energetic; their magnificent court and their splendid hospitality, gathered around them the most gifted and most advanced spirits of the people, thus at once calling forth a common individual development and creating a widespread popular influence. The Crusades brought the German warriors into contact with foreign climates and countries more luxurious and dazzling than their own, and with foreign characters more refined in habits and ideas than they were themselves; and when they returned home they brought with them treasures of wonder and adventure which pressed on their hearts for utterance. In their intercourse with the Spanish, English, and French knights they learned the arts of chivalry, especially the art of poetry. How to lay a tune, how to form a strophe, how to build a verse, how by this means to give the utterance the same wonderful charm as had the inward vision,—this they learnt, and the result was a profusion of lyrical songs in praise of love, honor, and fidelity, and of ballads revealing the wonders which life contained. The subjects of these ballads, especially of those which assumed a more decidedly epic character, are the same that we find in the chivalrous poetry of Provence, of Flanders and Champagne, of Brittany, etc. It is the traditions of King Arthur and his knights, of Charlemagne and Roland, etc., but in the German treatment these subjects are most curiously mixed up with traditions coming from the North and originating from the old Teutonic paganism. The most celebrated of these knightly poets were Walter von der Vogelweide, Hartman von der Aue, Wolfram von Eschenbach, and Conrad von Würzburg. The highest production of the period is the *Nibelungenlied.* An excellent collection of minor songs and ballads is given by Lachmann and Haupt under the title *Des Minnesangs Frühling* (Leipsic, 1857). With the fall of the Hohenstauffen dynasty the vital nerve of the art of the Minnesingers was deadened; the composition of lyrical songs continued for some time, but the contents became sentimental and affected, and the form lost all charm in its utter artificiality. In the fourteenth century the art died out entirely. Meanwhile, the development of the cities had reached a considerable height; commercial and industrial associations or corporations had been formed. The guilds presented themselves to the government, to the other estates, to the world at large, not only as elements of order and progress, but as a power. Although vastly inferior, both in privileges and in institutions, to the nobility and the clergy, still the burghers were now acknowledged as the third estate, and two circumstances, both of the greatest consequence, made it possible for literature, after it died out in the Church and the chivalry, to plant itself among the burghers. In the fourteenth century the University of Prague was founded, and similar institutions were soon after established in other parts of Germany. But of all institutions, the university is that one through which the third estate has received its highest mental development and exercised its greatest social influence. In the fifteenth century the art of printing was invented. Books became cheap; literature was no longer a privilege of the rich. At last the historical movement made the decision. The Reformation originated from and addressed itself to the third estate principally, and thus literature became the business of the burghers. It did not, perhaps, gain so very much by this change. With the exception of certain books of edification and confession, which are as dear to Protestants as books can be, and of some hymns, which any man of religious feeling and poetical sense must bow to as among the highest inspirations of religious poetry, the rest of the literature of this period is rather tame (even its satires) and clumsy (even its chronicles). But it was eminently practical. It derived its authority not from its enthusiasm and power of charming, but from its purpose and power of instructing. Its character was thoroughly didactic, but its influence was very great and beneficial, both as a combatant in the religious controversy and in general as a propagator of civilization. It worked in two different forms—the dramatic and the lyric—but the productions of the first form were without comparison the most important.

The small religious drama, representing some biblical event, which used to be performed in the church and by the clergy on the great Christian festivals, had grown during the Middle Ages into the large mysteries and miracle plays, which, containing many profane, even comical elements, were performed on the market-place by the guilds. To read these dramas is not very entertaining, but the picture of their performance is impressive—the immense scaffold, gorgeously ornamented and illuminated with fireworks and rockets; the deep earnestness and piety with which the actors entered into their parts; the devout fervor and enthusiasm with which thousands of spectators sat the whole day through before this stage as before a revelation. These mysteries were succeeded, during the period of the Reformation, by a much tamer sort of small dramas, which bore the same relation to them as the lyrics of the Meistersingers to the lyrics of the Minnesingers. The lyrical productions of the Meistersingers are extremely artificial expositions of dry and often narrow moral ideas, but they were held in very great esteem in their own time. Hans Sachs (1494–1576), a shoemaker in Nuremberg, the son of a tailor, and the master of all Meistersingers, wrote 4275 such pieces, which he published on fly-leaves. But his 208 dramas or dialogues in prose are much more interesting. They have sometimes humor, sometimes character, often a naïveté we must love, and often a naïveté irresistibly ludicrous, as when the God Father takes Cain and Abel on his knees and examines them in Luther's Catechism. But from the German mysteries came no Shakspeare, from the German Fastnachtspiele, no Molière. All the germs which the period contained were first frost-nipped by the tyrannical and barren dogmatism into which the fresh passion of the first Protestantism very soon became petrified, and then entirely cut off by the horrors of the Thirty Years' war.

But before the war ended literature made a new start in Germany, and this time with success, so far as it has since moved on continuously through a natural evolution of action and reaction, steadily enlarging its principles, developing its ideas, perfecting its forms, and increasing its influence. Compared with the great political and social agents which during the three former periods stimulated the literary spirit into action, the present starting-point seems rather small. Literature now begins, under the shelter of the university, as the business of the learned and addressing itself only to the educated class. Of course, the principle inherent in this situation is too narrow, and it may be that for a time the progress of the German literature was somewhat impeded and its total character somewhat impaired thereby, but there was no other starting point, and the issue is consequently exempt from all criticism. With Martin Opitz (b. 1597 at Bunzlau, and established in different positions at Liegnitz, Breslau, and other cities of Silesia until his death in 1639) the movement began. He was a man of solid learning, elegant education, much experience, and some talent. His *Comfort under the Miseries of War* is not without some strains of genuine warm feeling, and by his book on the *Art of German Poetry* (1624) he laid the foundation of this art. Originally, the German language was quantitative, like the Latin, but during the previous centuries the quantity of its syllables had been tampered with, the sense for it was lost, and the art of making verses was reduced to the mere counting of the syllables. This did very well as long as all verses were destined to be sung, but for verses without a tune the method was utterly insufficient. Opitz showed that the accent of the syllables would form as potent a principle of versification as their quantity, and thus he founded the metrical science of all modern Teutonic languages. A number of men, all of learning, some of talent—Paul Flemming (1609–40), Andreas Gryphius (1616–64), Philip von Zesen (1619–89)—gathered around him, and formed the so-called "first Silesian school." Literary societies were established at the universities and at the courts, and much was done for the purification of the language. Something, too, was done for the development of taste, but here was the weak point. The school could do nothing but imitate. Perhaps only a few people could feel that an imitation in unpolished German of the polished forms of the Italian and French languages, and an imitation in rough German elements of the refined ideas of Italian and French culture, resulted in caricature; but by degrees most people felt that it resulted in emptiness, and the reaction came in the form of the second Silesian school. At the head of this reaction stood Hofmann von Hofmannswaldau (1618–79) and Kaspar von Lohenstein (1635–83). The former wrote only lyrical poems, the latter romances and dramas. Neither of them possessed a truly creative imagination. The impression of life, reality, and truth which was missing with the poets of the first Silesian school they endeavored to produce by frivolities and crudities. Wild bombast took the place of the cold, flat tirade; violent reverses of fortune were substituted for the tame development of human destiny. Scream, grimace, murder, and blood filled the scene, but of character and passion there was none. Lohenstein's influence was enormous, however. Strolling bands of clowns and tragic howlers, who, instead of performing regular dramas, simply filled by improvisation a dramatic scheme, succeeded to the performance of mysteries and miracle-plays by the guilds, and found great favor. Lohenstein and his disciples furnished these bands with dramas, and the theatre actually made a step forward. Still greater was his success with his romance *Arminius and Thusnelda*, which called forth a flood of similar productions, and probably had the good effect that thereby people were allured to read books, and to seek in literature, if not an education, at least an entertainment. There was a correlation between the first Silesian school and the philosophy of Leibnitz, and between the second and the pietism of Spener and Francke, but only a very elaborate analysis could show the connection. The lines in which German civilization moved on were as yet widely separated from each other, and the literature proper, confined to that which concerns the general education, and exclusive of the special development of the sciences, was as yet only a feeble instrument of civilization, not the complete mirror of civilized life. That point it did not reach until the end of the next period, with Kant, Winckelmann, Lessing, and Herder. It had to make over again, but in a higher sphere and on an enlarged scale, the movement which it had performed already once through the first and second Silesian schools. The wildness, savagery, and confusion to which the second Silesian school had delivered over the German literature was tamed and reduced to order by Gottsched (1700–66), a disciple of the philosophy of Wolff. The theatre was his passion. By his *Cato*, the wonder and pride of its time, and by his numerous translations from Corneille, Racine, and Voltaire, he raised the theatre in public estimation, and helped the strolling bands to conquer a settled position as court-establishments: which of course was a circumstance of the utmost importance for the development of the theatre. But his influence extended far beyond these limits. By his handbooks and compendiums he made literature, criticism, and æsthetics interesting to people at large, and constituted himself a literary pope. He had no genius, however; he imported all his ideas from France. But without genius no literary standpoint can be vindicated. Jakob Bodmer (1698–1783), Jakob Breitinger (1701–76), and others formed the so-called Swiss Association in opposition to him. They considered the epos as the highest poetical form, and the English literature as containing the most perfect artistic types; and they were exceedingly positive in their views—the more so as they had as little genius as Gottsched. At last they attacked him, and a very hot controversy ensued. Several literary and critical periodicals were established, and the attention and interest of the public were roused. At the same time appeared Baumgarten's *Æsthetica*, by which that beautiful science which is called æsthetics was founded, and which gave to all literary and critical questions a deeper and broader signification. A quarrel, however, about whether the epos or the drama is the highest poetical form, or whether the French or the English literature contains the most perfect artistic types, can only end satisfactorily in one way. In disputes about æsthetical principles only *argumenta ad hominem* are decisive—that is to say, only creations of genius, which strike but argue not, can produce a true decision. And in this way ended the controversy between Gottsched and the Swiss Association. Two poets appeared—Klopstock (1724–1803) and Wieland (1733–1813). They did not belong to the two parties, but they represented pretty well the two principles at issue. Both of them had genius. Klopstock, heavy but deep, obscure but inspired, roused the enthusiasm for religion and Fatherland, and called forth ideas which elevated the mind and enlarged the heart. Wieland, light but elegant, sometimes frivolous but always brilliant, awakened a sense for clearness and gracefulness; and, flitting about from ancient Greece to mediæval Germany, he always brought brightness and joy along with him. They were great contrasts, these two men, but they did not contradict each other; it was possible to love them both. And this startling discovery found its full and brilliant explanation in the criticism of Lessing (1729–81). The first element of beauty is truth. All that is true to nature, whether its name is Klopstock or Wieland, is capable of impressing our imagination. But in order to produce an impression which is pure and full, the truth must be formed in accordance with the laws inherent in that special art which is to represent it. With merciless analysis he dissolved the praised forms of the French models into ridiculous conventionalities, and with an almost cruel irony he compared the ideas of Voltaire

with those of Shakspeare and Sophocles, and asked, Where is the truth? At this time the civilized class of the German people had reached a standpoint of taste superior to that occupied by any other nation. They displaced Voltaire, they reinstated Shakspeare; they infused new life in Greek art. And meanwhile the different agents of the German civilization drew nearer together and began to enter into communication. The battle of Rosbach and the *Kritik der reinen Vernunft* were not isolated influences any more. They met each other in the same consciousness, and began to work together. And thus the German public was not only capable of enjoying a great literature, but also able to produce it.

In the latter part of the eighteenth century an epoch begins in the German literature which may be compared with that of Pericles in Greece and Elizabeth in England, and which in the genuine excellence of its productions and their wonderful variety far surpasses that of Augustus in Rome and that of Louis XIV. in France. It is the period of Goethe (1749–1832). One of the most striking characteristics of the literary phenomena of this period is their great complexity. It was great in every respect. History (John von Müller, Schlosser, Ranke), philology (Wolff, Voss, Hermann, Lachmann, Böckh), theology (Schleiermacher, Neander), philosophy (Fichte, Schelling, Hegel), and the exact sciences (Alex. von Humboldt) were cultivated, not only with success, but with genius. New ideas broke forth everywhere. And with this brilliant state of the intellectual life the development of real life corresponded. In spite of long wars and great defeats, industrial and commercial business prospered, and in politics and religion and on every field of practical life new and powerful tendencies rose. Of this immense activity the literature of the epoch is a true mirror. There is a new moral system in Schiller's earlier dramas; there are politics and theology in the lyrical songs of the romantic school. The agencies of actual life and the results of scientific research, in all their diversity and singular intermixture, formed the ideas of the literature. But in spite of the great complexity which this circumstance gives to all literary phenomena of this period, still the whole epoch centres in Goethe, and all its productions may be classified with relation to him. The intimate co-operation of Goethe and Schiller (1759–1805) actually governed the German literature through several years. But while every one of Goethe's larger works formed a school, and became the starting-point of a new tendency, the direct influence of Schiller is comparatively small. They were very different, these two men, but they were not contrasts; by their differences they supplemented each other. In nature and history Schiller always searched after the law, while Goethe always looked at the life. The objective development of the necessary laws and their influence on human destinies form the fundamental construction of Schiller's dramas, all of which are historical in the strongest sense of the word, with exception of two of his earliest tragedies, in which the subject is not taken from history. In Goethe's two great historical dramas, *Götz von Berlichingen* and *Egmont*, it is the rich variety of circumstances, which like plants grow differently under a different sun and in a different soil, and their influence on human character, which form the centre. Both aspects found followers. The most prominent of Schiller's disciples are Christian Grabbe (1801–36), Friedrich Hebbel (1813–63), Friedrich Halm, and Heinrich Laube. With the two latter the conflict between the general law and the individual passion is generally somewhat tame—with the two former generally somewhat exaggerated. Among Goethe's followers there was one, Heinrich von Kleist (1776–1811), of eminent talent both as a dramatist and as a novelist. In one point Goethe's and Schiller's aspect of history coincided—namely, in their view of the antique world. It was impossible here to emphasize differently the working of the law or the splendor of the life, since the reconciliation of the objective law and the subjective passion to perfect harmony formed the fundamental idea of antique civilization. From Goethe's *Iphigenia*, and from his and Schiller's ballads, issued not only a poetical school, but a broad tendency of civilization, whose most eminent representative in the literature was Franz Grillparzer (1790–1871).

In strong opposition to Schiller, but in sympathy with Goethe, and actually inspired by several of his works, especially by *Faust*, developed the Romantic school, comprising a great number of highly gifted men—poets, critics, historians, philologists, and philosophers. Their intoxication with nature; their enthusiasm for all strongly marked traits of nationality, especially for the picturesque Middle Ages; their high respect for art as one of the principal forms of the human mind,—all the different elements of their creed they derived from Goethe, but he himself kept aloof from those exaggerations which made his ideas romantic. With him love of nature became a deep and patient study of natural philosophy; with the romanticists it grew into mysticism and demonism. To Goethe the Middle Ages were a rich mine of splendid poetical materials; to the romanticist they represented the highest type of social life. Many members of the romantic school turned Roman Catholics, and in politics they all favored reactionary tendencies. The idea of art as one of the principal forms in which the human mind lives and manifests itself they mixed up with Fichte's doctrines of the world-creating Ego, and the result was a deplorable contempt for all objective authority. Considered as a whole, the school was more critical than productive. Of the works of the two brothers Schlegel, August Wilhelm (1767–1845) and Friedrich (1772–1829), nothing has any interest now but their critical, historical, and philosophical essays. Of the works of Ludwig Tieck (1773–1853), the novels are still entertaining by their elegant irony, but his name is best known as a dramatic critic and as an excellent translator. Novalis (1772–1801), Clemens Brentano (1778–1842), E. T. A. Hoffmann (1776–1822), Lenau (1802–50), and others were more exclusively poets, but none of them possessed a very comprehensive or very intensive talent.

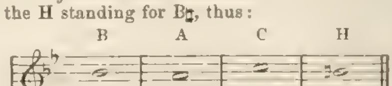
However brilliant this epoch is—and in philosophy, philology, theology, history, natural philosophy, almost in every field of intellectual life, it can show names corresponding to those of Goethe and Schiller—it always bears the character of being the literature of the educated class, not the literature of the people. It contains very few truly popular elements, such as those of Ludwig Uhland (1787–1862); those who try to be poets of the people become awkward, confused, and rough, like Ernst Moritz Arndt (1769–1860) and Friedrich Ludwig Jahn (1778–1852). So also think men like Ludwig Börne (1786–1837), Heinrich Heine (1799–1856), Julian Schmidt, and Wolfgang Mentzel; and the general tone of German criticism seems to indicate that this is felt and acknowledged in Germany, and a new starting-point, with a broader and truly popular principle, sought for. CLEMENS PETERSEN.

German Ocean. See NORTH SEA.

German Philosophy. See PHILOSOPHY, by HON. W. T. HARRIS, A. M., LL.D.

German Reformed Church. See REFORMED CHURCH IN THE U. S.

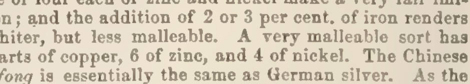
German Scale. With the Germans, the musical scale is represented by the letters A, *H*, C, D, E, F, G, not A, *B*, C, etc. It is customary with them to reserve the letter B for *B*♭, and its place is supplied by substituting the letter H. In German organ-music there are numerous fugues written in honor of the illustrious J. S. Bach, in which the leading theme or subject is formed from the four letters of his surname, the H standing for B♮, thus:



German Seventh-Day Baptists, a sect founded in 1728 at Ephrata, Pa., by Conrad Beisel, who led a secession from the so-called Dunkers. The members in 1732 entered a conventual life and adopted the Capuchin habit. Their principal settlement is at Snowhill, Franklin co., Pa. They take no monastic vows, hold property in common, keep the seventh day sacred, recommend celibacy, but do not forbid marriage. They are few in numbers.

German Silver, an alloy of variable constitution, designed as an imitation of silver. Eight parts of copper to three or four each of zinc and nickel make a very fair imitation; and the addition of 2 or 3 per cent. of iron renders it whiter, but less malleable. A very malleable sort has 10 parts of copper, 6 of zinc, and 4 of nickel. The Chinese *pakfong* is essentially the same as German silver. As the price of nickel has recently increased, various cheaper white alloys have to some extent superseded the use of German silver, which is, however, still extensively used in the arts.

German Sixth. In music, the augmented, superfluous, or extreme sharp sixth, comprising four whole tones of the scale, or one semitone more than the major sixth. It is the interval formed by D♭ and B♮, E♭ and C♯, F♮ and D♯, etc. Its elements, in harmony, are a major third, a minor third, and an augmented second, as in Ex. 1:

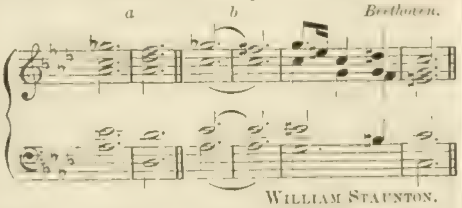
Ex. 1.


In harmony, this chord requires peculiar treatment, with great care, especially, in the management of its inversions. And as its form, when viewed apart from its grammatical relations, is precisely that of the ordinary dominant seventh, it may, by an enharmonic change (as of B♮ into C♭,

C♯ into D♭, D♯ into E♭, etc., or *vice versâ*), be made to produce the most surprising and beautiful effects. Thus, in Ex. 2, at *a* the *ordinary* progression of the dominant seventh on A♭ is given. But at *b*, by an enharmonic change of the seventh into the German sixth (by assuming G♭ to be F♯), a brilliant and unexpected transition is instantly made into the somewhat remote key of C major.

a *b* *Beethoven.*

Ex. 2.



WILLIAM STAUNTON.

German Theology. Thus far in its history, Protestantism has appeared under many different forms, which have generally presented themselves in separate churches. The principal among them have nevertheless a certain external unity, in that they have taken their rise especially among the Teutonic races and are the offspring of the Reformation. Nor do they lack a certain internal unity. As it was not a few individuals alone who accomplished the work of the Reformation, since the most influential Reformers would only be regarded as mere instruments for carrying out their modest share of the work of God, and they had been exalted almost against their will, through faithfulness in little things, to their far-reaching thoughts of reform; and as it was thus a comprehensive divine thought prepared in numberless places, and to be accomplished by the co-operation of the most favorable circumstances, that Christianity should be raised from its deep decline—yea, new chaos—to a higher stage in the appropriation of salvation and the building up of Christianity; so this one divine thought which created the Reformation has been the strong bond of union to all those who have attached themselves truly to the great reform movement of the sixteenth century, or would remain with it in unity of spirit, notwithstanding the manifold differences and divisions in Protestantism and its history. In spite of appearances to the contrary, there is to the present day a great family resemblance among all who call themselves Protestants. With good reason, therefore, may we speak of the unity of a Protestant or Evangelical Church, the more so as it is the common evangelical principle that the unity of the Church does not consist in the similarity of ceremonies or form of government of the Church, but in the preaching of the pure gospel and the administration of the sacraments in accordance with the principles of their institution. This one Evangelical Church, or Protestantism, has this distinguishing characteristic, that it would have the common features of Christianity apprehended by conscious personal appropriation, in the full sense of the word; that is to say, through the appropriation by the whole soul from centre to circumference, and indeed so that through the acceptance of the object of faith in our inmost souls the assurance of salvation is grounded in justification by faith in Christ, whereby immediate access to God is secured and enjoyed. And this assurance of salvation, as it opens up a new idea of God, of his acts, and of the destiny of mankind—thus a new conception of God and the world—contains no less a strong impulse of gratitude in order to the work of sanctification in one's self and for work in one's calling for the kingdom of God. This assurance of salvation is a knowledge which begets a new disposition, a new being, a new regenerate creature—which, recognizing itself, with a loving heart would engage in work. Christianity in Protestantism has advanced to a new stage in its appropriation by mankind, for it is not content either with a purely intellectual appropriation of Christianity, be it in a speculative form or more as a matter of memory, as is chiefly the case in the Greek Church, influenced by the Hellenic mind, or by a mere legal submission of the will to a system of doctrines, or even a practical ecclesiasticism, as in the Roman Catholic Church, influenced by the Jewish mind. Protestantism, on the other hand, as a unit, would be the personal expression of Christianity, above all as the religion of peace and reconciliation, and indeed of light and life from God.

Protestantism, so soon as the preparatory streams of the Middle Ages had worn for themselves deep beds and been combined in one channel, manifested itself in a twin form—the Lutheran, which on the whole prevailed in German Protestantism, and the Reformed. The one took possession of the eastern division of the German races, the other of the western. The difference is, that the Reformed confession carried out the evangelical principle more according to its realistic or practical side, or as a principle of the will, whilst the Lutheran confession, in accordance with the genius of the German people, unfolded it more according to the intellectual side. Thus, each has a relative advantage and a relative deficiency. If, in conformity with our task, we confine ourselves to German theology, and have to lay greater stress upon that which, within Protestantism as a whole, constitutes the peculiar strength of the German Church, it is not to exalt it above other confessions or to depreciate their superiority in other respects. We observe a prelude or type of German theology already in the Middle Ages in the German mysticism of Johann Eckart, Heinrich Suso, Ruysbroeck, Tauler, and the little book with the characteristic title *Ein Deutsche Theologey*, which Luther justly prized so highly. In the Middle Ages, indeed, men of the German race had distinguished themselves as scholastics, such as Albertus Magnus, Gabriel Biel, not to speak of Nicolaus Cusanus or Occam; but the Latin races then led the van in scholasticism. In analysis and the logical treatment of a subject they were in their element. The Teutonic (particularly the German) mind early tended to unite religious feeling or mysticism with speculation, together with a thoroughgoing reconciliation of faith and knowledge. The evangelical principle of faith unites faith and knowledge in the form of religious assurance; and in that it shows itself capable of establishing a Church, the soil is prepared upon which the peculiarity of the German mind may assert itself, and at the same time take up a position at the head of theology.

The evangelical principle ripened to its power of reform by satisfying the longing of the soul for immediate communion with God by the word of reconciliation through Christ and justification by faith; that is to say, in that the deep mystical tendency of the German mind attached itself in faith and faithfulness to historical Christianity, as it has its sources in the Holy Scriptures, thus possessing the truth no more outwardly as a law, but inwardly as an enlightening and quickening power. And so the principle of the Reformation reached its maturity in that faith and the Word, the Word and faith manifested and confirmed themselves in their necessary internal harmony. This is nothing else but what we now call the formal and material sides of the Protestant principle. The history of German theology is only to be understood from the movement of these constitutive factors. We distinguish in the following sketch a creative and formative period; a preservative and conservative period; and finally, in the last century, a critical or destructive period. The last, however, was only a purifying process in order to a regeneration which already announces itself in potent tokens.

I. The first creative period of the German Church and theology, embracing the period of the Reformation, is evidently characterized by the position which the doctrine of justification assumed in its critical and positive development. The prevailing church doctrine and order were critically measured by the word of God, contained in the Holy Scriptures, apprehended by faith. Faith in the Holy Scriptures was not based upon the authority of the Church, although historical tradition in other respects continued to be recognized. No more was the authority of the Church to decide respecting the canon (as the exclusion of the Apocrypha shows), or the interpretation of the Scriptures. The Holy Scriptures received their regulative place because the apostolic word about Christ, or because that which was recognized as the kernel of the Holy Scriptures, Christ accepted in faith, demonstrated to the soul its animating divine power. And so the real attestation of the Holy Scriptures was found in nothing else than Christ so far as He imparts to the soul through His Holy Spirit the assurance of divine salvation. Accordingly, whilst faith itself arises through the word of God, whether in the Holy Scriptures or in the preaching regulated by them, it is only through them as the specific means of grace. On the other hand, the Holy Scriptures are authority or norm for faith only through that which certifies them, through Christ their central theme. He is "the emperor over the Scriptures" ("der Kaiser über der Schrift"); a writing that "does not urge Christ" ("Christum nicht treibet") cannot claim canonical authority.

Faith in unison with the Holy Scriptures, and holding them in the hand as norm, now critically revised the whole ecclesiastical system of the Middle Ages, and established new religious views. The doctrinal type which resulted therefrom received its classical expression in the Augsburg Confession (1530), with its Apology, and in the two catechisms of Luther, with the Schmalkald Articles, which are essentially in unison with these writings of Melanchthon. These five symbols present the first formation of the Lutheran doctrine, the most systematic and summary being the Augsburg Confession; for justification by faith constitutes the centre from which all else is ruled (Art. IV.); its theological, anthropological, and Christological presupposi-

tions are given in the first three articles, while the fourth article contains the union of the free grace of God with the believing soul. It then proceeds to the doctrine of the origin and nature of this faith. Its origin is through the ecclesiastical office, which administers the word of God, and the sacraments, these being accompanied by the agency of the Holy Spirit (Art. V.). Faith grows into new obedience or love (Art. VI.). If this be the nature of evangelical faith in its origin and growth, it of necessity leads to the Church, which partly presupposes faith, partly supports it; therefore the Church is treated of at length in Arts. VII.–XVII. Art. VII. determines the fundamental idea of the Church as an everlasting communion of saints or believers, which is recognized externally by the pure doctrine of the gospel and the proper administration of the sacraments, and which preserves its unity even in the dissimilarity of human tradition. The Church in its realization is to a certain extent inconsistent with its idea, and hence there arises the distinction between the invisible and visible Church, which, however, does not find its expression in the Lutheran symbols. This inconsistency, however, on the side of the subjective factors of the Church does not go so far as to do away with the efficacy of the objective factors, the Word and sacraments. These objective factors, baptism and the Lord's Supper, were now positively stated (Arts. IX.–XII.) with silent polemic towards the Roman Catholic Church, and her apparently fuller doctrines of the sacraments (viz. penance, with confession and ordination); the *opus operatum* was rejected, because contrary to faith (Art. XIII.), and the evangelical idea of ordination was defined as the lawful call to the public administration of the means of grace, as opposed to anarchy as well as hierarchy, so that the balance is restored between church order and evangelical freedom. The principle of faith entirely unites the objective or necessary side with the subjective side, and transfigures both into evangelical freedom. On this very account the evangelical type of teaching is friendly to the state, which it acknowledges as a divine institution, and engages to serve with the cheerful obedience of love (Art. XVI.). Finally, Art. XVII. treats of the final destiny of the Church, excluding enthusiastic millenarianism. The remainder, for the most part, refutes misconceptions respecting evangelical doctrines, such as the supposed entire denial of free-will and the charging the divine causality with the origin of evil, the supposed despising of good works and the law; and closes with the rejection of the principal ecclesiastical abuses, such as withdrawal of the cup from the laity, the celibacy of the priests, the sacrifice of the mass, oral confession, laws about eating, monastic vows, as well as the unevangelical exaltation of episcopal power over against the laity and the state. That which has just been stated is the substance of the doctrines of the Lutheran Church—that which constituted the official doctrine until 1750. These Lutheran symbols contain in general an harmonious whole, and have shown themselves capable of establishing an evangelical Church and an independent evangelical literature and learning. Several important points, however, were either not discussed in this first confession, or were not clearly decided in harmony with the general evangelical type. Above all, the Holy Scriptures are indeed presupposed as authority, but are mentioned only as a means of grace; no doctrine respecting them as a norm is established, even though they are implicitly understood to be so as a matter of course. There is a marked difference in this respect in the Reformed confessions, since they very early presented the article respecting the Sacred Scriptures as a particular doctrine, some of them with a specification of the particular writings which were to be regarded as canonical. The Formula Concordiæ partly made up the deficiency. But it evidently proves that Luther's clear insight into the relation of faith to the word of God and the Holy Scriptures in the principles briefly mentioned above, as resulting from faith with respect to the canonicity and criticism of the Holy Scriptures, as well as their interpretation, had by no means become the general conviction of the Lutheran Church. The deficiency in the working out of this fundamental principle constitutes the mainspring of the theological movements of the two following centuries, which somewhat differ from the standpoint of the Lutheran Reformation. There are other inequalities or deficiencies, such as the following: Whilst the *opus operatum* is decidedly denied, owing to the fundamental principle that salvation must be apprehended by personal faith, yet regenerative power was ascribed to the baptism of infants even at the moment of its administration, not indeed by the Augsburg Confession, but by the common Lutheran doctrine. And notwithstanding Luther's attempts to escape the difficulty by the supposition that even infants who have been baptized have faith (analogous to Calvin's *fides seminalis*), another inconsistency threatened with the position decidedly taken against enthusiasts, that faith comes only through preaching. Luther hinted at a better solution in his Larger Catechism—namely, that baptism has not merely momentary significance as an act of the eternal God in His adopting grace, but is a revelation of His gracious will, which remains valid and efficient until human unbelief shall have destroyed the baptismal covenant. But this solution was not made use of by the Lutheran theologians.

There is another inequality with reference to the doctrine of predestination. It is indeed true that Luther never lost sight of the universality of the divine gracious will, and would found the consciousness of salvation not on the knowledge of everlasting election working through faith, but, on the contrary, on the gracious will revealed in the word and sacraments and apprehended by faith—maintaining likewise a possibility of a falling away from grace. Nevertheless, Melanchthon, in the first edition of his *Loci*, the earliest dogmatical work of the Reformation, as well as Luther's treatise *De servo arbitrio* (1525) against Erasmus, shows that in the beginning the leading men of the Lutheran Church, even up to 1550–62, as well as the so-called Gnesio-Lutherans, held fast to the doctrine of absolute predestination, with no essential difference from the Reformed Church. And indeed the Formula Concordiæ itself in the same way asserted an absolute predestination with reference to the elect. The German evangelical people, however, from the very beginning did not agree with the absolute denial of the freedom of the will, as is clear from the letters of the laity to the Reformers. Absolute *determinism*, even in the Augustinian form, did not please them, and they could not be contented with the mere *liberum arbitrium in civilibus* which the leaders of the Reformation early acknowledged. (*Conf. Aug. XVIII.*) This was in the interest of not letting the cause of evil, nor indeed the ruin of the descendants of Adam on account of original sin, fall back upon God. But since even the Reformers had been led by a religious motive to the denial of freedom towards the good—namely by the doctrine that all good cometh from above—it became a necessary as well as a difficult task to reconcile the apparent conflict in an harmonious, well-adjusted doctrine of sin and grace. Melanchthon attempted this in his so-called synergistic doctrine, which was repudiated by the Formula Concordiæ. But the Lutheran theologians of the Formula Concordiæ and subsequent times continued wavering and undecided in the effort to be rid of the double decree, and safely to preserve the assurance of salvation, without falling into doctrines of a Pelagian or synergistic tendency; whilst they, on the other hand, repudiated the exaggeration of Flacius, that evil had become of the substance of mankind. The Lutheran theology of the seventeenth century sought the solution by presupposing as necessary for conversion certain inevitable operations of grace, whereby the *liberum arbitrium* was restored, upon the use of which, then, our final fate depends. But it did not thereby escape the stumbling-block of the double decree, because they did not conceive the inevitable effects of grace to be universal, whether in this world or the next; and when in the eighteenth century the universal salvation of the heathen, even without Christ, was frequently acknowledged, nothing was gained thereby. It was not until the present times that the *universality of the call* by the gospel to faith and salvation was taught on the ground of 1 Pet. iii. 18.

With reference to Christology, finally, the Augsburg Confession and the other older symbols limited themselves to that which is common to Christianity, only that Christ as a conscious possession was placed in the centre, whilst he had hitherto been pushed into the background, and, as it were, "buried" by the doctrine of the saints and the merit of works. Nor did these symbols establish any doctrine in opposition to the Reformed Church. The germ of the conflict lay in Luther's doctrine of the Lord's Supper and his polemical writings against Zwinglius; yet this doctrine assumed only a subordinate position. Luther was concerned with reference to the Lord's Supper simply with the objectivity of the sacrament independent of faith, which did not make the sacrament, but only received it. To ensure this objectivity, he maintained that the body and blood of Christ were the divinely given pledge of the forgiveness of sins, which were imparted in, with, and under the bodily elements, so that whoever receives the elements, even though without faith, would likewise receive that pledge—the glorified body and blood of Christ. It was not clear, however, how far the objectivity of the sacrament depended upon the partaking of the body and blood on the part of unbelievers likewise, or why the equal objective *offer* did not suffice, as Brenz taught in the *Syngramma Suevicum*, which even Luther himself approved. On the other hand, it was not clear in what sense the invisible body and blood of Christ were to be a pledge, together with the visible pledges of bread and wine, of the invisible grace of the forgiveness of sins. It was not until the later Lutheran

theology since Hollaz that an especial significance was ascribed to the partaking of the former, in that, with Calvin and several Reformed confessions, the participation in the virtue of the glorified body of Christ was regarded as a blessing in itself, and no longer merely as a means of the assurance of the forgiveness of sins. It would not have been at all necessary for the Lutheran doctrine of the Lord's Supper to adopt the Lutheran Christology with reference to the *status exaltationis* and all its consequences, which threatened in a Docetic manner the true earthly humanity of Christ, his growth, learning, etc., unless it had already fully extended the *communicatio idiomatum* to the childhood of Jesus, instead of making a deep and real distinction between the state of humiliation and the state of exaltation. This course was considered necessary in order that the first Lord's Supper should become entirely identical with the subsequent ones; for which there was no real necessity, since the visible bodily presence of Christ afforded the disciples a complete compensatory pledge for that which the glorified body of Christ is said to veil behind the visible.

Melanchthon, whose native character was more ethical than religious, was the occasion of the controversies with reference to the relation of justification and sanctification to the law and good works, which were so decided by the Formula Concordiæ as more closely to define the Lutheran doctrine on this subject. Since Melanchthon ascribed such essential importance to the law for the origin of faith through repentance and the continuance of faith, George Major and others of his school asserted that good works were necessary to salvation. This doctrine was assaulted in many points by the Antinomianism of Johann Agricola. The law, he contended, belonged to the court-house, and not to the pulpit, true repentance originating entirely from the contemplation of the love of Christ. And, as Luther had shown that penitence and repentance presuppose a moral norm, he insisted at least that the believer no longer required the law, because the internal impulse of the Spirit works of itself that which is good. The Formula Concordiæ rightly decided that the law was of threefold necessity: (1) to secure civil order (*usus politicus*); (2) to work repentance (*usus elenchticus*); (3) to regulate even the life of the regenerate, who were still struggling with sin (*usus normativus*), whereby it was acknowledged that Christ alone, as the living Law, could lead to saving repentance as well as be the living mirror of holiness. On the other hand, the necessity of good works to salvation was truly recognized in the sense (contrary to Nicolaus of Amsdorf) that a good tree bringeth forth good fruit; but the opinion was repudiated that good works can in any way merit salvation: which would admit a depreciation of the justifying free grace of God.

In all these points the ethical spirit of Melanchthon was followed. It was otherwise with the controversy respecting the atonement and justification, which was raised by Andreas Osiander and Franz Stancarus of Mantua. The school of Melanchthon had been accustomed to base the atonement exclusively upon the expiatory sufferings of Christ, which led Stancarus to ascribe mediatorial significance *solely to the human nature* of Christ, which alone was able to suffer. Osiander thought it more frosty than ice to limit justification to deliverance from guilt and punishment, from which, indeed, we had been redeemed by the work of Christ 1500 years ago. It was rather the communication of the essential righteousness or divine nature of Christ, which is the archetype of humanity, eternally appointed for incarnation, and hence only the *divine nature can come into consideration with reference to salvation.* A *justitia forensis*, consisting merely in imputation, and indeed of the merit of Christ, blotting out guilt and punishment by His suffering, would not be sufficient to satisfy the divine good pleasure: but nothing less than the restitution of the divine image through the indwelling of the divine nature of Christ, which justifies in fact, and not merely in the way of imputation. Osiander in this appears to be ethically superior to Melanchthon; and indeed the Melanchthon type of doctrine did not attain the fervency and depth of the mysticism which, for instance, distinguished Luther's little book about the freedom of the Christian. But, on the other hand, the undervaluing of the atonement by Osiander, and of the blotting out of guilt and punishment, was not inspired by an ethical spirit; he leaps over the step of the appropriation of the forgiveness of sins, which in fact can only take place by a forensic act of God, and not merely on the ground of our habitual righteousness in faith; and he pays too little regard to the necessity of peace with God in order to sanctification. He would attain holiness immediately through the divine nature of Christ, which he does not conceive as sanctification. Moreover, he stops at *justitia essentialis*, and thus does not overcome an *unethical mysticism*. The Formula Concordiæ maintains the unity of the person of Christ in the work of salvation, the co-operation of the divine and human natures of Christ therein, and regards as Christ's work not only His passive suffering, but also His active obedience. And thus the imputation which it maintains against Andreas Osiander is so carried out that we are justified by faith because Christ represents us before God, having blessed us with His active obedience as well as His passive. Thus, Luther's doctrine is likewise preserved, that we enter by faith into union with Christ; and this opinion simply is rejected, that we receive forgiveness of sins or justification on account of the *justitia essentialis* which has become ours. Personal sanctification is first called forth by the love of God experienced in the forgiveness of sins, and appears in the form of responsive love. A remnant of ideas current before the Reformation pervades this doctrine of the Formula Concordiæ when it says that Christ, according to His divine nature, in which the human nature by virtue of the *communicatio idiomatum* participates, is the Lord of the law, and is not therefore obligated to it; and thus His double obedience produces disposable merit, which, by imputation, may be charged by grace to the account of believers. Thus, the fact is lost sight of that Christ by His entering into human life subjected himself (Gal. iv. 4) to its conditions and laws, therefore also to the divine law to which all men are bound. Finally, the internal goodness and necessity of the law is not regarded in this view, which does not admit that it should be conceived as depending for its validity on absolute power or arbitrary will.

II. The period of the Reformation was followed by an epoch of scholasticism which more and more fortified the doctrinal system of the symbolical books. In the place of the creative period which built up the doctrines of the Reformation, came a period of the cultivation and preservation of traditional doctrines; the sublime activity of the Reformation was followed by a period of slackness in spiritual things—the bold and yet well-regulated use of freedom by a kind of barrenness, anxiousness, and narrowness. The bravery and courage of the heroes in the spiritual battle of the sixteenth century remained as a model, but were exchanged for a hateful love of strife, which regarded the little things as great, and only too often the great ones as little. But just as we are not to despise or blame the generations subsequent to the apostles, however far below them they may have stood, inasmuch as they yet helped to conquer the world for the faith by their faithful testimony unto death, so our fathers in the epoch subsequent to the founding of the evangelical Church had to exhibit no trifling power of faith in the bloody conflicts which were excited and nourished by the counter-Reformation, especially by the Jesuits. It is enough that they accomplished something in true labor for the task which was laid upon them. The principle of the Reformation, in accordance with its great historical significance for the world, must first secure the firm establishment of Protestantism in the midst of the Old World. It was not of so much importance to bring forth new treasures out of the Holy Scriptures and the chambers of the believing spirit, as to carry out the Reformation's idea of the world through the consideration of the history of the Church. It was necessary to search into the entire sources of the revelation in the Old and New Testaments, to study them in the light of the newly-gained knowledge, and thus to take spiritual possession for the new Church of the whole previous world. It was necessary to find confirmation and proof for the truth of the Reformation in the Holy Scriptures and the history of the Church. The whole of theology under these circumstances became the servant of dogmatics—yea, almost became absorbed in it. What had been planted by the Reformation in the heart of the German people was taken possession of in the seventeenth century by the architectonic spirit, in order to build up a systematic structure for offence and defence. A well-organized method, equipped with logical power, endeavored to arm Protestant truth on all sides. The indefatigable diligence and acuteness of the great dogmatic writers of that century surrounded the district of evangelical truth on all sides with fortifications in order to present it as a great invincible citadel. In the beginning of the century, and indeed subsequently, there was no lack of the power of a spiritual life. It resounds with abundance of holy hymns and mighty chorals, and the people were edified by excellent evangelical preaching. But an abatement of spiritual power was soon manifest. The thought of the conquest of the world, Roman Catholic, heathen, and Jewish, was scarcely agitated, nor was there any great effort to carry out the Protestant principle in an ethical direction in the whole life of the Church. Rather with the one-sided effort to preserve that which had been won, the evangelical principle itself, in accordance with an internal law, changed in their very hands. This is shown in the treatment of the principle of the Reformation itself, which was for Luther the living soul and controlling centre of the whole, and which the *Augustana*

(see above) shows to be fruitful in the production of an entire system of doctrine, as well as in criticism and polemics. But now the principle became a single article of doctrine alongside of others, and in the scholastic treatment to which the doctrine of justification was likewise subjected can be traced, only too clearly, an internal uncertainty respecting important points in the principle itself, as well as in its systematic position.

There was an uncertainty respecting the time of the divine act of justification with reference to the individual; thus, whether justification is adjudicated to man only as subsequent to faith, either as coming into existence or confirmed, or whether, on the other hand, the declaration is made known to man by God that He *has* forgiven him for Christ's sake, and justification is thus offered in order that he may believe. Since faith and true repentance were more and more demanded in such a manner as a condition of justification that faith almost gained the significance of a meritorious or efficient cause of justification, the pious began to be doubtful whether they were in possession of true repentance and true faith, or not, as well as to doubt (in the eighteenth century) respecting the true evidences of genuine faith. Finally, these evidences were found in faith working by love, and the assurance of justification was drawn from good works as the evidences of true faith. And thus they had returned by a roundabout way to the boundaries of Rome. So likewise there appeared more and more uncertainty whether faith might be sure of eternal election or only of present grace, as Musäus claimed. It was of more importance to theology, however, that justification by faith was no longer treated as a principle, but only the Holy Scriptures. They were now brought forward in such a way that they were treated by the dogmatic writers as the only foundation of Christian truth. The doctrine of the Holy Scriptures was so wrought out that it should be clear that the evidence of the truth consisted solely and sufficiently in the fact that it could be proved to be contained in the sacred books. Accordingly, then, the theory of Philo respecting inspiration previous to the Christian era became almost the model for the Christian theory of inspiration. It was said that the contents and words of Scripture were dictated to their authors, and imparted *non ad sciendum sed ad scribendum*, whilst, on the other hand, it is the characteristic of the New Testament economy, by which it is essentially distinguished from the time before Christ, that the subject-matter of salvation no longer remained merely external to the spirit, but unites itself with its innermost convictions and knowledge of the truth. Whilst the significance of the gospel, according to Protestantism, consisted above all in the building up of free and conscious individuals, that theory made the pillars of the Church, the teachers of mankind, into mere machines, so that their personal faith and knowledge were not employed as co-operative factors in the preservation and transmission of the gospel. That theory passed rather lightly over the fact of the different individualities of the writers of the Holy Scriptures, as well as the various readings of the original text, the impossibility that believers in general should resort to the original sources, and the imperfections in the style and language of the various compositions. All the differences and lack of harmony in parallel historical statements were balanced, not unfrequently by an overstrained endeavor to harmonize them. Thus, there was a recoil from the critical principles of Luther with reference to the canonicity of particular writings, important as they were in religion and theology, as if they were something which was not to be followed, but rather pardoned in him. But they had nothing better to substitute for them than a renewal of the authority of the Church in constituting the canon, as indeed the view of Quenstedt was: that, granted the Gospel according to Matthew were spurious, it would nevertheless retain its authority if the Church should ascribe canonicity to it. In the same manner the difference between proto- and deutero-canonical writings of the New Testament, which was still recognized in the editions of the Bible of the sixteenth century, was abolished in the seventeenth. Yet they did not deviate so far from the standpoint of the Reformation as to treat mere historical faith (*fides historica*), or evidence of the same, as a substitute for the proper assurance of faith (*fides divina*). On the contrary, they laid great stress on the fact that a special operation of the Spirit accompanied the reading of the Scriptures to receptive souls, or that the Scriptures were the peculiar channel for the Holy Spirit, the Spirit of truth. This significance of the Scriptures as a means of grace—which characteristic they eternally possessed independent of all criticism—was, however, immediately inverted in the doctrine that the Holy Spirit gives immediately, and not only to true believers, divine assurance respecting their divine origin and the fact of their inspiration. Hence was derived their normal authority. Instead of their being acknowledged as the document and source of the knowledge of the genuine original Christianity, their contents, they were considered as likewise a sufficient attestation of the *truth* of these contents. Furthermore, it was granted that each individual could be enlightened and assured respecting the truth of the contents of the Scriptures through the working of the Holy Spirit in these Scriptures, without the necessity of the operation of the power of the gospel in changing the heart. This decline to the standpoint of intellectualism, with its latent Pelagianism, occurred in the so-called *Theologia irregenitorum*, which led the way to Pelagianism through the magical operation of the Scriptures and the Holy Spirit—a doing away of the difference between nature and grace, and between the regenerate and unregenerate.

Space does not permit us to go into details with reference to the deviations from the standpoint of the Reformation which are involved in the changes in the fundamental principle already described. However, we are not to suppose that all theologians took this direction of establishing a Protestant tradition as an external assurance of the redemptive power and truth of the gospel. The various universities (each of which had its peculiar type of theology) took up different positions with reference to this matter, and are represented by important theologians, the authors of remarkable dogmatical works. The strict Lutheran orthodoxy was especially represented in Wittenberg and Tübingen, subsequently also in Rostock. A freer tendency was represented by Calixtus and his school (called by their opponents, Calov, Hülsemann, etc., *Syncretists*) in Helmstädt, Königsberg, and the Nuremberg University of Altdorf. Jena assumed an intermediate position, with the great John Gerhard (author of the *Loci theologici* in 9 vols.; in the eighteenth century edited by Cotta—in the nineteenth century by Preuss), who with John Himmel and John Major, likewise Salomon Glassius (*Philologia sacra*, 1636–40), established the flourishing period of Jena, which was afterwards continued by the acute and philosophical John Musäus, and by W. Baier (*Compendium theologiæ*), as well as Buddeus (*Institutiones*). Leipsic also was more moderate in the seventeenth century, where Hoepfner (*De justificatione*), Scherzer (*Systema theologiæ*, in 29 definitions, not a few of which are prosy, 1667–83), and Rechenberg, the friend of Spener, flourished; Strasburg, where after Calvin, in the sixteenth century, Capito, Hedio, Bucer, P. Martyr, Zanchi, and even John Schmid, the teacher of Spener, later likewise Seb. Schmidt, taught. Subsequently, through the influence of Dorsche and Dannhauer, this university went over to the stricter Lutheranism. This was likewise the case with Rostock, where after Chytræus a prevailing practical theological tendency long maintained itself, united to some extent with mysticism. On the other hand, the chief representatives of the stricter Lutheran orthodoxy after Martin Chemnitz (*Examen concilii Tridentini*, 1552–1610) were Ægidius Hunnius in Marburg 1576–92 (subsequently in Wittenberg; d. 1603), who became the most influential in building up the Lutheran doctrine of predestination; Leonhard Hutter (d. 1616), who was the chief opponent of the Irenics of Melanchthon; the profound Hülsemann (1629–46 in Wittenberg and in Leipsic; d. 1661); the contentious Abraham Calov (in Königsberg, Rostock, Wittenberg; d. 1686; author of the *Biblia illustrata*, in 4 vols. fol., and the *Systema theologicum*, 12 vols. 4to); his father-in-law, Quenstedt (d. 1688), and his son-in-law, Deutschmann. In Tübingen, after Jacob Andreæ (d. 1590), and Heerbrand (d. 1600), flourished Hafenreffer (1502–1619), and Thumm (d. 1630), an advocate of *crypsis* in Christology. In the same university were also Lucas Osiander, called "Arndt's Scourge" (*Arndtomastix*), and John Adam Osiander (d. 1697; author of *Harmonia evangelica*). In Giessen were the advocates of *kenosis*, Balth. Menzer, and Just. Feuerborn.

III. But more and more complaints were raised against the scholastic bent of theology. On the one side, those of a humanitarian and freer tendency, who had been trained in philosophy, contended against the hostility to all philosophy which had been manifested in the Hofmann controversy. This we may regard as a revival of the Melanchthon school in the seventeenth century. It is the tendency of the great theologian of Helmstädt, George Calixtus, with his friends and pupils, Hornejus and Titius; in Königsberg of the same spirit were Behm, Dreier, Latermann; and in Altdorf, Hackspan, Saubert, and Dürr. But it was in vain that they attempted to stem the tide of polemical zeal; as so-called syncretists they only inflamed it the more, and were regarded with distrust on account of Reformed elements in their emphasizing of good works, and on account of Roman Catholic tendencies in their doctrine of the *consensus quinquesæcularis*, and their depreciation of the principle of justification. But still more weighty were the complaints on the part of vital piety in such men as John Arndt, Lütkemann, Valentin Andreä, Grossgebauer, Heinrich Müller, Tarnov,

Guistorp, Mayfahrt, and Schuppius, heralds of the pietistic movement of Spener. Already, previous to these, the mystical element, which in the Reformation ripened into an ecclesiastical form, had again separated itself and taken a position in hostility to the Church in Valentin Weigel, Jacob Bœhm, Rathmann in Dantzic, and others. But the severest blow against the orthodoxy of the seventeenth century was given by Philip Jacob Spener of Rappoltsweiler in Alsatia, through a thorough reform in theological study which he awakened, through a thorough revival of love for the Holy Scriptures, and through the foundation of the so-called *collegia pietatis*, which became *ecclesiolæ in ecclesia*. Whilst the Lutheran clergy, allied with the authority of the princes, held the so-called third class, *status œconomicus*, the laity and the congregation, in general in dependence, and made them into a mere *ecclesia audientium*, Spener again raised the banner of the universal priesthood of Christians, and trained by the study of the ecclesiastic order of the Reformed Church—for example, in Geneva—he demanded an analogous use of the presbyterian element. He would not deviate from orthodoxy in doctrines, but would simply modify the formula of subscription to the symbols. Yet his efforts for conscious faith, for regeneration and sanctification, were little in harmony with the prevailing spirit of the so-called orthodox, who persecuted him and his school in a conflict of more than thirty years. The orthodox, however, lost the confidence of the German people, by nothing so much as through their hostility to the school of Spener and its principles, by their boasting of a *theologia irregenitorum*, as well as the especial grace of the ecclesiastical office. As Calixtus, for instance, had permanently established the independence of ethics, so Spener on the practical side carried over the evangelical principle of faith into the ethical sphere; first of all, as was the case in the ancient Church, in the form that the idea of the Church of the future was fixed, and the way was paved to heathen missions; and thus the innermost vital impulses of the evangelical Church were awakened, and these from the centre were set in motion in an ethical direction. Moreover, Spener, by his idèas of church organization, exhibited a lively interest in the Church of his times. Yet the ethics of the Pietists were still much too negative, exaggerating the contrast between the Church and the world, and confining themselves for the most part to the sphere of personal and religious ethics. The North German pietism suffered likewise from a depreciation of the importance of scholarship, whilst on the other hand the South German branch, in the great theologian, critic, and exegete, John Albert Bengel (author of the *Gnomon Novi Testamenti*), gained a worthy representative of the harmony between scholarship and the Church, and thereby secured for the Church of his native land a powerful support, working even to the most recent times.

A long conflict was carried on by the orthodox theologians Carpzov, Schelwig, Neumeister, Edzard, and particularly Ernst Valentin Löscher, court-preacher in Dresden, against Spener and his disciples, August Herrmann Francke (founder of the orphan-house of Halle), George Anton, Breithaupt, Freylinghausen, Rambach, and the contentious Joachim Lange (*Œconomia salutis eaque moralis; Antibarbarus*, 1709). After this struggle had endured for a long time a kind of mediating school between orthodoxy and Pietism was formed—a gentler late summer of orthodoxy. To this belonged Hollaz (1713; *Examen theologicum acroamaticum*, 1707), Johann George Walch the Elder, the thoroughly learned and honest but unoriginal writer of the *Einleitung in die Religionsstreitigkeiten innerhalb und ausserhalb der Lutherischen Kirche je in 5 Baenden*, 1730, ff.; the very skilful and intellectual chancellor of Tübingen, Christoph Matthaeus Pfaff, advocate of the union of Protestants; the historian Lorenz von Mosheim of Göttingen (d. 1755). These have especial merit with reference to historical theology, as likewise Solomon Cyprian Salig (*Vollständige Geschichte der Augsburger Confession*) and Veit Ludwig von Seckendorf (*Historia Lutheranismi*). The Magdeburg Centuriators in the sixteenth century (1559–74), Matthias Flacius, Wiegand, and others, had employed their extensive historical material in such a manner that they regarded the ideal of the Church with reference to unity and purity of doctrine, especially of justification by grace, as realized in the most ancient times of Christianity, and from that time on they recognized no advance, but only a decline in the following centuries from the pure beginning, through the agency of the power of darkness concentrated in the papacy; thus the truth was regarded as having merely a history of suffering and not of progress; that is, a history of error, as if the truth were only to be maintained against it, and not unfolded. Gottfried Arnold, however, represented another method of treating history. In his *Kirchen und Ketzerhistorie* (1698–1700) he always takes the side of the heretics against the official doctrine and usages of the Church, by which it is true he did away with the claim that the Church was the unchangeable sanctuary of the truth, but still by no means found the true relation between the heretics or heterodox and the orthodox. It is true that Calixtus had not only claimed for the earliest beginnings of Christianity the possession of the pure doctrine, but had rather regarded the first five centuries as the ideal primitive time, and had thus distinguished the ancient Catholic Church from the papal period; but he found no sufficient grounds for the movements and changes in the system of doctrine. Whatever had been added to the common Christian doctrine given in the Apostles' Creed was to him indeed not necessarily erroneous or a decline, but a matter of indifference and subordinate, as then he did not reckon the doctrine of justification among the common Christian doctrines. The theologians subsequent to Calixtus, just mentioned, were, like him, characterized by a more objective historical spirit of investigation. It is true, they were in advance of Arnold, yet it was only through Arnold's exaggerations that their attention was directed to the importance of heretical movements; it was reserved for a subsequent period to recognize and show that it is by means of heretical movements that an advance in the Church is mediated, and to represent them not merely as an accidental swarm of opponents, but rather as those who stepped forth in opposition to a still unprepared Church doctrine in points where a further development was necessary, although with a one-sided or distorted emphasis of the elements that were still lacking.

The above-mentioned theologians, for the most part devoted to historical theology, in sympathy with the culture of the time, and in anticipation of approaching storms, desired to establish themselves on a good footing, and everywhere to break off the sharp edges of the old doctrines. Original sin became significant only after our consent to it; inspiration was merely assistance by the Holy Spirit; the *communicatio idiomatum* was more and more limited; the doctrine of justification was obscured by mixing it with sanctification. With reference to other doctrines, such as the Trinity, the incarnation, the work of atonement, the Lord's Supper, they avoided the difficulties of the Church form of doctrine by referring to their inconceivableness and mystery. A new regenerative principle was lacking. Yet they went back to the Holy Scriptures in distrust of the doctrinal development of the Church. Faith in the Holy Scriptures—which were identified, on their part, with revelation itself—was regarded in its way as Christian faith, so that they thought only of doctrines, especially of mysteries, in connection with it, and not of real vital communion with God in Christ, and of the assurance to be wrought by the Holy Spirit. In the seventeenth century, notwithstanding the systematic subordination of the material principle to the formal, it was still maintained that assurance was to be gained only through the Holy Spirit, whose testimony united itself to the reading of the Scriptures; whereby, to be sure, the contents of the testimony were more and more regarded to be not so much the power of the gospel unto salvation or the experience of salvation, as rather the divine origin of the Holy Scriptures (their inspiration), and through them the truth of Christian doctrines. In the eighteenth century the *testimonium Spiritus Sancti* was more and more abandoned, as in general the fervent sense of the active nearness of God and the presence of the Spirit in the Church vanished.

In order, now, to gain a substitute for the assurance of Christianity, the way of demonstration offered itself. To this path philosophy, which had begun its course since Leibnitz and Wolff with a strong feeling of self-consciousness, successfully invited. The school of Wolff, flourishing before the middle of the eighteenth century, undertook to establish Christianity by mathematical demonstration. Reusch, Schubert, Carpzov, Canz, Reinbeck, and particularly Sigmund Jacob Baumgarten of Halle, belong to this school. They began the proof for Christianity through a rational demonstration of the divine authority of the Holy Scriptures, which should be superior to what they regarded as the merely apparent proof from the experience of the operations of the Holy Spirit. The idea of God derived from the *lumen naturæ*, the righteousness, holiness, goodness, and power of God in the presence of sin and guilt, prove the necessity of the revelation of an atonement, if an atonement should in any way be possible or capable of being known. Its possibility is evident from the fact that the predicates ascribed to it are not contradictory; these predicates constitute at once the criteria whereby a true revelation may be known. Now, the Holy Scriptures correspond with these criteria, since they teach the way of peace, and contain mysteries which could not of themselves be derived from the reason. This method of proof goes no further into the consideration of the Scriptures, their origin, and the formation of the canon, whilst indeed these criteria

do not of themselves prove the divine authority of the Scriptures. About this time the science of biblical theology began, after Ernesti's *Institutio interpretis Novi Testamenti* (1761), through the labors of Büsching, Zachariä, Hufnagel, Ammon, G. Lorenz Bauer, and especially Gabler, who has the merit of having clearly stated the historical character of biblical theology (which has since been more thoroughly wrought out by Schmid and Œhler in Tübingen, Weiss in Kiel, Messner in Berlin, and others). From this circumstance, as well as the fact that Baumgarten's pupil, Semler, began the period of the criticism of the Holy Scriptures, it resulted that the elder Tübingen school, under Storr, Flatt, Süsskind, paved the way for the purely historical proof of the divine origin of the Sacred Scriptures, and thereby of Christianity. The apostles, and the scholars of the apostles, said they, composed the Scriptures of the New Testament canon (the proof of their authenticity and integrity); these Scriptures are historically worthy of confidence (*fides humana*); the apostles could, would, and must have spoken the truth. These writings describe, on the one side, Christ's sinless character—on the other side, His miraculous acts; both together attest the truth and full authenticity of His statements respecting himself and His divine mission. Now, Christ promised His disciples the gift of the Holy Spirit; and that He was able to fulfil this promise is proved by His miracles; and thus they were in possession of an inspiration corresponding with His veracity; consequently, whatever is contained in these writings is divinely attested (*fides divina*); and the authority of the Old Testament likewise rests on that of the New. That which is here called *fides divina* is thus by no means assurance of salvation or divine assurance, but is human assurance of divine things. This whole method of proof is based on the formal principle, and is a revival and improvement of the idea of Hugo Grotius: it is in an altogether intellectual form, and essentially changes the principle of faith of the Reformation. About the same time theological ethics were likewise more and more separated from their internal connection with the principle of faith, partly through the influence of the popular philosophy of Wolff (Steinbart, Eberhardt, Bahrdt) in the manner of eudæmonism, partly in earnest natures, under the influence of Kant, through the ethics of the reason.

The supernaturalism of the rational as well as the historical method formally maintained the supernatural character of Christianity—miracles, prophecy, etc.—but more and more tended to depreciate and weaken that which constituted the subject-matter of the doctrine. Thus, the doctrine of the Trinity (and this could not but be significant for Christology) was constituted by some in the form of subordination—*e. g.* by Töllner (who likewise denied the saving significance of the active obedience of Christ), by Döderlein, and by Flatt; by others, as Urlsperger, in the form of Sabellianism or a modal Trinity. In place of the Church doctrine of the atonement, it was supposed that there was a kind of *acceptilatio* of the obedience of Christ for the blotting out of our guilt; the Church was defined as a work of believing individuals uniting themselves together; and the doctrine of justification was placed almost at the end of the system. (Storr.)

The incongruity of the significance that was ascribed to the still remaining elements of Christianity with the supernatural form, now invited rationalism to advance with confidence of victory: so much the more as the first philosophic systems of Wolff, Kant, Jacobi, and Fichte gave systematic expression with ever-increasing boldness to the self-confidence of the newly-awakened subjectivity. Supernaturalism in vain sought to appropriate these systems and turn them in a direction favorable to itself. Thus, with reference to the system of Kant, Stäudlin, Süsskind, K. L. Nitsch, and Stapfer—to that of Jacobi, Vater, Steudel, Emmerich, Heydenreich. The rationalists of the school of Kant, Tieftrunk—subsequently likewise Ammon; furthermore Löffler, Henke, Schmid, Krug, Röhr, Paulus, Wegscheider (to a certain extent tinctured with the deism of the school of Wolff); likewise scholars of Jacobi, such as Heinrich Schmid, Köppen, Köhler, or of Jacobi and Fries, such as De Wette—forced back supernaturalism still farther from its standpoint, until that miserable abortion of a rational supernaturalism and supernatural rationalism threatened theology with self-destruction.

At first, the elements of Christian faith became rigid, and afterwards weakened; and this had the saddest consequences with reference to the Church, its constitution and laws. In the sixteenth and seventeenth centuries the clergy and civil authorities shared with one another in the management of ecclesiastical affairs; the people (*status œconomicus*) were excluded. The dangers of such a confederacy between the clergy and the autocratic power of the princes were observed by the declining orthodoxy of Johann Benedict Carpzov, who now sought, by an un-Lutheran enhancing of clerical authority (power of the keys), over against the state to secure independence for the Church; but it was in vain ("the *Apapa* had stepped in the place of the *papa*"—the popery of a Cæsar in the place of the cæsarism of a pope). Moreover, through Christian Thomasius the territorial system came into vogue, which handed over the Church entirely into the hands of the state, whose highest interest with reference to religion, according to him, was to see to it that the Church did not disturb the peace of the state. A more honorable position was assumed by the collegiate system of Pfaff, which at least guaranteed the Church its independence by presenting it as a collegium, as a society with the rights of a society. But then he regarded the Church as originating through the free inclination of the individual, and its relation to the state remained a purely accidental one. The territorial system, however, gained the supremacy until the nineteenth century, and it even reckoned the mode of worship as among the external things under the control of the state.

IV. Rationalism, under the influence of English deism and Voltaireism, more and more prevailed until the closing years of the eighteenth century. Among these we may mention Reimarus (author of the *Wolfenbüttel Fragments*), Nicolai (editor of the *Deutsche Bibliothek*), Biester, Gedike, Teller, Venturini (*Natürliche Geschichte des grossen Propheten von Nazareth*, 2d Aufl., 1806, 3 parts). Against these there was a significant reaction already in the second half of the last century, through distinguished men, who may be regarded as heralds of the theology of the nineteenth century. Among these were not only Klopstock and Claudius, who again turned with devotion and grateful love to the person of the Redeemer, but also Herder, who recognized and represented the indissoluble bond between poesy and religion, and sought to present Christianity as the religion of humanity. He had the special gift of discerning the true human element in the sacred documents, which is often misunderstood, as well as the noble and beautiful therein; and especially did he reconquer, so to say, the Old Testament for German literature. His highly cultivated mind, his large heart, attracted him to all that was great in the literature of all nations, especially of the Orient. He likewise conceived the idea of a philosophy of the history of humanity. Furthermore, we may mention Hamann, a man of profound mind, full of new ideas, although from lack of dialectic training he wrought out but little of the rich ore of his spiritual mine. A free, grand insight into the character of Christianity exalted him above the anxiety of the pious of his times, and, deeply rooted in evangelical Christianity, he could look with a humor that was sure of victory upon the efforts of the entire coterie of neologians who supposed they were capable of overthrowing Christianity. His favorite principle was *omnia divina et humana omnia.* He did not regard the eternal and the historical as being in irreconcilable contradiction, as the deistical Rationalists would have it; rather, history was to him the eternal becoming historical and embodied, and faith was the faculty of recognizing the facts of God in history and nature, of beholding the metaphysical, the eternal, and the historical in their unity by means of a mysticism which is not merely subjective, but objective, determined by the reality itself. Lessing was by no means, as many suppose, a mind hostile to Christianity. He issued the *Wolfenbüttel Fragments* in the conviction that Christianity was able to meet this assault, but that it needed an entirely different method of representation than the prevailing one of demonstration. He despised the enervating Rationalism, and preferred the muddy waters of orthodoxy to the dirty water of neology. But he was oppressed by the inconsistency between the eternal truths and history, and as he did not find the bridge, he offered, though in vain, a divine recompense to any one who would help him over the hideous chasm. And yet he had already in himself a presentiment that humanity needed something more than instruction in eternal truths, which still constituted the principal thing in his *Erziehung des Menschengeschlechtes.* There was likewise in him, notwithstanding all the power of his understanding, a deep mystical tendency. He ascribed to Christianity an internal truth, which, witnessing for itself, as the sun by its warming rays, makes all other testimony unnecessary. By emphasizing the *regula fidei* over against the criticism of the New Testament, he would give to susceptible Christians a secure position against assaults. At the same time, in contrast with that theology which makes the Holy Scriptures themselves a revelation, he would distinguish between Christianity as the foundation of revelation and the Bible as its record. He felt the need of a living God making himself known to the soul's experience, but remained shackled by the prevailing doctrines respecting God, which were held by deism as well as supernaturalism, which removed God too far away from history. This was all to be changed by the new philosophical movement which began with the nineteenth century.

The philosophical movement which originated in Germany after Kant and Fichte, through Schelling, Hegel, and Schleiermacher began to make up the acknowledged defects of the previous Christology and Soteriology with reference to the consideration of the being of God, as well as their mutual relation to one another. The fundamental tendency of these philosophers was the rejection of the barren deistical view: and although to some extent they approached too closely to the opposite extreme of pantheism, yet a more vital idea of God, and a more intimate relation between the being of God and man, were the common conviction of the more recent philosophies of religion, which could not but be of advantage to a series of doctrines; for, according to Schleiermacher, for instance, there is not merely a temporal interruption of the ordinary course of things in miracles or divine acts, which do away with the usual distance between God and the world, as was the view of supernaturalism, but an element of truth was now accepted from rationalism, which advocated immutable, eternal truths; and it was said that all things on earth are ordered according to a fixed, eternal decree of God, yet in this decree establishing a fixed order of nature he likewise regarded as included the eternal living presence and activity of God. Thus, the idea of the miracle as an abrupt act disturbing the order of nature was abandoned, and it was confined to its place as a part of the eternal decree. This does not mean that the entire contents of the eternal will of God are realized in every part alike, but that the temporal separation of the parts and the divine activity in different acts do not disturb the unity and continuity either of the decree or of the world: in that, rather, the new event attaches itself to that which already exists, which has developed so as to be capable of receiving and desiring it; yet, the new occurrence gains a permanent existence in the already existing one, or naturalizes itself in the world (*in der Welt sich naturirt*). Schleiermacher, who among those above mentioned has had the most permanent influence on theology, referred the Trinity solely to the world, and did not sufficiently maintain the independence of the Divine Being in and for itself. On the other hand, through his doctrine of Christianity as a second creation, and of Christ as a second Adam, he made several great scriptural truths fruitful, so that they came into play in overcoming the opposition between supernaturalism and rationalism. For Jesus was to him not from the earth, as merely the product of the sinful race, but, although true man, yet of a supernatural nature through the "existence of God in Him in a manner peculiar to Him alone" (*einzigartiges Sein Gottes in ihm*). In order to make the work of redemption easier of apprehension, he conceived the entire life of Christ, His actions and sufferings, as Christ's manifestation of Himself; and especially, in order that Christ's salvation might be imparted and man delivered from the consciousness of guilt and punishment, Schleiermacher applied the efficacious sympathy of Christ as high priest, and His position as the head of humanity, in whom God beholds the believing as parts of Christ's manifestation of Himself, so that they are well-pleasing to God on account of their vital union to Christ, and may know that they are justified, as then God has resolved to impart all His grace to humanity in Christ. Furthermore, Schleiermacher was the first to make the idea of the Church a living one, and recognize it in its glory. The Church was to him not a work of subjective choice or agreement, but a work of the Holy Spirit, who is constantly active in it, distributing His gifts; always, however, taking of that which is Christ's (John xvi. 14). Schleiermacher likewise rendered great service to the Church by establishing the boundaries of truth, or by marking out the heretical points of the compass. He fixed in a scholarly manner the difference between heterodoxy and heresy, which the Moravian Brethren, among whom he had been trained, had practically carried out in the different types which it would embrace within itself. He thus defined the conditions of church membership, the limits of liberty in teaching. This led to the great service which he rendered for the union of the Reformed and Lutheran churches in Germany. His *Glaubenslehre*, returning to the principles of the Reformation, sought a reconciliation of the Reformed and Lutheran types of doctrine. Thus, in the doctrine of predestination he combined Lutheran universalism with the Reformed absolute decree; Lutheran mysticism and the demand that objective Christianity should be appropriated in the inmost soul, with the ethical tendency of the Reformed type of doctrine; and the personal assurance in one's self with the awakening of the sense for the practical problems of the Church and of Christian national and political life: and thus he became, although without high ecclesiastical office, a true prince of the Church in revived German Protestantism. He would not have the union itself to be a mere work of the state or politics; still less did he require for union that all differences of doctrine should be abandoned. According to the principle of individuality which he regarded as so important, there is no justice or necessity for blotting out any true peculiarities, whether they appear in individuals or in the uniform belief of great masses; but only of delivering them from morbid conditions, among which was especially to be reckoned a separatistic position towards other individualities. Thus, he did not demand a union which should dissolve differences, nor indeed a postponing of union until a reconciliation of the points of difference in the Lutheran and Reformed doctrines should be reached through a higher unity: what he demanded was simply the mutual granting of church communion, especially in the Lord's Supper, and that such a significance should not be given to doctrinal differences as to allow them to bring about a separation of churches. It appeared to him unprofitable to go back to doubtful doctrines. He considered that the unity of the Church was not only consistent with the existence of different branches living in mutual recognition of one another, but that it was likewise quickened and enriched thereby in the interchange of spiritual blessings on the part of each one of the branches, which, going on without interruption, was thus preparing that higher unity.

Thus, the Augsburg Confession (Art. VII.), together with its Apology and the Schmalkald Articles, had distinguished between the common evangelical foundation, the *articulus principalis*, justification through faith in Christ, and other doctrines, respecting which pious and learned men might debate among themselves. Schleiermacher now gave this distinction its practical application in the Church to subordinate differences in doctrine, and thus pointed out in the future the ideal which the evangelical Church in its unity may realize. After that these principles had been established in law and in custom through the union in accordance with the ideas of the Reformation, we may speak in truth of a German evangelical Church, whose living members already exhibit a public spirit which asserts itself in manifold Christian works. Among these are the Gustavus Adolphus Association, Bible societies, foreign missionary societies, the central committee for domestic missions, the German Evangelical Church Diet, and the Eisenach conference of deputies of German church governments, which is even now about to constitute itself into a body representative likewise of those ecclesiastical bodies which have a synodical organization. Moreover, it is not a mere accident that in our days German Protestantism seeks and finds an increase of intercourse with Protestantism in other countries. But it is clear from this fact what a significant mission, with reference to the present condition of the Protestant Church and the combination of its members in the conflict with unbelief and superstition, the Evangelical Alliance will likewise have, since that it has had the mission, and has fulfilled it in North America, of affording the proof that different evangelical denominations, in spite of many not unimportant differences, may live together in unity of spirit, in prayer, and co-operation in the peaceful and profitable discussion of numberless scientific and practical questions.

ISAAC A. DORNER.

Ger'mantown, tp. of Livingston co., Ill. Pop. 369.

Germantown, a v. of Bracken co., Ky. Pop. 191.

Germantown, post v. of Mason co., Ky. Pop. 166.

Germantown, tp. and post-v. of Columbia co., N. Y., on the Hudson River. It has valuable fisheries. The tp. was settled by German refugees in 1710. The town is on the Hudson River R. R., 10 miles S. of Hudson. Pop. 1393.

Germantown, post-v. of Montgomery co., O. It has 1 national bank and 1 weekly newspaper. Pop. 1440.

Germantown, a former borough, now included in the 22d ward of Philadelphia, Pa. It is 6 miles N. W. of the old State-house, and was settled by Germans in 1684, under Francis Daniel Pastorius. Here was fought (Oct. 4, 1777) the battle of Germantown, so unfortunate to the American cause. Germantown is connected by steam and street railroads with the city proper; is very pleasantly situated, and contains a large number of fine residences, churches, etc., good public schools, a bank, a weekly newspaper, a community of Vincentian Fathers, a Roman Catholic college and seminary, a parish school with 390 pupils, and various charitable institutions. Pop. of ward, 22,605. (See PHILADELPHIA, by T. WESTCOTT.)

Germantown, post v. of Shelby co., Tenn., on the Memphis and Charleston R. R., 15 miles E. by S. of Memphis. Pop. 197.

Germantown, post tp. of Juneau co., Wis. Pop. 593.

Germantown, tp. of Washington co., Wis., on the Milwaukee and St. Paul R. R. Pop. 1954.

Germany. See GERMAN EMPIRE, by G. NEUMANN, Prussia.

Ger'many, tp. of Monroe co., Ala. Pop. 1537.

Germany, tp. of Richland co., Ill. Pop. 1040.

Germany, tp. of Adams co., Pa. Pop. 880.

Ger'mersheim, town of Bavaria, on the W. bank of the Rhine, 7 miles by rail S. S. W. of Spire, at the mouth of the Queich. It is strongly fortified, and has active business interests. Pop. 6223.

Germina'tion [Lat. *germinatio*, a "sprouting forth," from *germen*, a "sprout" or "bud"], in botany, is the term to denote the first steps of the development of the embryo or "germ" in the seed into the plant. It is naturally extended to the analogous development of any cryptogamous plant from its spore, which answers to seed. The embryo, originated in the ovule through its fertilization by a grain of pollen (see GERM and FERTILIZATION), completes its first stage of development in the seed while connected with the mother-plant; when the seed matures it has a period of rest; after which, when placed in favorable circumstances, germination takes place. Seeds vary greatly as to the length of time during which they preserve their vitality. Many seeds, especially oily ones, soon lose the power of germination unless they are committed to the ground soon after their ripening, although when in the ground they sometimes remain quiescent for two or three years. Others, especially leguminous seeds, when kept dry, may retain the power of germination for several, or even for many, years The same is true of many seeds when rather deeply buried in the soil; after long burial some of them germinate on being brought to the surface. But the accounts of "mummy-wheat," etc. growing after the lapse of 2000 or 3000 years may be wholly discredited. The conditions necessary to, or favorable for, germination are a congenial temperature, varying with the species. moisture, and darkness or a certain amount of obscurity. In the incipient process water is absorbed, and certain chemical changes set on foot, through which solid nourishing matter in the seed is gradually liquefied and made available for growth. In this a certain amount of carbonic acid gas is evolved and the temperature raised (which becomes very perceptible in bulk, as is seen in the malting of barley), showing that a portion of the store in the seed is consumed or decomposed to render the rest available. Sometimes this store of food is in the embryo itself, usually in the cotyledons, as in the bean and pea, when the germ makes the whole kernel of the seed; sometimes mainly outside of it, as in corn and other grain. The particular mode of development of the germ varies according to its conformation. Commonly, the radicle lengthens and projects from the seed, takes a vertical position, develops a root from its lower end, raises the cotyledons above the ground to expand as the seed-leaves, and above these develops the plumule or bud into the succeeding stem and leaves. In many cases the radicle does not lengthen, and the cotyledons remain under ground and within the coats of the seed; then the first foliage that appears belongs to the plumule, as in the pea and the oak. It is the same, with a certain difference, in corn and other grain. In any case, when the germ has developed into a plantlet, with root established in the soil and foliage in the air and light, so that it can provide its own nourishment, the process of germination is completed. REVISED BY A. GRAY.

1, section of seed of morning-glory, showing the embryo; 2, same embryo detached and straightened; 3, germination of the morning-glory; 4, same, further developed.

Germ-Theory of Disease, a theory which ascribes disease in general, and infectious diseases in particular, to the introduction into living organisms of minute parasitic forms of life, and their subsequent multiplication to the obstruction of the vital functions. Though this theory has, in recent years, attracted a great deal of attention, in consequence of the deserved celebrity of some of its advocates, it is not, as is commonly supposed, a theory which has originated in recent years. Traces of it appear in writings of very high antiquity, and more than 200 years ago it was brought distinctly forward by the celebrated Father Kircher, in his *Scrutinium Physico-Medicum Contagiosæ luis quæ pestis dicitur*, as an hypothesis to account for the infectious propagation of the plague. During the century which followed, moreover, it received the countenance of many other eminent men, among whom may be mentioned Lancisi, Vallisneri, Réaumur, and Linnæus. The discovery of the spermatozoa, which was made by Leeuwenhoek in 1677, soon after that of the infusoria by the same naturalist, gave a certain degree of plausibility to the doctrine; for, as these were generally regarded as real animals, the presence of microscopic living organisms within the bodies of men was supposed to be demonstrated; and it seemed to be quite reasonable to conclude that noxious as well as innocent organisms of this description might sometimes establish themselves there. But whatever plausibility this theory might at that early period have seemed to possess, it could then claim no higher rank than that of a bare hypothesis; and it has only been in times comparatively recent that observation has brought to light a sufficient number of facts apparently favoring it to justify our advancing it in the arena of scientific discussion to the higher dignity of a theory. Many of the most distinguished pathologists of the present day have, in fact, already declared themselves convinced of the substantial truth of the theory; and some idea of the progress which it has recently made, and of the light in which it is by many beginning to be regarded, may be gathered from the following passage, taken from the introduction to the monograph upon typhoid fever, by Liebermeister, recently published in Ziemssen's *Cyclopædia of Medicine.* The phrase *contagium vivum* in this extract will be understood to signify the propagation of disease by means of living organisms. "Within the last ten years a great revolution has taken place with regard to the popular signification of a *contagium vivum.* New investigations on the appearance, mode of propagation, and the significance of the low organisms, new facts in regard to the extension of national diseases, and also a number of quite positive discoveries by numerous investigators, have removed the old opposition to the theory, or even been the means of furnishing definite proof of its correctness. The prophecy which I believed myself justified in making in 1865—viz. that the theory of a *contagium vivum* would soon be the prevailing one, and that under its influence investigation would take directions that would probably lead to results of the greatest theoretical and practical importance, —this prophecy has actually been fulfilled, in part, during the last few years. A great number of the best experimentalists are the declared adherents of the theory. At any rate, it is now admitted, even by those who do not unreservedly acknowledge the theory of a *contagium vivum*, that it represents a view which points more clearly than any other to order in the chaos of facts."

The object of this article being to present in brief the evidence as yet gathered as to the important question to which it relates, it is proper to remark in the outset that it would be absurd to attribute all diseases to the invasion of the diseased system by microscopic parasites. From the laws of organic life, it is obvious that the causes of disease must be various. No living organism enjoys an existence of unlimited duration. Every such organism, under favorable circumstances, passes through three distinct stages, which are those of growth, vigorous maturity, and decline. The organism commences as a germ, and ends in dissolution and disintegration. Since the laws of life, as well as those of physics, are fixed and definite, there is reason to believe that all organisms of the same species, if placed in conditions equally favorable to their development, would be equally long lived; yet, in point of fact, those which pass through the regular stages constituting their normal life are comparatively few. In the large majority, the vital functions are, earlier or later, more or less disturbed, if not arrested, by an endless variety of causes tending to produce disease and premature death. In the human race, life is often shortened by ignorant or wilful disregard of the conditions necessary to the preservation of health. Accident, also, often exposes individuals to deleterious influences. Thus, in many cases, diseases arise from exposure to extremes of temperature or from excesses in eating and drinking persisted in until the organs of digestion become debilitated and fail to fulfil their proper functions. But besides these causes of disease, which may be classed under the head of "injurious conditions," there are other influences directly morbific which, whenever they come into play, cut short the duration of life. Poisons belong to this class, but the effects of these are felt only in occasional and accidental instances. Other noxious influences, of which the pernicious consequences are more widely spread, are those which produce the diseases called zymotic. Such are malaria, contagion, and infection, instrumentalities to which are owing the widespread ravages of epidemics. It may further be remarked

that there are many cases of disease in which the cause is not traceable directly to any of the sources above mentioned, but in which the disease has been transmitted by inheritance from a parent similarly affected. In such cases there is nevertheless every reason to believe that the disease in its first appearance was produced in a healthy organism by causes belonging to one or the other of the classes above named.

With all those varieties of disease which begin and end in the individual our present discussion has nothing to do. It is the propagation of disease only which concerns us; and this is a subject which has occupied more carefully the attention of physicians, and has led to more elaborate observation and experiment, and has given rise to more marked differences of opinion and more animated controversy, than almost any other in the science of pathology. That epidemics often arise from peculiar conditions of the atmosphere not in the least as yet understood, can hardly be doubted; and in this case the influence which excites disease simultaneously in many is not dissimilar to that by which contagious diseases are transmitted from individual to individual. It is, however, in this latter mode of transmission that, if the germ-theory is true, the evidence of its truth is most likely to be earliest detected; and hence, in the evidence which has hitherto been presented bearing upon the question under consideration, there is none which relates to diseases which are epidemic without being contagious. As to contagious diseases, the germ-theory does not stand alone. Opposed to it are two others—one of them commanding probably the largest number of suffrages and long familiar to the medical profession; and the other of recent origin, and as yet publicly advocated only by its distinguished author, Dr. Lionel S. Beale of London. The first of these may be properly called the chemical, and the second the vital or bioplasmic theory. The chemical theory is founded on a presumed analogy between the propagation of disease in living organisms and the process of fermentation in certain forms of organic matter without life. (See FERMENTATION.) This theory assumes a ferment to be an organized substance in a certain state of decay, which possesses the property of exciting the same decay in other organic substances with which it is in contact. Applying this theory to disease, it supposes that infection is communicated by the instrumentality of particles thrown from the person, or from substances proceeding from the person diseased, and borne by the air to other persons in full health, in whom they excite, probably by contact with the membranous linings of the lungs, or by absorption through the pores of the skin, the same diseased condition which exists in the patient.

The bioplasmic theory rests upon certain views entertained by Dr. Beale as to the nature of vitalized matter, and as to the distinction between those portions of the living organism which are really alive, and those other portions (constituting much the greater part) which are, as he expresses it, "formed tissue," and lifeless. This really living matter he calls *bioplasm*, and each separate portion of it a *bioplast*. Its simplest representative is the *Amœba* among the Protozoa. It is also present pure and simple as the white globule of the blood in all the mammifers. But it also forms the fluid or semi-fluid content of every animal and vegetable cell, the cell-wall being merely formed tissue which was originally a part of the bioplast which it encloses. Chemically considered, bioplasm is identical with the protoplasm with which Huxley has made all the world so familiar. Biologically, it is something more, in the respect that it possesses the property of contractility, which is characteristic of life in its lowest forms—a property which does not necessarily belong to protoplasm. According to Dr. Beale, the bioplasts of the blood multiply, like many of the Protozoa, by fissuration or self division, or by gemmation or budding. The fact of such multiplication is demonstrated, as he asserts, by direct observation with the microscope. In a healthy state of the animal, the process of multiplication is balanced by that of assimilation, and the bioplasts attain certain normal and uniform dimensions. But occasionally, under conditions impossible to define, there occurs an abnormal acceleration of the process of gemmation, each parent bioplast throwing off an immensely numerous progeny, of which the individuals never attain the normal dimensions, though they themselves become immediately the parents of another generation still more degenerate, until the blood is overloaded with these excessively minute and infinitely numerous organisms, and the regularity of the vital functions is disturbed. These minute bioplasts, according to the author of this theory, escape from the diseased individual in countless numbers. Protected by a coating of formed tissue, they float through the air, retaining their vitality for an indefinite period; and if at length they are absorbed into the circulation of a healthy animal, they recommence there the process of morbid development of which they are themselves the offspring, and thus engender the same disease in which they originated. This theory, it will be seen, is entitled to be called, in a certain sense, a germ-theory, but it is not *the* germ-theory. Its germs, in other words, are not embryos out of which are developed more perfect organisms, having individual characteristics and specifically distinct from other organisms. Their analogies, on the other hand, are quite as close with the ferments as with the true germs.

The germ-theory proper, however, presumes that the diseased person is suffering from an invasion of his system by microscopic algoid or fungoid vegetative forms having, like the presumed bioplasts of Dr. Beale, the property of rapid self-multiplication, and that the spores which proceed from these fungi or the cells of the Algæ are wafted in like manner by the air from person to person, penetrating the systems of the healthy, and establishing new colonies to generate disease in them. A *prima facie* evidence, which, so far as it goes, is favorable to this theory, is found in the well-known fact that all the forms of cryptogamic vegetation are propagated by spores, which they shed freely abroad in all directions, and that these are borne in infinite numbers through the atmosphere, which they pervade near the surface of the earth in all places. The fact of their universal presence is made manifest by the promptness with which fungoid growths spring up in all circumstances in which the conditions favor their development. Such conditions embrace a congenial temperature, and the presence of some organic substance suitable to serve as a nidus and furnish for them their proper food. There are peculiar forms of fungus which appear on particular forms of organism and nowhere else. Thus, the hoofs of dead horses are overspread, when exposed at a moderate temperature to moisture, with a vigorous growth which is seen in no other situation, and some of the larger plants are infested by their own peculiar fungi.

This constant appearance of minute forms of vegetable life could not take place so invariably in all varying situations were not the spores of the fungi continually present in the air throughout its whole extent. We know that the numbers of these spores which all fungi produce are incalculable. The larger fungi give us evidence of this. The spores of a single puff-ball have been estimated to be more numerous than the entire human population of the globe. It is true that to ordinary observation the presence of foreign matters in the atmosphere is not perceptible, except when such foreign matters take the gross form of clouds of smoke or dust; but particles of smoke or dust, and in general of all inorganic substances, are so heavy that they soon subside; yet when the air is thus left apparently free from all foreign admixture, it is demonstrably full of organic particles so extremely light as not to subside for many hours, or even days, of perfect rest. The chemist, it is true, is unable to detect them by his tests, delicate as they are; for, being organic, and composed in general of but two or three elements—which elements are in great part those of the atmosphere itself—they produce no distinctive reactions under the ordinary processes of analysis. But there is a mode of analysis much more delicate than even that of the chemist. It is that which has been applied incidentally to this question by Prof. Tyndall, in his interesting investigation into the chemical effects of light upon vapors. Prof. Tyndall discovered that there are many substances of great volatility which, when in the state of vapor, are easily decomposed by light. He found that a perfectly transparent vapor, like steam, when traversed by a luminous beam, is absolutely invisible; while we all know that if we admit a beam of sunlight into a darkened room through an aperture in the shutter, the path of the beam through the apartment is as distinctly marked as if it were a solid bar. That this visibility of a beam of light in the air is not owing to the power of the aërial particles themselves to reflect light, is demonstrated by him by proofs entirely conclusive. A beam of light from an electric lamp was made in his experiments to pass through a large glass tube closed at both ends by plates of glass ground on. No light was permitted to escape into the room; and accordingly, when the tube was exhausted of air altogether, and no light from its interior was reflected to the eye, it was perfectly invisible. But if the air of the room were allowed to re-enter it, it immediately became brilliantly luminous, as in the case of a sunbeam admitted through the window-shutter. If, however, the air before being admitted into the empty tube had been passed through a red-hot tube of platinum, the tube thus filled remained as completely invisible as when it was a perfect vacuum. This experiment, which is but one of many employed by Prof. Tyndall to demonstrate the same proposition, shows not only that the air is full of foreign matters, but that these foreign matters are organic; for were they not so they could not be destroyed by fire. He proved also that these particles are so numerous that they

cannot be entirely arrested by passing the air through the most energetic chemical reagents, as sulphuric acid, caustic potash, and the like; but that, though these substances arrested a large portion of the organisms, they allowed still not a few to escape. He showed, however, that a filter of rather closely compacted cotton will shut off entirely, or almost entirely, the organic matters which the air contains; and he showed, finally, that absolute rest for a long period of time will cause these particles completely to subside. Thus, a large flask which had been standing in the store-room was found to be, as he expressed it, "optically empty;" that is to say, the rays of light passed through it without showing any more trace of their path than if it had been a vacuum. He also experimented to ascertain how long a time would be required to free the air by subsidence of its suspended particles in a space completely closed; and for this purpose he constructed such a closed space, cubical in form and several feet in lineal dimensions, glazed so as to permit him to pass through it a beam of light, and to observe the path of the beam. This small apartment was made absolutely air-tight and left to itself. On each succeeding day the brilliancy of the transmitted beam grew less and less, and at length, at the end of a week, it could no longer be perceived at all. The apartment was optically empty. These experiments, and others no less interesting, by Prof. Tyndall, thus prove in the most conclusive manner that the ordinary air at the surface of the earth is always completely filled with particles of organic matter. It is not necessary to suppose that all these particles are living germs of vegetable or animal organisms; but when we see how constantly such organisms spring up wherever the conditions favor germination, it is impossible to doubt that a vast many of them have this character, and that these are the source of those growths of minute cryptogams which thus seem to spring up spontaneously. There is no other mode of accounting for such growths except to suppose that they are actually spontaneous; and accordingly the view has been taken by some physiologists—perhaps, it should be said, many—that the true mode of accounting for the appearance of microscopic forms of life is to suppose that they originate without organic antecedents, or, as they express it, *de novo*. It is no part of our purpose to discuss this question here. The history of the controversy, which has long been in progress, regarding it, is given in the article GENERATION, SPONTANEOUS.

From what has been said, it is evident that, if disease is not produced by the invasion of the blood or viscera of the patient by a parasitic vegetation, it is not for want of the germs from which such vegetation might spring. It is therefore important to consider first what has been already ascertained of the effects of such parasitic growths infesting the animal organism. A simple form of fungus, called the *Sarcina ventriculi*, is often found in matters thrown up by persons laboring under disorder of the stomach. It has also been met with in other parts of the body when diseased. But it is likewise found, and not unfrequently, in the stomachs of persons in perfect health, and, as Dr. Carpenter says, may accumulate there in considerable quantities without causing inconvenience. This parasite, therefore, cannot be regarded as an inciting cause of disease. The stomachs of many worms and insects are found, moreover, to be frequently infested with fungi, which grow there in great luxuriance. Many of these have been examined and described by Dr. Leidy of Philadelphia. It does not appear that they occasion inconvenience to the animals within whose bodies they thus establish themselves. On the other hand, some of the dipterous and hymenopterous insects, and some caterpillars, are liable to invasion by fungoid growths, which speedily spread through their entire bodies and destroy their lives. In the West Indies, according to Dr. Carpenter, it is not at all uncommon to see individuals of a species of *Polistes* (corresponding to our wasp) flying about with plants of their own length projecting from some part of their surface, the germs of which have been introduced through the breathing-pores at their sides. This fungoid growth, however, soon kills the insect; and a similar effect follows a similar cause in the case of certain caterpillars in New Zealand, Australia, and China, of which the bodies become so thoroughly interpenetrated and, as it may be said, replaced, by the fungoid vegetation, that when dried they have almost the density of wood; so that, in the language of Dr. Carpenter, "these caterpillars come to present the appearance of twigs, with long slender stalks formed by the projections of the fungus itself." Our common house-fly is a not unfrequent victim of a similar parasitic visitation. A fungus called the *Empusa muscæ*, originating from the germination of a single spore brought in contact almost anywhere with the body of the insect, pervades after a time its whole interior, and, while leaving the surface uninjured, emphatically eats out its substance. When the animal's life is nearly exhausted he comes to rest, and fungoid shoots put forth from his body on all sides, clothing him apparently with a kind of fur, consisting of filaments each bearing a fructification of innumerable spores. The harvest of spores becomes very conspicuous when the unfortunate animal makes his last stand upon the window-pane, forming a thin film over the glass to a considerable distance around him; and if by any chance a healthy individual of the same species comes within the limit of this infected area, the disease which has destroyed his fellow will be sure to attack him also. There are some forms of parasitic disease affecting insects which have had consequences of serious importance to certain great industrial interests to which these humble forms of animal life are tributary. A fungus called the *Botrytis Bassiana* is the occasion of the disease in silk-worms known by the name of *muscardine*. The spores of this fungus, entering the breathing-pores of the worm, soon germinate, and death is the invariable consequence. It is only, or at least rarely, however, the case that the cause of the fatality is manifest until after death has occurred; but then the fungus shoots forth luxuriantly, especially at the junction of the rings of the body. A still more destructive epidemic among silk-worms is that which has received the name of *pébrine*, and which is caused by the multiplication of a parasitical organism called *Panhistophyton*, fungoid in its nature. This disease is the more difficult to deal with, in that it is transmissible by inheritance, the *Psorospermiæ* entering into the eggs of the diseased worm. It was thoroughly investigated by Mr. Pasteur, who pointed out the means by which it might be extirpated—means which have since been successfully applied. But there are diseases produced by invasions of parasitic fungi in animals of much higher grade than worms or insects. There are, for example, many cutaneous diseases among men, caused demonstrably by the presence and multiplication of microscopic forms of parasitic life, usually vegetable, but sometimes animal. The *Tinea favosa*, a disease of the scalp, happily rare, covers the head with yellow scales consisting almost wholly of a fungoid vegetation. The thrush in the mouths of children is made up of white patches of similar vegetable character. The itch is caused by the burrowing, beneath the cuticle, of a minute insect known as the *Acarus scabiei*. Of deeper seated diseases, *Trichiniasis* owes its name to the animal, and *Mycosis intestinalis* to the vegetable, cause to which these diseases are severally owing. The widely prevalent and frequently fatal malady known as *Diphtheria* has been proved by the recent investigations of Cohn, Oertel, Eberth, Nassiloff, and others to proceed from a penetration of the tissues by particular forms of bacteria, one of them called the *Micrococcus* and another *Bacterium termo*; while still other analogous organisms appear in the false membranes which form in the mouth and fauces. The disease is readily communicated by inoculation; and when this experiment is made, "the point of inoculation," according to Oertel, "forms a centre from which the growth of these organisms radiates through the tissues; and the intensity of the infection is wholly proportionate to the degree in which the tissues are penetrated by these parasites. The mass of *Micrococci* developing in the body forms the criterion for the severity of the disease, and an exact indication of the virulence of the diphtheritic contagion." He adds: "There can be no longer a doubt that these vegetable organisms are not of accidental occurrence, but are inseparable from the diphtheritic process, just as the bacteria of decomposition are necessarily connected with decay and act as a ferment of it. *Without Micrococci there can be no diphtheria.*" Again, the epidemic among cattle called in England "the blood" is shown by the researches of Davaine to be occasioned by the presence in the blood of the diseased animals of innumerable living organisms resembling vibrios. This disease is communicable to man, producing what is called "malignant pustule," and this is attended with the development of the same organisms in the pustules thus produced. Prof. Lister, an eminent surgeon of Edinburgh, long ago observed that when a chronic abscess is discharged by means of a canula and trochar, the subsequent accumulations of fluid are frequently attended with putrefaction, though none had existed before. The putrid mass is also found to be swarming with vibrios, though none had been present in the first discharges. No explanation of this singular phenomenon, according to him, can be given, except that the germs of these organisms were introduced in the original operation with the canula and trochar. Another remarkable fact noticed by Prof. Lister seems strongly to corroborate the theory of inflammation and putrefaction above given. A wound in the chest producing effusion of blood in the pleural cavity is attended with great danger from the liability of the extravasated blood to putrefy. Yet when the lung is wounded by a broken rib, without any external opening, the blood, though escaping into the cavity

in quantity, undergoes no decomposition and excites in the surgeon no concern, even though air at the same time enters in such volume as to inflate the cellular tissue of the entire body. "These facts," says Prof. Lister, "involved to me a complete mystery until I heard of the germ-theory of putrefaction, when it at once occurred to me that it was only natural that the air should be filtered of germs by the air passages" of the lungs. Now, what Prof. Lister conjectures *a priori*, Prof. Tyndall, interested by this remark, subsequently proved experimentally. Through the path of a beam of light made visible by his lantern in the dark room described above, he caused the air from his own lungs to pass by breathing through a tube. The current at first but slightly affected the brightness of the beam, but as the air from the larger passages passed away, and that from the deeper network of the lungs succeeded, the light progressively faded, and at length gave place to absolute blackness. The experiment fully confirmed the anticipation of Prof. Lister, that the air which passed through the lungs would no longer contain the germs of living things or any other suspended foreign matter. But what an idea does this give us of our liability, through our lungs, to absorb into our system anything noxious which the air may contain, no matter how minute in quantity or how finely divided! If the quantity in given volume is minute, it is to be remembered that the volume we inhale in a limited time is enormous, amounting to two or three thousand cubic feet a day; and the accumulation which must result from even the partial exhaustion of this great mass, of its impurities, must become very considerable.

Having spoken now of the cases in which disease, local or general, in animals, is manifestly occasioned by the presence of parasitic vegetation, it is proper to mention, briefly, similar examples in plants. The smut in wheat, the rust in cotton, the *Oidium* in grapes, and the *Botrytis* in potatoes are examples of fungi constantly concomitant with disease, and presumably, almost certainly in the last two instances, its cause. Neither in plants nor animals, however, is it to be supposed that the noxious effects observed are occasioned merely by the presence of these parasites, mechanically interfering with and obstructing the vital functions, or acting directly as poisons in the ordinary sense; but rather by their own vital activity decomposing the substance of the organisms they infest, and making them their food. The consequences of their extensive prevalence to the material interests of communities and peoples, and to their means of subsistence, have been occasionally of the gravest character. The *Oidium* may be said to have exterminated the vine from the island of Madeira; the *Panhistophyton* cut down the product of silk in France from 130,000,000 francs per annum to 30,000,000; and the *Botrytis* threatened to depopulate Ireland, by destroying the vegetable which constituted, for the common people, the staple article of their food.

Putting together, then, the known facts regarding this subject before proceeding to more doubtful cases, we may say that the germ-theory has an amount of *prima facie* evidence in its favor which entitles it to careful consideration. In certain instances, and in a certain sense, the evidence is complete that the germ-theory is true. But when we come to apply it to infectious diseases in general, we find the analogies which they present with the limited class of examples above enumerated, to be unexpectedly feeble, while the points of dissimilarity are numerous and marked. It is not even enough to discover that in such diseases there are actually present in the blood, or in the tissues, or in the secretions, or in the dejections of the suffering individuals, living forms of microscopic cryptogams, since the evidence is rarely conclusive either that these minute bodies are injurious to the patient or that they were present antecedently to the attack. And if, as to the first of these points, the evidence in some cases *is* satisfactory, as to the second it can hardly be pronounced to be so in any.

As to the constant presence of vegetable organisms in the blood of men or animals suffering under infectious diseases of whatever kind, it is impossible to entertain a doubt. The testimony of all the observers who have occupied themselves with this subject is concurrent to this effect. Coze and Feltz, Klebs, Burdon-Sanderson, Klein, and many others have found bacteria invariably in the blood of patients suffering under typhoid fever, smallpox, scarlet fever, puerperal fever, pyæmia, and septicæmia. Dr. J. H. Salisbury of Cleveland, O., affirms that in healthy as well as in diseased blood there are always present two species of cryptogams—the one algoid and the other fungoid. In the pustules of smallpox Dr. Salisbury claims further to have observed a cryptogam having both a fungoid and an algoid development, of which the spores are also found in the blood. The existence of the smallpox fungus is treated by the German pathologists as fully established by their own observations. Again, in typhoid fever, according to Salisbury, a peculiar algoid vegetation is developed upon the external surface of the entire body and upon the mucous membrane of the interior cavities, which is regarded as the efficient cause of the disease and the means by which it is propagated. And of typhus fever Lebert remarks: "All the later writers agree that the disease is spread by a typhus germ." Dr. Ernst Hallier of Jena, who has published largely on this subject, and has made himself prominent as an advocate of the germ-theory, has described a large variety of vegetable forms found by him in diseased men and animals, many of which he has subjected to systematic cultivation in order to study their modes of development. He claims to have demonstrated the existence in the rice-water discharges of cholera patients, and within the intestinal canal of such persons, of a new and peculiar fungus, as marvellous for the rapidity of its development as for its strange forms of growth, and its terribly fatal destruction of the epithelial tissue of the intestine. This has been called by Profs. Thomé and Klob the *Cylindrotænium*, but is regarded by Dr. Simon and Dr. Harris as being an exotic member of the family to which belong the *Urocystis* and *Oidium* blights of cereals and fruits. Whether this parasite has been satisfactorily identified or not, however, the weight of medical opinion among the highest authorities on the continent of Europe, as will appear from citations given below, is decidedly in favor of the fungoid character of the choleratic contagion. It is proper, nevertheless, to remark that British authorities seem to lean in the other direction; and in the last and recently published edition of Dr. Parkes's *Manual of Practical Hygiene* we find the following explicit statement: "As regards cholera, the careful observations of Drs. Lewis and Cunningham in Calcutta seem to have disproved the possibility of either fungi or bacteria being the cause of cholera."

The disease which appeared in 1868 among the beef cattle brought to New York from the West, and which is known as the Texas cattle disease, was attributed at the time to a peculiar species of fungus, of which the spores were said to have been found both in the blood and in the bile of the diseased animals. The epizootic which attacked all the horses of the country in 1872 was also marked by the presence of fungi in the blood and the urine of the animals affected. These examples will probably be thought sufficiently numerous to justify the generalization that in infectious diseases the presence of microscopic algoid or fungoid cryptogams is a fact of invariable occurrence. What is the significance of this fact? In all these cases we find that the fluid in which the cryptogams occur is itself diseased. Is not the disease of the blood the very condition that is necessary to the development of the plant? When mould makes its appearance on the surface of paste, is it the presence of the mould which causes the paste to putrefy, or is it the putrefaction of the paste which provides a congenial nidus for the mould?

About forty years ago the yeast-plant was discovered by Cagniard de la Tour, and almost simultaneously by Schwann. (See FERMENTATION.) Till that discovery the chemical theory of disease had a strong support in the imagined analogy of fermentation. To the suggestion, after the discovery, that fermentation is probably a consequence of the rapid growth of the plant, there was at first a very general and natural dissent; but when, in 1843, Helmholtz made a direct experimental test of the question, by placing a fermenting liquid side by side with one of the same kind not fermenting, both being contained in the same vessel, but separated by a membrane which permitted the mingling of the liquids, but prevented the passage of the plant, that analogy lost its force, for the fermenting liquid continued to ferment, while the quiescent liquid remained quiescent. The case of fermentation assumed now a significance quite the contrary of that which it had before seemed to possess, and it began to be considered quite as conclusive in favor of the germ-theory as it had been before in favor of the chemical. In the words of Liebermeister: "Since we know that those ferment processes which here alone can be taken into consideration are all associated with the presence and multiplication of low organisms, the theory of fermentation becomes virtually identical with the theory of a *contagium vivum*."

But independently of the argument derived from the detection, or supposed detection, in the body of the patient, of the microscopic parasites which are the presumed cause of his disease, there are some considerations of a general nature bearing upon the question, which must be admitted to favor strongly the truth of this theory. It is, in the first place, a material substance, and not merely a dynamic influence, by which the infection of disease is communicated from individual to individual. This is proved by the fact that it is conveyed in merchandise, in clothing, in letters, in books, etc.; and that, in these and similar ob-

jects, if they are closely packed and excluded from the air, it will preserve its energy for an indefinite length of time. Now, being a material substance, the fact is significant that we find in it a power of reproduction, or of self-multiplication, which is at once strikingly analogous to that of all low living organisms, and at the same time difficult to be explained on any theory of chemical combination or decomposition. On this point, Dr. Liebermeister, in the treatise already cited, expresses himself as follows: "*The poisons of infectious diseases can reproduce themselves, and that to an unlimited extent.* With a minimal quantity of vaccine virus we can vaccinate a child, and obtain vaccine matter from him. From this child ten, and even more, children can be successfully vaccinated; from each one of these children ten more in turn, and so on; so that what at first was a scarcely appreciable quantity of the virus of the disease is sufficient to produce the disease in 1, 10, 100, 1000, 10,000 children, and so on *ad infinitum*. There is no limit to the extension of the disease until there are no individuals left to whom the poison can be successfully conveyed; otherwise, the number of persons who could be infected by a minimal quantity would be unlimited in the strict mathematical sense of the word. As with the vaccine virus, so with variola, measles, scarlet fever, typhus fever, syphilis, malignant ulcers, blennorrhœas, etc.—the poison can be multiplied to an endless extent. In opposition to such facts as these, all hypotheses which refer these poisons to certain known or unknown chemical combinations—and such views are even now sometimes advanced—must be abandoned as thoroughly untenable."

Another consideration, pointing in the same direction, is the fact that every contagious disease preserves for ever the same invariable type. On this point we cannot do better than to quote once more from Liebermeister. "A peculiarity of the infectious diseases," observes this authority, "which they have in common with the poisons proper, or *intoxications*, but by which they also differ in the most marked manner from all other diseases, is their *specificness*, which shows itself in the fact that always, and under all circumstances, a given kind of disease is solely due to a given kind of morbid agent or cause. There is no such constancy in the relations between cause and manifestations in other diseases. Exposure to the same degree of cold will occasion different affections, varying with the individuality of the person attacked—in one person a coryza, in another bronchial catarrh, in the third an attack of colic or diarrhœa, toothache, facial paralysis, or any other lighter or more severe 'rheumatic' affection; or, *vice versâ*, a catarrh can originate from irritants affecting the mucous membrane of the nose, as irritating fumes, pungent snuff, mechanical injuries; or also from cold to which the feet have been exposed, or by poisoning—as, for instance, with iodine, or even by infection. On the other hand, vaccination with the virus of variola alone produces variola, if any disease at all is produced by it; vaccination with vaccine matter produces vaccinia only; infection from a patient with measles only produces measles, and never anything else." And further: "Various physiological conditions, and, indeed, other pre-existing affections, are influential only so far as they increase or diminish the susceptibility; the *kind* of disease will not be determined by it. Through the longest series of generations, diseases preserve their specific character with the utmost persistency; and if, at times, some of these characteristics are not brought into complete maturity, owing to an unfavorable field for their development, yet they assume them again so soon as they are planted in favorable soil. The weather, the period of the year, the climate, the condition of the soil, etc., conduce to or prevent the spread of an infectious disease, but they never change the nature of the disease—the diseases which in all climates, as cholera, smallpox, syphilis, exhibit the same essential characters everywhere. The kind of diet and all other physico-chemical influences act indifferently with regard to the nature of the affection. In fine, it may be said that no individual or external influence ever decides the nature of the affection, and one infectious disease is never under such conditions changed into another." There is here something so closely resembling the persistency of species in organic nature that we cannot but recognize in the analogy a strong argument in favor of identity of cause.

Still another consideration of no less interest in this discussion than those already presented is derived from the phenomena attending the propagation of the class of diseases distinguished as *miasmatically contagious*. These diseases are not communicated from individual to individual, yet they never make their appearance in any place to which a diseased individual, or objects which have been in contact with such an individual, or morbid matter proceeding from such an one, has not been conveyed. Cholera is an example of this kind, and yellow fever is another. The attendants on cholera patients are no more frequently attacked by the disease than persons who hold themselves aloof with the severest caution. Yet in a thousand instances it has been proved that an atmosphere contaminated by effluvia proceeding from choleratic dejections, or a source of water which has been even remotely polluted by them, become active agents in spreading the disease. This singular anomaly is in entire harmony with what we know of the modes of reproduction of sundry known forms of parasitic animal life. The embryos must pass through two stages of development—one within the body of the animal which they infest, and the other without. When the *Trichina spiralis* has become encysted in the muscle of a living animal, the animal, if it survives the crisis, is troubled no more. Reproduction will not take place unless the cyst shall afterwards pass into the stomach of another animal. The *Tænia*, or tapeworm, cannot pass directly from one person to another. An intermediate stage of development is necessary. Examples of this description furnish us with a key to the explanation of miasmatic contagious diseases, which is not only consistent with the theory of a *contagium vivum*, but forms a strong argument in support of that theory. On this point Dr. Liebermeister says: "If we think that a procedure similar to what we know with sufficient accuracy takes place in the development of the *Tænia* also takes place in the development of every disease-poison—that, for example, the organisms which are the root of cholera have, in their reproduction, to pass through two stages of development, the one outside the human body, and the other within—then the difficulty which envelops the affair is removed. The fresh discharges of cholera patients contain these organisms in the stage of their development in which, if introduced into the body of another, they do not reproduce themselves further, and can cause no infection with cholera; before they are again capable of it they must pass through another stage of development outside the body." The phenomena attending the propagation of the miasmatic contagious diseases are thus in strict harmony with what we know of the modes of reproduction of many low forms of organic life; while, upon the purely chemical theory, they present an enigma incapable of solution. In the words of Lebert, the distinguished pathological anatomist of Vevay, who has discussed this subject in Ziemssen, "the universally accepted specific cholera-germ must be either an organic poison or a living organism. But in the whole range of toxicology, a subject now so accurately understood, there is not a single observation that speaks even approximately in favor of the purely toxic character of the cholera-germ."

Yet notwithstanding the undeniable weight of these arguments, the germ-theory of disease, at least when stated in all its generality, cannot be said as yet to have obtained acceptance with a majority of the medical profession. Serious difficulties present themselves in connection with the subject, which as yet it fails to explain; and among these are the objections strongly put by Dr. Bastian, that the theory demands a belief in the existence of about twenty different kinds of organisms never known in their mature state, and whose existence is not demonstrated, but simply postulated; and that these germs, if they exist, are not the germs of any known organisms, because such germs have been experimentally shown to be incapable of producing the particular diseases these are assumed to cause. Moreover, feeding on putrid flesh, as is habitual among the Kalmucks, is followed by no injurious consequences, though such flesh swarms with bacteria; and, as the author just referred to affirms, the organisms of ordinary putrefactions may be introduced even into the blood of men and animals without producing any of these specific diseases. The same writer asserts that in sheep-pox the blood and the secretions are not infective, though this disease is allied to, and even more virulently contagious than, human smallpox.

What account shall we give, then, of the multiplication of fungi and Algæ in diseased blood, if these organisms are not the cause of the disease? Simply, that the diseased condition furnishes to the organisms the pabulum, which is not present in the healthy state. For the cause of the disease we must, on this supposition, look elsewhere, and we shall be compelled, perhaps, to fall back upon the chemical doctrine of sympathetic decomposition. Many causes, in fact, produce profound changes in the blood with which parasites have nothing to do. This is true of prussic acid and of the venom of serpents, both of which produce fatal effects with singular rapidity. Of "the black death," which raged in the fifteenth century, Bastian quotes from Hecker that "many were struck as if by lightning, and died on the spot;" and he cites the testimony of Dr. Aitken to the fact that, when the cholera reached Muscat, instances occurred in which only ten minutes elapsed from the first apparent seizure till life was extinct. These are cases for which the germ-theory affords no solution. On the other hand, we

have the numerous observations and experiments of Coze and Feltz, of Burdon-Sanderson and Klein, of Klebs, of Davaine, of Zahn and Tiegel, and others, in which rabbits and guinea pigs were inoculated with bacterious blood drawn from patients laboring under a great variety of infectious diseases, including pyæmia, septicæmia, smallpox, measles, scarlet fever, typhoid fever, etc.—observations and experiments which seem to leave little room for doubt that these organisms are, in fact, in these cases, the vehicles of the infection and the causes of these several diseases. It was observed, for instance, that successive inoculations increase the intensity of the virus, and that along with the increase of toxic power the number of the organisms in the fluids manifesting it was correspondingly increased. It is true that the diseased fluid is itself necessarily introduced into the animal inoculated along with the contained bacteria, so as to leave the question still somewhat in doubt to which to ascribe the induced disease. Some light is thrown upon this question by certain experiments of Drs. Zahn and Tiegel, who in cases of septicæmia filtered the parasites from the liquid; and having done this, found that the clear liquid caused heavy but transient fever without suppuration, while the same fluid with the parasites produced suppuration extraordinarily widespread.

In view of the conflicting character of the evidence surrounding the vexed problem under consideration, it may be permitted us, perhaps, at present, to hold by the conclusion, that neither the germ-theory of contagious disease, nor the chemical theory, is exclusively true, but that each of these morbific influences has a range of action of its own; and that in some cases it is eminently probable that the disease in its inception is attributable to one of these causes, and that is the chemical, but owes its subsequent virulence mainly to the other—that is, to the presence of rapidly-multiplying vegetable organisms. By the proper application of this key we may succeed in solving most of the perplexing anomalies which particular examples have seemed to present, and shall find a common ground on which the champions of opposing views may meet and harmonize their differences.

As to the bearing of this question upon public hygiene and the principles which should govern sanitary legislation, it is to be observed that, if we accept the chemical theory of contagion as exclusively the true one, we can hardly avoid admitting the possibility that contagious disease may originate in a healthy individual without communication with a person already diseased. The causes, whatever they may be, will be found in surrounding conditions. It is certainly beyond question that the cholera in the Mississippi Valley during the summer of 1873 did not originate from without. Somewhere conditions must have existed which favored its origination *de novo* in our own country. In this view of the subject, the business of sanitary science is to discover the nature of the deleterious conditions tending to induce disease, and to prevent their occurrence.

If, on the other hand, infectious disease is propagated by living germs alone, what we have to aim at is to devise measures for promptly extirpating those germs the moment the disease appears. But as the necessary measures of precaution or extirpation will be substantially the same, whatever may be the theoretic views entertained as to the nature and the origin of the evil to be met, our legislation in any case is likely to be practically the same, however in its motive it may be logically different. Pure air, pure water, wholesome food, thorough drainage, rigidly-enforced cleanliness, the severe exclusion from towns and cities of industries which contaminate the air with noxious gases or offensive effluvia—especially such as arise from decaying organic matter—the prevention of overcrowding in dwellings, the prompt and complete disinfection of every spot where pestilence may lift its head, and of every article and substance, including the dejecta of the sick, which may serve as a vehicle of disease, and finally, a well organized sanitary police and untiring vigilance on the part of its members,—these are the objects which the guardians of the public health must labor to secure, to whatever school of etiology that they may happen to belong. It is indeed a fortunate circumstance—a fact hardly observable in any other department of practical human effort—that here the champions of conflicting theories, however freely they may splinter lances in the area of controversy, are always found marching harmoniously side by side in the field of actual warfare and in the face of the common enemy.

The study of the laws of hygiene is assuming at the present day, in the estimation of the public and of the medical profession itself, an importance which places it above even the proper business of the profession—that of the science of therapeutics. Drugs, whether remedial or prophylactic, are falling more and more into disrepute; and it is felt that prophylactic action is infinitely better than prophylactic draughts. Such has been the success of modern measures for closing up all the insidious approaches by which disease has hitherto effected its entrance into the family, the community, or the individual organism, as to encourage a hope, even so seemingly wild and visionary, as that a time is coming in which disease itself shall be utterly extirpated, and men shall begin to live out the days which Heaven intended for them. F. A. P. BARNARD.

Gérôme (JEAN LÉON), b. at Vésoul, France, May 11, 1824, son of a jeweller; became a student of painting with Paul Delaroche 1841; followed for a time the course at the École des Beaux Arts, and in 1844 went with his master to Italy. He exhibited paintings at the Salon in 1847, and since then has been a diligent contributor. A journey into Turkey and along the western banks of the Danube in 1853, and in 1856 a long excursion into Egypt, furnished him with rich materials for his art. In 1863 he was appointed professor of painting in the École des Beaux Arts; in 1865 was chosen member of the Academy; obtained a third-class medal in 1847, two second-class in 1848 and 1855, and a medal of honor at the Universal Exposition of 1867. In 1855 he was created a chevalier of the Legion of Honor; in 1867 he was made an officer; then two years later the decoration of the Red Eagle was conferred on him. Gérôme's pictures are well known through the photograph: *The Duel after the Masquerade*, *The Death of Cæsar*, *Cæsar and the Gladiators*, *King Candaules*, *Phryne*, *Cleopatra and Cæsar*, *Jerusalem*, are among the most familiar. The artist loves sombre and sinister themes, with a strong element of sensuous life in them. *The Age of Augustus*, *The Decay of the Empire*, *The Plague at Marseilles*, *The Death of St. Jerome*, are examples. His works are all powerfully imaginative and suggestive, though not often pleasantly so; a morbid taint runs through them, but they are clearly drawn and carefully studied; few of them are bright or glad, but few are destitute of a subtle and fascinating beauty. O. B. FROTHINGHAM.

Gero'na, province of Catalonia, Spain, bounded by France, the Mediterranean, and the provinces of Barcelona and Lerida. Area, 2413 square miles. Pop. 322,631. It is a romantic mountain-region, rich in wheat, wine, olives, walnuts, and all kinds of fruits, and traversed by the only highway which leads from Spain over the Pyrenees into France. Cattle are reared extensively, and along the coast the people are largely engaged in maritime pursuits. Cap. Gerona.

Gerona, fortified town of Spain, in the province of Gerona, on the Ter. Its cathedral is a fine Gothic building of the fourteenth century. It has been besieged twenty-eight times, and taken five times. Pop. 7661.

Geropi'ga, Geropig'ia, or **Jerupig'ia,** a factitious liquor exported from Portugal as brandy, and imported into the U. S. and Great Britain as wine. It is variable in composition, but generally consists of grape-juice, brandy, sugar, logwood-extract, and other ingredients. The U. S. is the principal market. It is used in making imitations of wine and other liquors. It is a villainous compound.

Ger'rish (FREDERIC HENRY), A. M., M. D., b. at Portland, Me., Mar. 21, 1845; graduated at Bowdoin College 1866, and took his medical degree there in 1869; became in 1873 professor of materia medica and therapeutics in Bowdoin College, and in 1874 became also professor of physiology, therapeutics, and materia medica in the University of Michigan; is also pathologist to the Maine General Hospital since 1874. Residence, Portland, Me.

Ger'ry, post-tp. of Chautauqua co., N. Y., contains several sulphur springs and a spring of inflammable gas. Pop. 1096.

Gerry (ELBRIDGE), b. at Marblehead, Mass., July 17, 1744; graduated at Harvard in 1762; became a successful merchant of his native town and a prominent provincial legislator and patriot; was specially interested in the naval operations of the Revolution, and was the founder of the Massachusetts admiralty court; in the Continental Congress 1776–85; signed the Declaration of Independence; one of the framers of the U. S. Constitution 1787, but refused to sign it; in Congress again 1789–93; was with Pinckney and Marshall a special minister to France 1797; chosen governor of Massachusetts (Anti-Federalist) 1810 and 1811, and defeated when running for that office in 1798, 1801, and 1812; chosen Vice-President of the U. S. in 1812; and d. at Washington, D. C., Nov. 23, 1814.

Gers, department of France, on the slope of the Pyrenees, ranges of which traverse it from S. to N., forming large, well-watered valleys. The soil, however, is only mediocre. Wine is the main produce, but it is of an inferior quality, and mostly transformed into Armagnac brandy. Many mules are reared for the Spanish market. Area, 2390 square miles. Cap. Auch. Pop. 284,717.

Gerson, de (JEAN CHARLIER), called DOCTOR CHRISTIANISSIMUS, b. at Gerson, near Rheims, France, Dec. 14, 1363. In 1377 he was sent to the College of Navarre, Paris, studied theology under D'Ailly (*Malleus hæreticorum*), from whose hands in 1392 he received the doctor's hat, having previously, while only a bachelor of divinity, been employed upon missions to the rival popes, with a view to ending the great schism then existing. In 1409 he went to the Council of Pisa, and in 1414 to that of Constance, in which he represented the Gallican Church, and in which he favored the superiority of the councils to the pope and the reform of the Church within itself. He zealously advocated the burning of Huss and Jerome of Prague. His opposition to the preaching friars (Dominicans) as rivals of the secular clergy, raised up so many enemies that he retired to Germany, where he lived until 1419, after which he went to the Celestine convent of Lyons and became a catechist of poor children. There he d. July 12, 1429. Gerson's chief aim was the reform of the Church from within itself. He was the great founder of Gallicanism. As a philosopher he hated the scholastic pedantry, and tried to substitute a practical and semi-mystical theology, opposing the mixture of divinity and human science then in vogue. He gave much attention to the subject of judicial astrology, which he combated with success. He was a voluminous writer, and many authorities (chiefly French or Benedictine) have claimed for him the authorship of *De Imitatione Christi*, usually ascribed to Thomas à Kempis.

Ger'stäcker (FRIEDRICH), b. in Hamburg, Germany, May 16, 1816. After a brief schooling he was apprenticed to a grocer, but ran away to Bremen, whence he shipped in 1837 as cabin-boy on a vessel bound for New York. After journeying through the U. S. and Canada, performing such work as he could get, being at different times a sailor, jeweller, hunter and trapper, and hotel-keeper, he returned to Germany in 1843, and published an account of his travels in several volumes (1843–49). He spent the years 1849–52 in making a journey around the world, and a narrative of his travels which he published on his return became very popular. In 1860–61 he made the tour of South America, and in 1862 accompanied Duke Ernest of Gotha on a tour through Africa; visited Central America in 1863, and in 1867 started upon another journey around the world, regarding which he wrote a number of interesting volumes. His works have been translated into English. D. at Vienna May 31, 1872. G. C. SIMMONS.

Ger'vas, a South American and West Indian shrub, *Stachytarpheta Jamaicensis* (order Verbenaceæ), whose leaves have valuable medicinal properties, and are used as a substitute for tea. Considerable amounts are used for adulterating tea in Europe.

Ger'vase of Til'bury, b. at Tilbury, Essex, England, was a reputed nephew of Henry II., and about 1208 was made marshal of the kingdom of Arles. Author of a remarkable *Otia Imperialia*, a medley of history, curious learning, fables, and the natural science of that day; and perhaps author of a *History of Britain*, which must not be confounded with the valuable *Chronicle* of Gervase of Canterbury, a monk probably contemporaneous with the foregoing, and author also of a history of the archbishops of Canterbury.

Gervi'nus (GEORG GOTTFRIED), b. at Darmstadt, Germany, May 20, 1805; studied at Heidelberg and in Italy; became in 1835 professor extraordinary at Heidelberg; was 1836–37 professor of history and literature at Göttingen, but lost his place for political reasons; became honorary professor at Heidelberg 1844, and d. there Mar. 18, 1871. His works include *Geschichte der Angelsachsen im Ueberblick*, 1830; *Geschichte der deutschen Dichtung* (1871); *Geschichte des neunzehnten Jahrhunderts* (8 vols., 1855–56); works on Shakspeare, etc. He was a prominent liberal politician and journalist. His history of the nineteenth century, written in admirable style, had a profound political influence in Germany, at once correcting the revolutionary tendencies of his time, and checking the opposing reaction of the conservative classes.

Gesells'ville, a v. of Fairchild co., O. Pop. 58.

Gese'nius (FRIEDRICH HEINRICH WILHELM), D. D., b. at Nordhausen Feb. 3, 1786; studied at Helmstädt and Göttingen, and taught in both universities; became in 1809 professor of ancient literature at Heiligenstadt, professor of theology at Halle in 1810, and d. Oct. 23, 1842. He was an outspoken rationalist, but gave a great impulse to Oriental learning by his philological works. The chief of these are *Hebräisches und Chaldäisches Handwörterbuch* (1810–12; many editions); *Hebräische Grammatik* (1813); *Kritische Geschichte der Hebr. Sprache* (1815); *De Pentateuchi Samaritani Origine* (1815); a translation and commentary on Isaiah (1820–21); the Hebrew and Chaldee *Thesaurus*, finished by Rödiger (1827–53); and *Scripturæ linguæque Phœniciæ monumenta quotquot supersunt* (1837).

Ges'ner (ABRAHAM), M. D., b. at Cornwallis, N. S., in 1797; studied medicine in England, and received his degree in 1827; acquired repute as a naturalist and chemist; was appointed to make a geological survey of the lower provinces of what is now the Dominion of Canada; patented a process for kerosene oil; author of *Mineralogy and Geology of Nova Scotia; Industrial Resources of Nova Scotia; New Brunswick* (1847); *Geology of New Brunswick, Nova Scotia, and Prince Edward's Island; Practical Treatise on Petroleum*, etc.; *Fisheries of the Provinces;* and other works. D. at Halifax, N. S., Apr. 29, 1864.

Gesner (JOHANN MATTHIAS), an eminent Latin scholar and editor, was b. at Roth, near Ansbach, Apr. 9, 1691; studied first in the gymnasium at Ansbach, and then in the University of Jena; was appointed associate rector in Weimar 1715; rector of the gymnasium in Ansbach 1728; removed to Leipsic as rector of the Thomas School in 1730, whence he was transferred, on the establishment of the University of Göttingen, to that institution as professor of philosophy in 1734. He founded the Seminarium Philologicum in the university, greatly improved the schools of Hanover, over which he had a general supervision, and was of great service to the university library. His literary productions were chiefly editions of the Latin authors and works in illustration of them—viz. *Scriptores Rei Rusticæ Latini* (the Latin agricultural writers), Leipsic, 1735, 2 vols. 4to (new edition by Ernesti, 1774); *Plinii Epistolæ; Claudianus; Horatii Eclogæ; Quintilian; Novus linguæ et eruditionis Romanæ Thesaurus*, Leipsic, 1749, 4 vols. fol.; *Primæ lineæ isagoges in eruditionem universam*, Leipsic, 1784, 2 vols. 8vo; *Opuscula*, Breslau, 1743–45, 8 vols. 8vo. A collection of his letters (*Thesaurus epistolarum Gesneri*) was published by Klotz, Halle, 1768. D. Aug. 4, 1761. (See CREUZER, *Gesch. der Class. Philologie; Narratio de J. M. Gesnero*, in ERNESTI'S *Opuscula*.) H. DRISLER.

Gesner, or Gessner (SALOMON), b. at Zürich Apr. 1, 1730; author of *Daphnis* (1754); *Inkle und Yarico; Idyls* (1756), and other poetical works; *Der Tod Abels* (1758, a prose poem), besides dramas, tales, etc. His etchings are for the most part very fine, and he had a good reputation as a landscape-painter. D. at Zürich Mar. 2, 1788.

Gesner, von (CONRAD), M. D., b. at Zürich, Switzerland, Mar. 26, 1516, of a family which subsequently produced many learned men; studied at the leading universities of Europe, and became a physician and professor in his native town; author of a very large number of learned works, of which *Bibliotheca Universalis* (1545–48), an important bibliographical treatise; *Catalogus Plantarum* (1542); *Historia Animalium* (5 books, 1551–87); *De Raris Herbis* (1554), are noteworthy. D. Dec. 13, 1565, and was for many years considered a high authority in botany, zoology, etc.—JOHANN VON GESNER, M. D. (b. at Zürich Mar. 28, 1709; d. Mar. 28, 1790), was also a prominent physician, and a leading writer upon botany, physics, and mathematics.

Gesneria'ceæ [from *Gesneria*, one of the genera], a natural order of exogenous herbs and shrubs, mainly tropical, often parasitic or epiphytic, and South American, although one sub-order or tribe is Asiatic and Polynesian. Some are handsome greenhouse plants, and a few yield useful dyes or fruits. Neither the U. S. nor Europe have any plants of the order.

Ges'ta Romano'rum, one of the oldest mediæval collections of pious legends, designed for the edification of the monks and clerks. It was compiled probably by one Elinandus at a very uncertain date, and moral reflections were interpolated by Peter Berchorius (d. 1362), a Benedictine of Poitou. It was written in Latin, but translated into most of the vulgar tongues of Europe, and down to the revival of learning was extensively read. Many of the legends are told with charming simplicity. Richard Robinson's translation (1577) is incomplete; Charles Swan's (1824, 2 vols.) has copious notes.

Gesta'tion [Lat. *gestatio*, from *gesto*, to "carry;" Fr. *gestation;* It. *gestazione;* Span. *gestacion;* Ger. *Trächtigkeit;* Gr. κύησις; syn. utero-gestation], the carrying of the young animal by the mother up to the time of its birth. This being effected by the uterus, or womb, occurs only in the MAMMALIA (which see), since the females of that class alone possess that organ. Gestation begins with conception, and is brought to an end by parturition, and includes the progress of the young animal in development throughout this period. Gravidity, or pregnancy, though of precisely corresponding duration, refers to the condition meanwhile of the mother alone. In birds and other oviparous animals the germ is expelled from the body of the female

as one of the constituents of the egg, and subsequently undergoes further development during incubation until the young is hatched. In the Mammalia the young animal—called the embryo in the human species during the first four months, and afterwards till birth the fœtus—is not separated from the mother till so far developed as to be capable of at once maintaining life independently of her.

The *fecundity* of animals, or their capability of bearing young, depends both on the frequency of gestation and the number produced at a birth; both of which factors vary inversely with the size of the animal and the duration of gestation, as a general rule. The elephant, camel, and horse very seldom produce more than one at a time; the lion, one, more often two or three, sometimes five or more. In these animals also gestation occurs only at comparatively long intervals, while by the dog, cat, and rabbit from six to ten or more are produced at a litter, and several times a year. Gestation, however, occurs far less frequently in animals still in the wild state than in the same when domesticated. Pigeons breed in the former state but twice a year; in the latter, six, and sometimes even nine, times. The fecundity of the domesticated rabbit (*Lepus cuniculus*) is truly astonishing. Since it begins to breed at six months, and has seven litters a year, each of from four to twelve, or even more, it was calculated by Pennant that the descendants of a single pair of rabbits would, without interference, amount in four years to 1,274,840. Fecundity increases within certain limits with the animal's age. The elk and bear produce but one at first, but afterwards two at a time, and lastly again but one. The young hamster produces only three to six at a litter, that of a more advanced age, eight to sixteen. The same is true of the sow. (*Burdach.*) In the human species the first is rarely a twin birth, especially if the mother be quite young; and although the maximum fecundity of woman is attained at twenty-five or twenty-six years, almost all the cases of triple, quadruple, and quintuple births have occurred after the age of thirty. In a remarkable instance which occurred in the city of New York the mother had twelve children within four years after her second marriage, at four births, there having been twins at the first, triplets at the second and third, and quadruplets at the fourth. The first (twin) birth occurred at the age of thirty-five: she had previously given birth to seven children, one only at a time. A still more remarkable case occurred in Mercer co., Pa., in 1816, ten children having been born within twelve months—five at each of two births. The mother died about a year after the second birth, but meantime gave birth to twins; or twelve children in twenty months. She was thirty-seven years old at her death. The *fertility* of animals refers to the actual number of births, independently of the capability of bearing, and is the product and measure of their fecundity.

The *duration* of gestation varies in different animals with their size and the degree of development of their young at birth, both of these influences being, however, modified by the animal's habits. It is shorter in carnivorous than in herbivorous animals of similar size, since the greater activity of the former would be essentially curtailed by a prolonged gestation and a corresponding increase of size and weight. Hence, also, their young are less developed at birth; the eyelids, for example, not being yet separated, and therefore the eyes not opening for several days afterwards. A very remarkable example of imperfect development at birth is presented by the kangaroo. The young animal is expelled from the uterus at the end of thirty-nine days, while still less than half an inch long, and in a gelatinous and embryonic condition, and then placed in a little pocket formed by a fold of skin in the inguinal region, where it remains, attached to a teat, until so far developed as to be capable of living when separated from the mother. The animals next to be named have the following periods of gestation: (1) *Herbivora.*—The elephant, 20 or 21 months; the giraffe, 14 months; dromedary, 12 months; buffalo, 12 months; ass, 12 months; mare, upwards of 11 months; the tapir, between 10 and 11 months; rhinoceros, 9 months; the cow, 9 months; many of the larger deer, over 8 months; reindeer, 8 months; sheep and goat, 5 months; the sow, 4 months. (2) *Rodentia.*—The beaver, 4 months; dormouse, 31 days; rabbit, 30 to 31 days; squirrel and rat, 28 days; guinea pig, 21 days or less. (3) *Carnivora.*—The bear, 6 months; lion, 108 days (Van der Hoeven says 3 months); the puma, 79 days; the fox, wolf, and dog, 62 or 63 days; the cat, 55 or 56 days. (4) *Marsupialia.*—The kangaroo (the largest), only 39 days; the opossum, 26 days. (5) *Cetacea.*—The Greenland whale, about 10 months. (6) *Quadrumana.*—The most common duration for the varieties of monkeys is 7 months, and they produce one, and sometimes two, at a birth.

It was erroneously claimed by ancient writers that every animal has a fixed period of gestation except the human female. The duration now generally accepted for her is 280 days from the termination of the last preceding menstrual epoch, and 275 days after insemination. But the former is merely an average statement. The somewhat shorter duration of a first gestation has long been a popular idea, and has recently been proved by statistics, but in case only of young mothers. Its increase with the age probably does not, however, continue after twenty-seven to twenty-nine years. The length and weight (size) of the child is also found to increase with the mother's age up to the limits just mentioned, while the number of the birth after the first has no influence in this respect.

Gestation may terminate prematurely from violence or otherwise, such an accident being termed an abortion if occurring before the beginning of the fifth month, and premature delivery if later, but still before the average time. If parturition occurs after the end of seven months (or 210 days) the child will probably live, the probability increasing the more nearly the average term is completed. Children born previously to seven months have also lived, but only in a few well-authenticated instances. Dr. Carpenter (*Human Physiology*) quotes two cases occurring at 27 weeks and less, and one of even 22½ weeks. Dr. Barker of Dumfries gives a case of birth on the 158th day (22⅔ weeks). The child grew to puberty. In the celebrated Kinghorn case the child was born 171 days (24½ weeks) after marriage, and lived more than eight months. The majority of the medical witnesses considered the child to have been begotten in wedlock. English law allows a child of seven months after marriage to be legitimate if former access can be denied; a circumstance that can seldom happen. According to the French code, a child is legitimate if born as late as 180 days after marriage.

The proposition that human gestation may be prolonged for several days, or even weeks, beyond the average duration, was by some of the older writers pronounced absurd; and a discussion was continued for a long time, and not without acrimony, between Bohn, Hebeinstreit, Bouvard, Mahon, Louis, and others on the negative side, and Zacchias, Alberti, Haller, Lieutaud, Bertin, Roussel, Vicq d'Azyr, A. Petit, and Lebas on the affirmative. (1) The presumption derived from comparative physiology is very decidedly in its favor. M. Tessier, whose observations were continued through a period of forty years with every precaution against inaccuracy, found that of 577 cows (the average term being 280 days), 20 calved beyond the 298th day, and some of these even as late as the 321st day—an excess of nearly six weeks. Of 447 mares (the average period being 335 days), 42 foaled between the 359th and the 419th day; the maximum protraction being 84 days, or one-fourth of the usual term. Of 912 sheep (average being about 151 days), 96 yeaned beyond the 153d day, and 7 of these went to the 157th day—an excess of 6 days. Of 161 rabbits (average about 30 days), 25 littered between the 32d and 35th day, the greatest protraction being one sixth of the whole period, and occurring also in nearly one-sixth of the total number. Even in the incubation of the common hen, Tessier found not infrequently a prolongation of 3 days, or one-seventh of the whole period. Earl Spencer, accepting 284 or 285 days as the average term for the cow, found the two longest terms in 764 cows to be 306 and 313 days; and also that of 106 calves born between the 290th and the 300th day, 74 were males, while all born after the 300th day were females. He also found that in 75 instances of the offspring of a particular bull, the average of gestation was prolonged from 284 to 288½ days. Mr. C. N. Bement found the average in 62 cows to be for males 288 days, and for females 282 days, the longest period to be 336 days, and the shortest 213 days. (*Am. Journal of Med. Sciences*, Oct., 1845.) The extremes of duration for the cow being thus found by these independent observers to be 321, 313, and 336 days, it might be expected that a similar prolongation is possible in human gestation, which is so nearly of the same average duration. (2) And facts, though few in number up to the present time, demonstrate a possible prolongation at least beyond ten months. Instances frequently occur to obstetricians of parturition 300 days or more after the cessation of the last preceding menstrual flow. But such cases are of no value in the present inquiry, since it is insemination, and not menstruation, that determines the time of conception, and therefore the beginning of gestation; and that may have occurred even 20 days after the last monthly period, and just before the next was due; and gestation therefore may have been prolonged but slightly, or not at all. Obviously, the only reliable cases are those of pregnancy from a single coitus or from connection on a single day; and in such, all the time beyond 275 days is to be regarded as a prolongation beyond the average duration. Of 25 cases given by Dr. Reid, the maximum of duration was 293 days; and of 50 reported by Dr. Montgomery, it was 297 days. The last case would have been at least 302 days after the

end of the last menstruation, as the calculation is usually made, and might possibly have been even 20 more (317 days), as before explained. The writer can also add a case of birth 301 days after insemination by a single coitus. Dr. Hodge mentions a case of gestation certainly continuing 302 days, and probably not less than 322 to 327 days. The French code is therefore not too indulgent in admitting the legitimacy of children born within 300 days after the separation of the parents. The Scotch law does not declare a child a bastard unless born later than ten months after the death or departure of the husband. English law is still more complaisant in deciding that a child born within eleven months after the death or the possibility of access of the husband shall still be regarded as his. In the Gardner peerage case, however—which was tried in London in 1825–26—it was decided that a child born 311 days after separation from the husband was illegitimate; but mainly, if not entirely, on the ground that the mother had lived in open adultery after the separation. Twelve of the seventeen distinguished medical witnesses gave the opinion that natural gestation might have been prolonged to this extent. (*Lancet*, vol. x. p. 289, 1826.) It has been decided in this country that a child born 317 days after separation was legitimate. (*Commonwealth vs. Post v. Am. Journal of Med. Sciences*, 1845.) E. R. PEASLEE.

Get'æ [Gr. Γέται], the ancient name of the Dacians (*Daci*). (See DACIA.) The old belief, that the Getæ were of the same race as the GOTHS (which see), is not now generally received.

Gethsem'ane [Gr. Γεθσημανῆ; Heb. *Gath* and *Shemen*, "olive-press"], a garden, or orchard rather, at the foot of the Mount of Olives, where our Lord spent a part of the night preceding His crucifixion, and which had been a place of frequent resort for Him and His disciples (John xviii. 2). The spot now shown by Latin monks is a short half mile from Jerusalem, nearly opposite the Golden Gate, just across the Kedron, at the angle made by the two paths that lead up over Olivet. The garden is nearly square 160 feet from N. to S. and 150 from E. to W., contains eight large olive trees, which are believed to be at least 1200 or 1300 years old, and, since about 1840 or 1850, has been enclosed by a high stone wall. The actual spot, in Dr. Robinson's opinion (1838), may have been a little farther up the hill. Dr. Thomson (1858) pronounces in favor of a more secluded locality several hundred yards to the N. E. of the present Gethsemane. R. D. HITCHCOCK.

Get'ty, tp. of Stearns co., Minn. Pop. 366.

Getty (GEORGE WASHINGTON), b. in Georgetown, D. C., Oct. 2, 1819; graduated at West Point Military Academy July, 1840; entered the army as second lieutenant of artillery; promoted to be first lieutenant 1845, captain 1853, major 1863, colonel 37th Infantry 1866, and transferred to 3d Artillery 1871; served on the northern frontier during the Canada border disturbances 1840; in garrison 1841–46; in the war with Mexico 1847–48; engaged in the battles of Contreras (brevet captain), Molino del Rey, Chapultepec, and the capture of the city of Mexico: in Florida 1849–50 against hostile Seminole Indians; in garrison 1851–56; on frontier duty 1857–61. During the civil war he served with the Army of the Potomac in the Virginia Peninsula campaign, 1862, as lieutenant-colonel and A. D. C., being engaged at Yorktown, Gaines's Mill, Malvern Hill, etc., and in Maryland at South Mountain and Antietam; appointed brigadier-general of volunteers Sept. 25, 1862, and engaged in the battle of Fredericksburg, Dec., 1862. In the Richmond campaign of 1864 he was severely wounded in the battle of the Wilderness, May 5; called to aid in the defence of Washington (July, 1864) and pursuit of the Confederate forces to Shenandoah Valley, he was engaged in the battles of Opequan, Fisher's Hill, and Cedar Creek, and subsequently with the Army of the Potomac from the siege of Petersburg to the final surrender of Gen. Lee, Apr. 9, 1865. For gallant conduct in battles during the war he was brevetted lieutenant-colonel, colonel, brigadier-general, and major-general U. S. A., and commanded various military districts till mustered out of volunteer service Sept., 1866; at present is in command of his regiment, the 3d Artillery. G. C. SIMMONS.

Get'tysburg, a v. of Darke co., O. Pop. 228.

Gettysburg, post-b., cap. of Adams co., Pa., is situated on the southern border of the State, 8 miles from "Mason and Dixon's line," 28 miles W. by S. of York, and 25 E. by S. of Chambersburg. The Susquehanna Gettysburg and Potomac R. R. is completed to this place. Gettysburg is the seat of Pennsylvania College, a Lutheran theological seminary, and minor educational institutions; has an orphans' homestead, 7 churches, 2 national banks, 2 newspaper-offices, 7 hotels, and a number of stores. Carriage manufacturing is a leading business here, and two granite-yards also employ a considerable number of hands. A passenger railroad connects the town with the Gettysburg Springs Hotel and Katalysine Spring, 1¼ miles to the W. The battle of Gettysburg occurred in and around this town July 1, 2, and 3, 1863. The National Cemetery at Gettysburg contains the bodies of 3580 Union soldiers, with a central monument costing $50,000, and a bronze statue of Gen. Reynolds costing $13,000. The Confederate dead have nearly all been exhumed from the battle-field and taken to Southern cemeteries. Pop. 3074. (See GETTYSBURG, BATTLE OF.) H. J. STAHLE, ED. "GETTYSBURG COMPILER."

Gettysburg, Battle of. The campaign which culminated at Gettysburg was inaugurated at Chancellorsville, and its final result was due in no small degree to the loss of the flower of the Confederate infantry and the fall of one of their most formidable leaders—"Stonewall Jackson." The two armies after that drawn battle remained in position on the opposite shores of the Rappahannock during the ensuing month (May, 1863). By an able manœuvre, Gen. Lee succeeded in blinding his adversary, and gaining, practically, a week's march. His movement was only revealed, too late for opposition, when the cavalry of Pleasonton, on the 9th of June, struck the enemy's columns at Beverly Ford and Brandy Station. On the 13th of June the division of Ewell was before Winchester, routing, on the 15th, the defending force under Milroy, and crossing the Potomac at Williamsport. Traversing on the 21st and 22d the narrow territory of Maryland, and pushing forward into Pennsylvania, one of his brigades (Rode's) was before Harrisburg and another (Early's) opposite Columbia. The corps of Longstreet and Hill followed the movement of Ewell, crossing the Potomac on the 24th and 25th, reaching Chambersburg on the 27th.

On the 14th and 15th, Gen. Hooker moved towards Centreville, crossing the Potomac on the 26th and 27th near Edwards' Ferry, reaching Frederick City on the latter day. On the same day he relinquished to Gen. Meade the command of the army. His demands, the rejection of which led to his resignation, are believed by the writer to have been just and his plan of operations judicious. The issue at Gettysburg is believed to have been but a natural sequence of them, and he well deserved the expression of thanks subsequently voted by Congress "for the skill, energy, and endurance which first covered Washington and Baltimore from the meditated blow of the advancing and powerful army led by Gen. Robert E. Lee."

The command of the Army of the Potomac was assumed on the 28th by Maj.-Gen. George G. Meade. Such a change of commanders on the eve of a most momentous conflict has scarcely a parallel in the annals of war. Wherever anything similar had occurred (*e. g.* Borodino and Dennewitz) the experience presented no reassuring examples. The relative positions of the antagonistic forces at this critical moment of change in the command should be alluded to. Taking Gettysburg, the actual theatre of conflict from which radiated the roads on which the troops were advancing or moving, as a central pivot, the opposing forces were scattered and interlaced over an elliptical area whose longest diameter N. and S. was about 60 miles. Lee, with Longstreet and Hill, was about 25 miles to the W. N. W.; Ewell, about 30 miles N. N. W.; Early, 30 miles to the E. Stuart's cavalry crossed the Potomac at Seneca, near the same place where Hooker had passed, and pursuing a devious course—so much so that for a time the Union army was interposed between Lee and his cavalry—reached Hanover, about 20 miles E. of Gettysburg, on the 30th, where, to his surprise, were the cavalry of Pleasonton, which had moved up from Frederick on the 28th, and had no idea that the enemy were anywhere near them. Meanwhile, Gen. Buford (up to his death undeniably the best of our cavalry commanders proper), charged with the duty of covering the left of the Union army, first followed the track of Lee up the Franklin or Cumberland Valley, then turned sharp to the right, crossed the South Mountain by the Monterey Pass, and at daylight of June 30 fell upon another stray force of Pettigrew's Confederate infantry, near Fairfield, 10 miles S. E. of Gettysburg. Both combatants recoiled, the Confederate officer falling back on his superior, Heth, at the head of Lee's main column pushing down the Chambersburg pike beyond Cashtown, and within a few miles (perhaps five) of Gettysburg. Buford on his side retraced in some measure his steps, moved to Emmittsburg, and thence marched N. by E. to Gettysburg. The next morning (July 1) the two bodies which had collided at dawn of June 30, near Fairfield, met again towards noon on Willoughby's Run, some 3 miles N. W. of Gettysburg. Here, to Buford's tenacity in holding with 4000 cavalry over 30,000 of all arms, the country owes the battle-field of Gettysburg, and made Buford (said his superior, Pleasonton) "the true hero of that battle."

Neither Lee nor Meade intended to fight where they

fought, nor as they did. Lee had promised his lieutenants not to risk the offensive on loyal ground, while Meade had determined to take up a defensive position on Pipe or Big Pipe Creek. The "strategy of Providence," however, which, after all, determines the fate of wars, campaigns, and battles, had decided otherwise.

On June 30, Meade's plan, predicated on a defensive battle along Pipe or Big Pipe Creek, was being carried out. The 6th corps, forming the right wing of his army, was ordered N. E. to Manchester; the 2d corps, N. N. E. to Taneytown; the 12th and 5th corps, forming the centre, in a general direction due N.; the 1st, 3d, and 11th corps, composing the left wing, under Reynolds, likewise N., towards Gettysburg. Space prevents a more detailed consideration of the preliminary movements. Suffice it to say, that before noon of the 1st, about the same hour (11 A. M.) that the battle of Waterloo commenced, Buford was checking the first onset of the Confederates on Oak or Seminary Ridge, towards Willoughby Run, to the W. of Gettysburg. Gallantly coming to his support, while reconnoitering Reynolds was killed in a grove on Oak Ridge, where the bloodiest portion of the first day's collision was fought out. The 11th corps followed the 1st into action on its right to the N. of Gettysburg; and had it not been for the prescience of a subordinate, Howard's faulty dispositions would have lost us the magnificent position which enabled the Union forces to foil Lee. Summoned to the field of decision by the appealing voices of cannon, the columns of Early and Rodes, by a concentric movement from the N. and N. E., fell, while the corps of Hill was attacking from the N. W., upon the 1st and 11th corps, overlapping them, and forcing them back, after vain prodigies of valor, upon the position which became that of the battle—Cemetery Ridge. The afternoon brought Hancock, whose aid and personal influence gave stability to our new position and confidence to our forces. The Confederate commander, in arresting his attack, threw away his best chances of victory. Like Napoleon after Bautzen, he postponed until the morrow ("everything to-morrow") all that was the imperative question and duty of to-day. He himself actually neutralized all the advantages that his lieutenants had won. The battle of Willoughby Run, of Oak or Seminary Ridge, was over; the first day of Gettysburg had been fought out. The fighting had been disadvantageous to the Union forces, but darkness nevertheless found them established in an impregnable position. Night brought the 3d corps, under Sickles, and the 12th, under Slocum. They took position on the left of the 1st and right of the 11th corps, and the horseshoe form of Gettysburg was occupied. Considering this position in its similitude to a horseshoe, the Round Tops constituted a heel-calk to the left and S. W.; Wolf's Hill to the right and S. W. the toe-calk was at the Cemetery overlooking Gettysburg; the frog was Power's Hill. The opposing forces did not materially exceed 75,000 on either side. The preponderance of force was perhaps 5000 in favor of the Confederates. Both the Union and Confederate cavalry were on the wings. Longstreet's corps (Lee's right) faced the Union 3d and part of the 1st corps, reinforced in the course of the afternoon and towards night by the 5th and 6th. Hill's corps (Confederate centre) fronted the Union 2d and part of the 11th, Ewell's corps (the Confederate left) the right of the 11th, Wadsworth's division of the 1st, and the 11th.

A skirmish about noon for the possession of some cattle brought on the terrible engagement of the second day. It was doubtless the intention of the Confederate commander to turn the Union left. This movement, if successfully carried out, would have neutralized all the magnificent advantages of the Union position. To frustrate this attempt, Sickles advanced his line, so that it constituted a great salient angle, with its left in the Devil's Den, stretching even across Plum Run to the granite spur of the Round Top. Its apex was at the blood-drenched Peach Orchard, and its right in echelon to the front and left of the Union centre, whose batteries protected what has been erroneously styled a *gap*. This disposition, severely criticised by the Union commander, as well as by Gen. Halleck, was, after a personal examination of the ground, pronounced "right" by Gen. Grant; and the writer, after similar examination and review of the testimony, maintains, and has ever maintained, the same. The 3d corps, after heroism unsurpassed, as at Hazel Grove, on *the mighty* (third) day of Chancellorsville, was shattered and forced back, fighting grandly to the last. Sickles, holding his devoted men up to their terrible work, lost his right leg. Thanks to the prompt arrival and support of the 5th corps, Crawford leading, bearing the colors of the 1st Pennsylvania Reserves—like Miloradowitch and Grouchy at Novi (1799) or the archduke Charles at Aspern (1809)—to the indomitableness of Humphreys', and the unrivalled fighting qualities of the 3d corps, the Round Tops, the key of our position, was preserved. Meanwhile, there had been some hard fighting on the Union right. The Confederates had made a vain attempt to storm Cemetery Ridge, and had gained some slight advantage towards Rock Creek. The moon arose upon the fearful struggle, but nevertheless, when our men sank down to their rest the question was decided that if Lee counted upon victory, he had to win it by a grim aggressive, with no points in his favor. The morning of the 3d of July dawned upon a renewal of the struggle on the Union right, where the Confederates had gained a slight lodgment within the Union line of defence on Culp's Hill. This operation had commenced on the 2d, about 6 P. M., with a simultaneous attempt at this point and along the Baltimore turnpike. The fighting was still carried on by moonlight, and only ended with absolute darkness. Owing to the withdrawal of the greater part of the 12th corps, the Confederates, easily repulsed on Cemetery Ridge, made good a lodgment on Culp's Hill. With the return of that portion of the 12th corps which had been sent on the previous evening to strengthen the menaced Union left, commenced the process of recovering what had been lost. The consequent fighting was not very hot, and ended from 10 to 11 A. M. with the expulsion of the Confederates from every inch of ground which they had won. The last sputtering skirmish-fire at the base of Culp's Hill ceased about noon. Then came an hour's ominous silence, which had become positively oppressive when, about 1 P. M., 150 guns opened fire and tortured the air for the subsequent two hours. Neither this prolonged bombardment, nor the responsive 80 guns from the Union lines, produced any material effect. Doubtless supposing that this cannonade had swept away opposition, or shaken at least the *morale* of the Union defensive, Lee launched 15,000 to 18,000 of his best troops against the Union centre. These, in column, had for their indicative objective the umbrella-shaped clump (since become historically famous) of trees at the mid-centre of Cemetery Ridge, in the same way that Ney at Bautzen, by written order from Napoleon, directed his march upon the steeple of Hochkirch. Much has been said in praise of this advance of over a mile up a gentle slope, the very best ground for the defensive sweep of artillery. This assault failed, and the BATTLE OF GETTYSBURG had been fought. The writer is not permitted to venture upon debatable ground, nor to say whether Meade failed to gather, by a vigorous pursuit to the Potomac, the full fruits of the campaign. The lamented President Lincoln is said to have made one of his forcible comments, that "Providence had twice" (*i. e.* once after Antietam) "delivered the army of Northern Virginia into our hands, and with such opportunities neglected we ought scarcely to hope for a third chance." Gen. Lee entered Pennsylvania (according to the estimate of Gen. Humphreys) with 85,000 infantry, 8000 cavalry, and a due proportion of artillery. This is a low estimate, for there is reason to think he mustered over 100,000 men, not over 83,000 of which were in the actions of the 1st, 2d, and 3d. Straggling on both sides was enormous. Humphreys states that the Army of the Potomac comprised 70,000 infantry and 10,000 cavalry, with 300 guns. Meade certainly did not bring into action four-fifths of this force, and the 6th corps was comparatively fresh as to fighting on the 4th. Lee's losses were 18,000 killed and wounded, and 13,600 missing, a large part of the latter prisoners; making a total loss of 31,600. Our losses were 16,500 killed and wounded, and 6600 missing, chiefly prisoners captured on the first and second days (allowed to be carried off with the defeated army); making a total loss of not less than 23,000. J. WATTS DE PEYSTER.

Gey'er (HENRY SHEFFIE), b. at Frederick, Md., Dec. 9, 1790; was admitted to the bar 1811; an officer during the war of 1812–15; removed to St. Louis; was the first Speaker of the Missouri house, and twice re-elected; published *Statutes of Missouri*, 1818; one of the framers of the code of 1825; declined the secretaryship of war 1850; U. S. Senator 1851–57. D. at St. Louis Mar. 5, 1859.

Gey'ser [Icelandic, *geysa*, to "gush forth"] is the name given, generally, to a kind of water-volcanoes or springs of boiling water found in Iceland, but applied more especially to one single spring, the Great Geyser, situated 70 miles from Reikjavik, in the neighborhood of the volcano of Hekla. On a low plateau of trap formation, and of an area of half a square mile, a great multitude of these hot springs gush forth, as if a powerful subterranean river had been put over fire here and brought to boil. Many of them are small, and remind the spectator of the trickling of water from an overboiling tea kettle, but two of them, the Strokr (the "Churn") and the Great Geyser, are phenomena of a most imposing character. The mouth of the Great Geyser consists of a mound 15 feet high, whose top contains a basin 4 feet deep and 72 feet in diameter, which is formed of a siliceous incrustation, a deposit of the silica contained in the water of the spring. This basin is generally filled with

hot water, 188° F. at the edge and 221° at the centre, where it wells up through a shaft 8 feet wide and 83 feet deep. When the spring is in a quiet state, the water ascends slowly up the shaft, is cooled off in the basin, and discharges itself through a small aperture in the incrustation, winding its way down the plateau. But every four or five hours a subterraneous noise is heard like the rumble of a train of artillery over a pavement. The noise increases rapidly, an ebullition takes place in the basin, and for some minutes jets of boiling water several feet high are thrown up through the shaft. Once a day, or about every 30 hours, these eruptions assume astonishing dimensions. The rumble becomes a terrific thundering, the jets ascend 100 feet, stones even are sometimes thrown up, and such volumes of vapors are discharged as to fill the whole atmosphere and form clouds which shut in the horizon on all sides. After such an eruption the basin is empty for several hours. The Strokr is only 100 yards distant from the Geyser. It is smaller, calmer, more easily accessible, and, although it is somewhat different from the geyser, both in form and manner of working, it bears the same general character. (For an explanation and a more detailed description of this remarkable phenomenon, see *Travels in Iceland*, by SIR GEORGE MACKENZIE (1810); BUNSEN in *Tracings of Iceland*, by R. CHAMBERS (1855); *Island; Det 18 Aarhundrede*, by M. STEPHENSSON (1808); *Island fra et lægevidenskabeligt Synspunkt*, by P. SCHLEISSNER (1849).) Outside of Iceland there are geyser-fields in New Zealand, Formosa, and the U. S. In this country the most important are in the National Park, and principally in Wyoming Territory; for the so-called geysers of California hardly deserve the name, while some of those of the National Park exceed in power and grandeur any elsewhere known, several of the springs occasionally throwing up streams of water over 200 feet high. (For a description see article YELLOWSTONE VALLEY, by PROF. F. V. HAYDEN, M.D., M.N.A.S., in this work.) The principal geysers of New Zealand are those of the northern island. They are but little inferior to those of the U. S. Little is known of the geyser-fields of Formosa, but their springs would appear to be inferior in power to those previously noticed; but they are in principle the same—thermal springs whose waters are from time to time expelled in a jet by the action of superheated steam. C. W. GREENE.

Giant Geyser,
National Park, U. S.

Ghaut, or **Ghât** [Eng. *gate*], in India, (1) a pass through a mountain-range; (2) a landing-place or stairway for people to use in going on or off boats in the rivers of India. These ghauts are used also as bathing-houses, and as places of rest and recreation. Some of them are architecturally fine structures.

Ghauts, The, two chains of mountains in the peninsula of Hindostan, running respectively along the eastern and western coasts, joining each other in Cape Comorin, and enclosing on the two sides the table-land of the Deccan. The Western Ghauts form a distinct range, though interrupted by the gap of Palghatcheri, of a height varying between 4000 and 7000 feet. Their gold-mines have long been worked, but in 1874 gold-bearing strata of extraordinary richness were discovered. The W. side of these mountains is very steep, but towards the interior they slope in gentle undulations. The Eastern Ghauts are lower, their average height being only 1500 feet; they are often interrupted, and almost disappear before they reach Cape Comorin.

Ghazepoor′, town of British India and the capital of the province of Ghazipoor, is situated on the left bank of the Ganges. Rose-culture and the manufacture of rose-water and rose-oil furnish the most conspicuous articles in its bazaars. Pop. 38,573.

Ghee [Hindoo, *ghi*], a variety of butter prepared in India from the milk of the buffalo or the cow. The milk is boiled, then cooled, curdled with sour milk, churned, and after the butter comes it is put aside till it begins to grow rancid; then boiled, mixed with sour milk (*dhye*), salt, and sometimes with aromatics, and is then ready for use. It has a strong and disagreeable smell and flavor, but is very extensively used in India.

Gheel, town of Belgium, in the province of Antwerp. Since the seventh century this town and its surroundings have been inhabited by a great number of idiots and lunatics, who at first sought a cure here from the shrine of St. Dymphnea, and later from the peculiar and often advantageous treatment they underwent in the houses of the citizens and farmers. The establishment is now under government control. Pop. 11,614. The Gheel system of treatment for lunatics has of late attracted much attention elsewhere.

Ghent, or **Gand,** city of Belgium, and the capital of the province of East Flanders, is situated at the confluence of the Scheldt and the Lys, and traversed with numerous canals and branches of the rivers, which divide the city into twenty-six islands, connected with each other by about 300 larger and minor bridges. The general character of the city is that of a town of the Middle Ages which has partially become modern; dark and narrow streets, with singular houses towering like castles, alternate with open and beautiful quays lined with elegant edifices. The best view of the city may be had from the Belfry (Beffroi), which occupies a central position, is 396 feet high, built 1183–1339, and adorned on its highest point by a golden dragon, which the crusaders brought hither from the church of St. Sophia in Constantinople. Other interesting edifices are the cathedral, one of the most splendid church edifices of Belgium, the interior covered with marble, the doors cast in bronze, the crypt built 941, the choir and the chapels 1228; the church of St. Nicholas, a Gothic structure of the fifteenth century; the church of St. Michael, also of the fifteenth century, with an unfinished tower; the church of St. Peter, restored in 1720, and containing many fine pictures; and the ruins of the chapel of St. Macarius, belonging to the old citadel. A new citadel, built between 1822 and 1830, stands on the Blandinusberg, to the W. of the city. The town-house, standing near the Beffroi, is a very interesting structure; its front, finished in 1200, is very rich in its ornamentation; in the hall the Confederation of Ghent was signed in 1576. The university, situated on the other side of the Beffroi, was built in 1818 by Roelandt, and contains a magnificent commencement-hall, a rotunda with room for 1700 persons, and lighted from above through a cupola. The Bourse occupies the lower part of the Palace of Justice, built in 1844 by Roelandt, and presenting an elegant peristyle of the Corinthian order; opposite stands the beautiful theatre, built in 1848. The Beggynhof, at the Bruges gate, consists of 400 small houses, 18 convents, and 2 churches, and is inhabited by about 800 Beguines. Ghent also contains 20 monasteries. The penitentiary, an octagonal building, with nine inner yards, and cells for 2600 convicts, is a model establishment of its kind. The meat-market, built in the fourteenth century; the Prinzenhof, where Charles V. was born; the old Audeburg and the s'Gravencasteel (Château des Comtes) are also interesting buildings. Among the public places the most remarkable are—the Vrydag-markt, where the "Dulle Griete" ("Crazy Margaret") lies, a giant cannon from the fifteenth century, and where the executions under the duke of Alva took place; and the Kauter, a parade-ground and flower-market, where Van Eyck and Jacob van Artevelde lived. Ghent has a university, a celebrated library of 60,000 volumes, an excellent botanical garden, a conservatory of music, and numerous other scientific and benevolent institutions. With respect to its manufactures, Ghent does not occupy as prominent a place as it formerly did, yet its spinning, weaving, and cotton-printing industry, and its manufactures of leather, sugar, and machinery, are considerable, and its horticulture is carried on on an immense scale. Its commerce is extensive, and its harbor and shipping facilities excellent; vessels drawing 18 feet can get close to the city. Ghent is a bishop's see.

In historical respects Ghent is a famous place. In 949 the emperor Otto the Great built a castle in order to defend the city against the counts of Flanders; nevertheless, in 1000 the counts seized the city. In the fourteenth century Ghent, under Jacob van Artevelde, waged violent wars against Louis of Flanders and the dukes of Burgundy. It

was at that time at the culmination of its prosperity. It mustered an army of 50,000 men; the contingent of the wool weavers alone was 18,000 men. In the fifteenth century it fought obstinately against Charles the Bold, but under the emperor Charles V. its splendor began to wane: it was conquered by the emperor in 1540, and heavily taxed. In 1576 the "Pacification de Gand" was concluded in Ghent, a confederation between Holland, Zealand, and the southern provinces of the Netherlands against Spain. It was conquered in 1584 by the duke of Parma, and in 1678 by Louis XIV. of France, who, however, restored it to Spain. In 1713 it fell to Austria. Several times it was taken by the French, but by the Peace of Paris in 1814 it was incorporated into the kingdom of the Netherlands; on the establishment of the kingdom of Belgium in 1830 it became a Belgian possession. Pop. 127,333. A. NIEMANN.

Ghent, post-v. of Carroll co., Ky., on the Ohio River opposite Vevay, Ind. Pop. 461.

Ghent, tp. and post-v. of Columbia co., N. Y., 125 miles N. of New York, on the Harlem and the Boston and Albany R. Rs. Pop. 2886.

Ghent, Treaty of. This treaty, between the U. S. and Great Britain, negotiated on our part by John Q. Adams, Henry Clay, Albert Gallatin, and two other envoys at Ghent, was concluded Dec. 24, 1814, and the ratifications were exchanged Feb. 17, 1815. It put an end to the war which was begun by an act of the two Houses of Congress, signed by the President June 18, 1812. The leading provisions were—1st, restoration of all territory, places, and possessions taken by either party from the other during the war, except certain islands mentioned below. Public property remaining in such places at the time of ratifying the treaty was not to be destroyed or carried away, and the same engagement was made as to slaves and other private property (Art. I.). 2d. Article IV. provides the appointment of a commission to decide to which of the two powers certain islands in and near Passamaquoddy Bay belong; and if the commission should fail to come to a decision, the subject is to be referred to some friendly sovereign or state. 3d. Articles V.–VIII. provide for several commissions to settle the line of boundary as described in the treaty of 1783—one commission to settle the line from the river St. Croix to where the 45th parallel cuts the river St. Lawrence (called the Iroquois or Cataraqua in the treaty); another to determine the middle of the water-communications from that point to Lake Superior; and a third to adjust the limits from "the water-communication between Lakes Huron and Superior to the most north-western point of the Lake of the Woods." If either of these commissions should not make a decision, the subject was to be referred to a friendly sovereign or state, as before. 4th, Article IX. binds both parties to use their best endeavors to abolish the slave-trade, as being "irreconcilable with the principles of humanity and justice." The Treaty of Ghent is remarkable for omitting to provide for some important interests. The impressment of seamen, one of the main causes of the war, and the claims of the U. S. still to participate in the fisheries according to the provisions of the treaty of 1783, were passed over in silence; and no conclusion was reached touching the naval forces to be maintained by the two parties on the northern lakes, which were common to both parties.
T. D. WOOLSEY.

Gherar'di (BANCROFT), U. S. N., b. Nov. 10, 1832, in Louisiana; entered the navy as a midshipman June 29, 1846; became a passed midshipman in 1852, a lieutenant in 1855, a lieutenant-commander in 1862, a commander in 1866. He commanded the steamers Chocura and Port Royal (West Gulf blockading squadron) during 1863 and 1864, taking part in the latter vessel in the battle of Mobile Bay. His services in this action are thus highly spoken of in the official report of Capt. Thornton A. Jenkins, commanding the steam sloop of war Richmond: "I have the honor to report that, in obedience to general orders and plan of battle for attacking Fort Morgan and the rebel fleet, Lieut.-Com. Bancroft Gherardi, commanding the U. S. steamer Port Royal, reported himself with his vessel to me, ready for action, a little before daylight this morning (Aug. 5, 1864). The Port Royal was lashed on the port side of this vessel, with her stern pivot-gun sufficiently far aft of the quarter of this ship to enable it to be used against the enemy as effectively as one of my own broadside guns. To Lieut.-Com. Gherardi I am greatly indebted for his cool and courageous conduct from the moment the attack commenced to the time that his vessel was cast off, by my order, to go in chase of the enemy's three wooden gunboats, the Morgan, Gaines, and Selma. My orders on board of this ship to the helmsman, and to the officer stationed at the engine bell, were repeated by him on board of his own vessel, and the soundings passed from his vessel to this with a coolness and clearness of voice that could not but excite my admiration. The after pivot-gun of the Port Royal (the only one that could be brought to bear upon the enemy's batteries from that vessel) was worked most effectively." FOXHALL A. PARKER.

Ghibellines. See GUELPHS.

Ghiber'ti (LORENZO), an Italian goldsmith and sculptor, lived and wrought in Florence from 1378 to 1455. He came from a family of goldsmiths; his father, a skilful worker in the fine metals, taught his son the arts of drawing, modelling, and casting. He was still young (but twenty-three) when he competed with the most illustrious sculptors of his time, Donatello and Brunelleschi being among them, for the honor of designing and executing a bronze folding-door for the Baptistery of San Giovanni, one of the two having already been made by Andrea Pisano. Donatello and Brunelleschi were alone ranked with Ghiberti, and they voluntarily confessed his superiority and withdrew. Twenty-one years the artist devoted to his task, and the door when finished was so beautiful that he was commissioned to execute another as companion to it. About an equal length of time was spent on the second, which was declared superior to the first, and pronounced by Michael Angelo worthy to be a gate to Paradise. A description of these exquisitely wrought gates cannot be given here, nor is there need, for their general design can be understood from the familiar plaster-casts, and the delicacy of the modelling and decoration, the wonder of grouping and perspective, are recalled by the photograph. These bronze gates have made Ghiberti's renown, casting into the shade other lovely pieces—a statue of John the Baptist outside of Or San Michele, two bas-reliefs on the baptismal font in the cathedral of Siena, the St. Stephen, the St. Matthew, and even the sarcophagus of St. Zenobius, in the S. Maria del Fiore—which share with the gates the praise of being the finest works of their kind in Italy. Ghiberti was an architect also, deemed worthy to be associated with Brunelleschi, and an excellent painter on glass. He was, too, a man of letters, author of treatises on Italian art, on proportions, and on sculpture. The first was published entire in 1841. The last was published in part. Lübke calls Ghiberti "one of the greatest sculptors in all ages." O. B. FROTHINGHAM.

Ghi'ka, the name of a princely family of the Danubian principalities, over which several Ghikas ruled as hospodars, and in which many of them held very high state offices. In 1657, George Ghika was first appointed by Turkey hospodar of the principalities, and after him eight other members of that family held the same princely office in Moldavia or in Wallachia. Since the beginning of this century, Alexander, Constantin, Demetrius, and John have been the most celebrated and the most active members of the Ghika family. They took part in all the conspiracies and political measures which finally brought about the fusion of the two principalities of Moldavia and Wallachia into a single state, now called Roumania, and they hold a large influence in that country. John Ghika d. Apr., 1881. FELIX ADLAIGNE.

Ghilan', province of Persia, on the north western slope of the Elbrooz and along the Caspian Sea. The coast is swampy and bordered by sandbanks and lagoons, but as soon as the ground rises a little large fields of rice and sugar-canes appear, the former being raised in such abundance as to be used as food for horses. With the hills begin the forests—fruit trees, especially figs and mulberries, of a most luxuriant growth and intertwined by vines to the very top. After the forests follow the pastures, and over the whole rise the naked, snow-clad peaks of the Elbrooz. But this beautiful land, whose fertility is equalled by the vales of Hindostan only, is very unhealthy; and neither its area nor the number of its inhabitants is known.

Ghirlanda'jo (DOMENICO BIGORDI, or, as some say, CORRADI), a Florentine painter, called GHIRLANDAJO after his father, who derived the name either from the manufacture or the sale of children's garlands—whether in metal or not is doubtful. He was a goldsmith, and under him his distinguished son learned drawing and designing. Domenico was b. in Florence probably in 1449, and d. probably in 1498; the dates vary. As a boy he was remarkable for correctness of eye and hand, and used, says Vasari, to catch the likenesses of people as they passed by the shop. The chapels and churches of Florence bear testimony still to the originality, freshness, and delicacy, as well as to the exuberance, of his genius. The accuracy of his portraits, the freshness of his nature, the liveliness of his grouping, the unconventional ease of his treatment, attracted attention from the beginning. He painted men and women in the costumes of their time, discarded tinsel ornaments, gilded scrollwork, and plaster borderings, substituting in their place honest brush-work. The aërial perspective was so wonderful that he is credited with having been the discoverer of its laws. He painted in oil, but

chiefly in fresco, and very much in places exposed to the weather; which explains the ruinous condition of many of his pictures. When about thirty years old, Pope Sixtus IV. invited him to Rome to assist in decorating his chapel. Of his two pictures there, but one, *Christ calling Peter and Andrew from their Nets*, is preserved. Ghirlandajo painted in Pisa, Lucca, and Siena, but his best work is seen in Florence, especially in the Tassetti chapel, in the church of the Trinità, and in the choir of Santa Maria Novella. In the first series portraits are introduced of Lorenzo de' Medici and other eminent Florentines, and in the last series, in the portion illustrating the life of the Virgin, is the celebrated portrait of Ginevra de' Renci, a young beauty of Florence. The altar-piece of the Tassetti chapel, in which the artist has introduced his own portrait as a shepherd, is in the gallery of the Academy. Ghirlandajo's influence on Italian art was very great. He was a man of ideas as well as of skill, of great facility and boldness of conception—an innovator and discoverer. Michael Angelo is said to have studied with him as an apprentice, for three years, when fourteen years old. O. B. FROTHINGHAM.

Ghirlandajo (RIDOLFO), son of the preceding, also an artist of very great talent. He was b. in 1482; d. in 1560. One of his best works represents St. Zenobius raising a dead boy to life. This extraordinary picture is in the Uffizi at Florence.

Ghiustendil', or **Kostendil'**, town of European Turkey, in the province of Nissa, on the Strymon. It has warm sulphurous springs. Pop. 8000.

Ghi'zeh, or **Gizeh** [also written JEEZEH], in Egypt, on the left bank of the Nile, just above Cairo. It was formerly a large and splendid town, but now it is mostly in ruins. The principal pyramids are in its immediate neighborhood. (See PYRAMIDS.)

Ghiz'nevides, a famous dynasty of Afghan monarchs who reigned at Ghazni (Ghizni or Ghuznee) and at Lahore from 961 A. D. to 1184. At the time of the Sultan Mahmoud (d. 1030) the empire had its widest extent, occupying a great part of Persia, Western Tartary, a part of India, and the intermediate countries. These sultans were zealous orthodox Mohammedans.

Ghiz'ni, or **Ghuznee**, town of Afghanistan, on a river of the same name. It was formerly a strong fortress, but is now of little consequence. In the neighborhood are the ruins of Old Ghizni. Pop. from 3000 to 10,000.

Ghog'gra, or **Ghog'ra**, a river of Hindostan, one of the largest affluents of the Ganges, rises in lat. 30° 28′ N., lon. 80° 40′ E., at an elevation of between 17,000 and 18,000 feet, in the glaciers of the Himalayas; enters the plains of Hindostan in lat. 29° 6′ N., lon. 80° 13′ E., at an elevation of 798 feet, and joins the Ganges in lat. 25° 46′ N., lon. 84° 40′ E., 150 miles below Benares, after a course of about 600 miles. After its descent into the plains it is navigable for large boats in all seasons, though its navigation is somewhat difficult on account of shoals.

Ghost [Ang.-Sax. *gâst*, "spirit," "breath"], the spirit of a human being, or, in a more popular sense, an apparition, or a departed human spirit made visible. Belief in the occasional appearance of ghosts exists in all countries, and has existed in all ages. Among the more recent developments of this belief we may note the newer phases of the so-called spirit manifestations, which are (1873–74) being studied by Sir W. Crooke and his able coadjutors.

Artificial ghosts, such as are seen upon the stage, are easily made by means of glass plates which reflect only a faint outline of the person who personates the ghost. By equally simple means the ghosts may be magnified, distorted, decapitated, etc., in many surprising ways.

Ghost, Holy. See HOLY GHOST.

Ghost-Moth, the *Hepialus humuli*, a European moth of the family Bombycidæ, whose destructive larvæ, known as *otters*, bore in hop-vines and the stalks and roots of many plants. The moths are white below and brown above; and hence, as the upper surface is turned towards or away from the spectator in flight, the moth appears and disappears by turns. Hence the name. The genus is American also.

Ghumurdji'na, town of Roumelia, Turkey, 80 miles S. W. of Adrianople, and not far from the Ægean Sea. Pop. 8000.

Ghûr, Gaur, or **Ghore, Dynasty of**, descendants of an ancient race of Afghan princes, were the second line of Mohammedan rulers in Hindostan. Allah-ad-deen (d. 1160) almost destroyed the power of the Ghiznevides, and his successors conquered the whole country from the Caspian to the Bay of Bengal; but their power was short-lived. The period of their authority is usually given as from 1176 to 1206, after which their power was feeble and hardly more than nominal. They are also called GHÛRI and GOURIDES.

Gi'ant and Dwarf. The term *giant* [Gr. γίγας] is primarily a mythological one. The Greek giants were huge earth-born beings, who, according to the older writers, had the form of men (later writers made them hideous monsters), and who revolted against the gods, who finally slew them. The Norse mythology gives the giants (jotuns, frost-giants, etc.) a very prominent place. The giants are held by some writers to represent the adverse forces of nature—by others, human enemies of foreign race. Thus, English folk-lore abounds in traditions and nursery-tales of Cornish and Welsh giants, and Cæsar speaks of the huge stature of the ancient Germans and Gauls. But in authentic history there are accounts of races of men of very large size. The Hebrew Scriptures allude to giants (nephilim) before the Flood, and in and about Palestine there were, in Joshua's time, the Rephaim, Anakim, Emim, and Zamzummim, all men of great stature. The names of Og, two Goliaths, Ishbibenob, and Saph are preserved to us. In comparatively recent times there was a belief that the Patagonians and the men of Guayaquil were giants; and it is now unquestionable that the former do considerably exceed in stature the average of mankind. Scores of well-authenticated instances could be cited of persons exceeding 7½ feet in height. Several are on record of men measuring 9 or even 9½ feet, but these examples are open to some question. Very tall persons, it is observed, are much less numerous than those who are undersized. As a rule, "giants" are comparatively feeble in body and mind, and nearly all are short-lived. There is on record an account of Bishop Berkeley's attempt to produce a giant. We are told that he fed an orphan named Magrath on selected articles of food, and that when he died, aged twenty, Magrath's height was 7 feet 8 inches. Of the parentage of Magrath, or of the food used, we know nothing.—DWARF (Gothic *zwerg;* perhaps, says Grimm, the Gr. θεουργός, "divine worker") is also a mythological name. Dwarfs, fairies, elves, pygmies, pixies, and a host of nations of little folk, figure in the traditionary lore of many nations. It is remarkable that the Greeks placed the pygmies on the banks of the upper Nile, precisely the region where modern travellers have found whole tribes of dwarfish men. The Esquimaux and other far Northern races are also undersized. It is probable that the character of the food and the other surroundings have in these instances determined the dwarfish habit. In isolated cases it appears mostly to result from disease of the fœtus or its envelopes. It may terminate in premature decay of mental powers and in early death, but is far less likely to do so than the opposite overgrown condition. Indeed, there are many examples of dwarfish persons with more than ordinary intelligence who have lived to a great age. A dwarfed state is sometimes associated with rachitic deformity, but many dwarfs are perfectly symmetrical. C. W. GREENE.

Giant's Causeway, The, a magnificent exhibition of columnar basalt on the N. coast of Ireland. The out-

Giant's Causeway.

pouring of lava in Tertiary times that formed the beds of basalt of the islands of Mull and Staffa, off the Scotch coast, at the same period overwhelmed extensive tracts in what is now the county of Antrim, and the coast for some miles E. of Portrush is formed of dark volcanic rocks, which by their unequal decomposition give rise to a line of cliffs from 400 to 500 feet in height, remarkable for their boldness and wild picturesqueness. The transition from the snow-white chalk rocks which it overlies to the almost black basalt gives additional variety and beauty to the scenery around the Causeway. The cliffs consist of thick sheets of basalt, with intervening beds of ochreous clay. The lower layers of basalt are rich in zeolitic and other minerals, and in certain beds the columnar structure is very strongly developed, and in places these are beautifully exposed. The Causeway itself is a promontory of columnar basalt that has been laid bare by the waves, but has itself resisted their action; and here the visitor can make his way for a long distance over an irregular floor formed of perfectly developed polygonal columns, which remarkably illustrate the peculiarities of this kind of rock-formation.

EDWARD C. H. DAY.

Giaour' [Turkish: Persian *gawr*, "infidel"], a term applied by Turks and other Mohammedans to Christians and others not of their own faith. Its use is not always intended as a reproach, but very commonly has that character.

Giard, post-tp. of Clayton co., Ia., on the Milwaukee and St. Paul R. R. Pop. 1294.

Giar're, a Sicilian town of considerable commerce, in the province of Catania. It lies near the sea-shore, and in its neighborhood, at Carpineta, are some of the largest chestnut trees known; among them the famous *castagno dei cento cavalli*. Pop. 17,114.

Giave'no, town of Italy, in the province of Turin, formerly possessing considerable silk manufactures, which have now declined. It has an ancient castle surrounded by walls, in which the old dukes of Savoy sometimes wintered with their court. Pop. 9683.

Gibbes (ROBERT WILSON), M. D., born at Columbia, S. C., July 8, 1809, graduated at South Carolina College in 1827, where he became assistant professor, and afterwards professor of chemistry; took his medical degree in Philadelphia; became distinguished as a palæontologist, ornithologist, ichthyologist, and antiquary, as well as a physician; was twice mayor of Columbia, and for some time editor of the *Daily South Carolinian* and the *Weekly Banner;* became in 1861 surgeon-general of South Carolina. In 1865, when Columbia was burned upon its occupation by Sherman, his mansion, with its treasures of art and literature and its valuable cabinets, was burned. Author of an excellent *Monograph of the Squalidæ;* one of great value on *Typhoid Pneumonia* (1842); *Memoir of James De Veaux* (1845); *Documentary History of South Carolina* (3 vols., 1853); *Sketch of Charles Fraser; Memoir on Mososaurus; Cuba for Invalids* (1860); and many scientific papers. Was a member of numerous learned societies in Europe and the U. S. D. at Columbia, S. C., Oct. 15, 1866.

Gibbes (ROBERT WILSON), M. D., son of the above, b. June 10, 1831; graduated at the South Carolina College 1850, and received the degree of M. D. at the Medical College of South Carolina in 1852, after which he spent two years abroad, continuing his professional education, chiefly in Paris and Dublin; since which time he has been in active duty as a physician and surgeon. Has contributed various articles to different medical journals, and also filled the chairs of anatomy and surgery in the University of South Carolina at Columbia until Oct., 1873, when he resigned in consequence of changes in the administration of the university.

Gib'bites, a fanatical sect of Scotland in the last part of the seventeenth century. They combined some of the doctrines of the Quakers with others of the strict Covenanters, and were never numerous. Imprisonment of the Gibbites in jail broke up the movement, and they soon ceased to exist as a separate body. Their leader was a sailor named John Gib.

Gib'bon, a name applied to the tailless monkeys of the East Indies, belonging to the genus *Hylobates*, and constituting, with the gorillas, chimpanzees, and orangs, the group called anthropomorphous apes. They are rather small, very long-armed, destitute of cheek-pouches, and provided with naked callosities upon the buttocks. They are of gentle disposition. They live among the branches of trees, and leap from branch to branch with great freedom. Among the rather numerous species may be mentioned the active gibbon (*Hylobates agilis*), the hoolock (*Hylobates huluk*), the lar (*Hylobates lar*), and the white-handed gibbon (*Hylobates albimanus*).

Gibbon, post-village of Buffalo co., Neb., on the Union Pacific R. R., 193 miles W. by S. of Omaha.

Gibbon (EDWARD), b. at Putney, Surrey, Apr. 27, 1737; studied at Westminster and Oxford, and in 1753 declared himself a Roman Catholic; was placed under the instruction of a minister of Lausanne 1753–58, under whose training he renounced Roman Catholicism (1754), and acquired a vast knowledge of history and of Latin and French literature; returned to England, and pursued the reading of Greek authors with much zeal; entered Parliament in 1774 as a member for Liskeard; was a constant Tory, and in 1778 became a member of the board of trade; resided at Lausanne 1783–93, chiefly occupied with the completion of his *History of the Decline and Fall of the Roman Empire*, the production of which was first thought of at Rome in 1764, the first volume appearing in 1776 and the last in 1788. Besides this great work, he produced some other relatively unimportant writings. The best editions of the *History* are those of Milman and of William Smith (1855). The great merit of Gibbon's work is diminished by his lack of fairness towards Christianity, for he seems incapable of appreciating the nobler traits of the early Christians, while alive to all their faults. Recent ingenious attempts to show that Gibbon was a Christian have quite failed. In early life he was disappointed in a suit for the hand of the lady who became Mme. Necker and the mother of Mme. de Staël. He never married, and for many years enjoyed a large inherited fortune. D. in London Jan. 16, 1794.

Gibbon (JOHN), b. in Pennsylvania 1826; graduated at U. S. Military Academy July, 1847, and entered the army as brevet second lieutenant of artillery; promoted to be second lieutenant Sept., 1847, first lieutenant Sept., 1850, captain Nov., 1859, and colonel 36th Infantry July, 1866. Gibbon's first service was in the war with Mexico, being present at the city of Mexico; subsequently he was in garrison and on frontier duty against hostile Indians till the outbreak of the civil war in 1861. During this struggle he served as chief of artillery of Gen. McDowell's army till May, 1862, when he was appointed brigadier-general of volunteers, and assigned to the command of a brigade in the Army of the Potomac, participating in the second battle of Bull Run, of South Mountain, and Antietam; in Nov., 1862, he was placed in command of a division, which he led in the battle of Fredericksburg, where he was wounded. At the battle of Chancellorsville he was engaged in the storming of Marye's Heights; at the battle of Gettysburg he received severe wounds while in command of the 2d corps, and did not rejoin the army until Mar., 1864, when he was placed in command of a division of the 2d corps, and was engaged in Gen. Grant's Richmond campaign at the battles of the Wilderness, Spottsylvania, Cold Harbor, etc.: he subsequently commanded the 24th army corps, and was constantly engaged in the operations about Petersburg against the army of Gen. Lee, up to the surrender of the latter in Apr., 1865. For gallant services in battle he received the successive brevets from major to that of major-general U. S. A. In 1869 he was transferred to the command of the 7th Infantry.

G. C. SIMMONS.

Gib'bons (ABBY HOPPER), b. in Philadelphia Dec. 7, 1801, daughter of Isaac T. and Sarah Hopper; was a teacher in Philadelphia and New York; was married in 1833 to James S. Gibbons of Wilmington, Del.; since 1836 their home has been in New York. In 1845, Mrs. Gibbons was an efficient co-worker with her father in the formation of the Women's Prison Association, and in founding the homes for discharged prisoners, since known as "The Isaac T. Hopper Home." In this interest she has been a frequent visitor to the Tombs, Blackwell's and Randall's Islands, and similar institutions. In 1861, Mrs. Gibbons visited the army hospitals at Washington, and throughout the war rendered efficient services in hospital and camp, often at great personal risk. The anti-slavery sympathies of her husband and herself were well known, and in the New York riots of 1863 their house was one of the first to be sacked. In 1871 she was actively interested in the establishment of the New York infant asylum, and is now one of its chief managers. In 1873 she took an active part in opening the New York diet kitchen, and is president of the association which supports it.

SARAH S. THAYER.

Gibbons (CHARLES), fourth son of W. G., a distinguished member of the Philadelphia bar, was b. at Wilmington Mar. 30, 1811; studied law in the office of Charles Chauncey, Philadelphia, and was admitted to practice in 1838; was president of the National Whig Club in 1844; for several years a member of the State senate, and Speaker of that body in 1847; actively promoted the passage of a law to punish the kidnapping of negroes, to prevent the use of the State jails for the detention of fugitive slaves, and prohibiting the judges of the State courts and magistrates from issuing writs for the arrest of such fugitives; was chairman of the first Republican State committee, one of the founders of the Union League, the first organization of that

kind in the U. S., and the author of its constitution; represented the government under a special commission during the civil war in the argument of prize cases in the U. S. courts at Philadelphia, and is now a practising lawyer in that city. He is connected with a number of the most useful benevolent institutions in the city and State.

Gibbons (EDWARD), fifth son of W. G., was b. in Wilmington Dec. 7, 1817; studied law, and resided some time in Philadelphia; subsequently graduated in the Crosby Street Medical College of New York; removed to San Francisco in 1850, and became a successful physician. Is now a member of the California State legislature.

Gibbons (GRINLING), a wood-carver, b. in Rotterdam in 1648; came to London after the Great Fire of 1666, and was taken into the employment of Charles II., and afterwards of George I. Several of the princely houses of England—Chatsworth, Petworth, and Burghley—contain specimens of his exquisite work in screens, sideboards, chimney pieces, ornamental panels with flowers, fruit, birds, carved with a precision and delicacy that entitle them to the rank of works of very fine art. Gibbons d. at his house in Bow street, London, Aug. 3, 1721. O. B. FROTHINGHAM.

Gibbons (WILLIAM), M. D., was one of the fifth in descent from the Quaker emigrants who accompanied William Penn and settled in Pennsylvania about 1673–80. He was b. in Philadelphia Aug. 10, 1781, and was educated with special care by his father, who was for some years a classical teacher of eminence in that city. William studied medicine, and obtained his degree in the medical school of the University of Pennsylvania in 1805, soon after which he settled in Wilmington, where he resided the rest of his life. To the duties of his profession he added the study of the natural sciences. He made excellent progress in philological studies and the acquisition of languages, and among them the Hebrew, in which he attained to a remarkable proficiency. In the earlier part of his professional career, while his medical practice was not yet arduous, he devoted much time to the culture of ornamental plants, and established a nursery of grafted fruit trees—a business which has been maintained, and is still prosecuted in that locality. He was among the earliest promoters in Wilmington of associated efforts for the spread of scientific knowledge, among which was the Delaware Academy of Natural Sciences, of which he was the first president, and to which he contributed many valuable essays. He was the first president of the Peace Society and also of the State temperance organization in Delaware. He was an active member of the society for preventing the kidnapping of colored people—a business which was promoted by the proximity of Wilmington to the Baltimore slave-market. About 1823–25 Wilmington became the head-quarters of a prolonged religious controversy originating in an attack by an eminent Presbyterian clergyman, under the signature of "Paul," on the principles and doctrines of the Society of Friends. The dispute soon enlarged, and grew into a general polemical war between the Unitarians and the Trinitarians. Dr. Gibbons, though deeply interested, did not appear in the controversy as a writer, but near the close of it, under the signature of "Vindex," he addressed a letter to the Presbyterians, entitled *Truth Vindicated*, an able and successful refutation of the charges preferred by "Paul," and one of the clearest expositions, and perhaps the best defence, of the doctrines of Friends which has been published in modern times. WILLIAM DARLINGTON.

Addenda.—The religious controversy noted above was soon followed by another, in which Dr. Gibbons took a leading part; this was between the two divisions of the Society of Friends which have been known since that time as "Friends" and "Orthodox Friends." The final separation of this long harmonious body was consummated in 1827. (See QUAKERS.) Dr. Gibbons established and maintained for several years, at his own expense, a religious periodical publication called *The Berean*, which in four volumes covering the period from Feb., 1824, to Sept., 1828, is esteemed by the Society of Friends as the best-accredited history extant of the events embraced by it.

Dr. Gibbons was himself one of thirteen children, and left a family of the same number, of which eleven still survive.—HENRY GIBBONS, the eldest, was b. in Wilmington Sept. 20, 1808; graduated in the medical department of the University of Pennsylvania in 1829; practised medicine some years in Philadelphia, and was widely known as a lecturer; removed to San Francisco in 1850. He is now professor of the principles and practice of medicine in the Medical College of the Pacific; president of the California State board of health, and senior editor of the *Pacific Medical and Surgical Journal*. He is the author of a prize essay on tobacco, and of many addresses and essays on scientific subjects.—His oldest son, HENRY GIBBONS, JR., is also a graduate of medicine, associate editor of the *Medical and Surgical Journal*, and a successful practitioner in San Francisco. He entered the hospital service during the civil war, and became a skilful surgeon.—JAMES SLOANE GIBBONS, the second son of William, was b. July 1, 1810; in early life removed to Philadelphia, where he engaged in mercantile business; became a resident of New York in 1835, and since that time has been connected with banks and finance. He is the author of a work on *The Banks of New York, the Clearing-House, and the Panic of 1857*, 350 pp.; also of a volume entitled *The Public Debt of the U. S., Taxation, and Liquidation*, 275 pp.; and contributor to various literary and financial periodicals.—WILLIAM PETERS GIBBONS was b. in Wilmington Apr. 19, 1812; removed to Philadelphia, where he engaged in the printing business; established a scientific journal, of which he was the editor; removed, on invitation, to Poughkeepsie, N. Y., to take charge of a boarding-school for young ladies; in the mean time studied medicine, and graduated in the New York University; removed to San Francisco, where he is now a successful practitioner and an occasional writer on scientific subjects.

Gibbs (ALFRED), b. in New York 1824; graduated at West Point, and entered the army as brevet second lieutenant mounted rifles, July, 1846. In the war with Mexico he was engaged in the siege of Vera Cruz, in the battles of Cerro Gordo (where he was wounded), Contreras, Churubusco, Chapultepec, and was present at the capture of the city of Mexico; brevet first lieutenant and captain for gallant conduct in battle. Promoted to be second lieutenant of rifles in 1847, and first lieutenant 1853. From 1848 to 1856 he was aide-de-camp to Gen. Persifer F. Smith, serving on the Pacific coast and in Texas; from 1856 to 1861 he was engaged mostly on frontier duty and against hostile Indians. In July, 1861, he was taken prisoner in New Mexico. Upon being paroled (Aug., 1862), he was appointed colonel of the 130th New York Vols., Sept., 1862, being engaged in operations about and defence of Suffolk, Va., till Aug., 1863, when his regiment was changed to be the 1st New York Dragoons, and for several months he was engaged in organizing it as a cavalry regiment, and stationed at Manassas, guarding the Orange and Alexandria R. R. During Gen. Grant's Richmond campaign (1864–65) he commanded a cavalry reserve brigade, participating in various actions till Aug., 1864, when he resumed command of his regiment in the Shenandoah campaign, leading it in the battles of Opequan, Fisher's Hill, Cedar Creek, besides numerous minor actions. Appointed a brigadier-general of volunteers Oct. 19, 1864, in the final conflict with, and pursuit of, the Confederate army of Northern Virginia, he commanded a brigade of cavalry, being engaged at Dinwiddie Court-house, Five Forks, Sailor's Creek, etc., and present at the surrender of Gen. Lee at Appomattox Court-house. He subsequently commanded a cavalry brigade and division in the division of the Gulf, and was mustered out of the volunteer service Feb., 1866. For gallant conduct during the war he received the various brevets from major to that of major general U. S. A. Promoted in the army to be major 7th Cavalry in July, 1866, he served on frontier duty in Kansas. D. Dec. 26, 1868, at Fort Leavenworth, Kan. G. C. SIMMONS.

Gibbs (JOSIAH WILLARD), LL.D., b. at Salem, Mass., Apr. 30, 1790; graduated at Yale in 1809; was tutor there 1811–15; professor of sacred literature 1824–61; librarian of the college 1824–43. He published several philological works and many valuable papers. Among his works are a Hebrew lexicon, 1824; an abridgment of Gesenius's lexicon, 1828; *Philological Studies*, 1857; *Teutonic Etymology*, 1860, etc. D. at New Haven, Conn., Mar. 25, 1861.

Gibbs (WOLCOTT), M. D., LL.D., b. in New York City Feb. 21, 1822; after graduation at Columbia College, 1841, studied chemistry and physics in Giessen and Berlin. Shortly after his return from Germany, Dr. Gibbs was elected professor of physics and chemistry in the College of the City of New York 1849; in 1863 resigned this position, having been elected to fill the Rumford professorship in Harvard University. Dr. Gibbs is the author of many elaborate and valuable chemical researches; as, for example, on the platinum metals, on the ammonia-cobalt bases, on the equivalent of cobalt, on niobic acid, etc. Besides these he has made extensive contributions to analytical chemistry, both organic and inorganic. In the department of physics his contributions have been equally valuable and almost as numerous; among them we mention as examples his elaborate work on the wave-lengths of light, that on vapor densities, and his methods of avoiding the troublesome effects of temperature and pressure in gas analysis. His memoirs on these subjects, along with those on theoretical chemistry, are scattered among the volumes of the *American Journal of Science and Arts*, of which he has for many years been one of the editors.

Gib'el, or **Prussian Carp**, a small European fresh-

water fish, the *Cyprinus gibelio*. It is prized for the table, but is not very easy to catch, as it seldom takes the hook.

Gibelli'na, small town of Sicily, in the province of Trapani, near which (at Magione) are found very curious remains of troglodyte habitations—a large number of cells and niches excavated in the sides and on the top of a hill; thence called *Le Finestrelle*.

Gib'eon, town of Palestine, 5 miles N. W. of Jerusalem, is mentioned in Joshua x. 2, and in several other places in the Old Testament. Its site is now occupied by a small village, *El Jib*, and the surrounding district is well cultivated.

Gibral'tar, the southernmost promontory of Spain, is an insulated rock connected with the mainland only by a low, sandy slip of land between the Bay of Gibraltar on the W. side and the Mediterranean on the E. side. This rock, together with that of Abyla, now Ceuta, on the African coast, formed the so-called Pillars of Hercules, which by the ancients were considered the western boundary of the earth. The Rock of Gibraltar is 1400 feet high, almost perpendicular on its southern and eastern sides, and sloping and accessible only on its northern and western sides. Here is situated the town of Gibraltar, containing a population (exclusive of the garrison) of 18,695, consisting of Englishmen, Spaniards, Jews, and Moors, and carrying on a considerable transit-trade. Its chief importance, however, Gibraltar has as a fortress. In 1704 it was taken by the English, and they have retained it since as the key to the Mediterranean, and have fortified it, especially on its western and northern sides, so as to make it impregnable. Gibraltar was named *Gebel al Tarik* ("Tarik's Mountain"), from Tarik ben Zeyad, a famous Saracen leader who landed here in 711. It remained a Moorish stronghold till 1309, when Ferdinand IV. took it. The Moors held it again 1333–1462, and it was surprised and taken by the English 1704; besieged 1704–05; ceded to Great Britain 1713; besieged again 1727; blockaded and besieged by the French and Spaniards 1779–83, when it made one of the most obstinate and famous defences recorded in history. It is the see of an Anglican and of a Roman Catholic bishop.

Rock of Gibraltar. The signal-station from the south side.

Gibraltar, tp. of Door co., Wis., on Green Bay, Lake Michigan. Pop. 466.

Gibraltar, Strait of, connects the Atlantic with the Mediterranean by a channel 15 miles wide and 900 fathoms deep, between Spain and Africa. The central current of the channel constantly sets from the Atlantic into the Mediterranean, and makes it very difficult for sailing vessels to pass through to the Atlantic unless aided by a brisk east wind. The lower level of water in the Mediterranean is caused by its greater evaporation.

Gib'son, county of S. W. Indiana, bounded on the N. W. by the White and Wabash rivers. Its surface is broken and well timbered, and its soil productive. Cattle, grain, tobacco, and wool are staple products. Carriages, wagons, and flour are manufactured. Coal of good quality abounds. The Evansville and Crawfordsville R. R. traverses the county. Cap. Princeton. Pop. 17,371.

Gibson, county of W. Tennessee. Area, 760 square miles. The soil is highly productive. Cattle, corn, wheat, cotton, and tobacco are produced. Lumber, wagons, brick, and flour are among the manufactures. The Mobile and Ohio and the Memphis and Ohio R. Rs. traverse the county. Cap. Trenton. Pop. 25,666.

Gibson, tp. of Morgan co., Ala. Pop. 1274.

Gibson, tp. of Sierra co., Cal. Pop. 520.

Gibson, a v., cap. of Glascock co., Ga.

Gibson, tp. of Washington co., Ind. Pop. 1525.

Gibson, Ill. See Gibson City.

Gibson, post-v. of Corning tp., Steuben co., N. Y., 1 mile E. of Corning. Pop. 372.

Gibson, tp. of Mercer co., O. Pop. 1100.

Gibson, tp. of Cameron co., Pa. Pop. 1236.

Gibson, post tp. of Susquehanna co., Pa. Pop. 1368.

Gibson, tp. of Manitowoc co., Wis. Pop. 1638.

Gibson (Charles Bell), M. D., son of the professor who so long occupied the chair of surgery in the University of Pennsylvania, was b. in Baltimore, Md., Feb., 1816; d. of a heart affection in Richmond, Va., Apr. 23, 1865, near the close of the war between the States. Soon after his birth the family moved to Philadelphia, where his father opposed his studying medicine, but finding him so accurate in a description of an operation then just performed, the parent at once changed his mind. Dr. C. B. Gibson soon commenced lecturing to private classes, and so successfully that he was invited to the chair of surgery in Washington Medical College, Baltimore; in 1848 to the same professorship in the Richmond Medical College, Va. When that State united with the seceding States, he was made surgeon-general. In Richmond he became the chief consulting surgeon and operator, and from excessive labor and fatigue heart disease was induced, of which he died. Like his renowned father, Dr. Gibson, Jr., was a gifted man, and gave promise of great usefulness when suddenly cut off in the prime of life. Paul F. Eve.

Gibson (Edmund), D. D., b. at Bampton, Westmoreland, England, 1669; passed M. A. at Queen's College, Oxford, 1694; became bishop of Lincoln 1715, of London 1723. D. at Bath Sept. 6, 1748. Gibson was a man of severe virtue and great learning, but of an intolerant spirit, for he advocated penal laws against the Quakers and caused Meade's edition of the *Restitution* of Servetus to be burned. His edition of the *Saxon Chronicle*, with notes (1692), and the *Codex juris ecclesiastici Anglicani* (1713), are very import-

ant. His polemical works, written against Romanism and infidelity, are highly esteemed. He translated Camden's *Britannia*, and wrote also upon archæological and biographical subjects.

Gibson (GEORGE), b. in Pennsylvania; entered the army as captain of infantry in 1808; served through the war with Great Britain 1812–15; appointed quartermaster-general, rank of colonel, 1816; commissary-general 1818; which latter position he held for upwards of forty years; brevet brigadier and major general, U. S. A. D. Sept. 21, 1861.

Gibson (JOHN), an English sculptor, b. July 19, 1790, at Gyffyn, near Conway, Wales, the son of a landscape-gardener; at the age of fourteen was apprenticed to a cabinetmaker, then to a wood-carver. He first studied sculpture under the Messrs. Francis, statuaries of Liverpool. Several gentlemen, attracted by his genius, which was revealed in models and figures, supplied him with money for a two years' residence in Rome. There, in 1817, Canova welcomed him, admitted him without charge to his studio and academy, and procured for him distinguished patronage. His first pieces, *Mars and Venus* and *Hero and Leander*, were executed for the duke of Devonshire. After Canova's death (in 1822) Gibson placed himself under Thorwaldsen. In Rome he lived, revisiting England but once in twenty-four years. The patronage of the rich and great was lavished on him. King Louis of Bavaria ordered from him several groups, the nobility both of Italy and England prized his works, and wealthy merchants were glad to own them. Liverpool boasts of many pieces by his chisel. He modelled the statues of the queen in Buckingham Palace and in the Princes' Chamber of the Houses of Parliament. His ideal pieces, mostly repetitions of classic themes and showing little originality, are familiar through copies of photographs. Gibson partially revived the ancient practice of tinting marble statues by adding color to the *Aurora*, the *Venus*, and the statue of the queen, but did not carry the questionable practice far. He was regularly an exhibitor at the Royal Academy in London, was chosen an associate in 1833, and made a member in 1836. He was also a member of the academies of Munich, St. Petersburg, Turin, and St. Luke in Rome. At the Paris Exposition of 1855, Gibson had four pieces—a hunter, a hunter and dog, a wounded Amazon, and *Hylas carried away by Nymphs*. D. in Rome Jan. 27, 1866. O. B. FROTHINGHAM.

Gibson (JOHN B.), LL.D. See FIRST BIENNIAL SUPPLEMENT.

Gibson (TOBIAS) was b. in Liberty co., S. C., in 1771; joined the Methodist ministry in 1792; labored with notable success in the South-east till 1800; went then to Natchez, and founded his denomination in Louisiana and the South-west generally. He endured extreme hardships in his pioneer ministry, and was a genuine hero and saint. D. at Natchez in 1804.

Gibson (WILLIAM), M. D., LL.D., was b. in Baltimore, Md., 1784; d. in Savannah, Ga., 1868, whither he had gone in feeble health. He took his medical degree from the University of Edinburgh; was the pupil and associate of Sir Charles Bell; was at the siege of Corunna, 1809, and Waterloo, 1815, where he was slightly wounded; was intimate with Sir Astley Cooper, Velpeau, etc., and had met Napoleon Bonaparte, Lord Byron, Hastings, Abernethy, Halford, etc. In 1819 he succeeded Dr. Physick in the chair of surgery in Philadelphia. Dr. Gibson published a *System of Surgery*, in two vols., which passed through nine editions; was also the author of several lectures, of *Rambles in Europe*, 1839, containing biographical sketches of surgeons, etc. He resigned his professorship in 1855, which he had occupied thirty-six years. He was the first to perform the cæsarean operation twice on the same patient, successful to both mother and children. He was, too, honest enough to publish his unsuccessful cases. He was a man of indomitable energy, of astonishing memory, and left no superior as a lecturer. PAUL F. EVE.

Gib'sonburg, post-b. of Luzerne co., Pa., on the Delaware and Hudson R. R., 11 miles N. E. from Scranton. It has mines of coal. Pop. 1156.

Gib'son City, post-v. of Ford co., Ill., on the Toledo Wabash and Western, at the crossing of the Gilman Clinton and Springfield and the Chicago and Paducah R. Rs. It has one weekly newspaper.

Gib'son Station, post-v. of the Creek Nation, Indian Territory, on the Missouri Kansas and Texas R. R., 108 miles S. of Parsons City (7 miles from Fort Gibson).

Gib'sonville, a v. of Hocking co., O. Pop. 67.

Gid'dings, post-v., cap. of Lee co., Texas.

Giddings (DE WITT C.), b. in Susquehanna co., Pa., July 18, 1827; studied law, and removed to Texas in 1852, making Brenham his residence; opposed secession in 1861, but immediately after the withdrawal of that State from the Union entered the Confederate service as a private in the 21st Texas Cavalry, and rose to the rank of colonel. In 1866 was a member of the constitutional convention of that State, and subsequently became a member of the 42d and 43d Congresses. A. H. STEPHENS.

Giddings (JOSHUA REED), an American statesman, was b. at Tioga Point, Pa., Oct. 6, 1795. His father removed from Lyme, Conn., to Pennsylvania in 1772. Six weeks after the birth of their child his parents removed to Canandaigua, N. Y. When he was about ten years old they removed to Ashtabula co., O., a part of the Connecticut Western Reserve. His youth was one of severe toil, yet he became a man of great size and strength, as well as of capacious mind and generous and enterprising spirit. After Hull's surrender in 1812 he enlisted as a volunteer in the U. S. service, and took part in a severe action near Sandusky Bay. After Proctor's retreat the troops with which Giddings served were sent home. His education was obtained by reading books, mostly borrowed, and read at night by the light of a hickory fire. He taught school, studied law with Elisha Whittlesey, a prominent lawyer, and was admitted to the bar in 1821. In 1826 he went as a representative to the State legislature; declined re-election in 1827; was defeated in running for State senator in 1828; devoted himself to his profession, in which he rose to the first rank. In 1839 he was sent to Congress. He was not then, and was never, an abolitionist in the strict sense of the term. The men who claimed that title did not approve his views and seldom commended his action. His adhesion to the Whig party exposed him to their assaults. They labored for the abolition of slavery in the States, while he admitted that it was out of the reach of Federal enactments. He revered the Constitution which they denounced. He zealously labored to preserve the Union, which they were willing to divide. At the same time, he believed that Congress had no right to protect slavery in the States, that slavery was a great evil, and that it was wrong and unconstitutional to compel the free States or the general government to return fugitive slaves to their owners. He also believed it was the duty of Congress to prohibit slavery in the District of Columbia and the Territories, and to break up the coastwise slave-trade. At that time the U. S. government was thoroughly committed to the defence of slavery in the States, and it was not lawful to present petitions relating to it, all such petitions being laid at once on the table without debate. During his membership of Congress a large share of his attention was given to the tracing out of the constitutional relations of the government, the States, and the people to slavery, and the exposition of his views thereupon; but he also took a prominent part in questions of tariff and of appropriations and in other important affairs. He opposed the Florida war, on the ground that it was an attempt to recapture fugitive slaves at the expense of the U. S. In 1841 the Creole, a vessel laden with slaves, sailed from Norfolk, Va., for New Orleans. The slaves arose, seized the vessel, and finally found the British port of Nassau, N. P., where they were recognized as free. Mr. Webster, then secretary of state, having demanded compensation of the British government, Mr. Giddings introduced into the House resolutions declaring that the slaves upon the Creole were guilty of no crime in taking their freedom upon the high seas, inasmuch as they were outside of the jurisdiction of Virginia, that persons held in slavery cease to be slaves when upon the high seas, and that the demand for the slaves or for compensation for them was not warranted by the U. S. Constitution. For presenting these resolutions (which he temporarily withdrew at the earnest request of many friends) Mr. Giddings received the censure of the House, without being permitted to speak in his own defence. He thereupon resigned, but was at once re-elected without opposition. In his early years in Congress his views were shared by no member except his friend, John Quincy Adams. In 1843 he produced the famous "Pacificus" essays upon the slavery question. He zealously opposed the annexation of Texas. In 1844 he successfully opposed the bill to pay for the Amisted negroes. He resisted the joint occupation of Oregon with Great Britain, and asserted the right of the U. S. to the whole. He opposed the insertion of clauses in Indian treaties requiring the return of fugitive slaves. He strongly favored the Wilmot proviso. Upon the nomination of Gen. Taylor for the Presidency in 1848 he left the Whigs and joined the new Free-Soil party. He declined to vote for a Whig Speaker of the House in 1847 and 1849, and thus in the latter year caused the choice of a Democratic Speaker. In 1850 he opposed the new compromise, the fugitive slave bill, and the $10,000,000 Texas bill. He afterwards resisted Mr. Douglas's Kansas policy, and in 1855, as senior member of the House, administered the oath to Mr. Banks, the first Republican Speaker. In 1859, after twenty-one years' service, he closed his Congressional career. Twice during

this time he fell and became unconscious while addressing the House. He was twice assaulted in Congress by armed men, and was once set upon by a mob in Washington. He met such attacks with great courage. In 1853 he published a volume of speeches; in 1858 the *Exiles of Florida*, an historical sketch of much interest. In 1861 he was appointed consul-general to British North America. He wrote a Congressional history of slavery, and in 1864 published *The Rebellion, its Authors and Causes*. D. at Montreal May 27, 1864. He was a man of deep religious character, strong convictions, and great ability. A vigorous writer, a cogent reasoner, a ready and able debater, a bold, clear speaker, he often, especially when opposed, displayed great oratorical power. His services contributed largely to the great changes which have in recent years been made in the current of public opinion. A. G. RIDDLE.

Gid'dy Swamp, tp. of Lexington co., S. C. Pop. 358.

Gien, town of France, in the department of Loiret, on the Loire. Pop. 6528.

Gier Eagle, a bird mentioned in the Bible, is generally thought to be the "Pharaoh's hen" or EGYPTIAN VULTURE (which see); but some believe it is the *Pelecana onocratalus*, a pelican of the Levant.

Gie'seler (JOHANN KARL LUDWIG), b. at Petershagen, Germany, Mar. 3, 1792; studied and taught in the Halle Orphan House 1803–13; served against Napoleon 1813–15; taught at Halle, Minden, and Cleves 1815–19; became professor of theology at Bonn 1819, and at Gottingen 1831; where he d. July 8, 1854. His great work on *Church History* (1824–57) is one of the most valuable and impartial works of the kind ever produced, but a somewhat rationalistic spirit has been remarked in it. The best English translation is that of H. B. Smith (New York, 4 vols., 1856).

Gies'sen, town of Germany, in the grand duchy of Hesse Darmstadt, on the Lahn. It has a university (founded in 1607) and other educational institutions. Pop. 9551.

Giffard's Injector. See STEAM-ENGINE.

Gif'ford (ROBERT SWAIN), an American painter, b. on the island of Naushon, Gosnold, Mass., Dec. 23, 1840. His parents were poor laboring people. Living on the sea shore (his father was a boatman), the boy's love for art early showed itself in marine studies, his removal, at the age of three years, to New Bedford and neighboring towns not withdrawing him from the associations of his childhood. His only education for the first ten years was derived from the public school, which ill-health forbade his attending regularly. From that time onward he was indebted to his own exertions for his mental acquirements. A natural taste for art, inherited, it would seem, from his mother, was developed by a German artist, who employed the lad in little services, and thus became interested in his genius. Subsequently, good friends, seeing his promise and attracted by his character, lent their aid. The youth rapidly rose in power and reputation, and at present stands in the front rank of the younger landscape painters. His best pieces are from studies made in the East in 1870–71. At present (1874) he is making further æsthetic explorations in the same fruitful field. Mr. Gifford married a daughter of Hon. T. D. Eliot of New Bedford. His residence is in New York City. O. B. FROTHINGHAM.

Gifford (SANDFORD ROBINSON), an American artist, b. in Greenfield, Saratoga co., N. Y., July 10, 1823. His ancestors were among the earliest settlers in New England. His father was an iron founder at Hudson on the Hudson. Mr. Gifford, the fourth of a large family, received, as all did, a fair education; was two years at Brown University (1842–44); came to New York in 1845, and studied drawing, perspective, and anatomy with John Rubens Smith; drew from casts and from life at the National Academy, and attended lectures on anatomy at the Crosby Street Medical College. At this time he painted portraits. His attention was directed to landscape painting in 1846 by pedestrian tours among the Catskill Mountains and the Berkshire Hills. In 1851, Gifford was elected an associate of the National Academy, and in 1854 an academician. Two years and a half (1855–57) were spent in Europe in faithful art work. At the breaking out of the civil war Gifford joined the 7th New York regiment, and saw six months of service. Eighteen months more in Europe (1868–69) added to his stores of material. Subsequently the artist visited Colorado and Utah, California, Oregon, British Columbia, and Alaska. The fruit of all these journeyings has been presented in forty or fifty oil paintings of remarkable merit of design, sentiment, and execution. Mr Gifford has his studio in New York, and is one of the most popular of American artists. His *Mansfield Mount*, *Shrewsbury River*, *San Giorgio*, *Tivoli*, *On the Nile*, *Venetian Sails*, *Baltimore in 1862*, are among the most characteristic of his pieces. O. B. FROTHINGHAM.

Gifford (WILLIAM), b. at Ashburton, Devon, England, Apr., 1757; went to sea in childhood, was apprenticed to a shoemaker in 1772, and afterwards, through the kindness of friends, was sent to Exeter College, Oxford, and received the patronage of Lord Grosvenor. His successful *Baviad* (1797), directed against the Della Cruscans, was followed by the *Mæviad* (1795) and the severe *Epistle to Peter Pindar*, which called forth an equally caustic reply. In 1797 he became editor of the *Anti-Jacobin*, and in 1809 of the *Quarterly Review*. His translations of Juvenal (1802) and of Persius are spirited and accurate, but his reputation is founded on his work as a critic and reviewer. He was a most bitter enemy of the Whigs, and was distinguished for his hostility to Hunt, Keats, and all the liberal authors of his day. His editions of the old English dramatists are noteworthy. Gifford was of small stature, very ugly in his appearance, but kind, says Southey, to every living thing except authors. The general voice of subsequent criticism has been adverse to his opinions on most questions of literary taste. D. in London Dec. 31, 1826.

Gift, in law, a voluntary or gratuitous transfer of personal property. It differs from a contract in not being based upon a consideration, which is essential to give a contract validity. But the correspondence between the principles relating to gifts and those appertaining to contracts is so very close—since in both cases there is contemplated a change of ownership by mutual consent—that the effect of the absence of all consideration upon a proposed transfer of lands or goods either by one mode or the other is the same. A promise to confer a gratuity in the future is virtually an executory contract without consideration, and the lack of this indispensable prerequisite renders the intended gift unenforceable, even though the actual purpose of the donor may have been to completely fulfil his offer, and the most confident expectations may have been excited in the intended donee. It is only the entire execution of a design to confer a gift that is regarded as an equivalent of a consideration, and in whatever other stages of fulfilment the purpose of the donor may be, no liability is fastened upon him, but he may recall his proffer when he will. A gift actually conferred is, therefore, in effect, an executed contract—one merely promised, an invalid executory contract. Gifts are divided into two classes—gifts *inter vivos*, or between living persons, and gifts *causa mortis*—*i. e.* bestowed in anticipation of the donor's death.

I. *Gifts inter vivos.*—Strictly speaking, this technical designation is incorrect, since all gifts must necessarily be made between living persons, but it has become firmly established as a legal term whose extent of application must be understood as limited to cases in which there is no immediate apprehension of death on the part of the giver, or, if there be such apprehension, where it is not given on that account. The real distinction is, that gifts of this class may be complete within the donor's lifetime, while gifts *causa mortis* only take absolute effect from his death, being, as long as life lasts, conditional and revocable. The capacity to confer gifts which shall be valid and irrevocable demands the same qualifications in the donor as to make binding contracts or to perform other legal acts. Coverture, infancy, insanity, and duress would be causes of disability, in consequence of which the gift might be retracted. When the donor is under no incompetency, the necessity that his intention be executed requires a delivery of the property conferred into the possession of the donee. The transfer of ownership must be in reality consummated. The delivery may be either actual, as by placing the very article intended to be given in the hands of the donee, or constructive. Giving the key of a warehouse in which the goods are deposited, or an order upon a bailee which the latter accepts, are instances of a sufficient constructive delivery. The thing given must have an actual existence. The promise of the donor, though in writing, cannot be the subject of such a gift. Thus, if a person give his own promissory note or a check drawn upon a banker to another, or an order upon a bailee who refuses to be bound by its directions, the donor's title is not in the least affected until the money is collected or the article demanded and received; and before that time the gift is revocable. The gift in such cases is but a promise without consideration. Even a court of equity will not enforce an inchoate gift, but will only lend its aid to require specific performance when some valuable consideration has been advanced, and a contract thereby established. After a complete and valid delivery of a gift has been made, the only remaining cause for which it may be avoided is that the donor's act was induced by fraudulent means, or that the gift would be prejudicial to the rights of creditors. Artifices practised to mislead any person to his injury invalidate a gift in the same manner as they would a contract. In protecting the rights of creditors the law has adopted the moral maxim that "a man must be just before he is generous," and will

not allow a debtor to expend in gratuities what he ought to use for the discharge of his just obligations. (A fuller discussion of this question will be found under the topic FRAUDULENT CONVEYANCE.)

II. *Gifts causa mortis.*—Gifts bestowed in anticipation of death differ, in several important respects, from gifts *inter vivos.* They are conferred only upon the presumed condition that they shall take effect in case the donor dies by his existing disorder. A recovery from the illness operates of itself as an avoidance of the gift, and no express revocation is necessary. Moreover, though delivery is an essential element to the validity of the donor's act to the same extent as in gifts *inter vivos,* and though it may, in the same manner, be either actual or constructive, it does not, nevertheless, have the same effect, at least until the donor's death. For as long as he continues to live he has power to revoke his gift, even though actual delivery may have been made.

But apart from these fundamental distinctions, there is a general resemblance between the two classes of gifts. The same rules as to legal capacity are applicable, and as to the effect of the donor's gratuitous promises. The doctrine of constructive delivery as applied to valid rights of action, such as mortgages, policies of life insurance, deposits in savings banks, etc., has been carried farther than in gifts *inter vivos,* in order to effectuate the donor's intent. Mere delivery in such cases is in general sufficient, even though there be no written assignment of the mortgage, policy of insurance, etc. Moreover, the same qualifications are applicable as to the effect of fraud upon the legality of the gift, and the rights of existing creditors receive the same protection. Questions concerning gifts *causa mortis* are frequently entertained by courts of equity, though this is by no means the invariable practice. The validity or invalidity of a pretended gift *causa mortis* is oftentimes difficult of proof, since the donor's testimony is of course unobtainable, and excellent opportunities are frequently afforded for the assertion of fraudulent claims by professed donees. On this account every claim of the kind is examined with careful scrutiny, and clear proof is required that the gift was actually made as maintained by the donee.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Gi'ger (GEORGE MUSGRAVE), D. D., b. in Philadelphia June 6, 1822; graduated at Princeton with honors in 1841, and studied divinity at that place; was a tutor there, and in 1846 became adjunct professor of mathematics; in 1847 adjunct professor of Greek; was professor of Latin 1854–65. D. in Philadelphia Oct. 11, 1865, and bequeathed his library and a large amount of money to the college.

Gignoux (FRANÇOIS RÉGIS), a landscape painter, b. at Lyons, France, in 1816; educated at Fribourg; studied art in the Academy of St. Pierre at Lyons; entered later the School of Fine Arts in Paris, and afterwards was a pupil of Delaroche. He it was who confirmed his bent towards landscape-painting. In 1840 he came to America, married, and entered on an industrious career in New York and Brooklyn. His pictures are sincere studies of Nature, chiefly in her more cheerful aspects; they display a sympathetic feeling, a correct hand, an eye for picturesque effects, a rich sense of color, a healthy fondness for beauty, an absence of everything morbid, and a freedom from monotony and mannerism that indicates good training and well-poised faculties. His style is unambitious; his subjects commonly unobtrusive, as, for example, *Spring, The First Snow, The Indian Summer.* He is, however, bold at times, as in the *Niagara in Winter,* the *Bernese Alps at Sunrise,* and other large canvases placed in public exhibitions. The *Niagara by Moonlight,* in the Belmont collection, is a good example of his power. Mr. Gignoux has been a sincere servant of art in his adopted country. He was chosen the first president of the Brooklyn Art Academy.

O. B. FROTHINGHAM.

Gi'hon (ALBERT LEARY), M. D., b. 1833 in Philadelphia; graduated first in his class at the Philadelphia High School 1850; professor of chemistry in the Philadelphia Medical College 1853–54; entered the medical department of the U. S. navy 1855; has attained the rank of commander, and is medical inspector (1875). Author of *Practical Suggestions in Naval Hygiene* and various professional papers, and a large contributor to periodical literature.

Gijon', town of Spain, in the province of Asturias, on the Bay of Biscay. Its Instituto Asturiano, with professorships in mathematics, navigation, the English and French languages, its large cigar manufactures, and its considerable trade in fruit and coal, make Gijon quite a lively place. Pop. 10,378.

Gi'la, Ri'o, a river which rises in Socorro co., N. M., in the Sierra Madre, and flows first S. W., then S., and finally W., joining the Rio Colorado about 180 miles from its mouth. Its course is entirely within the Territories of New Mexico and Arizona. Its total length is not far from 500 miles. One-half its course is through mountain-cañons, but its lower half flows through a somewhat level but rather narrow valley, well wooded, and in some parts very fertile when irrigated. Its waters are utilized also in gold and silver mining. Its lower valley abounds in ruins, the relics of an ancient civilization represented at present by the Pima and Maricopa Indians, and a few other partly civilized tribes. In its lower course its depth averages 3 feet, its breadth 60 feet, and its current 2 miles per hour.

Gil'bert (NATHANIEL), a lawyer and Speaker in the house of assembly in Antigua, West Indies, is distinguished in the history of Methodism as the founder of that denomination in those islands. He was in England in 1758, when he and two of his slaves heard Wesley preach. Master and slaves became converts, the slaves being baptized by Wesley. On his return to the West Indies, Gilbert held religious meetings in his own house. He became a local preacher of Methodism, and founded a society, chiefly of blacks, which was the beginning of the extensive Wesleyan missions in the archipelago, by which many thousands of negroes have been Christianized. Methodism became one of the chief means of West India emancipation, and it now prevails through most of the islands.

ABEL STEVENS.

Gilbert, or **Gilberd** (WILLIAM), M. D., b. at Colchester, England, 1540; was educated at St. John's, Cambridge, and in 1573 settled in London. In 1603 he became first physician to James I. Author of *De magneti magneticisque corporibus* (1600) and *De mundo nostro Philosophia* (1651), works of surprising accuracy of statement and full of profound thoughts. He stood far in advance of his time as a scientific observer and theorist, and as a recorder of facts. D. Nov. 30, 1603.

Gil'bert Hol'low, tp. of Lexington co., S. C. P. 872.

Gil'bertines, an order of monks and nuns founded in England by St. Gilbert of Sempringham (1083–1189). It at first contained only nuns who were Benedictines, but in most of their houses were also monks who were canons regular of St. Augustine. There were also lay brothers, who followed the Cistercian rule. The rules of the order were very strict with regard to the separation of the monks and nuns. The order was extinguished by Henry VIII.

Gil'bert Isl'ands, or the **Kingsmill Group,** the south-easternmost group of Micronesia, containing sixteen inhabited islands of coral formation, situated in the Pacific, between lat. 1° S. and 2° 30′ N. and lon. 172° and 174° 30′ E., and belonging to the Mulgrave Archipelago. The islands are low, and covered only with a thin layer of vegetable mould. Cocoanuts, taro, and pandanus are cultivated. The inhabitants, who number about 60,000, and have some resemblance to the Malays, are very rude, and are occasional cannibals. Promising missions are maintained here by Hawaiian and American Congregationalists.

Gil'bertville, post-v. of Hardwick tp., Mass., on the Ware River and the Ware River R. R., 16 miles N. E. of Palmer. It has important manufactures.

Gil'boa, tp. of Benton co., Ind. Pop. 452.

Gilboa, mountainous tp. of Schoharie co., N. Y.—GILBOA, post-v. of this tp., is at the falls of the Schoharie Creek. Pop. of tp. 2227.

Gilboa, post-v. of Blanchard tp., Putnam co., O. Pop. 315.

Gil'christ, post-tp. of Pope co., Minn. Pop. 169.

Gil'das, a Welsh historian, b., according to Ussher, in 511 A. D., and said to be the brother of Aneurin, a famous bard. His *De Calamitate, Excidio et Conquestu Britanniæ* has been often printed. He is called "the Wise," and became a prominent ecclesiastic in Ireland, and later in Brittany. D. 570 (*Ussher*). It is, however, sharply questioned whether such a person ever lived.

Gil'der (WILLIAM H.) was b. in Philadelphia Sept. 17, 1812; was educated at the Wesleyan University, Conn., and entered the ministry in 1833. In 1840 he began a Methodist paper in Philadelphia called the *Depository.* He served during several years as principal of the female institute at Bordentown, N. J., and subsequently as president of the female college, St. Thomas's Hall, Flushing, L. I. For some time he was editor of the *Literary Register.* In 1862 he became chaplain in the army, and d. in hospital at Culpeper, Va., in 1864.

ABEL STEVENS.

Gild'ing, the application of a thin layer of gold upon the surface of another substance. There are various methods in use of effecting this. The ancient process, that of applying gold-leaf, is still the best for many kinds of work. Gold-leaf is made to adhere by the use of "gold-size," a tempera priming rendered adherent by an admixture of glue; or by "oil-size," a varnish of linseed oil and ochre,

the last chiefly used for work that is exposed to the weather. For gilding book-covers the leaf is made to adhere by heat and pressure (if the cover is of cloth), or by the use of albumen or gelatine for leather-work. Gold is often applied to metals by means of an amalgam (which is rubbed on and then heated) or a solution. A brass or copper wash affords the best surface for this kind of gilding. Whatever method is employed, the gilded surface has to be burnished afterwards. Much gilding is done by the electrotype process (see ELECTROTYPE), or even by simple immersion of the article to be gilded in a gold solution. Glass and porcelain are gilded by the encaustic method. For the gilding of particular kinds of goods there are innumerable special processes, many of them involving widely various chemical reactions. Most of them are comparatively recent inventions. Gilding can be applied in layers of incredible thinness by the newer methods, and at a small cost; but the old standard process by the use of gold-leaf is, where applicable, unsurpassed for durability and handsome appearance.

Gil'ead ("rocky region"), a district of Palestine, bounded W. by the Jordan, E. by the Arabian desert, N. by the Hieromax (*Yarmûk*), and S. by the Arnon (*Mojib*). Northern Gilead extended from the Hieromax to the Jabbok (*Zerka*), about 35 miles; in the time of Moses was under the dominion of Og, king of Bashan, and after its conquest was assigned to the half tribe of Manasseh. Southern Gilead extended from the Jabbok to the Arnon, about 50 miles; in the time of Moses belonged to Sihon, king of the Amorites, and after its conquest was assigned to the tribes of Reuben and Gad. In this southern portion, which at one time belonged to the Moabites, were Nebo, Pisgah, and Peor. The whole district is wildly mountainous (the greatest elevation being about 4000 feet above the sea), but exceedingly picturesque, clad with noble forests, and very fertile. The streams, unlike those W. of the Jordan, are perennial. R. D. HITCHCOCK.

Gilead, post tp. of Calhoun co., Ill. Pop. 498.

Gilead, post-v. and tp. of Oxford co., Me., on the Grand Trunk Railway, 80 miles N. W. of Portland. Pop. 329.

Gilead, post-tp. of Branch co., Mich. Pop. 794.

Gilead, tp. of Morrow co., O. Pop. 2017.

Gilead, Balm of, a product of Oriental lands, once highly valued as a vulnerary and cosmetic, and for its odor as well as for its medicinal properties. In the Levant it still sells for a very high price, and is now known as Mecca balsam. It is the product of *Amyris Gileadensis*, an evergreen shrub now found chiefly on the shores of the Red Sea. Some think that the ancient balm of Gilead was MASTIC (which see), the product of *Pistacia Lentiscus*.

The "balm of Gilead tree" of the U. S. is the *Populus balsamifera*, a tall poplar whose large buds are in spring covered with a strong-smelling, copious resin, which is used as a vulnerary and stimulant in domestic medicine.

Giles, county of Middle Tennessee, bordering on Alabama. Area, 600 square miles. The soil is remarkably fertile. Cattle, corn, cotton, tobacco, and wool are produced. Among the manufactured articles are lumber, brick, and building-stone. It is traversed by the Louisville Nashville and Great Southern R. R. Cap. Pulaski. Pop. 32,413.

Giles, county of S. W. Virginia, between the Appalachian ranges known as Peter's and Walker's Mountains. Area, 275 square miles. The surface is very rough. Grain, tobacco, and wool are produced. Cap. Pearisburg. Pop. 5875.

Giles, tp. of Van Buren co., Ark. Pop. 611.

Giles, tp. of Amelia co., Va. Pop. 3597.

Giles (HENRY), a clergyman, lecturer, and author, b. Nov. 1, 1809, in Craanford, Wexford co., Ireland; educated in Belfast, at the Royal Academy, in the Roman Catholic faith; this he departed from till he became a Unitarian. As a minister of this sect he preached in Greenock and in Liverpool; in the latter city he bore an able part in the controversy between the Unitarians and Episcopalians, in 1839, with Mr. Martineau and Mr. Thom. In 1840 he came to America, where his excellence as a preacher and lecturer made him known in every city as a man of brilliant gifts. He has published several volumes of essays, lectures, and discourses marked by ingenuity of thought, fulness of diction, and fervor of style. Their titles are—*Lectures and Essays* (2 vols., 1845); *Christian Thought on Life* (1850); *Illustrations of Genius* (1854); *Human Life in Shakspeare* (1868). For many years Mr. Giles has been withdrawn by illness from public view. His residence at present is at Hyde Park, Mass. O. B. FROTHINGHAM.

Giles (WILLIAM BRANCH), b. in Amelia co., Va., Aug. 12, 1762; was educated at Princeton, N. J.; became a lawyer of Petersburg, Va.; was in Congress 1790–98, 1801–02; in the U. S. Senate 1804–15; governor of Virginia 1827–30; Presidential elector 1801, 1805. D. Dec. 4, 1830. Mr. Giles entered public life as a Federalist, but very early left that party, and acted mainly with the Jeffersonians, but was often found outside of all party lines. He was one of the best debaters and parliamentarians of his time, and was prominent as a State legislator, and published several severe but effective political letters. A. H. STEPHENS.

Gilesville, a v. of Lafayette tp., McKean co., Pa., is the S. terminus of the Buffalo Bradford and Pittsburg R. R., 26 miles from Carrollton, N. Y. It is an important shipping-point.

Gilfil'lan (GEORGE), b. at Comrie, Perthshire, Scotland, 1813; was educated in Glasgow University; in 1835 became a minister of the United Presbyterian Church, and since 1836 has been settled at Dundee. Author of *Gallery of Literary Portraits* (1845–55, 3 series); *The Bards of the Bible* (1850); *Night*, a poem (1867); *Martyrs, etc. of the Scottish Covenant* (1852), and numerous other works, including an edition of the *British Poets* in 48 vols. His too ornate style has invited severe criticism, but his productions have had wide popularity. D. Aug. 13, 1878.

Gil'ford, tp. of Tuscola co., Mich. Pop. 353.

Gilford, tp. of Belknap co., N. H., on Lake Winnepiseogee, contains part of LACONIA (which see), the capital of the county, and part of LAKE VILLAGE, an important manufacturing place, on the Boston Concord and Montreal R. R., 27 miles N. E. of Concord. Gilford has 5 churches, a savings bank, a large trade, and manufactures of hosiery, iron goods, machinery, shoes, etc. The scenery is charming. Pop. 3361.

Gill. See WEIGHTS AND MEASURES, by F. A. P. BARNARD.

Gill, tp. of Sullivan co., Ind. Pop. 2135.

Gill, post-tp. of Franklin co., Mass., on the W. side of the Connecticut River, 4 miles N. E. of Greenfield. It is a beautiful and fertile tract, and has a good town-hall and a public library. Pop. 653.

Gill (HENRY Z.), M. D., b. at Richborough, Bucks co., Pa.; took his medical degree at Jefferson Medical College, Philadelphia, 1857; practised at Columbus, O., until 1861; served 1861–65 as assistant surgeon and surgeon in the U. S. volunteer service, and received the brevet rank of lieutenant-colonel in 1865; studied medicine in Europe 1866–67; practised his profession in St. Louis until 1873, when he removed to Jerseyville, Ill.; was president of the St. Louis Microscopical Society, recording secretary of the St. Louis Medical Society, corresponding secretary of the Missouri Medical Association; was one of the publishers of the *St. Louis Medical and Surgical Journal* 1872–74; author of many professional papers.

Gill (JOHN), D. D., b. at Kettering, North Hants, England, 1697; became a Baptist pastor; settled at Horsleydown 1719, and d. there Oct. 14, 1771. He was profoundly versed in Latin, Greek, and Oriental biblical literature; was a high Calvinist. Author of a voluminous and very learned *Exposition of the Bible* (1746–66), a *Body of Divinity* (1769–70), sermons, treatises on baptism, etc.

Gill (THEODORE NICHOLAS), M. A., M. D., Ph. D., naturalist, resident at Washington, D. C., b. in the city of New York Mar. 21, 1837; received a classical education in private schools and under special tutors; honorary M. A., M. D., and Ph. D., and member of the National Academy of Sciences. His earlier contributions to science were chiefly on fishes, and later on mammals, but in the course of his investigations he has published articles on mollusks, crustaceans, and other departments of natural history, in all amounting to nearly 200 papers. The most noteworthy of these are *Arrangement of the Families of Mollusks* (1871), *Arrangement of the Families of Mammals* (1873), and *Arrangement of the Families of Fishes* (1873), all published by the Smithsonian Institution.

Gil'lam, tp. of Jasper co., Ind. Pop. 635.

Gil'lem (ALVAN C.), b. in Tennessee 1830; graduated at the U. S. Military Academy July, 1851, and entered the army as brevet second lieutenant of artillery; promoted to be second lieutenant Dec., 1851, first lieutenant 1855, captain and assistant quartermaster 1861, and colonel 24th Infantry July, 1866; served in garrison and on frontier duty 1851–61, and in the civil war in defence of Fort Taylor, Fla.; as brigade and chief quartermaster Jan., 1861, to June, 1862, being engaged in the battle of Shiloh and siege of Corinth; appointed colonel 10th Tennessee Volunteers May, 1862, and was provost-marshal of the city of Nashville Aug.–Dec., 1862; appointed brigadier-general of volunteers Aug., 1863, and participated and commanded in numerous engagements and expeditions in Tennessee. Upon the reorganization of the State government of Tennessee he was vice-president of the convention to revise the constitution and a member of

the State legislature; he subsequently commanded a cavalry division, and was engaged in various expeditions and combats in Tennessee and North Carolina. In Sept., 1866, he was mustered out of the volunteer service. For gallant conduct in the field he received the successive brevets from major to that of major-general U. S. A. In 1869 he was transferred to the command of the 11th Infantry, and in 1870 to that of the 1st Cavalry. He was conspicuous in the pursuit of the Modoc Indians, which resulted in their capture. D. Dec. 2, 1875. G. C. SIMMONS.

Gilles'pie, county of Western Texas. Area, 925 square miles. The surface is hilly, the valleys narrow, but very fertile. The inhabitants are principally Germans. Grain, wool, fruit, and pork are the chief products. The climate is dry and healthful. Coal, limestone, and iron have been found, but the extent and value of the mineral deposits are not known. Cap. Fredericksburg. Pop. 3566.

Gillespie, post-v. of Macoupin co., Ill., on the Indianapolis and St. Louis R. R., 45 miles E. of E. St. Louis.

Gillespie (WILLIAM MITCHELL), LL.D., b. in New York 1816; graduated at Columbia College 1834; studied in Europe; returned in 1845, and was professor of civil engineering in Union College 1845–68; author of *Rome as Seen by a New Yorker in 1843–44* (1845); *Roads and Railroads* (1845), a work which has passed through many editions; *Philosophy of Mathematics*, after Comte (1851); a treatise on *Land-Surveying* (1855); another on *Levelling, Topography, and the Higher Surveying* (1870). D. at New York Jan. 1, 1868.

Gil'let (RANSOM H.), b. in New Lebanon, N. Y., Jan. 27, 1800; removed first to Saratoga co., and in 1819 to St. Lawrence co., N. Y.; studied law with Silas Wright, and became a lawyer of Ogdensburg, where he was postmaster 1830–33; Democratic member of Congress 1833–37; an Indian commissioner 1837–39; register U. S. treasury 1845–47; solicitor U. S. treasury 1847–49; assistant U. S. attorney-general 1855–58; solicitor of the court of claims 1858–61. Author of a *History of the Democratic Party*, *The Federal Government* (1871), etc. D. Oct. 24, 1876.

Gil'lett, post-tp. of Oconto co., Wis. Pop. 268.

Gillette (ABRAHAM DUNN), b. at Cambridge, N. Y., in 1809; became a Baptist minister; held the pastorate of Calvary church, New York, etc.; author of *Memoir of D. H. Gillette, Pastor's Last Gift*, etc., and became a large contributor to denominational literature.

Gil'leys, tp. of Dale co., Ala. Pop. 400.

Gil'lies (JOHN), LL.D., b. at Brechin, Scotland, Jan. 18, 1747; was educated at Glasgow, where he was some time Greek professor; became historiographer-royal for Scotland in 1793. D. at Clapham, London, Feb. 15, 1836. Author of a *History of Ancient Greece* (1786–1810); published translations from Aristotle, Lysias, and Isocrates, and was author of several other works. Of these his *History* is the only one ever of any value. Its style is faulty, and the works of Grote, Curtius, and other late students have entirely superseded it.

Gil'liflower [Fr. *girofle*, a "clove," alluding to the odor of some kinds; others say *July Flower*], a popular name for the cruciferous plants of the genus *Matthiola*, called also by the general name of stock or stock-gilliflower. They are herbaceous or partly shrubby. All the common kinds are European. *Matthiola annuus* includes the ten-weeks stocks; *Matthiola Græcus*, the Grecian stock; *Matthiola incanus*, the purple gilliflowers, Brompton stocks, etc.; and *Matthiola fenestralis*, the large window stocks. The varieties are many, and several species besides the above are recognized. Considerable skill is required in growing fine stocks, which are favorite flowers in cultivation, especially in Great Britain.

Gil'lis (JAMES H.), U. S. N., b. May 14, 1831, in Pennsylvania; entered the navy as a midshipman Oct. 12, 1848; became a passed midshipman in 1854, a lieutenant in 1855, a lieutenant-commander in 1862, a commander in 1866; commanded the little steamer Hale in Rhind's spirited engagement with a battery of two long 24-pounders on the Dawho River, S. C., and received the commendation of his superior officer for "skilful handling of his vessel" and "effective planting of his shells" in the action. In command of the steamer Commodore Morris (North Atlantic blockading squadron) in 1863 and the first part of 1864, during which period he was actively engaged afloat and ashore. Commanded the iron-clad Milwaukee at the time she was blown up by a torpedo off Spanish Fort, near Mobile, Mar. 28, 1865, from which date until Apr. 8, when the fort surrendered, he was in charge of the naval battery engaged in its reduction. Speaking of this battery, Rear-admiral Thatcher, in his official report of the capture of Fort Alexis and Spanish Fort, says: "These very strong works were heavily bombarded last evening, from five until seven o'clock, by army and navy. Our battery on shore, under command of Lieut.-Com. Gillis, late of the U. S. iron-clad Milwaukee, is highly spoken of by Gen. Canby for its efficiency in the attack." FOXHALL A. PARKER.

Gillis (JOHN P.), U. S. N., b. Sept. 6, 1803, in Wilmington, Del.; entered the navy as a midshipman Dec. 12, 1825; became a passed midshipman in 1831, a lieutenant in 1837, a commander in 1855, a captain in 1862; retired from active service, owing to physical disability, in 1864. Commanded the Monticello at the capture of Forts Hatteras and Clark, and the Seminole in the battle of Port Royal, and was commended by Rear-admiral Dupont, in his official despatch of Nov. 11, 1861, for "zeal and ability."

FOXHALL A. PARKER.

Gil'lis Bluff, tp. of Butler co., Mo. Pop. 203.

Gil'liss (JAMES MELVIN), b. in D. C. in 1810; midshipman U. S. navy 1827, captain 1862; organized one of the first astronomical observatories in the U. S. 1838; organized the naval observatory 1842–45; was put in charge of the national observatory 1861. D. at Washington Feb. 9, 1865. Published a volume of the *American Astronomical Observations* (1843), and a *Report of the U. S. Astronomical Expedition of 1849–52* (2 vols., 1855), besides many scientific papers of importance. He also introduced important improvements in the instruments employed in astronomical work.

Gill'more, tp. of Isabella co., Mich. Pop. 88.

Gillmore (QUINCY ADAMS), b. at Black River, Lorain co., O., Feb. 28, 1825; graduated at West Point at the head of the class of 1849, and entered the army as brevet second lieutenant of engineers; served three years as assistant engineer in construction of the defences of Hampton Roads, Va., returning to West Point in 1852 as instructor of military engineering. In July, 1856, he was promoted to be first lieutenant, and placed in charge of the engineer agency at New York. He was promoted to a captaincy Aug., 1861, and made chief engineer of the Port Royal expedition under Brig.-Gen. T. W. Sherman. After a careful reconnoissance of Fort Pulaski, Ga., Capt. Gillmore reported that he deemed the reduction of that work practicable by batteries of mortars and rifled guns established on Tybee Island, 1 mile distant from the fort; and he was at once placed in command of the troops engaged in the siege. After nearly two months of incessant labor, Fort Pulaski was completely invested and the Savannah River blockaded, and on the evening of Apr. 9, Gen. Gillmore (then acting brigadier-general) issued his order for the bombardment. On the 10th, the commandant of Fort Pulaski having refused to surrender, the bombardment was commenced at 8¼ A. M., continuing with little cessation till 2 P. M. of the 11th, when the white flag was raised from the fort, the surrender being consummated during that afternoon and evening. (See BOMBARDMENT.) In Aug., 1862, Gen. Gillmore was assigned to the command of a division of troops in Kentucky. In Jan., 1863, he was placed in command of the central district of Kentucky, defeating Gen. Pegram at the battle of Somerset, for which service he was brevetted colonel. In June, 1863, he was called to command the department of the South, and in July following the 10th army corps. It was while holding this command that he conducted the operations against Charleston, comprising the descent on Morris Island, the reduction and capture of Fort Wagner, and the bombardment and practical demolition of Fort Sumter from batteries 2 miles distant. The general-in-chief (Halleck), in speaking of this siege, said: "Gen. Gillmore's operations have been characterized by great professional skill and boldness. He has overcome difficulties almost unknown in modern sieges. Indeed, his operations on Morris Island constitute a new era in the science of engineering and gunnery." Transferred to the James River in 1864 in command of 10th army corps, he was engaged (May 13) in the assault in front of Drury's Bluff, and (May 16) at the battle of Drury's Bluff. Summoned to Washington in July, on the approach of Early, he commanded two divisions of the 19th army corps in the defence of that city and subsequent pursuit of Early's command, when he received severe injuries from the fall of his horse. From Nov., 1864, to Feb., 1865, he commanded the department of the South, resigning his volunteer commission Dec., 1865. After serving on various boards he was assigned to his present duty as engineer in charge of fortifications on Staten Island, N. Y., and South Atlantic coast, embracing North Carolina, South Carolina, Georgia, and Florida, being also entrusted with the improvement of Charleston harbor, the Savannah and St. John's rivers. In June, 1863, he was promoted to be major, and Jan., 1874, to be lieutenant-colonel of engineers. For gallant conduct at Morris Island, Forts Wagner and Sumter he was brevetted brigadier-general and major-general U. S. Army. Among his published works are the *Siege and Reduction of Fort Pulaski;*

A Practical Treatise on Limes, Hydraulic Cements, and Mortars; Engineer and Artillery Operations against the Defences of Charleston in 1863; Report on Béton Aggloméré, or Coignet-Béton. G. C. Simmons.

Gillott′ (Joseph), b. in Warwickshire, Eng., 1800; became a knife grinder of Sheffield, and began in early life the manufacture of steel pens at Birmingham in a very small way. But his improvements in steel pens gradually increased their popularity, and his establishment became by far the largest in the world in that line of manufacture. His acquired wealth was great, and he made a famous collection of paintings. D. at Birmingham Jan. 6, 1872.

Gill-over-the-Ground, or **Ground Ivy,** the *Nepeta Glechoma*, a strong-smelling, trailing plant naturalized in the U. S. from Europe, belongs to the Labiatæ. It was formerly used in medicine, chiefly as a domestic remedy for colds, coughs, etc.

Gill′ray (James), b. 1757 at Chelsea, Eng., the son of a pensioner; was a goldsmith's apprentice; ran away with a company of strolling actors; studied art at the Royal Academy; became a good engraver, chiefly distinguished as an unrivalled political caricaturist, in which line of art he produced some 1200 copper-plate etchings. His intemperate habits brought on insanity, and he d. of delirium tremens at London June 1, 1815. (See his *Life and Times* (1873), by T. Wright.)

Gills [Lat. *branchiæ*], the organs of respiration in fishes, batrachian larvæ, insects, crustaceans, mollusks, molluscoids, etc. In Bryozoans and Brachiopods the gills are fringes of tentacles around the mouth. These are hollow, and contain the circulatory fluid, which is aërated through their walls. The Lamellibranchiates are so named from the fact that their gills are thin lamellæ, two of these generally being within the mantle, one on each side of the body. The gills of the Gasteropods are extremely various, and the various groups are named according to the position of the gills. Cephalopods have two gills (Dibranchiata) or four (Tetrabranchiata). In most crustaceans the gills are fringes and expansions of the limbs. In the Decapods they are feather-shaped, and within the abdominal cavity. Many insects have gill-like breathing-organs, either external or internal. Batrachians have temporary fish-like gills, which disappear when the animal enters the adult condition. The gills of the fishes show many remarkable modifications, the object in all being to present a large surface to the external water, the substance of the gill-surfaces being charged with blood, which is kept supplied by gill-arteries, often contractile. (For an enumeration of these modifications see the article Comparative Anatomy.)

Gill's Creek, tp. of Lancaster co., S. C. Pop. 2040.

Gill's Creek, tp. of Franklin co., Va. Pop. 2453.

Gil′man, post-v. of Iroquois co., Ill., at the crossing of the Illinois Central and the Toledo Peoria and Warsaw R. Rs. It is also the N. E. terminus of the Gilman Clinton and Springfield R. R. It has 1 newspaper, 1 opera-house, a library building and a public library, 3 hotels, 2 schools, 2 churches, 1 bank, 2 public fountains flowing artesian water obtained by boring 90 feet; 1 nursery of 600 acres, and 20 small fruit-farms. The town derives its support from small fruit, corn, and cattle. It has fine pasturage and good water. Pop. about 1500. Ed. Rumley, Ed. "Star."

Gilman, post-v. of Marshall co., Ia. It has one weekly newspaper.

Gilman, tp. of Pierce co., Wis. Pop. 503.

Gilman (Arthur), b. in 1837 at Alton, Ill.; educated in New York, and was for a time engaged in business, but removed to Berkshire co., Mass,, where he engaged in literary pursuits and in labors in behalf of education and religious instruction. In 1871 he became editorially connected with the publications of the American Tract Society, Boston. He has contributed much to periodicals, and has published a popular manual of English literature.

Gilman (Caroline), b. in Boston, Mass., Oct. 8, 1794, was the daughter of Samuel Howard and the wife of Rev. Dr. Samuel Gilman (1791–1858). In youth her poems *Jephthah's Rash Vow* and *Jairus's Daughter* attracted much attention. In 1819 she married and removed to Charleston, S. C., and in 1832 began to edit *The Rosebud*, afterwards *The Southern Rose*. She is the author of numerous volumes of prose and verse.—Her daughter, Mrs. C. H. Glover (b. 1823), is also a gifted writer of poems and tales.

Gilman (Chandler Robbins), M. D., b. at Marietta, O., Sept. 6, 1802, received his medical degree at the University of Pennsylvania, his father having removed to Philadelphia several years before. Dr. Gilman for many years practised medicine in New York; was appointed in 1840 professor of obstetrics and diseases of women and children in the College of Physicians and Surgeons, and in 1851 assumed also the chair of medical jurisprudence. He wrote *Legends of a Log Cabin* (1835), *Life on the Lakes*, and a number of professional writings, besides some translations from the German, etc. D. at Middletown, Conn., Sept. 26, 1865.

Gilman (Daniel Coit), b. at Norwich, Conn., July 6, 1831; graduated at Yale in 1852; was superintendent of schools New Haven, Conn., 1856–60; professor of physical and political geography at Yale and college librarian 1856–72; superintendent of schools in Connecticut 1863–65; president of the University of California 1872–75; became in 1875 president of Johns Hopkins University, Baltimore, Md.; author of numerous reports, addresses, scientific, historical, and educational papers, etc.

Gilman (John Taylor), b. at Exeter, N. H., Dec. 19, 1753, joined the Revolutionary army at Cambridge, Mass., 1776; was prominent in State and national affairs; was in Congress 1782–83; treasurer of New Hampshire 1783–92; governor 1794–1805 and 1813–16. He was a strong Federalist. D. at Exeter, N. H., Sept. 1, 1828.

Gilman (Nicholas), a brother of J. T. Gilman (1753–1828), b. about 1762, was sent to Congress from New Hampshire in 1786; was one of the framers of the U. S. Constitution, and was again in Congress 1789–97, and U. S. Senator 1805–14. D. at Philadelphia May 2, 1814.

Gilman (Samuel), D. D., b. at Gloucester, Mass., Feb. 16, 1791; graduated at Harvard in 1811; was a mathematical tutor there 1817–19; pastor of the Unitarian church, Archdale street, Charleston, S. C., 1819–58; and was the author of several volumes of miscellaneous literature and many contributions in prose and verse to periodicals. His best known work is the *Memoirs of a New England Village Choir* (1829). D. at Kingston, Mass., Feb. 9, 1858.

Gil′manton, tp. of Benton co., Minn. Pop. 193.

Gilmanton, post-tp. of Belknap co., N. H., 20 miles N. E. of Concord, has an academy, five churches, and manufactures of farming implements, sash, blinds, etc. P. 1642.

Gilmanton, post-tp. of Buffalo co., Wis. Pop. 715.

Gil′mer, county of the N. of Georgia. Area, about 460 square miles. It is mountainous, and abounds in gold, marble, and iron. Tobacco, wool, and corn are staple products. Cap. Ellijay. Pop. 6644.

Gilmer, county of Central West Virginia. Area, about 230 square miles. Its surface is hilly, but fertile. Iron, salt, and coal are found. Corn and tobacco are staple products. Cap. Glenville. Pop. 4338.

Gilmer, tp. of Adams co., Ill. Pop. 1425.

Gilmer, tp. of Guilford co., N. C. Pop. 2311.

Gilmer, post-v., cap. of Upshur co., Tex., 40 miles W. of Jefferson.

Gilmer (George Rockingham), b. in what is now Oglethorpe co., Ga., Apr. 11, 1790; became a lawyer of Lexington, Ga.; was 1813–18 an officer of the 43d U. S. Infantry, and served against the Creeks; served in the State legislature; was governor of Georgia 1829–31, 1837–39; was in Congress 1821–23, 1827–29, 1833–35; a Presidential elector in 1836 and 1840; trustee of Georgia University for thirty years, and in his will left to it large benefactions. D. at Lexington, Ga., Nov. 15, 1859. Author of *Georgians* (1855), a book containing much valuable information.
A. H. Stephens.

Gilmer (Jeremy Francis), b. in Guilford co. N. C., Feb. 23, 1818; graduated at the U. S. Military Academy, and entered the army as second lieutenant of engineers July, 1839, and continued in the service of the U. S., in the construction of fortifications, surveys, improvements of rivers, etc., till 1861, being then captain of engineers, when he resigned and espoused the Southern cause, being appointed major of engineers C. S. A. Sept., 1861, and served as chief engineer on the staff of Gen. A. S. Johnston until the death of the latter on the field at Shiloh Apr. 6, 1862. In the battle of Shiloh, Gen. Gilmer himself was severely wounded. After his recovery he served a short time with the army of Northern Virginia, being assigned (Aug. 9, 1862) to the office of chief of engineer bureau at Richmond, Va., with the rank of colonel of engineers. This office he continued to fill till the close of the war, although not constantly in Richmond. Promoted to be major-general C. S. A. Aug. 20, 1863, he was ordered temporarily to Charleston, S. C., to direct the defences of that city; returning to Richmond in June, 1864, he resumed charge of the engineer bureau, continuing to perform this duty till the close of the war. In the fall of 1865, Gen. Gilmer was elected a director of the Georgia Central R. R., afterwards president *pro tem.*; in 1866 elected president of the Savannah Gas-Light Co., which office, together with that of director Georgia Central R. R., he now holds. G. C. Simmons.

Gilmer (John A.), b. in Guilford co., N. C., Nov. 4,

1805; was member of the State senate from 1846 to 1856; was then member of the 35th and 36th Congresses; from the latter he withdrew in 1861; was delegate to the national Union convention at Philadelphia in 1866. D. May 4, 1868. A. H. STEPHENS.

Gilmer (THOMAS WALKER), a native of Virginia; was often a member of the house of delegates, of which he was Speaker; held many positions of high character, was governor in 1840; and was member of Congress from 1841 to 1843, when he was appointed secretary of the navy by Pres. Tyler; was in this office when killed by the accident on the U. S. steamer Princeton, Feb. 28, 1844. A. H. STEPHENS.

Gil'more, post-tp. of Benzie co., Mich., on Lake Michigan. Pop. 169.

Gilmore, post-v. of Tuscarawas co., O. Pop. 133.

Gilmore, tp. of Greene co., Pa. Pop. 703.

Gilmore, tp. of Jackson co., W. Va. Pop. 2169.

Gilmore (JOHN R.), b. at Boston, Mass., in 1823; received a mercantile education; became the head of a successful shipping-firm in New York in the Southern coastwise trade; retired from business 1857; was one of the founders of the *Continental Monthly;* wrote much under the name of "Edmund Kirke;" author of *Among the Pines, My Southern Friends, Down in Tennessee, On the Border, Life of Jesus, Among the Guerrillas,* and other works, besides copious contributions in prose and verse to periodical literature.

Gilmore (JOHN TAYLOR), M. D., b. Dec. 7, 1835, in Lowndes co., Miss.; took the degree of A. M. at the University of North Carolina 1856; studied medicine under Prof. Thomas of New York City, and graduated M. D. in the Jefferson Medical College, Philadelphia, 1858; entered the Confederate army as surgeon to Barksdale's famous Mississippi regiment; was soon advanced to brigade, then to division surgeon; and at the close of the war was in charge of hospitals at Greenville, S. C. He became professor of anatomy in Mobile (Ala.) Medical College in 1868, and in 1871 was transferred to that of surgery. D. in 1875. PAUL F. EVE.

Gilmore (JOSEPH ALBREE), b. in Weston, Vt., June 10, 1811; d. in Concord, N. H., Apr. 17, 1867. Went to Boston at a very early age, and engaged in mercantile pursuits; removed to Concord, N. H., in 1843, and continued in the same business for a time, but subsequently became superintendent of the Concord and Claremont, Manchester and Lawrence, Concord, Concord and Portsmouth, and other railroads; member of the State senate 1858–59; president of that body 1859; governor of New Hampshire 1863–65.

Gilmore (JOSEPH HENRY), b. at Boston, Mass., Apr. 29, 1834; graduated at Brown University 1858; studied theology at Newton Seminary, where he was instructor in Hebrew 1861–62; held pastorates of Baptist churches at Fisherville, N. H., and Rochester, N. Y., and became in 1868 professor of logic in Rochester University.

Gilo'lo, or **Halmahe'ra,** an island in the Malay Archipelago, belonging to the Moluccas or Spice Islands, and situated on the equator in lon. 128° E. It is separated from Celebes, which it resembles somewhat in shape, by the Molucca Passage, from Ceram by Pitt's Passage, and from New Guinea by the Gilolo Channel. It is mountainous, densely wooded, very fertile, and produces spices and fruits, horses and cattle, gold-dust and pearls. Edible birds' nests are one of its exports. Its area is estimated at 6500 square miles.

Gil'pen's, tp. of Fayette co., Ala. Pop. 411.

Gil'pin, the smallest, but one of the most prosperous of the counties of Colorado. Area, 150 square miles. It abounds in mineral wealth. Gold-mining is the chief industry. It is mountainous, and is traversed by the Colorado Central R. R. Cap. Central City. Pop. 5490.

Gilpin (BERNARD), "Apostle of the North" of England, b. at Kentmire, Westmoreland, in 1517, was a nephew of Tonstall, and was patronized by Wolsey; educated at Queen's College, Oxford, he was converted to Protestantism by discussions with Hooper and Peter Martyr; was protected during Mary's reign by Tonstall, and afterwards became rector of Houghton-le-Spring, archdeacon of Durham, and itinerant preacher in the Debatable Land; was famous for laborious benevolence, for large hospitality, and for beneficence towards poor students. D. Mar. 4, 1583. His *Life,* by Bishop Carleton, is an English classic. (See also *Life* by W. GILPIN.)

Gilpin (CHARLES), M. P., b. in Bristol, England, in 1815. He came from a Quaker family, and during his life remained attached to the Society of Friends; brought up to trade, he became, in the course of time, a man of wealth. He served for some years as a member of the common council of London, and during that period succeeded in abolishing street-tolls in the metropolis. In 1852 he was a candidate for Parliament from Perth, but was defeated; but in 1857 was elected in the Liberal interest for Northampton, and retained the representation of that borough in the House of Commons up to his decease. In 1859 he was appointed by Lord Palmerston secretary to the poor-law board, which position he resigned in 1865. Outside of his legislative position, Mr. Gilpin held many private offices of trust—viz. chairman of the National Freehold Land Society, director of the South-eastern Railway and of the National Provident Institution; also chairman of the Metropolitan and Provincial Bank. D. Sept. 9, 1874. G. C. SIMMONS.

Gil'roy, a city and tp. of Santa Clara co., Cal., on the line of the Southern Pacific R. R., 80 miles from San Francisco and 30 miles from San José, the county-seat. It contains 6 churches, a fine public school, 3 private schools, 1 newspaper, a flour-mill, a tobacco and cigar factory, 2 hotels, 1 bank, and the usual number of stores, etc. Water works supply the city with good water, and the town is lighted with gas. It is the second city in size in Santa Clara co., and the streets are wide, macadamized, and clean. It has a municipal government and 3 fire companies. Farming is the principal business, although dairying is quite extensively carried on. Tobacco is beginning to be extensively cultivated and cured by a patent process, which makes it equal to the best Havana. Pop. of city, 1625; of tp. 3195. H. COFFIN, ED. "ADVOCATE."

Gil'sum, post-tp. of Cheshire co., N. H., has manufactures of lumber, woollens, wooden ware, etc. It is 50 miles S. W. of Concord. Pop. 590.

Gilt-head, a name given to numerous fishes (Sparidæ) of the genus *Chrysophrys,* especially to the *Chrysophrys*

The Gilt-head.

aurata of the European and African coasts, and the *Chrysophrys aculeata* of the North American Atlantic waters. The former is very highly prized for the table. The name is given to several other marine fishes.

Gil Vicen'te, best of Portuguese dramatists, called "the Portuguese Plautus," was b. probably in Barcellos in 1485; became an actor, and was patronized by John III. Author of many comedies, tragedies, farces, and Christmas pieces. D. in 1557. He was one of the fathers of the modern drama. A good edition of his works is that published at Hamburg in 1834.

Gim'bals, pairs of brass or copper rings in which are mounted a ship's compasses, chronometers, or barometers. One of the rings turns on a horizontal axis; the second ring, within the first, turns upon an axis at right angles with that of the first. The object is to keep the instrument right side up in spite of the pitching and rolling of the ship. To this end the instrument is weighted heavily. The object is attained in a very satisfactory, though by no means perfect, manner.

Gin, or **Gene'va** [Fr. *genièvre,* D. *jenever,* "juniper-berry"], an alcoholic spirit distilled from grain and flavored with the volatile oil of juniper. A principal seat of its manufacture is Schiedam in the Netherlands, which has some 220 gin-distilleries, and hence the liquor sometimes bears the names of Hollands and Schiedam schnapps. One part by measure of barley-malt and two parts of the best rye are usually mashed together for gin, but buckwheat and other grains have a limited use. The mashing (at 165° F.) lasts until the grains are brought to a smooth paste, when, after resting the process two hours, the whole mash is cooled to 80° by adding the spent wash of a former distillation till the worts show 33 by Dicas' hydrometer. Good yeast is added, and the grains and worts ferment for two or three days. Grains and all ("whole worts") are then put into the still, and the low wines are taken off, which are very weak. These are then redistilled with about a pound of juniper-berries to every fifty gallons of low wines; a little

salt and a pugil of hops may be added. The resulting liquor is gin. It commonly stands about 17° below proof, and before it reaches the consumer its proof is still farther lowered. Ordinary British and American gin is made by rectifying corn-whisky with a little oil of juniper or oil of turpentine, while coriander, grains of paradise, orange-peel, etc. still further improve or modify the flavor. Gin is also made in Great Britain from a mash of malt, rye, and potatoes, and rectified with oil of turpentine. The oil of juniper or of turpentine present gives gin a diuretic quality which causes it to have a great popular reputation for the cure of diseases of the kidneys. It has also a limited use in regular practice, but is not officinal in the U. S. or Great Britain. Gin is a very popular stimulant in England. There is no question but that the abuse of gin in supposed kidney disease is a fruitful cause of diseases of the kind it is intended to cure; and the so-called cirrhosis of the liver ("gin drinker's liver"), and the consequent ascites or dropsy of the abdomen, are often produced by it.

Gin'ger [Gr. ζιγγίβερις; Lat. *zingiber*; Sans. *sringavêra*, "horn shaped"], the prepared rhizome of *Zingiber officinale* (order Zingiberaceæ), a plant native to India and Southern China, now extensively cultivated in tropical America and West Africa, as well as in its native lands. The plant has a biennial or perennial, creeping, somewhat tuberous root-stock, which is the part employed. This may be dug when the plant is one year old, and must soon be scalded to prevent sprouting. If it now be at once dried, it constitutes the *black* ginger of commerce, but if it be decorticated also, it is called *white* ginger, of which that from Jamaica has the best reputation. Bleaching is sometimes employed to bring the scraped root to the proper whiteness. Calcutta exports the principal part of the ginger of commerce. Canton supplies much preserved ginger-root, which is boiled, and then cured with sugar. The West African colonies ship considerable quantities of ginger. Ginger is used as a flavoring for food and medicines, and has valuable stimulant and carminative properties. Good ginger affords 5 per cent. of an oleo-resin (the piperoid of ginger of Beral), which possesses all its active properties, for the residuum is inert. A volatile oil and several resinoids are believed to be combined in the oleo-resin. Ginger in the root (before grinding) is known as race-ginger (*radix*, a "root"). Ginger generally reaches the consumer in the powdered state, and is liable to very considerable adulteration.

Ging'ham [a name of East Indian origin], a cotton fabric woven from colored yarn, either plain or in checks or figures. Ginghams were originally made in Asia by hand, but are now made very extensively in Europe and the U. S. by power-machinery. Great Britain is the principal seat of the manufacture, but it is also carried on successfully in the U. S.

Ging'ko Tree, a large tree of China and Japan, the *Salisburia adiantifolia* (order Coniferæ, sub-order Taxineæ), now rather common in Europe and the U. S. It is very remarkable for having wide flat leaves, a character possessed by very few trees of the order. They resemble those of the maiden-hair ferns, whence the specific name. It is prized for its excellent timber, which resembles that of pine. Leaves of extinct species of this genus are obtained in the Eocene of the U. S. and British America.

Gin'gras, county in the N. of Dakota. Area, 1512 square miles. The Rivière au Jacques, or Dakota River, rises here, and a fork of the Cheyenne traverses the N. W. portion.

Ginguené (PIERRE LOUIS), b. at Rennes, France, Apr. 25, 1748; entered the public service at Paris 1778; was imprisoned by the Jacobins 1793–94; was chosen to the Institute in 1796; minister at Turin 1798. D. at Paris Nov. 16, 1816. Author of poems, reviews, and a great amount of miscellaneous writing; chiefly remembered for his *Histoire littéraire d'Italie* (9 vols., 1811–19), a work of high value.

Gin'seng [Chinese], the root of the *Aralia (Panax) Ginseng* of Asia, and of the *Aralia quinquefolia* of the U. S. These two plants resemble each other very much, and are perhaps identical. The root is exported from the U. S. to China, where it is highly prized as a medicine, though less esteemed than Asiatic ginseng. The prices it formerly brought were very high. It has a pleasant aromatic taste, but its medicinal qualities are not important. Ohio, Minnesota, and West Virginia chiefly export it.

Giober'ti (VINCENZO), a distinguished Italian philosopher and statesman, the prophet of the uprising of Italy, as was Mazzini its apostle: b. in Turin Apr. 5, 1801. Left an orphan in his boyhood, he was early trained to loneliness and want, and in his later years he used to say with David, "Pauper sum ego et in laboribus a juventute mea." And indeed he lived poor and died poor. At sixteen, having already decided upon the clerical profession, Gioberti obtained a place in the ecclesiastical household of the king of Sardinia. He became an earnest student of the Bible, of ecclesiastical history, and of the Latin and Italian classics, reading at the same time contemporaneous works with great avidity. Even then it was his habit to annotate the books he read, and after a third perusal to make copious extracts and summaries. When only eighteen he had already planned a work to be entitled *Della Scelleratezze dei pontifici*, for the purpose of showing that all the misdeeds of the popes had resulted from their temporal power, and all their virtues from their reverence of gospel precepts. The varied reading of Gioberti soon rendered his mind almost encyclopædic, and at the same time quick, elastic, and apt at everything, preparing him also for a tolerant and amiable writer. In 1823, Gioberti was made doctor of divinity, and two years later he took sacerdotal orders. His dissertations, *De Deo et religione naturali* and *De Christiana religione et theologicis virtutibus*, secured him the chair of theology in the University of Turin. In 1828 he went into Lombardy, where he made the acquaintance of Manzoni; and into Central Italy, where he became the friend of Giacomo Leopardi, who predicted great things of the young philosopher. In 1830 the work of Rosmini concerning *L'origine delle idée* was published at Rome, and Gioberti was the first to study, teach, and circulate it. He now gathered about him certain young priests and other ardent juvenile students, whom he endeavored, through the philosophic teachings of Pasquale Galuppi, to lead to free and independent habits of thought. Instigated by the Jesuits, the eyes of the police were soon upon him. Having received, as court-chaplain, a first admonition from the abbot of Bricherasio, Gioberti, feeling his dignity wounded and desirous of greater freedom, resigned his office. Twenty days after, while walking and philosophizing with some of his friends, he was arrested (May 31, 1833), was detained in prison four months, and then sent into banishment. His name was also cancelled from the list of doctors of the university on the charge of his being (*like Socrates*) *a corrupter of youth*.

Gioberti went to Paris, where he devoted himself entirely to the study of philosophy, and formed a friendship with his fellow-exiles, Carlo Botta, Pellegrino Rossi, Guglielmo Libri, Terenzio Mamiani, etc. Mazzini attempted to draw him to his own party, and reproached him for his independent attitude, but Gioberti, averse to *societies* and conspiracies, preferred to keep his freedom of action intact. After fifteen months in Paris he went to Brussels to teach philosophy in a private institution. There also he had the society of other distinguished refugees, and there he began the publication of his *Teorica del Soprannaturale*, dedicated to the Piedmontese Paolo Pallia, his companion in study, who died in exile, "victim of the cruel severity of an Italian prince." These words caused the work to be prohibited in Piedmont. Then followed the publication of the *Introduzione allo studio della Filosofia*, undoubtedly his greatest philosophical work. In 1842, Gioberti was offered the chair of philosophy in the University of Pisa, but the intrigues of a *Sanfedista* minister of the court of Sardinia rendered his election impossible. In 1843 his most popular work, entitled *Del primato morale e civile degli Italiani*, appeared at Brussels. This work, dedicated to Pellico, was a trumpet-call. Somewhat emphatic in style and exaggerated in sentiment, its object was to magnify the civil and national power of the papacy in Italy. The clergy were roused by it, and began to take part in the agitation in favor of Italian independence. The whole idea of the book was certainly utopian, but it kindled a zeal for the cause of Italy in many hearts before indifferent, and this enthusiasm hastened the fortunate crisis. The *Primato* was followed by *I Prolegomeni*, a still bolder work, in which he was very careful to distinguish between the Jesuits and the rest of the clergy, and earnestly insisted that the liberators of Italy should be the Italians themselves. The Jesuits were prompt to attack him, and he defended himself triumphantly in a work called *Il Gesuita Moderno*, which was the chief instrument in driving out the Jesuits from Piedmont, while it revealed the great polemic ability of Gioberti. One month after the glorious "five days" of Milan, and after fifteen years of exile, Gioberti, already proclaimed a prophet throughout Italy, left Paris for Turin, where he was most enthusiastically received. From thence he made a triumphal journey through Lombardy and Tuscany to Rome—where Pope Pius IX was beginning to be alarmed by the uprising of Italy—and there preached the necessity of a Guelph confederacy of Italian princes, with the pope at their head. Wherever Gioberti appeared he was received with acclamations of joy. The Subalpine Parliament having opened, he was elected president of the chambers, and he and Collegno were afterwards named presidents of the

new ministry. After the defeat of Custozza (1848) the ministry was obliged to resign, and was succeeded by the Revel cabinet. This again having fallen, Gioberti was recalled, and he selected, from among the deputies of the opposition, Rattazzi as a colleague. It was this ministry that in the spring of 1849 advised the resumption of hostilities which were to end in the disaster of Novara. After that discomfiture the ministry of Pinelli was formed, and Gioberti was sent to Paris, as minister, to secure the good offices of French diplomacy in the negotiations for peace with Austria. He could obtain nothing, but, once there, he remained, and, although broken in health and crushed in spirit, he sought comfort in his studies. He wrote at that time his beautiful book, *Del Rinnovamento civile d'Italia,* in which he prophesied the greatness of Cavour; and he prepared his *Protologia,* published after his death, which occurred in Paris Oct. 25, 1852. On his bed were found two open volumes—the *Imitation of Christ* and *I Promessi Sposi.* His body reposes in the Campo Santo at Turin, where a monument has been erected to him by that city. The posthumous works of Gioberti have been published by Giuseppe Massari, who is also the author of *Studii sopra Gioberti.* F. A. P. BARNARD.

Gioj'a del Col'le, a handsome and wealthy commercial town of Italy, in the province of Bari, about halfway between Bari and Taranto. It is believed to have been founded in the sixth century, and in its neighborhood, especially at Monte Sannace and Santa Sophia, ancient vases of great value, as well as Greco-Roman coins, have been found. Pop. 13,094.

Giojo'sa, town of Southern Italy, province of Catanzaro, near the railway from Taranto to Reggio, and near the site of the ancient *Locri Epizephyrii.* Pop. 6899.—Another Giojosa is on the N. coast of Sicily. Pop. 4624.

Giorda'ni (PIETRO), b. at Piacenza in 1774; d. at Parma 1848. He left the Benedictines—which order he had joined in early youth to please his parents—and accepted at first civil employment, and afterwards a literary professorship at Bologna. Cardinal Gonsalvi deprived him of his office as secretary of the Academy of Fine Arts on account of his liberal opinions, and he afterwards suffered bitter persecution in Florence, in Piacenza, and in Parma, where he died, and where, in spite of the presence of the Austrians, his obsequies were magnificently celebrated. Giordani is regarded as the father of Italian epigraphy, and as the best prose-writer of his day, although he wrote no extensive work, but confined himself rather to inscriptions, eulogies, critical articles, etc. Gussali, in his edition of Giordani's most valuable *Epistolario,* has prefixed to the first volume a full life of the author. Giordani was the friend of almost all the distinguished scholars of his time, and it will be a lasting honor to him that he was the first to discover and encourage the wonderful genius of Giacomo Leopardi.

Giorda'no (LUCA), b. in 1632, became a famous painter, distinguished for the variety of his styles and the surprising amount of his work, which brought him wealth and fame. His works are very numerous, and of unequal merit. He had undoubted genius. His etchings are very spirited, and are of masterly execution. D. at Naples Jan. 12, 1705.

Giorgio'ne (GIORGIO BARBARELLI), called GIORGIONE, or "the big," from his great stature and noble aspect, an Italian artist, b. at Castelfranco about 1477, the same year with Titian, with whom he was a fellow-student in the school of Giovanni Bellini in Venice. Being gifted with original powers, he early departed from the traditions of the school, and, aided by the study of Leonardo da Vinci, acquired a freedom and breadth of treatment and a richness of color till then unknown in art. Much of his work was done in fresco on walls and façades, and consequently perished from time and weather. The panel-painting at which he was much employed was remarkable for warmth of tone. A tendency to realism, or the painting of objects as they were, will account perhaps for his preference of portrait-painting to historical or sacred subjects, and for his superiority therein. His portraits rank with the work of the greatest masters. The genuineness of pictures ascribed to Giorgione has been so much discussed that but few pieces can be mentioned as unquestionably his. One of undoubted genuineness, and of great beauty, *The Concert,* in the Pitti Palace at Florence, is a fine example of his best style. The galleries of Dresden, Vienna, Milan, and Venice contain pieces from his hand. His own portrait of himself, one of his finest, is in the gallery at Munich. Giorgione passed his life in Venice, and d. there in 1511, at the age of thirty-four—some say of the plague, others say of mental despondency and a broken heart, produced by the desertion of his mistress and the faithlessness of his friend. O. B. FROTHINGHAM.

Giotti'no (TOMMASO DI STEFANO), a painter and sculptor, b. in 1324; d. 1356; surnamed GIOTTINO from his devoted study of Giotto's works. He has left heads so like those of his great prototype as to create disputes among critics. An early death cut short his promising career. (See HORNER'S *Walks in Florence.*)

Giot'to, di (BORDONE), an eminent Italian painter, sculptor, and architect, b. at Vespignano in 1276; d. in 1336. He was a shepherd, and was discovered by Cimabue drawing figures on stones. To Cimabue he owed his introduction to art and his earliest instruction, but to his own genius was due his success. In composition, design, and color Giotto was a master and a creator. His works, which are very numerous, are found in all the chief galleries of Italy, but the most admired are in Padua, Bologna, and Florence. The beautiful bell-tower of the S. Maria del Fiore was his design, and in part his work. He died before it was finished, but left complete models of the whole, which, however, were departed from in the spire alone. The main structure in its details is his, and is regarded as a gem of the building art. The hand of the sculptor is seen in the decorations. Much of Giotto's work was in fresco. Of his oil-paintings, his crucifixions have a celebrity aside from their artistic execution, as inaugurating a new method of treating that painful subject by transferring the agony from the coarse muscles of the frame to the head and face, and spiritualizing the expression of suffering. His greatest work, on the whole, is in the S. Maria dell' Arena at Padua, the walls and vaults of which he covered with paintings representing the history of Christ and the Virgin, with the *Last Judgment* at the entrance. In the S. Francesco at Assisi is another great series. The large mosaic at the porch of St. Peter's at Rome, representing the ship on the stormy sea, was executed after his designs. The genius of Giotto was felt throughout Italy from Venice to Naples; the Italian art of his age felt in every department the influence of his commanding mind. Taddeo Gaddi, Spinello Aretino, and Niccolò da Pietro were his most famous pupils, but innumerable compositions in chapel and sacristy show how deep a mark he made on his time. Giotto was a contemporary and personal friend of Dante; his portrait of the great poet, on the wall of the palace of the Podestà in Florence, though defaced by time and marred by restorers, is still recognizable as a masterpiece. O. B. FROTHINGHAM.

Giovina'zzo, a rich commercial town of Italy, in the province of Bari, on the Adriatic. This city is very ancient, and the seaward portion of the wall, with which Trajan surrounded it, is still standing. It suffered severely during the wars of the Middle Ages. Pop. 9108.

Giraffe [Fr., from the Arabic-Egyptian *zorafeh,* "long-neck"], or **Camel'opard** [Lat. *camelopardalis,* the "camel-pard," because it was fancied to combine the characters of the camel with the spots of the panther or pard], the *Camelopardalis giraffa,* a ruminant mammal of Africa, whose habitat extends from the Cape of Good Hope almost to Egypt. It is the only species of its genus or of the family Giraffidæ. The shortness of its body, the length of its legs, the slope of its dorsal line, the excessive length of its neck, and the persistent, bony horns covered with skin, the extensile tongue, are all remarkable characteristics. The giraffe feeds chiefly upon the leaves of trees. It is gentle and inoffensive, but when it feels so disposed will kick dangerously. It runs with an awkward amble, and is not very swift. The greatest height reported is about eighteen feet, so that it is the tallest living animal. It is hunted for its skin, which makes good leather. The flesh of the young giraffe is very palatable.

Girard', tp. of Russell co., Ala. The village is pleasantly situated on the Chattahoochee, opposite Columbus, Ga., with which it is connected by a fine bridge. It is the N. W. terminus of the Mobile and Girard R. R., and is connected with Opelika by the Columbus and West Point R. R. Pop. 3984.

Girard, post-v. of Macoupin co., Ill., on the Chicago Alton and St. Louis R. R., 13 miles N. by E. of Carlinville.

Girard, post-v., cap. of Crawford co., Kan., 126 miles S. of Kansas City, on the Missouri River Fort Scott and Gulf R. R. It has a savings bank, a grain-elevator, a grist-mill, 2 weekly newspapers, 2 hotels, 5 churches, and about 30 stores and shops. Trade supported principally by farmers, stock-raisers, and dairymen. Pop. about 980.

EDS. "GIRARD PRESS."

Girard, post-tp. of Branch co., Mich. Pop. 1230.

Girard, tp. of Clearfield co., Pa. Pop. 490.

Girard, post-b. and tp. of Erie co., Pa., $1\frac{1}{2}$ miles from the Lake Shore and Michigan Southern R. R., in a belt of very rich farming land. It has a national bank, a broker's office, 25 stores, 1 newspaper, 5 churches, excellent graded schools, a wrench-factory, a furniture-factory, planing-mill, etc. Pop. of b. 704; of tp. 2018.

JACOB BENDER, ED. "COSMOPOLITE."

Girard (CHARLES), b. at Mulhouse (Mühlhausen), Alsace, in 1822; became Agassiz's pupil; attended him to America (1846); became a resident of Washington, D. C., 1850. Author of reports, memoirs, and papers, chiefly upon fishes and serpents, published by the Smithsonian Institution, in the government reports of scientific expeditions, etc.

Girard (STEPHEN), b. near Bordeaux, France, May 21, 1750; became a sailor, and before the Revolution engaged as the master of vessels in the American coasting and West India trade; and during the Revolution was a grocer, sutler, and liquor seller in and near Philadelphia, where he had already married and separated from his wife. He was again in the West India and coastwise trade in successful partnership with John, his brother, in 1780–90; gained money by receiving valuables from the Haytian planters during the insurrection (1791–1804), for much of this property was never called for; and by leasing property in Philadelphia when business was dull at low rates, and then renting at high rates in times of industrial activity. In 1812 he became a private banker, and was later a director of the second U. S. bank. He was for years by far the wealthiest man in the U. S. He was very eccentric in his habits, a free thinker, ungracious in manner, ill-tempered, and lived and died without a friend; but was always a liberal benefactor of the public charities, and even of churches, which he despised. During several yellow-fever seasons in Philadelphia no citizen was more active in relieving distress by free expenditure of money or by personal care of the sick; and at his death nearly all his estate was bequeathed to various charitable and municipal institutions of Philadelphia and New Orleans, and to the founding of the Girard College for orphan boys. D. at Philadelphia Dec. 26, 1831.

Girard' Col'lege, at Philadelphia, Pa., was founded by the bequest of more than $2,000,000, left by Stephen Girard, for the benefit of poor white male orphans, who are admitted between the ages of six and ten, and, according to the will of the founder, are to be apprenticed to some industrial occupation when between the ages of fourteen and eighteen. The buildings are situated 2 miles N. W. of the old State-house, in a fine enclosure of 41 acres. The principal building (169 feet long, 111 feet wide, and 97 feet high, with fine Corinthian columns each 55 feet high) is by far the best specimen of Greek architecture in America. It is built mainly of white marble, with no inflammable material, as nearly as possible in accordance with the minute directions left by Mr. Girard, according to whose will no minister or ecclesiastic of any sect or Church is allowed to visit the premises on any pretext, or to have any connection with the institution. The construction of the buildings was commenced in 1833, and finished in 1848. The greater part of the bequest would have been absorbed in the construction but for this delay in opening the establishment. It now accommodates some 500 boys, who are supported and educated by the institution.

Girardin, de (ÉMILE), b. in Paris June 22, 1806, natural son of the count de Girardin: entered upon journalism as conductor of *Le Voleur*, a periodical compiled from other journals, and *La Mode*, a fashion paper. His *Journal des Connaissances utiles* and *Journal des Instituteurs* won great success from their exceeding cheapness. He also was very influential in establishing savings banks and in issuing cheap and good literature and maps for the people. He was concerned also in *Le Musée des Familles*, *Le Journal des Gardes Nationales*, and *Le Gastronome*, a highly successful journal treating of food and cookery. His great distinction, however, was gained as conductor of the *Presse*, a cheap daily, which he edited most of the time from 1836 to 1856. This journal made him one of the great political powers of France. In 1848 he persuaded Louis Philippe to abdicate. Under Napoleon III. he was a vigorous member of the opposition, but in 1870 he was made a senator, although the decree to that effect was never published. He was (1866–70) editor and owner of *La Liberté*, and in 1872 became connected with the *Journal Officiel*. Among his published works are many political brochures; *Questions de mon temps* (12 vols., 1858, compiled from his political editorials); *L'Homme et la femme* (1872); and *Du droit de punir* (1871). De Girardin has never been constant to any political principle except hostility to Great Britain and friendship for Russia. His first wife, DELPHINE (b. Jan. 26, 1804; d. June 29, 1855), was a daughter of the novelist Sophie Gay (1776–1852); married M. de Girardin in 1831; was a very talented poet, and author of many clever novels and highly successful plays, besides political essays and effective literary criticisms. Her *salon* was one of the social and political centres of Paris. Her beauty, cleverness, and charming manners contributed much to her husband's success.

Girardin (JEAN PIERRE LOUIS), b. at Paris Nov. 16, 1803; was chemical professor at Rouen 1838–58, and since then in other French towns. Author of numerous handbooks of science for popular use, besides *Leçons de chimie élémentaire* (1835), *Mélanges de agriculture, etc., et des sciences physiques appliqués* (1852), and other works.

Girardin (SAINT MARC), generally called MARC GIRARDIN, one of the most celebrated and one of the noblest representatives of that singular class of people which modern civilization has created and designated with the somewhat vague title of *littérateurs*, was b. at Paris Feb. 12, 1801. He studied at first law; wrote in 1827 an article in the *Journal des Débats*, which made a great sensation, and after that time participated in politics, both as a journalist and as a member of the legislative assembly. He was not a politician, however. Very early he turned from the study of law to that of literature and philosophy. In 1822 he received a prize from the Academy for a paper on Lesage, in 1827 another for a paper on Bossuet, and in 1828 a third for his *Tableau de la littérature française au xvi. siècle*; in 1844 he became a member of the Academy. He was, nevertheless, not exactly an author. In 1831 he succeeded Guizot as professor in history at the Sorbonne, which chair he changed in 1834 for that of French literature and poetry; and for more than thirty years he delivered his lectures, often to an audience of 3000 or 4000 people. He also took a great interest in all questions concerning education, travelled through Germany to make himself acquainted with its schools, and filled at different times different positions in the ministry of public instruction. Yet he was not a teacher. In the newspaper and in the legislative assembly, in the Academy and in the committee-room, in his books and before the audience, he was always only a *littérateur*—that is, a man who interests himself more for the application of science than for its progress, unlike the scientific man; more for the educational power of literature than for its internal development, unlike the author; more for the elevating and harmonizing influence of art than for its ideal perfection, unlike the artist; and who, utterly unlike the teacher, takes people as they are, grieving with them when they are sorrowful and laughing with them when they are merry. His acquirements were enormous. He was thoroughly familiar with all the prominent languages and literatures; in philosophy he was one of the first, and one of the very few Frenchmen who ever understood Hegel; in history nothing was foreign, in science nothing was strange to him. His talent, great by nature and perfect by training, was that of comparative criticism. He would choose a certain subject—for instance, maternal love—and then run through all periods of all literatures, showing how maternal love has been represented by different nations and in different ages; and thus he would rise from a penetrating analysis of the various phenomena to an elevated and powerful conception of the idea. On this plan is written his principal work, *Cours de littérature dramatique* (5 vols., 1843–68). In 1869 he retired from his chair at the Sorbonne, but continued as editor of the *Journal des Savants*. D. Apr. 11, 1873.

CLEMENS PETERSEN.

Giraso'le [It., "sun-turning," because its finest tints appear only in a strong light], a precious stone of various colors and qualities, but all distinguished by a strong, deep reflected light. The fire-opal and quartz resinite are among its varieties. Fine specimens bring very high prices. This stone is found in many countries, but good specimens are rare. The same name is given to several other minerals which afford bright tints in a strong sunlight.

Gir'dle of Ve'nus, the *Cestus Veneris*, an acaleph of the order Ctenophoræ, family Beroidæ. It is found in the

Girdle of Venus.

Mediterranean, and is often five feet long by two feet wide; the breadth, however, typically representing the length of most other organisms. It is of a very delicate structure, moves with a graceful, waving motion, and is one of the most beautiful of natural objects when seen in the water. By night it often seems a band of fire. Its mouth is seen about midway of its length. It was named from the *cestus* or zone of Venus, which had the power of compelling all beholders to love the wearer of it.

Gird'letree Hill, post-v. of Worcester co., Md. P. 74.

Gir'geh, or **Geer'geh** [from *Girgis*, or *George*, the patron saint of the Coptic Church], an Egyptian town, of Christian origin, on the W. bank of the Nile, about 108 miles below Thebes and 12 miles from the ruins of Abydus. It was formerly the capital of Upper Egypt, and a town of fine appearance, with its palm trees, eight minarets, and Roman Catholic monastery (the oldest in Egypt), standing about a quarter of a mile from the river. The Nile is now rapidly washing it away. Pop. about 10,000.

R. D. Hitchcock.

Girgen'ti, province of Sicily, on the south-western coast. Area, 1377 square miles. Pop. 289,018. It is mountainous, but extremely fertile, and produces corn, oil, wine, salt, and sulphur in great abundance.

Girgenti [Lat. *Agrigentum;* Gr. Ἀκράγας], a maritime town of Sicily, in the province of Girgenti, in lat. 37° 17′ N., lon. 13° 28′ E. It was founded 584 B. C. by a Greek colony from Gela, at the foot of an older acropolis called Camicus. Through commerce with Carthage the new colony grew rapidly rich and powerful, though later it suffered greatly from wars with that city. In the days of its greatest prosperity Agrigentum contained 200,000 inhabitants within its walls, and including suburbs the population is said to have reached 800,000. The government, though sometimes in the hands of a tyrant, was generally free and independent till the time of the Punic wars, when the city became a Roman possession, and soon began to decline. In A. D. 826 it was taken by the Saracens, who held it nearly 300 years, since which time it has shared the changing fortunes of the island. Girgenti stands on a high, steep rock, commanding a glorious view of the Mediterranean, and overlooking rich olive-slopes and luxuriant gardens and vineyards, while, conspicuous everywhere, rise the vast temples, more or less in ruins, which bear such splendid witness to its former greatness. Among these are the temple of Concord, a beautiful Doric structure, and one of the best preserved of all the ancient temples; the temple of Juno, also in partial preservation; and the temple of Jupiter Olympius, the largest in Sicily, and still imposing in its ruins. Other striking remains of temples, towers, and tombs are seen on every side, and not a few precious objects of art, such as carved gems, etc., have been found in the vicinity. Notwithstanding its advantages of climate, soil, and situation, this town, though containing a very considerable population, was too miserable a few years since to shelter the traveller comfortably, even for a night. At present there are signs of returning life. In 1865 water was brought, by an expensive aqueduct, to the highest part of the town; elementary and normal schools have been established; its exports of oil, soda, sulphur, and fruit are on the increase; and works are now in progress for improving the harbor, which, though not good, is the most available on the southern coast of Sicily. Pop. 20,646.

Geo. P. Marsh.

Gironde, department of France, situated around the estuary of the Gironde, formed by the confluence of the Garonne and the Dordogne. Its western part is low and flat, consisting of lagoons and sand-dunes planted with pine forests; it is generally called *Les Landes.* The eastern part is hilly and calcareous, and produces the finest claret wines — 44,000,000 gallons annually. Area, 3714 square miles. Pop. 701,855.

Giron'dists [Fr. *Girondins*, from the Gironde, whence several of their leaders came], the conservative republican party of the French legislative assembly from Oct., 1791, to Oct., 1793. When the assembly was at first organized, the future Girondists, who were cultivated men, full of admiration for the spirit of ancient Grecian liberty, proposed severe measures against the priests and *émigrés*, and opposed the reactionary policy of the court. In Mar., 1792, the king selected four of them for his new ministers, but dismissed them June 13—an act which led to a popular insurrection. On Aug. 11 they were recalled. The party of the Mountain (1792) and the Jacobins (1793) violently opposed them, and the latter (June 2) procured the arrest of thirty of their leaders. Throughout the provinces there followed a series of popular uprisings in their favor, but the Convention had the advantage of previous organization and strong leadership, and the armed Girondists everywhere met a fearful overthrow. In October the leaders were arraigned before the revolutionary tribunal, but so strong was their eloquent self-defence, and so conspicuous their patriotism and their innocence, that not even that court could convict them. But by order of the Convention they were sent that very night to the guillotine (Oct. 31, 1793), chanting the *Marseillaise* while on the way. During the following year great numbers of other real and suspected Girondists perished. The Girondists were looked upon as *doctrinaires*, and were in part victims of the prejudice of the Parisian rabble against educated men; but their greatest offence was their opposition to the mad zeal of the ultra-republicans.

Gir'van, town of Scotland, in Ayrshire, on the Girvan. It has a lively trade with Belfast. Pop. 7047.

Gis'co, the name of many distinguished Carthaginians, of whom the most distinguished was a general who commanded at Lilybæum during a part of the First Punic war, in which he was exceedingly popular with the soldiers. The latter, during the mutiny known as the Inexpiable war, received Gisco at Tunis as a messenger from the government, but treacherously made him a prisoner, and put him, with 700 others, to a cruel death, about 239 B. C.

Giti'ades, a statuary, architect, and poet of Lacedæmon, flourished about Ol. 60 (O. Müller and C. F. Hermann), B. C. 536. He erected the temple and fashioned the statue of Athena Poliouchus ("city protector"), also called Chalciœcus ("of the brazen house"), in his native city. He composed a hymn in honor of the same goddess, with a few other poems in the Doric dialect. (See Sillig, *Dict. of Ancient Artists;* Müller, *Ancient Art and its Remains.*)

H. Drisler.

Git'schin, town of Bohemia, noted for the encounter which took place here (June 29, 1866) between Prince Frederick Charles of Prussia and the Austrian general Clam-Gallas. The prince marched the second army corps from Podol and the third from Turnan towards Gitschin, and attacked the Austrians, who occupied a favorable position on some hills, and had one-half of the Saxon army as reserve. Clam-Gallas was defeated, and retreated behind Gitschin, leaving the defence of the town to the Saxons; in the night it was taken by the Prussians. The Prussians lost 2000 men; the Austrians about 4000 men, besides 2000 prisoners. Pop. 6570.

August Niemann.

Giudi'ci- [Emilia'ni], (Paolo), b. at Mussomeli, in Sicily, June 13, 1812. At the age of sixteen, and against his own will, he entered a Dominican convent, where he devoted himself to the study of design and of literature. These pursuits kindled his patriotism, and, as a first symptom of his love of freedom, he quitted the convent and applied for a chair in the University of Palermo. Not only was this refused, but he was put under *surveillance*, whereupon he fled from Sicily into Tuscany. There he formed a friendship with the poet Niccolini, and encouraged by him, began his principal work, *La Storia della Letteratura Italiana*, written from a critical and political point of view. About this time he received a handsome legacy from his friend Emiliani—whose name he then took—and was thus enabled to prosecute his studies at leisure. In 1849 he became professor in the University of Pisa; in 1851 he published his *Storia dei Municipii Italiani*, then *Storia delle Belle Arti in Italia.* In 1861 he succeeded Niccolini as secretary to the Academy of Fine Arts in Florence. In 1864 he resigned his professorship, and passed much of his remaining life in England. In 1867 he was elected to the Italian Parliament. D. at Hastings, in England, in 1872.

Giuglia'no, town of Italy, in the province of Naples. Pop. 11,772.

Giulia'ni (Giambattista), the most distinguished of living commentators on the *Divina Commedia*, was b. at Canelli, in Piedmont, in 1818. He entered the religious order of the Somaschi, and between 1837 and 1847 he held various professorships in different schools of learning, occupying himself at the same time with the profound study of Dante. In 1841 he published a much-approved *Treatise on Algebra;* in 1845 his celebrated *Saggio di un Nuovo Commento della Commedia di Dante Allighieri;* in 1846, before the Scientific Congress of Genoa, he declared that the *Divina Commedia* embodied the earliest and most authentic material for Italian history. In 1847–48, while professor in the University of Genoa, he was named, under the new liberal reforms, censor of the Press, the duties of which office he performed with great dignity and liberality. Among the works of Giuliani the volume entitled *Sul vivente Linguaggio della Toscana* should be mentioned as having contributed largely to his reputation. In 1856 appeared *Le Norme di Commentare la Divina Commedia, tratte dall'Epistole di Dante a Cangrande*, a most important work, which was followed by his *Metodo di commentare la Divina Commedia*, and afterwards by a new critical

and annotated edition of all the works of Dante, this last being still (1875) in course of publication at Florence.

Giu'lio Roma'no, an Italian painter and architect, b. at Rome in 1492; d. in Mantua in 1546. The family name was PIPPI. As a painter, much of his reputation has been due to his association with Raphael, who held him in high esteem, entrusted to him the execution of important works, placed him at the head of his scholars, made him one of his heirs, and, dying, confided to him, along with Gio. Fran. Penni, the finishing of his uncompleted pieces. The pupil did not justify the master's predilection. His pictures, while showing boldness of conception, learning, and mastery of materials, are destitute of harmony, grace, delicacy of sentiment, and refinement of expression. His success was greatest in battle-pieces. In sacred subjects he did not excel, though his most famous picture, in the church of S. Stefano at Genoa, was one of this kind—*The Martyrdom of St. Stephen*, an important work, and still regarded as a masterpiece of composition and drawing. His celebrated paintings, *The Apparition of the Cross to Constantine* and the *Battle between Constantine and Maxentius*, in the Hall of Constantine at the Vatican, and the *Fall of the Giants*, in the Palazzo del Tè at Mantua, are examples of his grandest manner. Giulio Romano's fame rests more on his capacities as an architect than on his genius as a painter, though his architecture had the same general characteristics with his painting. Leo X. and Clement VII. employed him on the Vatican, and when in Rome he erected two palaces, the church Madonna del Orto, and other buildings. Called to Mantua by its duke, he did an immense amount of work in construction and reconstruction, of which the Palazzo del Tè is the crowning achievement. The cardinal Gonzaga had a saying that Mantua belonged to Giulio Romano by right of creation. When the emperor Charles V. came to Mantua, the architect erected the triumphal arches in his honor. His renown became so great that the pope invited him to return to Rome and undertake the construction of St. Peter's, but death prevented. As a figure in the history of art, Giulio Romano occupies large room; as a creator in the world of art, the place assigned to him is not the highest. His has been styled "an evil art, founded on art, and at variance with nature."

O. B. FROTHINGHAM.

Giurge'vo, town of Wallachia, on the Danube, 40 miles S. W. of Bucharest. It is one of the principal trading-places on the Danube. Pop. 20,000.

Gius'ti (GIUSEPPE), b. at Monsummanno, near Pescia, 1809; d. in the house of the marquis Gino Capponi, Florence, Mar. 31, 1850. He studied first at Pistoja and Lucca, then in the University of Pisa. While still a student the manuscript poems of Giuseppi Giusti were greatly in vogue, but these early specimens were coarse and burlesque rather than satirical. The revolutionary attempts of 1831 roused the patriotic spirit of Giusti, and it found expression in his admirable satires, which, far from being imitations, are a new form of that branch of poetry—popular, graceful, and biting. He well merits the name of "the Tuscan Béranger," although, according to the judgment of Italians, and even of many foreigners, Giusti far surpasses the French poet in delicacy of taste, in elegance, and richness of thought. The satires of Giusti remained many years in manuscript, but immediately upon their publication, they obtained a wide circulation throughout Italy, and everywhere excited great enthusiasm. They were the noble precursors of the revolutionary movements of 1848—more noble even than that revolution itself; for Giusti, who had always hitherto been a republican, when he found himself in personal contact with furious demagogues, became a *moderate*, and adhered to the policy of Gino Capponi, whom he had already taken for his literary adviser. When the first Tuscan national assembly was convoked, Giusti was elected deputy, and by voting with the conservatives he naturally brought upon himself the hatred of the radicals, who abused him as a traitor. The grand duke being restored, Giusti saw his dearest hopes crushed, and, suffering partly from depressing hypochondria and partly from a pulmonary affection, he died a few months after. The unhappy life of this poet was in singular contrast with the apparent gayety of his verses, but in the smiles of Giusti there lurk bitterness and tears. No one better understood or better used the Tuscan speech than Giusti. Clear proofs of this are to be found in the collection of Tuscan proverbs completed and illustrated by Capponi after the death of his young friend, and also in his letters, among which are many models of the epistolary style.

Givet, town of France, in the department of Ardennes, on the Meuse, near the Belgian frontier. It is strongly fortified, and has famous leather manufactures. P. 6404.

Givors, town of France, in the department of Rhône, on the Rhône. It has large glass manufactures. P. 9352.

Giz'zard, in birds and some invertebrates, a portion of the alimentary canal, which is very muscular and strong, being fitted for grinding up the food, a function performed by the teeth of many animals. Some of the Bryozoa have such a gizzard between the œsophagus and the true stomach. Many Gasteropods have gizzards armed with teeth (*Aplysia*) or calcareous plates (*Bulla*), and some Cephalopods have both powerful jaws and strong gizzards between the crop and the first stomach. Many insects and crustaceans have gizzards, in some cases armed with strong teeth. Most birds have a true gizzard, excepting only those whose food is very soft and succulent. The food, unlike that of the invertebrates above alluded to, is acted upon by the gastric juice before it is ground up in the gizzard. This organ is the homologue of the pyloric portion of the stomach of most of the vertebrates. It is lined by a horny epithelium, the "gizzard-skin," and most birds swallow pieces of gravel to assist the gizzard in grinding food. The "gizzard-skin" of the pigeon was, and perhaps still is, a domestic remedy for indigestion—a curious example of a popular prescription whose merits have been confirmed by science, since it is only quite recently that the stomachs of sheep and swine have been in like manner exhibited as "pepsin" for the same purpose, and as the result of scientific observation.

Gla'brio, an important family of the Roman plebeian gens Acilia, of which the most distinguished name is that of MANIUS ACILIUS GLABRIO, who became tribune of the people 201 B. C., a decemvir of sacred rites 200; prætor 196, consul 191, conducted with success the war in Greece against Antiochus III. of Syria and his allies; triumphed in 190, and after 189 B. C. withdrew from public life.—Another of the same name was prætor urbanus B. C. 70, consul 67, proconsul in Cilicia 66, where, after an inglorious campaign against Mithridates, he was succeeded by Pompey; became a pontiff in 67 B. C. He was a grandson of P. Mucius Scævola, and had a high reputation as a jurist.

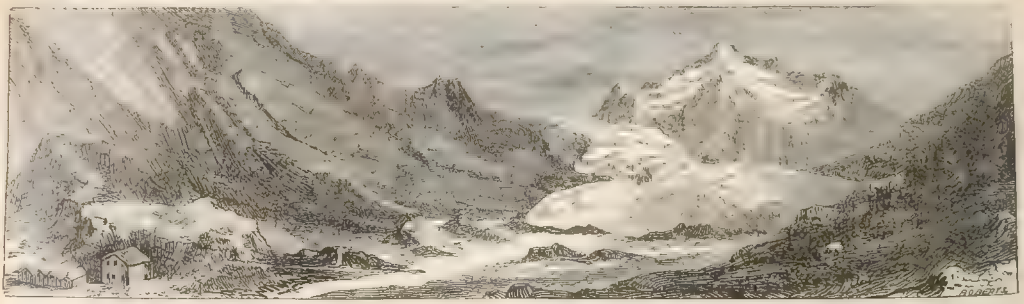
Glabrio (C. ACILIUS) filled the offices of quæstor B. C. 203, and tribune of the plebs, and acted as interpreter to the Athenian embassy, consisting of the three philosophers Carneades, Critolaus, and Diogenes, before the Roman senate, A. U. C. 599, B. C. 155. He wrote a history of Rome in Greek, translated by a certain Claudius into Latin, which translation was known to and used by Livy. The fragments are collected in KRAUSE, *Hist. Script. Frag.*, pp. 84–87. (See BAHR, *Gesch. d. Röm. Lit.*, vol. ii. p. 31; G. C. LEWIS, *Credibility of Early Roman History*, vol. i. p. 33.)

H. DRISLER.

Glacier [Fr., from Lat. *glacies*, "ice"]. In every part of the world high mountains are more or less covered with permanent snow, extending from the topmost crests to the limit where the annual melting exceeds the annual supply, which forms what is called the *snow-line, or limit of perpetual snow*. Among mountains that rise far above that limit we usually find the upper ends of the higher valleys occupied by continuous masses of ice that originate in the region of perpetual snow, but extend far below the snow-line, often reaching the zone of forests, and sometimes descending into inhabited districts, in the midst of corn-fields and fruit trees. The ice is very different in appearance from what is commonly seen in winter on streams and lakes. The surface is rough and undulating, and not seldom scarred by deep clefts. Towards the lower end these ice-masses are usually strewn with sand and rough gravel and trains of large blocks that disguise the natural color. These ice-masses are called *glaciers*. In former conditions of the earth's surface they attained enormous dimensions, but, if we except those of Greenland, yet unexplored, none are known that exceed about 30 miles in length and 2 or 3 in breadth. The countries where glaciers have been found on a large scale are the Alps of Switzerland and Tyrol, the North-western Himalayas, the Rocky Mountains, North-western Scandinavia, and Greenland. In each of these regions all the important phenomena of glaciers may be studied, but it is in Switzerland and the adjoining districts of Tyrol, Savoy, and Piedmont that all the earlier investigators have pursued their inquiries into the origin, the motion, and the structure of glaciers. It was there also that the facts were first observed that proved the vast extension of glaciers at a very recent geological period, and the important share they have had in fashioning the surface of many large districts to the condition in which we now behold it. Hence the Alps have become the classic land of glacial phenomena, and in attempting to explain them it is necessary to refer to the observations that have been there made.

Origin of Glaciers.—A large part of the heat which the sun sends to the earth is expended in converting water into vapor and raising it into the atmosphere. Under given conditions of temperature and density the air can retain in suspension no more than a fixed quantity of aqueous vapor. When that limit, which is called the point of saturation, is

surpassed, the superfluous vapor is precipitated, at first in the form of cloud, and, if the process is continued, ultimately reaches the earth again in the form of rain or snow. Several causes, which need not be here discussed, concur to lower the temperature of the air as it is raised above the earth's surface, and at a sufficient height it becomes so cold that whatever vapor is condensed takes the form of snow or sleet. In falling to the earth this is usually reconverted into water, but on high mountains, where the temperature of the surface is also low, the greater part of the aqueous vapor returned from the atmosphere retains the form of snow. When the air is calm, the snow of the high Alps consists of regular crystalline forms of exquisite beauty, being wonderfully varied modifications of a six-rayed star. When the air is disturbed, the snow assumes a new condition, which is that of small frozen pellets, no larger than a pin's head. It is this that forms that blinding snow-dust well known to those who have ever experienced the *tourmente*. The snow that falls on the exposed ridges and steep slopes does not long remain there. A large portion is generally carried away by the wind; a further portion accumulates till the slope becomes too steep, when it slides down in an avalanche; and a small share is disposed of by melting and evaporation. The result is, that nearly the whole of the snow falling on high mountains is retained in the hollows or on the more level parts of the surface. If these hollows and plateaus are below the level of perpetual snow—or, in other words, if they are so situated that the annual melting equals the quantity of fresh snow annually supplied—no accumulation can take place. A certain quantity of snow is gathered into these storehouses every winter, and is removed during the following summer, the same process being renewed year after year. This condition of things is seen in the Carpathians, the ranges of Central Spain, and many other European mountains whose summits rise above the level of perpetual snow. The case is otherwise when the winter snows are gathered in hollows and plateaus where the amount annually melted is less than the fresh supply. The first impression of a person speculating on the subject would be that under such circumstances the accumulation would go on without limit, and that a layer of snow constantly increasing in thickness would be piled up. To understand what actually occurs, a little detail is necessary. The higher region of the Alps and other high mountains is subject to a constant alternation between heat and cold. In clear weather this takes place between each day and night; in clouded weather the intervals are longer. The sun shining upon the mass of snow-dust and minute crystals partially melts them, and ultimately fuses them together till they form grains of larger size, which are frozen together into compact particles of ice during the next interval of cold. At first this process is confined to the uppermost layer of the snow, but as the alternate melting and congelation are frequently renewed, a similar change extends through the mass, which is gradually converted into that peculiar condition that has been called *névé*, or in German *Firn*. The longer the exposure of a layer of snow has lasted, the more complete the change into *névé;* the sooner a fresh layer falls, the more imperfect will be the conversion of the older one. A section of the upper strata of the *névé*, here and there exposed on the sides of a crevasse, shows successive layers, whose upper surfaces are seen to be more near the condition of ice than the underlying portions. In the lapse of years the *névé* increases layer by layer, one of them corresponding to every considerable fall of snow, until a great weight presses on the lower and older portions of the mass. To understand what effects are produced by this pressure, we must bear in mind an important property of ice, to which the name of *regelation* has been given. Two surfaces of ice at or very near the melting-point, when brought into contact, freeze together so completely that no trace of the original separating surface remains. Adequate pressure applied to a mass of fragments of ice, by forcing them into positions where their surfaces come into contact, causes regelation, and the closer the contact the more completely will the separate portions be welded together. Such is the change that is effected in the reservoirs where the alpine snows are stored. Having been first brought to the condition of granular *névé* by the sun's action, these grains are more and more completely united in the deeper portions of the mass into nearly compact ice.



Glacier.

If the reservoirs of which we have spoken were closed basins of sufficient extent, they would become filled with stationary masses of ice. But such ice-lakes, if they exist, must be very uncommon. The reservoirs partake more or less of the general slope of the mountain, and each is connected with the lower level by a valley, glen, or ravine, through which the snow would quickly flow if it were converted into water. But the masses of imperfect ice that are accumulated on the flanks of the higher mountains possess a considerable degree of plasticity. When the accumulated mass, and the weight consequently pressing on the lower strata, are great enough, the whole begins to yield in the direction of least resistance, and with a slow, constant, imperceptible motion to crawl downward towards the lower region, where the ice, being exposed to a higher temperature, is rapidly consumed. In other words, the mass has become a glacier.

Motion of Glaciers.—It will now be understood that the essential attribute of glaciers is the fact of their progressive motion from the upper level where they are formed towards the lower valleys. There may possibly exist in the polar regions great accumulations of stationary ice, but these are not true glaciers. All the characteristic phenomena hereafter described are inseparably connected with glacier motion; and if usage permitted the use of *ice stream* as an English equivalent, this would be the most correct and expressive name for these remarkable objects. The onward motion of the greater glaciers must have been known from a remote period to the herdsmen who in summer led their cattle to the pastures on the banks of these ice-rivers. Huge blocks of stone often rest on the surface of the ice, and it was a familiar fact that at the recurrence of each yearly visit the blocks were found to have advanced a considerable distance. But, though men of science had speculated on the cause, no one had undertaken such accurate observations as could alone supply a secure basis for physical reasoning.

Laws of Glacier Motion.—The first to undertake a regular system of observations with a view to ascertain the facts and investigate the causes of glacier phenomena was the late Prof. Agassiz. In company with several friends he established himself in 1840 on the Lower Aar Glacier, and with remarkable enterprise and perseverance persisted for several successive years in carrying on systematic observations, which are recorded in his work, *Nouvelles Etudes sur les Glaciers*. The previous studies of Prof. Agassiz and his companions had not given them a familiarity with the principles of physics, and it naturally followed that they did not at first devise the most effectual means of investigation; hence it happened that as to the most important results they were partly anticipated by better prepared competitors. In July, 1841, M. Arnold Escher von der Linth made the first well-devised attempt to determine the main facts of glacier motion, by planting on the surface of the great Aletsch Glacier two series of stakes at equal intervals of 100 mètres, the one carried in a direct line across the glacier, the other being parallel to the direction of its motion. Had he been aware of the rapid wasting of the surface of a glacier during summer, M. Escher would have doubtless been the first to determine the general laws of glacier motion. Returning after an absence of five weeks, he found that the surface of the glacier had lost fully three feet in thickness through melting and evaporation, and that not one of the stakes firmly planted in the ice still

remained standing. In Aug., 1842, the late Prof. J. D. Forbes, by well devised observations, ascertained all the most important facts, and was thus enabled to establish the general laws of glacier motion in terms that, with slight modification, are accepted by all those who have followed him in this inquiry. Forbes judiciously reflected that the rate of the annual progress of the great glaciers, as then roughly known, was such that if the motion were continuous the rate would be measurable in very short periods, if instruments of sufficient accuracy were provided; and further, that if the rate of motion at a number of points suitably chosen on the surface were ascertained, the laws of glacier motion might thence be inferred. When the right question is put in the right way, nature is not slow to reply. In the course of a single week the chief facts of glacier motion were ascertained; but the late professor extended his observations to other questions connected with the phenomena of glaciers, and continued his observations during several subsequent journeys. The following conclusions were established: (1) The motion of glaciers is continuous, and sensibly uniform during short periods. (2) The rate of progress is somewhat retarded at night, and still more by prolonged cold weather. (3) The central part moves more rapidly than the sides in all parts of the glacier. (4) The rate of motion is not uniform throughout the length of the same glacier, but varies with the inclination of the bed and the width of the channel through which it moves. (5) The increase in the rate of motion in passing from the sides towards the centre of a glacier is regular and continuous, so that a series of points fixed in a straight line across the surface is gradually bent into a curved line by the onward motion of the glacier. (6) The upper surface advances more rapidly than the interior, and the interior more rapidly than the under surface. (7) The advance of a glacier is not suspended, but only retarded, during winter. To these main conclusions an addition was made some years later by Prof. Tyndall. He ascertained that when a glacier flows through a bend in the valley, the point of most rapid motion is shifted from the centre towards the convex side of the curve.

The inference to be drawn from these facts, established by repeated and multiplied observations, is unavoidable. A glacier *does not move* as a rigid body, slipping forward on its bed, whose parts retain their relative positions during its progress; it *does not move*, as some had conjectured, by dilatation, or the expansion of the substance of the ice in the direction of least resistance; it *does move* as a plastic substance, conforming to the laws that regulate the motion of imperfect fluids.

Cause of Plasticity of Glacier Ice.—Although the law of glacier motion was established by the observations and experiments of Forbes, no satisfactory explanation was given of the mode in which a substance so different in obvious properties from those known to possess plasticity is enabled to conform to the behavior of semi-fluids acted on by gravity. The most important step towards the solution of this seeming paradox was made by Prof. Tyndall, who showed that it is mainly owing to that peculiar property of ice, first observed by Faraday, which we have spoken of as *regelation*, that a glacier is enabled, without losing its continuity, to advance in a sinuous channel, not only changing its external form to suit the irregularities of its bed, but also suffering internal dislocations by the constant rearrangement of its parts. By actual experiment he showed that lake ice, much more compact than ordinary glacier ice, may by adequate pressure be moulded to any given form. The first effect of pressure is to cause fractures in the ice, and thus enable the fragments to assume new relative positions. Owing to the property of regelation the newly-formed surfaces, when brought into contact, reunite by freezing together; but if the pressure be continued, new fractures arise, and regelation again welds the parts together; and the process is repeated until a condition of equilibrium is attained. An identical experiment is performed on a great scale in the laboratory of nature when a glacier descends through a valley. The enormous weight of the mass is partially resisted by contact with the sides and the bottom of the valley, but acts with greater force, and encounters a less resistance, in the centre of the ice-stream. This force, not acting uniformly, but constantly shifting the point of greatest pressure, causes local yielding and fracture of the ice; and if it were not for the property of regelation the glacier might gradually be reduced to a mass of incoherent fragments. But at each step in the progress of the glacier the damage done to the continuity of the ice is repaired, and by the twofold process of fracture and regelation the whole mass moves onward, constantly changing its form, yet in appearance an almost continuous mass.

Objections Answered.—In the course of continued controversy to which the physical theory of glaciers has been exposed many objections have been taken to the explanation here given, and several rival theories have been propounded; but few of these now require notice. The most notable exceptions are the views advanced by Prof. James Thomson of Belfast and by Canon Moseley. Prof. Thomson derived from theoretical considerations first developed by Sadi Carnot the conclusion, since experimentally verified, that the freezing-point of water is lowered by pressure. It is well known that water when at or near to the freezing-point is denser than ice, as shown by the familiar fact that ice floats on the surface of cold water. Under the ordinary pressure of the air ice will remain solid at the temperature of 32° F., but if pressure be applied to it, the particles tend to assume a new molecular arrangement, in which they yield somewhat to the pressure by filling less space than they did before, or, in other words, to become water. The greater the pressure the more the melting-point will be depressed, but the whole effect is but slight. To lower the freezing-point by 1° F. requires a pressure of more than 74 atmospheres, or nearly half a ton per square inch. According to Prof. Thomson's theory, the pressure produced at various points in a glacier suffices to liquefy portions of the ice. The water finds its way into new positions where the pressure is less intense, and where it is consequently reconverted into ice. Hence, the virtual plasticity of glacier ice—the temporary assumption of the fluid state throughout successive points of the glacier—enables the parts to change their relative positions, while the speedy reconversion into ice of the liberated water maintains the general continuity of the mass. There can be no doubt that the process here described is physically possible, and it may be surmised that in some experiments where ice has been moulded under great pressure the change of form is partly effected in this way, and not exclusively by fracture and regelation. Further than this, it appears certain that some peculiarities of glacier structure, noticed hereafter, are due to partial liquefaction of ice submitted to extreme pressure. But as a general explanation of the process by which glaciers advance in conformity with the law of semi-fluid motion, the views of Prof. J. Thomson have not commanded general assent.

Canon Moseley, who had previously originated an ingenious theory of glacier motion, which has found little support amongst those who have observed the phenomena, has sought to prove that the descent of glaciers by their own weight is a mechanical impossibility, and hence that the explanation given above is untenable. The relative displacement of the particles of ice, which is a necessary consequence of the ascertained facts of glacier motion, however it may be caused, must overcome the cohesion of the substance, which is measured by what is called in mechanics the *shearing force*. Canon Moseley has sought to ascertain by experiment on a cylinder of ice the amount of this force —*i. e.* the force necessary to cause one portion to advance while the adjoining portion is forcibly retained in its place. From the mean of two experiments he concludes this to be equivalent to the pressure of 75 pounds per square inch. It is easy to show that on such slopes as we commonly find in the lower part of great glaciers the mere weight of the mass cannot produce a pressure nearly so great as this; and it is inferred that some other force, and not that of gravity, must be the efficient cause of motion. To this it may be answered that glacier ice is not usually nearly so solid a substance as that experimented on by Mr. Moseley, and that it is impossible to reason correctly on the assumption that a glacier is a uniform mass made up of parts that offer equal resistance in all directions to external force. It is still more important to note that although glacier motion undoubtedly involves the relative displacement of adjoining portions of the ice, the process is extremely slow, and has no real analogy with those involved in Mr. Moseley's experiment. He sought to measure a visible amount of displacement produced within a short time. But the displacements arising in the glacier would, within so short a period, elude the most accurate instruments. The greatest amount of relative displacement yet observed amounts to a difference of 1 inch in 24 hours between two points 16 feet apart. In other words, if we were able to measure accurately enough the motion of two points in the glacier 1 inch apart, we might find at the end of 28 minutes that one had advanced more rapidly than the other by $\frac{1}{10000}$th of an inch. There is great reason to believe that many seemingly rigid bodies as well as ice, especially when brought near to the temperature of liquefaction, are capable of slowly modifying their form under great pressure.

The most important facts bearing on the glacier-theory lately brought to light are due to observations made by Mr. W. Mathews of Birmingham. He found that a plank of ice 2½ inches in thickness, supported on bearers 6 feet apart, and exposed at a temperature somewhat above the freezing point, was rapidly deflected from its original form until in about

seven hours the centre had subsided as many inches below its original position. In a subsequent and more important experiment a plank $1\frac{7}{8}$ inch in thickness, supported in the same manner, but exposed to a temperature always some degrees lower than the freezing-point, was slowly bent from its original form to the extent of about $2\frac{1}{2}$ inches in 24 hours, preserving meanwhile its optical continuity, and maintaining for a time its altered form when its position was reversed.

Glacier Crevasses.—It has been seen that under the influence of the forces called into play glacier ice possesses a virtual plasticity, and there is even reason to admit that it is really somewhat plastic—*i. e.* that it can be moulded to a different form without solution of continuity. Inasmuch as most plastic substances are also viscous, it not unnaturally happened that, in publishing his conclusions as to the laws of glacier motion, Forbes attributed to the glacier as a whole the quality of viscosity, as well as plasticity, and designated his own views as the *viscous theory* of glacier motion. The characteristic of viscous substances is that they yield to tension without a breach of continuity, or, in common language, can be more or less stretched without being broken. But, in point of fact, glacier ice is especially devoid of this quality, and can yield not at all, or only imperceptibly, to tension. When the general movement of the glacier tends to draw asunder adjoining portions of ice, this is unable to obey the strain, the mass is rent through, and in this manner are formed the *crevasses*. These are among the best known and most characteristic of glacier phenomena. They are most numerous and widest in summer, when the glacier moves most rapidly, and are partially or completely closed up in winter, when the onward flow of the ice is slackened. But the same causes recur year after year, subject to slight variation owing to the differences of seasons, and, as a general rule, crevasses reappear annually in the same places, though the ice in which the rent takes place may have been some hundreds of feet higher up the stream in the preceding season. Crevasses are at first narrow fissures, and are gradually enlarged by the onward motion of the glacier, increasing in width from a few inches to many feet, and sometimes reaching to a great depth. The positions in which crevasses usually oppose the most serious obstacle to the alpine traveller are those where the bed of the glacier suddenly changes its inclination from a gentle slope to a steeper declivity. The ice, as it bends over the convex surface of rock, is rent by transverse crevasses of great depth and width, which often cross the entire breadth of the ice-stream, and these are repeated as each successive portion arrives at the same point; so that the result is to form a series of deep parallel trenches, divided by massive walls or ramparts of ice, giving the glacier, when seen from a distance, the appearance of a gigantic staircase. It not unfrequently happens that in the same places where the ice is thus rent by one set of parallel crevasses, another system of crevasses may be formed running transversely across the first. In this way the whole of the surface is cut up into isolated tower-shaped masses. When first formed, the sides of crevasses are more or less vertical walls, with well-defined edges, but the exposed parts of the ice are rapidly attacked by the sun, and even by the air and by rain. In a short time the flat-topped ramparts and turrets have their upper edges eaten away, till the broad rampart becomes a sharp ridge and the tower a pointed pinnacle. This is the origin of those singular and beautiful forms that are often seen towards the lower part of an ice-fall in the greater glaciers, where the crevasses penetrate to a depth that must be reckoned by hundreds of feet.

The Bergschrund.—A peculiar sort of crevasse, somewhat different in its origin from the rest, is best known by the German name *Bergschrund*. This appears at the upper limit of a glacier, along the line of separation between the fields of *névé*, that partake more or less of the downward movement, and the upper snow-slopes, that remain attached to the rocky skeleton of the mountain. A continuous fissure, sometimes 20 or 30 feet in width, marks the separation, and sometimes interposes a formidable obstacle to the traveller who seeks to reach the higher peaks.

Séracs.—When an ice-fall occurs in the higher part of a glacier, where it is covered by a considerable depth of *névé*, the crevasses naturally cut through the *névé*, and expose sections showing the outcrop of the successive beds of snow from which it was originally formed. When it is cut up by the intersection of transverse crevasses, the *névé* often appears in the form of huge square blocks, known, since Saussure, by the name *séracs*.

Moulins.—A remarkable phenomenon, seen only on the greater glaciers, is that presented by the so-called *moulins*. During the summer, when the sun acts with great force, the melted ice forms rivulets on the surface. In portions of the glacier intersected by crevasses the superficial water is quickly carried off, but where the ice is compact, these rivulets, uniting together, may accumulate until they form a considerable stream. Sooner or later this encounters a crevice, perhaps at first very small, but this is enlarged by the action of the falling water till a vertical shaft is formed in the ice, through which the stream is poured in a waterfall that is lost to sight in the depths of the glacier.

Wasting of the Surface: Ablation.—Among other apparent objections to the above explanation of the origin of glaciers, it may occur to the reader that, as considerable pressure is necessary to account for the conversion of the *névé* into ice, the upper strata, which have not undergone this pressure, ought to continue in the state of *névé*, and hence that the upper surface of the glacier should consist of *névé*, and not of ice. This objection loses sight of the vast amount of *ablation*, or loss, which a glacier annually undergoes through the melting of the surface. By mounting high enough on each glacier, we do find the upper surface composed of *névé*, but as it descends to a lower level a fresh slice of the surface is annually cut away by melting, so that if we follow the stream, we find as we advance that the ice under our feet constantly becomes older and more compact, until we reach the point where the annual loss by melting equals the supply brought down by the progress of the glacier, and where, consequently, this comes to an end. The amount of ablation, or loss by melting, depends upon many different circumstances, and varies on different parts of the same glacier. The most frequent cause is the direct effect of the sun's rays, but exposure to warm winds is another important agent; and a still more efficient, though unfrequent one, is heavy rain at a temperature much above the freezing-point. The latter, by its rapid effects on the snow-fields and glaciers, is the main cause of those formidable inundations that sometimes visit the skirts of the Alps and other mountain-countries. If we possessed continuous series of observations on the rate of progress in different parts of a glacier, and of the corresponding amount of annual ablation, we might estimate pretty closely the depth of the ice in the upper part of the glacier where the main accumulation occurs. There is strong reason to believe that in the greater glaciers the depth is much in excess of what has been commonly supposed. During the summer months the surface of a glacier is by day usually seamed with tiny streamlets, produced by the melting of the ice, the sun is constantly eating away the edges and sides of the crevasses, and the air and the earth consume some small portion of the under surface. The water from all these sources finally makes its way to the rocky bed, where it flows under the ice, and finally issues from the foot of the glacier. When the form of the bed is favorable the waters unite into a single torrent, often of great volume, and then the overhanging ice commonly forms a dome-shaped vaulted arch, whose azure tints attract the admiration of travellers.

Glaciers of the Second Order.—The details hitherto given apply to true glaciers, which, as has been seen, are rivers of ice flowing through definite channels. But in high mountain-countries we find, along with the main glaciers, very numerous accumulations of *névé* lying in the lesser hollows and recesses of the surface, and giving birth to minor glaciers, that exhibit in a slight and imperfect manner the phenomena of the greater ice-streams. These are called *glaciers of the second order*. In these the accumulation of *névé* is smaller, and this is less completely converted into ice, and their downward motion, which is much less rapid than that of the great glaciers, is mainly effected by sliding on the underlying surface of rock.

Veined Structure of Glacier Ice.—Glacier ice, especially when examined some distance above the lower end, is usually of a nearly white color, and this tint is due to the multitude of minute air-bubbles contained in it. It very often happens, however, that the mass is seamed by countless parallel veins of the purer azure color characteristic of ordinary ice. On examination, this is found to arise from the fact that the blue veins are almost completely free from air-bubbles. This structure, seemingly noticed in the first instance by the late Sir David Brewster, and subsequently well described by M. Guyot in 1838, has furnished matter for much discussion by subsequent investigators, and may yet afford room for further inquiry. The most satisfactory explanation of its origin is that given by Prof. Tyndall in his work on the *Glaciers of the Alps*. He has established the fact that the blue veins are first developed in parts of the glacier that have been subjected to extreme pressure. A common instance of this occurs where two glaciers unite to form a single stream. It often happens that the bed of the united glacier is no wider than that of each separate affluent, and at the point of junction the ice, urged on by the weight of the advancing mass, is forcibly compressed and made to enter the relatively contracted channel. The blue veins are produced at right angles to the direction of

greatest pressure, but when once the structure is developed it is more or less retained throughout the subsequent progress of the ice. The exact nature of the process is perhaps not yet fully disclosed, but it is highly probable that a chief cause of the phenomenon is the fact brought to light by Prof. J. Thomson, that intense pressure causes portions of the compressed ice to be converted into water, thus facilitating the escape of the imprisoned air-bubbles.

Moraines.—One of the obvious differences between a glacier and an ordinary stream depends on the fact that earth and stones that fall on the surface rest there, instead of sinking to the bottom. Hence, it is not rare to find in the lower part of a glacier the natural appearance of the ice completely masked by fine sand and gravel, not to speak of blocks of various sizes borne down by the ice-stream. The traveller who chooses a commanding position for the purpose sees a great glacier stretch downward from the snow-covering that envelops the upper region of the mountain. He will observe that it is formed by the confluence of several smaller ice-streams, each of which issues from a lofty reservoir. As it descends the color is more and more soiled by superficial impurities. Along either bank will be seen a fringe of blocks that have fallen from the impending slopes, and one or more trains of blocks, forming conspicuous ridges on the surface, that extend along the middle of the stream parallel to its banks; while at the lower end an irregular accumulation of similar blocks, mixed with finer materials, often forms an unsightly termination to the view. These are the *lateral, medial,* and *terminal moraines.* In the lateral moraine we often find blocks that have fallen on the glacier at points much higher up in the stream that have slowly travelled along with it. As they are borne onward, and the ice is constantly wasted by the increasing temperature, some of these blocks are stranded on the banks; others slip down between the edge of the ice and the adjoining rocks; others, again, fall into the crevasses that often yawn near the sides of the glacier, but only in rare cases do they reach the lower end of the glacier. When two glaciers meet and unite to form a single stream, it is clear that the right-hand lateral moraine of one and the left-hand one of the other will be joined together, and form a single medial moraine somewhere about the centre of the united glacier. The same process will be repeated whenever a new affluent is added to the main stream, and hence some great glaciers have as many as eight or nine medial moraines. The blocks are often of great size, and as they protect the underlying ice from melting, the medial moraines often appear as an elevated ridge rising 50 feet or more above the general level of the glacier. As such ridges become steeper in the lower part of the glacier, the separate blocks sometimes slip or roll down the slope on either side, so that the original limits of the moraine become effaced, and the materials are then distributed irregularly over the tongue-shaped end of the glacier. It may be inferred from what has preceded that a large part of the solid materials borne downward on the surface of a glacier fails to reach the terminal moraine. Those of the lateral moraine are nearly altogether intercepted, and some part of the medial moraine also disappears in crevasses or reaches the sides of the ice-stream. Nevertheless, when a glacier remains for a long period stationary, a terminal moraine of great size may be accumulated. Whenever a gradual change in local meteoric conditions causes a diminished supply of material in the upper snow-fields—as has occurred in the Alps during the last twenty years—the effect is a gradual withdrawal of the glaciers towards their sources. A terminal moraine marks the limit reached during the period of expansion, and the materials that would have gone each year to add to its bulk if the glacier had remained stationary, are spread over the space between that limit and the present end of the glacier. In several instances in the Alps the space left by the retiring glaciers exceeded in 1873 a quarter of a mile. During a period when opposite conditions prevail the extremity of each of the great glaciers advances down the valley. A portion of the materials of the terminal moraine is shoved forward, while the rest is crushed beneath the advancing mass.

Glacial Mud.—A universal characteristic of the streams that issue from glaciers is their milky color. This is due to the quantity of fine mud carried in suspension—so much finer than ordinary mud that the water continues turbid at a distance of more than 50—nay, even 100—miles from its source. The origin of this mud is easily understood when we observe the processes carried on beneath the glacier. It has been already said that a considerable part of the materials of the moraines are intercepted before they reach the lower end, falling between the ice and the rocky bed of the glacier, either from the banks or through open crevasses. The fragments either get set into the under surface of the ice or lie between this and the bed. In this way a gigantic mill is formed in which all the surfaces exposed are slowly ground down. The harder blocks are reduced to flattened cakes, striated and polished on either side; most of the materials are reduced to sand and flakes of mineral matter; but a large part is crushed to a powder so fine that it is not completely deposited after resting for many days. The whole is gradually carried down by the streams that run under the glacier, till it reaches the main torrent, there to undergo further reduction, the finer matter being carried to great distances, and the coarser materials to intermediate stations, according to the force of the current. When a glacier retires, a certain portion of the materials here described is left on the surface of the rock, and constitutes what is known as *glacier mud.* By the practised eye this is easily recognized, but it is most certainly identified by the condition of the scored and striated pebbles scattered through it.

Action of a Glacier on its Bed: Glaciated Rocks.—The materials of the mud formed on the bed of the glacier are not exclusively derived from the rocks and gravel of the moraines: a considerable part of the finer matter is produced by the abrasion of the rocks forming the bed. Unmistakable evidence is found in the condition of those rocks. The general outline is always reduced to that of gentle curves, and the projecting ridges are worn down to the form of an inverted boat without a keel, or that of a sheep's back, whence they have been called in Switzerland *roches moutonnées.* The appearance of the surface, when examined near at hand, is no less characteristic, and entirely different from that produced by aqueous erosion. It is all covered with fine striæ, amongst which are seen coarser scratches, and at intervals deeper furrows, that may sometimes be traced for a long distance. These are usually exactly parallel, and always tend in the direction of the former motion of the glacier. Rocks that exhibit these characteristic appearances, which, so far as we know, can be produced only by the passage of ice, are called *glaciated rocks.*

Former Extension of Glaciers.—In describing, with what may appear too great detail, several of the phenomena of glaciers, there are others of a less essential kind which need not be here discussed. But it is necessary to advert to the important part which glaciers have played in periods historically very remote, but which are among the most recent in the geological chronicle, and to the nature of the evidence by which this page of the chronicle has been interpreted. The late Swiss geologist, M. de Charpentier, was the first to call attention to the facts by which the former extension of the Alpine glaciers is established. Having converted to these new views Agassiz—who in the first instance disputed their validity—along with many other vigorous adherents, Charpentier became the founder of a school which seems, in some respects, to have outrun his anticipations. For the last quarter of a century geologists have been divided between those who admit an amount of glacier extension compatible with a moderate change in climatic conditions, and those who believe in an extension so vast that the greater part of the temperate zones—nay, even large regions of the tropics—were covered with wide sheets of ice of such dimensions as to mask all but the most prominent mountain-summits; a state of things now existing only in some regions near the poles. It may be safely asserted that where subsequent changes have not effaced the record the former presence of a glacier in a valley is as completely proved as the existence of extinct animals by their bones, teeth, or scales. The entire surface over which the glacier moved exhibits the peculiar appearances already described as *glaciation.* The direction of the striæ and scorings preserves the general downward slope, though at particular spots portions of the glacier may have passed over convex masses, and the striæ may there slope upward. The stranded blocks left on either bank by the shrinking of the lateral moraines, known to Swiss geologists as *blocs perchés,* occur at intervals, resting on slopes so steep that no other known agency could have placed them there, and often so arranged that a contour-line carried through them would correspond with the slope of the glacier. Finally, the moraines which have been left by the extinct glacier differ in many respects from the other accumulations which are the results of subaërial denudations. They are characterized by the absence of arrangement among their contents; small angular gravel, glacial mud, blocks of all sizes, of which some may have their edges abraded, while others are unworn, are all mixed together without a trace of order. Especially characteristic are the small scored pebbles, of which a certain number may almost always be found in the terminal moraine. A further note of distinction between the moraines of ancient glaciers and other accumulations similar in general appearance arises from the regularity with which the materials of the moraines are distributed. The rocks belonging to each recess of the mountains wherein one of the tributaries of the main glacier has

originated will be preserved in the medial moraines flanking that particular part of the main stream, but will not be found elsewhere; and although some partial mingling may occur in the terminal moraines, it will be found that the distribution of the materials borne down by a glacier gives a correct key to the order of the rocks in the part of a mountain-chain whence it has flowed. A careful examination of the evidence leaves no room to doubt that in all the chief mountain-regions of both hemispheres the glaciers have, at a not very remote period, extended very far beyond their present limits, and were present in countries where they do not now exist.

Some scientific men are disposed to extend very much farther the supposed limit of the ancient glaciers, and to believe that extensive regions, even in the warmer temperate and tropical zones, were covered with a continuous ice-sheet. Others hold that the evidence for these wide conclusions is altogether insufficient. They point out that vast masses of floating ice, such as form the icebergs that descend annually from the polar lands through the Northern Atlantic, constantly grind against the sea-bottom down to depths of fully 800 feet, and that the markings on the rocks must be very similar in character to those made by glaciers. These icebergs are, in fact, detached fragments of the enormous glaciers of Greenland and other polar lands, that descend into the sea, and there break loose from the land ice. They bear on their surface portions of the moraines of the parent glaciers, and as they are floated southward into warmer latitudes these are deposited on the sea-bottom, either in isolated blocks when they break away in deep water, or in denser accumulations on shallow coasts, where, year after year, icebergs are stranded, and their remains are piled up and go to increase the size of the banks, as happens off the coast of Newfoundland. It is argued that if a portion of the bed of the Northern Atlantic were raised above the sea-level, it would exhibit most of the appearances that have been thought to prove the former existence of an ice-sheet covering the whole surface.

Erosion of Valleys and Lake-Basins.—The limits of this article permit but a brief allusion to the controversies that have arisen of late years as to the important part which some geologists attribute to glaciers in fashioning the earth's surface by excavating valleys and lake-basins. It is indeed generally admitted that glaciers have had a share in moulding the minor features of the surface in most mountain-countries; but there are wide differences of opinion as to the extent to which the erosive process has been carried, and especially as to its supposed action in scooping out extensive lake-basins. It may be safely said that a more complete acquaintance with facts is required before attempting to pass a final judgment on these controversies. Careful and prolonged observations are needed to determine the amount of abrasion performed by glaciers under various conditions. Some are disposed to rate this high; others believe that, save at comparatively few points, where the inclination of the bed undergoes rapid change, it is quite inconsiderable. In speculating on the origin of lakes, it is no less desirable to have exact information as to the form and dimensions of the lake-basins, as to which little is known, even approximately, except in a very few instances. It is equally necessary, in connection with the same problem, to ascertain the law of glacier motion when a glacier lies on an extensive level surface. If, as some have surmised, the motion of the glacier on its bed then disappears, or becomes quite insignificant, it would follow, *a fortiori*, that the larger lakes cannot have been excavated by glaciers. It is an interesting illustration of the close connection between all branches of natural knowledge—a connection daily more and more apparent—that geological problems so important and interesting should depend for their solution on the minute study of physical phenomena apparently so remote and so exceptional.

Bibliography.—A brief list of the more important works connected with the physics of glaciers and their relations to the recent geological history of the earth is here subjoined. Two or three only of the works of the earlier explorers of the Alps who were the first to speculate on these subjects have been included. Several valuable papers that have appeared within the last quarter of a century will be found in the *Bulletin de la Société Géologique de France*, the *London and Edinburgh Philosophical Magazine*, and many other scientific periodicals published on either side of the Atlantic, but are too numerous to be here cited. List of works connected with glaciers: SCHEUCHZER, *Itinera Alpina*, Leyden, 1723; GRUNER, *Die Eisgebirge des Schweizerlandes*, Berne, 1760; HUGI (J. J.), *Naturhistorische Alpenreise*, Solothurn, 1830; DE SAUSSURE (H. B.), *Voyages dans les Alpes*, Neuchâtel, 1803–06; DE CHARPENTIER (J.), *Essai sur les Glaciers*, Lausanne, 1841; FORBES (J. D.), *Travels through the Alps of Savoy, etc.*, Edinburgh, 1843, and *Occasional Papers on the Theory of Glaciers*, Edinburgh, 1859; AGASSIZ (L.), *Système Glaciaire, etc.*, Paris, 1847; SCHLAGINTWEIT (H. and A.), *Untersuchungen über die physikalische Geographie der Alpen*, Leipsic, 1850, and *Neue Untersuchungen, etc.*, Leipsic, 1854; TYNDALL (J.), *The Glaciers of the Alps*, London, 1860; HUBER (W.), *Les Glaciers*, Paris, 1867; RÜTIMEYER (L.), *Ueber Thal-und Seebildung*, Bâle, 1869; DOLLFUSS AUSSET, *Matériaux pour l'Étude des Glaciers*, a valuable collection of observations connected with the physics of the Alps, published at intervals; nine large volumes have appeared. J. BALL.

Glacis [Fr.], in fortification, the bank of earth which conceals the scarp-wall, itself forming the parapet of the counterscarp, and sloping gently from the main fortification. (See FORTIFICATION, by CAPT. O. H. ERNST, U.S. Army.)

Gladbach. See BERGISCH-GLADBACH and MÜNCHEN-GLADBACH.

Glad'den (ADLEY H.), b. in South Carolina; in the war with Mexico he served as major of Butler's regiment of South Carolina volunteers, which he commanded at Churubusco, where both his superior officers were killed; and at the conflict of Belen Gate, where he was himself severely wounded; in the civil war in America he was appointed a brigadier-general in the Confederate army in 1861; mortally wounded at the battle of Shiloh, Apr. 6, 1862.

Glad'den (WASHINGTON), b. at Pittsgrove, Pa., Feb. 11, 1836; graduated at Williams College, Mass., 1859; has held Congregational pastorates in Brooklyn and Morrisania, N. Y., and North Adams, Mass.; has been connected with the *Independent* and other journals of New York and Brooklyn, and is a successful lecturer. Author of *From the Hub to the Hudson*, and of contributions to periodical literature.

Glade, tp. of Warren co., Pa. Pop. 899.

Glade, tp. of Barbour co., West Va. Pop. 1302.

Glade, tp. of Webster co., West Va. Pop. 447.

Glade Creek, tp. of Alleghany co., N. C. Pop. 640.

Glade-net, a net made of fine thread, and set in glades of forests in Europe for fowling. The woodcock especially is taken in this way. The birds are driven towards the net, which is set in a place where they are known to be accustomed to pass, and at the proper time the net is dropped upon them by a fowler concealed near by.

Glade Spring, post-v. and tp. of Washington co., Va. The village is 14 miles E. by N. of Abingdon, on the Atlantic Mississippi and Ohio R. R., at the junction of the Saltville branch. Pop. of tp. 2898.

Gladeville, tp. of Wise co., Va. Pop. 1252.

Gladia'tor [Lat., from *gladius*, a "sword"], in ancient Rome a person who was employed to engage in combat at public shows. This custom was introduced into Rome in 264 B. C. It was of Etruscan origin, and is believed to have sprung from the old and once quite universal custom of slaughtering captives and slaves at the funerals of the great. Gladiatorial shows (*munera*) were at first exhibited chiefly at funerals, but later they were shown on the grandest scale as mere entertainments or as means of winning the popular favor. Gladiators were captives, slaves, criminals, or even free citizens. They were trained with great care, and carefully fed. The life of a vanquished gladiator might be spared or not according to the will of the spectators. The gladiators were regarded as a bad and dangerous class. Their number was very great, and at one time, under the lead of Spartacus, they threatened the existence of the Roman state.

Gladi'olus (a "little sword," alluding to the shape of the leaves), a genus of plants of the order Iridaceæ. Most of the species have bulbs, and are South African. The *Gladiolus segetum* and *communis* of Europe were formerly prized in medicine. The starchy bulbs of some African species are used as food. But the genus is chiefly noteworthy for its beautiful flowers, the ornament of almost every garden and greenhouse. Many splendid varieties have been produced by cultivation.

Glad'stone (Rt. Hon. WILLIAM EWART), D. C. L., b. at Liverpool, England, Dec. 29, 1809, fourth son of Sir John Gladstone, Bart., a Scottish merchant; was educated at Eton and Christ Church, Oxford, where he graduated double first-class in 1831; was made a fellow of All Souls' College; entered Parliament in 1832; became in 1834 a junior lord of the treasury, and in 1835 under-secretary for the colonies, under Peel; was sworn of the privy council 1841, and became vice-president of the board of trade and master of the mint; author of the revised tariff of 1842; president of the board of trade 1843–45; secretary of state for the colonies 1845–46; chancellor of the exchequer 1852–55, 1859–66, and 1873–74; high commissioner extraordinary to the Ionian Islands 1858–59; in 1868 he became first lord of the treasury and prime minister, retaining that

position until Feb. 17, 1874, when the ministry of Disraeli came into power. Mr. Gladstone's premiership was characterized by many important measures, such as the disestablishment of the Irish Church (1869), the Irish Land bill (1870), immense reforms in legal administration, the abolishment by royal warrant of the purchase of commissions in the army (1871), and the settlement of difficulties with the U. S. by the Geneva Conference. Gladstone entered public life a Tory and a High Churchman, but his political views have gradually changed, and since 1859 he has been a leader of the Liberal party. His literary abilities are great, and many of his Parliamentary speeches and financial papers are models of style and of argument. Author of *The State in its Relations with the Church* (1838); *Church Principles Considered* (1840); *Studies on Homer, etc.* (1858); *Essay on Ecce Homo* (1868); *A Chapter of Autobiography* (pamphlet, 1868); *Juventus Mundi* (1869); and of many published addresses, etc. His pamphlet on the *Vatican Decrees* (1874; enlarged by P. Schaff, New York, 1875) produced a profound sensation, and has called forth numerous replies, among which those of Dr. John H. Newman and Archbishop Manning are noteworthy.

Glad'win, county in the N. E. central region of the southern peninsula of Michigan. It is largely covered with forests. In the census of 1870 it was returned as being without inhabitants. Area, 484 square miles.

Gladwin, tp. of Midland co., Mich. Pop. 122.

Glagolit'ic Alphabet [Slavic *glagol*, a "word"], one of the South Slavic alphabets. According to Schafarik, it is older than the so-called Cyrillic, and was itself the invention of St. Cyril (see CYRILLIC ALPHABET), while the so-called Cyrillic is a corruption of this. Others make the Glagolitic much older than the time of Cyril. Still others regard the present Glagolitic as a corruption of the so-called Cyrillic. There is a small Glagolitic literature, chiefly ecclesiastical. A Glagolitic liturgy is used by some Dalmatian and Istrian Roman Catholic dioceses.

Glaish'er (JAMES), F. R. S., an aëronaut of Scottish parentage, b. about 1800; became F. R. S. in 1849, in consequence of his meteorological observations made in balloons; attained in 1862 the height of 37,000 feet above the earth's surface; became in 1865 president of the meteorological department of the British board of trade; has also been president and secretary of the Meteorological Society. Is one of the authors of *Travels in the Air* (1870).

Glamor'ganshire, the southernmost county of Wales, bounded S. and W. by the Bristol Channel, E. and N. by the counties of Monmouth and Brecknock. Area, 856 square miles. Pop. 396,010. The southern part, the "Vale of Glamorgan," is a plain, very fertile and well adapted to wheat-growing. The northern part is mountainous, and contains some of the richest coal-fields in the kingdom. Merthyr Tydfil, Neath, Swansea, and Cardiff (the cap.) are the principal towns.

Glance, a name for several native metallic sulphides, arsenides, etc. Galena or lead-glance, argentite or silver-glance, copper-glance, gold-glance, etc. are all valuable ores.

Gland [Lat. *glans, glandis*, an "acorn"], in animal and vegetable anatomy, a name applied to certain organs, some of which produce secretions or eliminate excretions, while others do neither. In plants, glands are integumentary cell-masses sometimes found at the bottom of a pit or depression of the surface of the plant, and sometimes elevated above the surface, or even stalked. Some vegetable glands appear to secrete poisonous principles (the nettle), others to contain essential oils (orange-leaf), while still others have no known function. In animals, the glands are of two kinds: (1) the *ductless* glands, including the mesenteric and lymphatic glands; and (2) the secreting and excreting glands. The ductless glands proper are the spleen, the thymus, and the thyroid gland, the suprarenal capsules, and probably the pituitary body. (Each of these is described under its alphabetical head.) In general, these bodies are proportionately or even absolutely larger in the fœtus than in the adult. It is almost certain that their function is to assist in fitting the materials of the blood for the work of nutrition. This function appears to be shared, especially in the fœtus, by the liver and the marrow or soft material within the cavities of the long bones. The glycogenic function of the liver is of this general character. The lymphatic glands (situated along the course of the lymphatic vessels which pass through them), the mesenteric glands (similarly situated on the lacteals), and Peyer's glands (situated near the absorbent blood-vessels of the intestine) are all similarly concerned in preparing the materials in the lymph, chyle, or blood, and adapting it to the nutrition of the organism. That the character of the absorbent and the ductless glands is essentially similar is illustrated by the fact that diseased states of either class of organs may lead to leucocythæmia. The glands for secretion include the salivary glands, the liver, pancreas, kidneys, mammary glands, and many others. The true function of secretion is the product of a material partly derived from the blood and partly originating in the gland itself, like bile or milk; the function of removing effete matters already existing in the blood is excretion. The functions of secretion, and perhaps excretion, are shared by some of the simple epithelial cells; and indeed the epithelial cell may be considered the essential element of all the glands of this class. Next higher in the scale come the follicles, simple tubes lined with secreting cells; and the most complicated and perfect glands of all, such as the liver and the kidney, are ultimately but aggregations of such follicles. The ovaries and testes may be considered glands in typical structure, but they produce living cells (sperm-cell, germ-cell), and not lifeless secretions.

C. W. GREENE.

Glan'ders (*equinia, malleus humidus*), a dangerous and very contagious disease of the horse, ass, and mule, communicable to man, but not, as far as is known, to other animals. It is characterized by an inflamed state of the nasal mucous membrane, upon which chancre-like sores appear, discharging a viscid humor. The lymphatic glands are secondarily affected. When the swelling of the lymphatics appears to supersede or exceed in importance the nasal affection, the disease is called FARCY (which see). Four types of the disease are recognized: acute glanders, acute farcy, chronic glanders, and chronic farcy. They are severe and fatal in the order named, but even chronic farcy, the mildest form, is seldom really cured. The farcy-buds, as the lymphatic tumors are called, are sometimes the seat of profuse or even gangrenous suppuration. Glanders has proved fatal to man in less than a week, but it has been known to last a year or more. A good constitution, a liberal diet, and perfect cleanliness may carry a patient through the disease and restore comparative health if the glanders be of the chronic type; but no remedy is known. Every glandered or farcy-budded horse should be killed at once, or reserved for experimental treatment by competent veterinarians.

Glan'vil, or **Glan'ville, de** (RANULPH or RALPH), an English jurist who in 1165 became sheriff of York; was custodian of Queen Eleanor at Winchester 1173–89; captured William the Lion at Alnwick 1174; justice itinerant 1175; was ambassador to the earl of Flanders 1177; led an army in Wales 1181; was connected with the English government in Ireland 1185; went with Richard Lion-heart to the Holy Land, and d. near Acre 1190. He is the reputed author of a valuable *Tractatus de legibus consuetudinibus*, often reprinted, and in 1812 translated by John Beames into English.

Gla'rus, canton of Switzerland, bounded by the cantons of St. Gall, the Grisons, Schwytz, and Uri. Area, 280 square miles. Pop. 35,150. It consists of three valleys enclosed by high mountains—namely, the Klönthal, the Sernfthal, and the Linththal; which latter is the most important, being formed by the Linth, which from the foot of Tödiberg (11,880 feet high) runs through the whole length of the canton and falls into the Lake of Wallenstadt. The climate is very severe; agriculture inconsiderable; the rearing of cattle is more important, but manufactures of cotton, linen, silk, and paper are the chief business of the inhabitants.

Glarus, in Switzerland, the capital of the canton of Glarus, on the Linth, shut in by lofty mountains, has some breweries and manufactures of cloth and calicoes. The Reformer Zwingli was pastor here from 1506 to 1516. On the night of May 10, 1861, more than 500 buildings, including the old parish church, were destroyed by fire. The inhabitants, most of whom are Protestants, are noted for the primitive simplicity of their manners. Pop. 5516.

Glas'co, post-v. of Saugerties tp., Ulster co., N. Y., on the Hudson River, 3 miles S. of Saugerties; has a large trade in brick and stone.

Glas'cock, county of the E. of Georgia. Area, about 160 square miles. Corn and cotton are staple products. Cap. Gibson. Pop. 2736.

Glascock (THOMAS), b. in Georgia; served as lieutenant at the siege of Savannah, under Count Pulaski, and exhibited great skill and valor; was appointed colonel of the troops ordered out by the legislature in defence of Georgia against the Indians, in the war of 1812, on the Western frontier; and was afterwards appointed general of militia; was a representative in Congress from Georgia from 1836–39, and highly respected for his talents and exemplary character. D. at Decatur, Ga., May 9, 1841.

A. H. STEPHENS.

Glas'gow, the commercial and industrial metropolis of Scotland, is situated in Lanarkshire, lat. 55° 51′ 32″ N.,

lon. 4° 17′ 54″ W., on both sides of the Clyde, which here is crossed by three elegant stone bridges and two suspension bridges, 21 miles from its mouth. The name of the city is of Celtic origin, and is said to signify "dark glen," referring to a ravine in the north-eastern part of the city formed by the Molendinar. Here stands on an eminence overlooking the whole city the cathedral, founded in 1187 by Bishop Jocelin, but not finished until the present century, and one of the finest buildings in the country. Close by stands the university, founded in 1451 by Bishop Turnbull, and from these two buildings as its nucleus the city gradually developed. In 1660 it had 12,000 inhabitants; in 1801, 83,769; in 1851, 347,001; in 1871, 547,538. When by the union between Scotland and England the trade with the American colonies was opened to Scotch enterprise, Glasgow became the centre of the tobacco-trade, and later of the sugar-trade with the West Indies, and thereby its prosperity was largely increased. Still more rapidly has it developed in this century, having become the centre of the cotton and iron manufacturing industries of Scotland. Situated as it is in a region rich in coal and iron, and provided with good shipping facilities, nature has given it the most splendid opportunities, and it has known how to use them. The Clyde has been made navigable for vessels of 2000 tons burden, and an excellent harbor has been formed on the Clyde and Forth Canal. Over 2,000,000 spindles, supplying 27,000 power-looms, and consuming annually 125,000 bales of cotton, are in operation. Nearly as extensive are the iron manufactures, especially the building of iron steamships, and the manufactures of chemicals. The chemical works of St. Rollox are the largest in the world, and employ more than 1000 hands. The dyeworks, calico-printing establishments, woollen manufactures, glass-works, and breweries are also very extensive. The value of the exports of 1871 amounted to £10,049,987; that of the imports to £6,577,575. The aspect of Glasgow is of course that of a great manufacturing place. Some parts of it—as, for instance, the former suburbs, Calton, Bridgeton, and Camlachie—are rather poor, but others again are very fine. The quays along the Clyde are open, lined with handsome buildings, and present many fine views. Buchanan street, with its magnificent shops, and Blythswood, Garret Hill, and Kelvin Grove, with their elegant residences, are also noticeable. In general, the streets are broad, straight, well paved, and well lighted. The city has three fine parks, beautifully laid out—the Green (140 acres) at the E. end, near the river; Queen's Park (100 acres) to the S.; and Kelvin Grove (40 acres) to the W. Besides the cathedral there are 175 churches and chapels: Established Church, 40; Free Church, 43; United Presbyterian, 37; Roman Catholic, 12; Independent, 9; Baptist, 7; Episcopalian, 5; Reformed Presbyterian, 4; other denominations, 18. A great number of elegant monuments are scattered throughout the city, among which the most noticeable are the statue of James Watt by Chantrey, that of Sir Robert Peel by John Mossman, and that of Sir John Moore by Flaxman; and it possesses a valuable collection of pictures, several good public libraries, and a large number of benevolent, educational, and scientific institutions. Among these is the Andersonian University, with schools of chemistry and medicine, and courses of gratuitous popular instruction. Glasgow sends three members to Parliament. It is the see of an Anglican bishop and the seat of a Roman Catholic delegate-apostolic, who has the rank of an archbishop *in partibus infidelium*. The Anglican see is united to that of Galloway.

Glasgow, University of, was founded in 1451, by Turnbull, bishop of Glasgow, by authority of Pope Nicholas V. Lord Hamilton gave it a building in 1480. Mary, queen of Scots, handsomely assisted the university in her day. Her son, James I. of Great Britain, gave it its present charter in 1577. In 1870 its new buildings were opened. The splendid Hunterian museum was presented to the university in 1781. Besides the regular academical course, there are law, divinity, medical, and scientific examinations, degrees, and professorships. Fine buildings have been lately erected. The university joins that of Aberdeen in sending a member to Parliament. The old University of Glasgow is not connected with the ANDERSONIAN UNIVERSITY (which see).

Glasgow, post-v., cap. of Barren co., Ky., on the Cumberland and Ohio R. R. (incomplete), and terminus of the Glasgow branch of the Louisville and Nashville R. R. It has 2 banks, 1 newspaper, a male and female college, 6 churches, several large mills and shops, 5 hotels, 1 carriage manufactory, 2 wagon manufactories, and 31 stores. It is only 3 miles from the flowing oil-wells of Kentucky. Pop. 733. E. Y. KILGORE, PUB. "TIMES."

Glasgow, post-tp. of Wabashaw co., Minn. P. 1769.

Glasgow, city of Chariton tp., Howard co., Mo., is in the N. E. part of the county, on the Missouri River, on the Keokuk and Kansas City R. R. It contains 2 banks, 1 newspaper, 2 large flouring-mills, 4 tobacco manufactories, 1 carriage and 1 wagon manufactory, 5 churches, a public library with 4000 volumes, and a large library building and hall, a city-hall, a city market-house, 2 colleges, a free public school, with a 2-story brick school-house, also a free public colored school, 3 hotels, and 9 stores. There are Masonic, Odd Fellows, and Good Templar lodges, also a German relief society. Glasgow is surrounded by a fine agricultural region, and is the centre of a great tobacco market. Pop. 1795. LUCIAN J. EASTIN, ED. "GLASGOW JOURNAL."

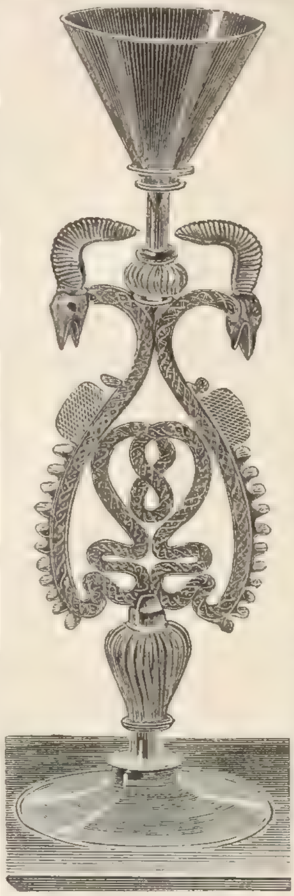
Glas'ites, the followers of John Glas (1695–1773), a Scottish minister. The sect is more generally known as the SANDEMANIANS (which see).

Glass [Saxon, *glaes*]. In the early stages of the Indo-Germanic tongues the word *glass* was applied to all shining bodies. The old Germans called amber *gles*, and the Swedes termed gold *glis* and *gläs*, while the Phrygians gave it the name of *gleros*. The word *glare* and the Latin *glacies*, French *glace*, "ice," all belong to the same family, in common with *glance*, *gold*, and *glitter*. The Sanscrit *las*, to "shine," also *kash*, probably indicate the general origin of the word. The name of glass is given, says Laboulaye, in its most general acceptation, to every transparent or translucid body which is brittle and sonorous at ordinary temperature, becomes soft and ductile, finally melting, under the influence of heat, and which presents when broken the peculiar appearance known as the vitreous fracture. In the arts the term is limited to compounds of silex, potash, or soda, sometimes with lime or oxide of lead, alone or mingled, giving by fusion a substance which is not soluble in water, nor, when well made, in any acid except hydrofluoric. Borax, oxide of manganese, litharge, red lead, and other materials are used in making glass, according to the kind wanted. Specifically, glass in its simplest form is composed of silica and an alkali. In order to aid the fusion together of its materials a flux is added to some kinds of glass; which flux is generally lead. An old story told by Pliny ascribes to the Phœnicians the invention of glass. Certain sailors of this nation, who had a cargo of soda, having landed by the Belus, a little river at the foot of Mount Carmel in Palestine, wanting stones to support their pots, used lumps of soda, which, being liquefied with the heat, formed with sand, which was also fused, glass. The possibility of this legend has been denied, but on insufficient data. It is certain that the Egyptians made glass at a very early period of their national existence. Paintings of the reign of Osirtasen I. at Beni-Hassan, representing glass-blowers making a very large vase, show that 3500 years ago, or before the Hebrew Exodus, the Egyptians were far advanced in this art; and the fact that glazing was applied to many objects about the same time indicates great skill not only in combining the materials of glass, but in its manipulation. The writer has observed in Egypt that the common blue glaze, such as was used in the earliest ages, is still made for inkstands, buttons, and other articles among the peasants. An Egyptian glass bead "of very advanced art," found at Thebes by Capt. Hervey, bears an inscription which indicates that it was made during the reign of Thothmes III. (1500 B. C.). The curious glass beads called *aggry*, which are valued in Ashantee like diamonds, and which are found deep in the ground in the Dinkira, Akim, Warsaw, Ashantee, and Fantee countries, are supposed to be of ancient Egyptian manufacture. If so, they prove that the Egyptians surpassed the moderns in some respects in making glass. "The variegated strata of the aggry beads are so firmly united, and so imperceptibly blended, that the perfection seems superior to art. The surfaces of some are covered with flowers and regular patterns so very minute, and the shades so delicately softened one into the other and into the ground of the bead, that nothing but the finest touch of the pencil could equal them. The agatized parts disclose flowers and patterns deep in the body of the bead; and thin shafts of opaque colors run from the centre to the surface." The recent Ashantee war has made the public in England somewhat familiar with these beautiful beads. There is observed in them different colored clays baked together without blending, as well as certain peculiarities of manufacture which cannot be well explained. It is remarkable that these beads bear some resemblance to the celebrated *glain neidyr*, or Druid holy snake beads of glass, found in Wales. The most beautiful specimens of *ancient* Egyptian glass in the British and other museums, which so closely resemble turquoise, jasper, and other stones, are nearly all opaque, and strictly speaking are a kind of smalt, such as was produced in great perfection by the ancient Romans and Venetians, and such as is made at present in Norway. Beckmann, however, declares that as regards the use of *cobalt*, smalt was invented about the beginning of the

sixteenth century, and that the blue glass of the ancients was colored with iron. However this may be, the Egyptian opaque glass was apparently thickened with earthy or aluminous matter. Under the Roman rule the Egyptians excelled in glass-making. Cæsar Augustus, having a great admiration for the glass of Egypt, when he had subdued that country (26 B. C.) ordered that it should form part of the annual tribute to be paid to the victors. This became a source of incredible wealth to Egypt, for the Romans, having thereby become familiar with Egyptian glass, ordered it in immense quantities, and the Egyptians devoted themselves to a very large export trade, of which they preserved the monopoly until the reign of Tiberius (14 A. D.), at which time, according to Pliny, this industry began to be cultivated at Rome. The Egyptians, to suit their customers, studied Roman (or rather Greek) patterns, and a beautiful fragment in the British Museum of Egyptian manufacture is of elegant Greek design. Long previous to this time the Sidonians and the Tyrians had made very elegant glassware. The only color which the Egyptians certainly originated is the *bleu de Nil*, a rich blue, which has of late, by a caprice of fashion, become the *mode* in Paris for glass beads. In the tombs of Thebes small solid pieces of turquoise-colored glass enamel have been found which were used for glazing beads and figures. The Egyptian glass of other colors is supposed to have been derived from the Greeks and Romans. The art of depriving glass of color and making it like crystal was a very late invention, but it would appear to have been Egyptian, since the vessels of pure transparent glass which the emperor Hadrian valued so highly were received by him at Alexandria. Glass had been made in Rome two centuries B. C., but under Nero Egyptian artists in Rome and the natural intelligence of the Romans, stimulated by the extravagant luxury of the court, developed the industry to such an extent that in a short time the Roman wares attained an elegance which is as yet one of the lost arts. Under Alexander Severus an entire and separate quarter of the city was filled with glass-makers (A. D. 210). From Rome the art spread to Gaul, Spain, and Britain. The Latin writers of the Augustan age make frequent mention of glass. Virgil compares it to the clearness of the Fucine Lake, and it would appear from Horace that it was very lustrous and transparent. Athenæus states that glass cups were made in his time imitating all the shapes of foreign potters. From the context it would appear that when Cassander founded his city he was very desirous that it should be distinguished by having its own peculiar pattern of wine-vases of glass, and that the statuary Lysippus gratified his wish. Glass continued for a long time to be imported from Egypt. The Phœnicians at a very early age had made and exported, even to Britain, much glass, and Alexander Nesbitt, a very high authority, thinks that the aggry beads are of Phœnician make—a theory which would account for their identity with the British *glain neidyr*. The analyses made by Prof. John of Berlin, given by Von Minutoli, show that Egyptian blue opaque glass owed its color to copper, or copper and iron; semi-transparent blue to cobalt, or the same with lime; violet to manganese; and black to iron. These processes were all employed by the Romans. Greenish glass was made in Abyssinia B. C. 722, but the colored glass discovered at Nineveh by Layard is probably Roman. According to Labarte, the beautiful little glass vases called Greek, so often found in tombs on the Mediterranean, are really Phœnician, though of Greek (or more rarely Egyptian) form. Those in the British Museum are very elegant. All forms and styles centred in Rome, where ere long glass was much more used than at the present time. Collectors soon sprung up; among these was the emperor Tacitus, of whom his biographer, Vopiscus, tells us that he was incredibly pleased with the elaborate adornment and variety of glass vases. The Portland Vase in the British Museum, which is made of two layers of glass, the surface being cut away by hand, is of such rich and firm material that four of the principal art-critics who have written on it believe it was cut from some stone, such as chalcedony or agate. It was in making glass of the texture and body peculiar to jasper and other stones that the Romans excelled. It bore cutting on the wheel and engraving better than any glass now made, took a gem-like polish, was less brittle, and did not display to any great degree the vitreous fracture. It partook, in fact, more of the character of *smalt*. These peculiarities explain more readily how it was that certain statues of antiquity, the so-called Holy Graal, etc., were mistaken as to their material for precious stones. Almost every means of decoration and manipulation of glass was known to the Romans, and every year brings forth new proofs of their astonishing knowledge. The largest collection in England of fragments of Roman glass, made by a lady some years ago, had in it every variety of whorls, spirals in sheets, strips, pipes, canes, rosettes, and threads of the Venetian style. As regards the rich stone-like quality of the glass, the writer has seen a specimen imitated to perfection under the direction of Sir William Drake in Murano. That gentleman says that while it is perfectly possible to imitate the peculiarities of the richer Roman colored glass, it would be impossible to do so at a profit, owing to the want of appreciation on the part of the public. The Romans excelled in working *glass within glass*; they also made singular combinations of glass and terra cotta, many of which would be almost impossible to workmen at present. But their skill was chiefly shown in the celebrated *diatreta* or bored work. This was done either by making a vase in two layers, the outer extremely thick, and then cutting away the latter in patterns of very bold relief, frequently of network and flowers, or else by applying the patterns with the ponty or with the blowpipe and other instruments, and then cutting the work when cold. The celebrated *diatreta* vase found at Strasburg in 1825, formerly belonging to the emperor Maximinian, was a fine specimen of the former process; some cheap vases found in Britain illustrate a mere imitation of the latter by *applied* glass. Very few Roman glass vessels of an ornamental character have been preserved, though urns of plain glass, used to contain the ashes of the dead, and bottles, are very common. But from the immense quantity of fragments it would appear that vases of singular elegance and great value were relatively much commoner than at present. It would also seem that during a long period there was a systematic destruction of these wares. The emperor Gallienus, it is true, drank from gold, and said of glass that nothing was more vulgar, but his subjects thought differently. The Romans made glass of transparent colors—blue, green, purple, and amethystine, amber, brown, and rose; of opaque, white, black, red, blue, yellow, green, and orange; and all these were remarkably good, the blue shades being extremely rich and varied, often closely resembling lapis-lazuli and turquoise. Their green, purple, and crimson are often very fine, and in the combinations, imitations of onyx, porphyry, granite, and agate are frequently produced which far surpass anything made at present. The analyses of this glass, as given by Von Minutoli, show the use of the oxides of lead, copper, or iron in combination with silica, alumina, and lime, these materials alone in different proportions forming opaque red, green, or transparent blue. They also used cobalt sparingly for blue, gold for rose-color, manganese for violet, and the oxides of tin and arsenic for white and orange. Two methods of working glass were highly developed—firstly, by combining rods or threads of glass of different colors, and joining them together in one rod or cane, which when cut transversely into slices gave as many duplicates of the pattern; and secondly, by spreading one color or coat over another. The former class includes the so-called mosaics and *millefiori*. This process was Egyptian, and as it is always found most perfect in objects of Egyptian character and design, there is reason to believe that to the last Egyptian workmen in Rome continued to excel the natives in this branch of the art. Very beautiful ornaments, representing such subjects as faces, flowers, and birds, are often met with, and these so astonishingly delicate and minute that feathers and hairs are accurately represented which are invisible to the naked eye. This was effected by making the pattern on a large scale or with large rods, which while hot were drawn out to any degree of fineness. In the British Museum there is a small bust in glass, with a lock of hair not broader than a horsehair, on the forehead; but when examined with a lens this lock is seen to be composed of nine threads alternately of transparent and opaque glass. Plaited bands and threads of glass, or rolled strips of many quaint patterns and of different colors, were embedded in transparent material with great skill. Glass in layers or strata, of which the outer was cut like a cameo, was the second class, and in this the Romans—or, what is more probable, the Greek artists who worked for them—have never been equalled. The Portland Vase, the amphora of the Museo Borbonico at Naples, and the Auldjo Vase of the British Museum are of this kind. The ground of these vases is generally transparent blue, lined with white, to "throw up" the color or opaque blue, while the *cut* outer layer is a rich opaque white. It should be remarked that some very elegant Roman glass is very light; one specimen is but little more than twice its weight of water—viz. specific gravity, 2049. Nearly all their colored glass *feels*, so to speak, differently from the modern. Some is heavier, but it is generally warmer. "The more a manufacturer gets acquainted with ancient fragments, the more firmly he appreciates the high state of perfection to which ancient workers in glass carried their art, but of which skill we find few records in ancient literature." The same author is of the opinion that the Romans used both lead and barytes to produce density and brilliancy. A very fine Roman goblet seen by him was much heavier than any

modern flint-glass. It had been blown in a mould, after the modern Bohemian manner, and cut on a wheel. *Krinkled* glass, as it is called, made by blowing bottles, etc., in cages of wire, was often made: "pillar moulding" was also extensively practised, a process by which projecting ribs are formed on the sides. Houses were also ornamented, both as to walls and pavement, with glass slabs or mosaics; as these were generally cut with a wheel, they must have been enormously expensive. Roman window-glass has been found even in England, and in the House of the Faun at Pompeii a small pane remains in a bronze sash. The Roman *specularii*, spoken of A. D. 377, were no doubt glaziers. A beautiful industry in glass among the Romans consisted of imitating gems, seals, and cameos for jewelry. Those who could not afford cut gems on hard stone gladly purchased imitations in glass, which were so well made as to be but little inferior to the originals. These are found in immense quantities about Rome. It is probable that in them we have copies of almost every gem or statue or work of art of any great value known to antiquity. A part of these glass gems were cast, but many were cut by hand with great care.

After the fall of the Roman empire glass-making declined, but not so rapidly as other arts. Glass mosaics of good quality were made at Rome from the time of Constantine until that of Charlemagne. Window-glass for churches was made, according to Lactantius, in the fourth century; it is alluded to by St. Jerome early in the fifth, and by Gregory of Tours and Fortunatus in the sixth. In the seventh century workmen were sent from Rome to glaze a church in England. As the art declined in Rome it flourished in Constantinople, and there is every reason to believe that it was cultivated to a considerable extent among the pagan Saxons, the Picts, and Irish, as all had their own peculiarly formed goblets and ornaments of glass. Those of the Irish are very characteristic, their mosaics displaying considerable skill, as is shown on the crozier of Lismore, the cross of Coirg, the shrine of St. Mogne, and the Tara brooch. It is supposed that as several Irish illuminated MSS. present an analogy with Egyptian art, and as there is direct evidence in the *Leabhar Breac* of seven Egyptian monks having come to Ireland, it is possible that Ireland learned the art, like Rome, from Egypt. Beads were made by all the Celts, even in the earliest times, with great skill, after the style of the Egyptian or Phœnician aggry type. A large bead from an old Irish grave near the Giant's Causeway consists of terra-cotta with inlaid glass. Very little remains of early Byzantine art; the bacchanalian cup of Baron Lionel de Rothschild, the situlæ in Venice, and two specimens in the British Museum are among the few known. After the revival of Byzantine art which followed the decline caused by the Iconoclasts, glass-making produced a few beautiful works, such as the famous Sacro Catino at Genoa, long supposed to be cut from a single emerald, and the blue cup at Monza, which is so perfect that it is doubtful whether it be not really a sapphire. In the eleventh century glass-making was practised with great success in Persia and Alexandria, and in 1163 Benjamin of Tudela says there were at New Tyre 400 Jews, "ship-owners and manufacturers of the celebrated Syrian glass." From this time elegant cups, bowls, and lamps of Oriental manufacture became common, enamelling having been extensively developed and applied to glass. Many European kings obtained specimens of this ware—much of it made at Damascus—and prized it highly. Among these are the cup of St. Elizabeth of Hungary (d. 1231), now in the museum of the University of Breslau, the glass of Charlemagne, and the celebrated Luck of Edenhall. The treatises of Heraclius, a Frenchman, and of the monk Theophilus, a German, of the eleventh and twelfth centuries, contain full details for making glass in great variety, both for windows and vessels. Glass-making was never lost either in France or England. In the former country it was extensively practised in the seventh century, and the records of Colchester (England) show that three *verrers* or glass-makers were taxed in that town in 1300. The tomb of Edward the Confessor in Westminster Abbey is decorated with glass mosaic, probably Byzantine or Venetian. Glass for such mosaics was made in Ravenna to the sixth century, in Rome to the ninth, and again in the twelfth and thirteenth. "In the latter centuries it was much used in Central Italy in the decoration of monuments, etc., where it was inlaid in white marble." Glass-making in Venice is asserted to date from the seventh century, but "both monumental and documentary evidences are entirely wanting as regards the period antecedent to the thirteenth century, with the exception of the mosaics in the churches of Murano, Torcello, and St. Mark." The earliest of these was completed in A. D. 882, but these were probably Byzantine. The immense labor of covering the interior of St. Mark's with glass mosaic in the eleventh and twelfth centuries probably attracted to Venice skilled Byzantine workmen; and as fine sand and plants yielding good alkali abounded there, glass making soon became a national art. It is evident that not only were the processes extant in the East speedily transferred to Venice, but that careful study of all the Roman devices of the millefiori, filigree, and ribbon work, never perhaps entirely lost, soon revived nearly all that was known of old. The taste for solid elegance had departed, but that for the light, flower-like, and even the frivolous, had increased; and in this direction Venice soon attained perfection. Millefiori was revived previous to 1100, and soon after the celebrated *vitro di trina* (lacework or reticulated glass) followed it. The millefiori or mosaic glass, made from sections of rods welded together, never equalled the old Roman in taste or success, but the filigree or reticulated far surpassed anything of the kind known to the ancients. The *latticino*-work is a variety containing milk-white threads, often running by hundreds in graceful spirals around a cup expanding from a common point, while on the other side another series spread in the contrary direction. In the fifteenth century Venetian glass attained incredible popularity. At this time porcelain was almost unknown,



Venetian Drinking-glass.

and, with the exception of gold and silver, glass furnished the only material for elegant ornament to gratify the inordinate luxury of an age in which all genius was devoted to ornament, and in which utility itself was despised unless equally developed with art. The Venetian glass is often strangely fantastic, and being made without lead is very light. The government guarded the secrets of the art with great jealousy, and when two Venetian glass-workmen went to Germany, they were followed up and murdered. The workmen still affect great mystery, but the real secrets of the craft have always consisted of extraordinary skill in manipulation or dexterity. In 1291 the glass-makers of Venice were all placed in the island of Murano, and the art, as a source of incredible profit to the state, was made highest in respectability, or, as it is generally claimed, all who practised it were held to be noblemen. At Murano six kinds of work were developed. In the sixteenth century the glasses were generally made so thin as not to bear enamelling. The *crackled* or *frozen* glass of the sixteenth century has since been successfully produced by Mr. A. Pellatt. *Avvanturino*, or smalt speckled with gold, was invented in the eighteenth century.

Venetian Drinking-glass.

Of late years the Venetian glass-work of Murano has revived, and its goblets, vases, and chandeliers, are extensively sold in London.

About the year 1860 several persons interested in the development of the industries of the Venetian provinces attempted to revive the then dormant art of glass-making in the island of Murano, where its traditions still lingered, and where the descendants of the glass-blowers of the sixteenth century yet existed, though no longer holding the proud position assigned them in the palmy days of the republic. The persons to whom the merit of this attempt is due were Muranese; amongst them may be mentioned Bigaglia, who sought to reproduce the composition known as avventurino; Franchini, who revived the "millefiori;" Fuga, who directed his attention to the fabrication of mirrors of the old Venetian

Venetian Drinking-glasses.

type; and Radi, who applied himself to the production of enamels. Dr. Antonio Salviati, a native of Verona, availing himself of the practical knowledge and enterprise of the manufacturers, sought to give a commercial value to their product by establishing an emporium for its sale in England; where he also sought to introduce a taste for mural decoration in glass mosaic. He also established a furnace on a small scale at Murano for the production of blown glass, and then called to his aid two of the most apt workers. Dr. Salviati was in some respects well qualified for the speculation he had undertaken, but his efforts would have been unavailing for want of capital and commercial experience had he not succeeded in interesting in its manufacture a gentleman whose early youth was spent in Italy, and who throughout a remarkable career never faltered in his exertions to restore to that country the ancient prestige which attached to her art production. Henry Austen Layard, the early explorer of Nineveh, took the work in hand which Dr. Salviati had initiated. By his influence, aided especially by Sir William R. Drake and W. L. M. Bate, a small private company was formed, and English capital and energy were called in. As is generally the case, the promoters of the new company, looking at the business too much from an art loving point of view, paid far too dearly for it, and in a very short time the comparatively large capital subscribed was practically lost; but those who had undertaken the direction of the company refused to abandon it; and by providing fresh capital, and by perseverance under difficulties of no ordinary character, they have succeeded in making the business self-supporting, have established ateliers where boys learn to become mosaic artists; and have succeeded in producing works which vie in beauty of form and material with the most renowned specimens of the best period of the Venetian glass manufacture. Space would not admit of our particularizing the various methods employed in producing the artistic specimens which the company can show. Specimens of their Egypto-Roman glass are undistinguishable from the fragments found in the tombs of Egypt, Greece, and the Roman empire. The peculiarity of Venetian glass consists in its extreme lightness, the elegance of its forms, and the great variety of material used, added to the fact that it is, almost without exception, produced by the blowpipe, without the assistance of moulds; so that the accuracy of the shape depends entirely upon the correctness of eye and the dexterity of the artist. Thus it presents that indescribable charm which handiwork possesses as compared with the product of machinery.

Engraved Flagon (Clichy Glass-work).

Glass was made during the Middle Ages, especially for windows, in all European countries. French specimens indicating skill and taste are not rare. The Germans produced an immense quantity of cylindrical drinking-cups, generally of greenish glass enamelled. These are called *Wiederkom* or "come-again." They generally bear the arms of the Roman empire, whence they were often called Römer, from which the English word rummer. They were made from 1553 to 1725, and are profusely imitated at the

Bohemian Glass.

present day. In the beginning of the seventeenth century the Bohemians began to produce fine crystal glass, and developed the art of engraving on it. Then Henry Schwanhard invented engraving with fluoric acid. In 1756, Bohemian goblets were made which cost £1,400—$7,000. The gold ruby glass, though already made by Romans and Venetians, was perfected in Germany by Kunckel at Potsdam in 1679, both with gold and copper. Great efforts were made in Germany, not without success, to excel in glass work. In elaborate work the Bohemians often equalled the Venetians. Bohemia has always been able to produce very cheap glass, and even when coarse it has a certain

odd character which commands a sale. At the present day more than 30,000 persons are engaged in its glass works. In the seventeenth century the French made vigorous efforts to excel in the art, and introduced Venetian workmen. Oxide-of-lead flint-glass was made in 1784 at St.-Cloud, and other factories were soon after established. Glass-casting and plate-works had previously been established by Thévart. At the present day French plate-glass is the best known. In England glass-painting was practised by one Bristol in 1338, and by others at the same time, especially by John Thornton of Coventry. The splendid W. windows of York cathedral are by him. In 1485, English window-glass cost much more than any other. Yet the art greatly declined until the middle of the sixteenth century, when a revival took place, and in 1557 window and coach glass was produced nearly equal to the Venetian. Cornelius de Lauroy, Jean Quarie, and other Flemings established glass-works in London in 1567; Dollyne and Carye of Antwerp obtained a monopoly to make glass. In 1589 there were fifteen glass-houses in England, and about this time the manufacture rose to importance. Sir Robert Maunsell's monopoly, obtained in 1615, to make and import glass, seems to have been used principally to obtain it from abroad. About 1670 the duke of Buckingham established a factory with Venetian workmen at Lambeth; from this came the small mirrors with bevelled edges still found in old houses. The influx of French Huguenot glass workers in 1685 gave an impulse to the manufacture, and in 1736 English glass was considered by Dr. Pococke to be superior to that of Bohemia, and only inferior to that made in Prussia, under royal patronage, at unlimited outlay. Plate-glass was made in 1771 at Prescot, Lancashire; the patent plate was introduced in 1840. At the present day perfectly pure glass, free from specks or striæ (lines), is made in England better than in any other European country; and with all the elegance and originality of Venetian patterns, its finest work is inferior to the English and French as regards mechanical accuracy. The French, however, at an early date made plate-glass very large and of good quality. Soon after 1688, Thévart at Paris and at St. Gobain, Picardy, cast plates 60 inches by 40. Blancourt in 1698 says that plate glass was invented 200 years before by a workman, who while melting glass spilt some which ran under a flat flagstone; when taken out it had formed a perfect plate. But St. Jerome tells us that in his time glass was *cast* into plates for windows. In England glass-making suffered until within a few years from excise restraints which now seem incredible, every process requiring a permit from an official. It is a matter of astonishment, says Pellatt, how flint-glass works existed at all under such commercial and manufacturing hindrances as were imposed by the excise.

Optical glasses are probably almost as old as glass, for it is not likely that men who worked in this material would not almost at once observe the magnifying properties inherent in every piece thicker in the middle than at the sides. A lens was found in Nineveh, and the Chinese chronology of Père Gaubil states that the emperor Chan (2283 B. C.) observed the planets through an optical glass. Ptolemy is said to have had a telescope in Egypt. In 1303 a French surgeon, Gui de Chauliac, recommended spectacles as well known. A tombstone in Florence declares that they were invented by Salvino d'Armato, who died in 1317. Cornelis Drebbel (1572) and Zachary Janson (1590) invented the compound microscope, afterwards perfected by Dollond. Kepler (1571) is regarded as the modern inventor of the telescope. The telescope was invented, or rediscovered, in 1606 by Hans Lippershey of Middelburg, Holland; the states-general granted him a patent on condition that he should add a second tube to it, or make it *binocular*. The so-called Galileo's glass was invented by Metzu in 1609. Glass for optical instruments is the most difficult to make. According to Lardner, one of the most scientific opticians in London was unable during ten years to obtain a piece sufficiently free from defects to be used in a telescope. Great advances in the preparation of optical glass were made by M. Guinand, a Swiss, and by Fraunhofer of Munich. A single pot or a single fragment of pure glass has more than once stirred up an excitement among all the opticians in Europe, and caused a spirited competition to obtain it. The method by which Guinand was enabled to make larger and clearer lenses than any known before consisted in agitating the glass while in fusion and annealing it in the pot; a method which has been greatly improved of late years by Mr. Pellatt. From Guinand's son the secret was conveyed to Bontemps of Paris, by whom the glass was further improved and enlarged. In 1848, Bontemps transferred his work to the celebrated glass-factors, Messrs. Chance, who possess the largest works in England, and by whom lenses are now made of extraordinary size and purity.

Qualities of Glass.—Glass is a salt, every salt being the result of a combination of an acid with an alkaline base—*i. e.* an alkali or alkaloid of organic nature. In the case of glass the acid is silica or silicic acid, and the *base* a mixture of an alkaline with an earthy base, such as lime, or with the oxide of one of the heavy metals, such as lead. Silica exists in nature in such minerals as flint, agate, rock-crystal, or quartz. Its character as an *acid* was first clearly established by Berzelius. This does not appear until it is at a red heat, when it acts very powerfully, and, expelling other acids, combines with *bases* to form solid compounds or salts called silicates. Glass may be made by substituting boracic acid for silica. It is remarkable that while the silicates formed by nature crystallize, those made by art do not. Potash and soda are the most important ingredients, next to silica itself, in glass. They act as a flux, rendering the glass easy to melt. Lead renders glass brilliant, clear, and fusible, but in excess softens it. Lime increases the density, hardness, and lustre of glass. Carbon in the form of charcoal aids the fusion. Glauber's salt with lime is sometimes used instead of soda, and muriate of soda, or common salt, is extensively used as a flux for coarse ware. A small admixture of the black oxide of manganese is essential in making flint-glass, its property being to clear and purify the mass from the discoloration caused by particles of carbon and iron. For this reason it is called the "glass-maker's soap," as it appears to wash away all impurities. In excess, manganese causes reddish colors. This may be removed by agitating the glass. Coarse greenish glass is, however, made white by an *excess* of manganese. The purple-pink windows sometimes seen in dwelling-houses are made so with manganese. As a general principle, the glass is less fusible and offers greater resistance to the action of water and acids the larger its proportion of silica and alumina, while the contrary results from an excess of potash, soda, baryta, lime, magnesia, or oxide of lead. Lustre and the refractive power of glass are produced in the highest degree by lead-glass, next by baryta, next by potash, and least by soda-glass.

Toughened Glass.—A very recent and important invention has been made by M. de la Bastie, which has been fully tested and verified by scientific men in London and New York. It consists of plunging hot glass, manufactured in any form, into hot oil or a heated oleaginous compound. When cool it becomes almost as tough as metal, so that a cup or mirror made of it may be thrown violently many feet or dropped on a stone floor without receiving any injury. When very violently broken it separates into granulated fragments, without sharp edges, so that the danger of being cut by it is much diminished. The process does not affect the transparency or beauty of the glass in any way.

Frit or *batch* in glass-making consists of the ingredients needed for any kind of glass powdered, mixed, and carefully dried. The following are the ordinary glasses: Bottle-glass, sp. gr. 2.732, very infusible, from its excess of alumina over soda.—French: prepared from varec, 30 or 40 pounds; lixiviated ashes, 160–170; fresh ashes, 30–40; ferruginous clay, 80–100; cullet (old glass), 100; or from quartz sand, marl, wood-ashes, and salt. English: lixiviated ashes, 100 pounds; kelp, 40–90; wood-ashes, 30–40; clay, 80–100; cullet, 100. Apothecaries' and chemists' vials and glass-ware, hard, bearing changes of temperature well: common potash, 30–35 pounds; lime, 17; ashes, 110–120; binoxide of manganese, 0.35–0.50.

Window-Glass.—In France a mixture is used of 100 parts quartz sand with from 30 to 40 parts of dry carbonate of sodium (or as much sulphate with charcoal), and 30 to 40 parts of chalk. German window-glass consists of a double silicate of chalk and potassa; *e. g.* 100 parts of quartz sand, 50 parts of pearl-ash, from 25 to 30 parts of chalk, and 2 parts of nitre. In many mixtures common salt is an ingredient. According to A. F. Gehlen, it is prepared with 100 parts of quartz sand, 50 parts of dry Glauber's salt, 17.5 to 20 parts of lime, and 4 parts of charcoal. Peligot's formula: silica, 69.06; lime, 13.04; soda, 15.2; alumina, 1.18. An analysis of ancient window-glass from Pompeii gave—silica, 69.43; lime, 7.24; soda, 17.31; alumina, 3.55; oxide of iron, 1.15; oxide of manganese, 0.39, with traces of copper. No fixed proportions of materials can, however, be agreed upon, and the manufacturer has to determine the amount of real alkali in every fresh supply of ash.

Plate Glass.—Silicic acid, 72; soda, 17; lime, 6; oxide of iron, 2; alumina, 2. This is similar to crown-glass, the only essential bases with silicic acid being soda and lime, but a larger proportion of alkali being used, the point of fusion is lower than in crown-glass, used for mirrors. Plate-glass, according to Dr. Knapp, differs from window-glass (including crown and cylinder sheet-glass) only by greater purity of the materials. The superiority of the French plate-glass, especially that of St. Gobain, to English, is

due to the fact that it is a true chemical compound, consisting of one atom of the trisilicate of soda and one of the trisilicate of lime, with a small percentage of alumina. The English plate-glass, on the contrary, consists of a mixture of two glasses of different densities, its inferiority being shown by an imperfect reflection. It is, however, harder than the French, and cheaper. Flint glass contains more lead than the crystal, and is made of silicate of potash and oxide of lead. Analysis: silicic acid, 45; potash or soda, 12; oxide of lead, 43. Recipe: (Bontemps) white flint sand, 261; minium, 261; potash, first quality, 60; borax, 18. Guinand's: flint sand, 225; minium, 225; potash, best, 52; borax, 4; nitre, 3; manganese, 1; arsenious acid, 1; cullet, 89. *Crystal-Glass,* used for optical purposes: silica, 59.2 (or boracic acid); potash, 9, and lead, 28. Tomlinson: silicic acid, 61; potash or soda, 6; oxide of lead, 33. Newcastle crystal: silica, 0.514; potash, 0.094; aluminum, 0.012; oxide of lead, 0.374. Practical mixture, or frit: white sand, 100; minium, 55 to 65; potash, 25 to 30; nitre, 2 to 5; peroxide of manganese, 0.001; arsenious acid, 0.0005 to 0.001; cullet, 50 to 100 parts. In the experiments conducted by Herschel, Faraday, Dollond, and Roget in Pellatt's glass-house, an optical glass was formed of remarkable purity, consisting of silicate of lead and borate of lead, the materials being vitrified in a platinum crucible, and the air-bubbles disengaged with spongy platinum in powder. This glass is very pure, but decays gradually. *Strass,* a variety of flint-glass used for imitating precious stones: silica, 44; potash, 12; oxide of lead, 43; and colored by various metallic oxides. Recipes: rock-crystal ground, 4056 grains; red lead, 6300 grains; pure carbonate of potash, 2154 grains; borax, 276 grains; arsenic, 12 grains. Recipe No. 2: of same ingredients, 3456, 3328, 1944, 216, 6. *White Table Glass for tumblers, tubes, etc.:* silica, 71.7; soda or potash, 15; lime, 10. Recipes: potash, 40; chalk, 11; sand, 76; manganese, ½; white cullet, 95. Bohemian table or plate-glass: quartz, 63; pure potash, 26; sifted slaked lime, 11; and some cullet. *Enamel* consists of silica, soda, and oxide of lead, rendered opaque by oxide of tin or antimony. The proportions vary greatly, according to the colors required. Enamel is for the most part a double silicate of lead and potassium, rendered opaque by stannic oxide. In one specimen Dumas found 8.3 per cent. of potash, 50.3 of oxide of lead, 9.8 of stannic acid, and 31.6 of silica. Arsenious acid produces a similar effect to the stannic oxide.

"The mirror above a mantelpiece can be made from the mantelpiece and the ashes and fire beneath; the stones furnish silex, the ashes potash, and the marble lime." The base of all glass is sand, and the quality of this is of great importance. Formerly calcined and powdered flints were used, but now in England sand from the Isle of Wight, Lynn, and Reigate is used. To fit it for use it is dried or burned, sifted and washed, the Isle of Wight sand requiring eight waters. Much fine sand is taken from New Jersey to France. The two principal modern inventions in glass-work are both entirely American. One of these is *pressing* glass into shape by machinery; the other is the process invented by Tilghman of Philadelphia, by means of which glass or stone may be cut or worked into any shape, or be engraved upon, by the simple process of a sand-blast, the sand being blown steadily upon the portions to be removed. The sand acts with great difficulty on organic or fibrous substances, but very promptly on hard and amorphous bodies, so that if a piece of lace be put on a pane of glass exposed to a sand-blast, the pattern will be cut on the glass without injuring the lace. In preparing the *frit,* saltpetre, binoxide of manganese, and arsenic are sometimes used to purify the melted metal. Red lead (minium, Pb_3O_4) has the same effect in the compound glasses, which renders it superior to litharge. Lime, soda, and potash are used in all their forms. Coal, wood, or peat is the common fuel, great care being taken to exclude the smoke or carbonaceous deposits, and to use only the best qualities. In some furnaces in America powdered resin is employed to great advantage.

Coloring or Staining Glass.—This is a very important part of the manufacture, involving much skill. At one time dark *massive-colored* glasses were generally used. By color *en masse* we mean that which is tinted all through. At present hues are conveyed by covering a body of pure flint glass with one or more thin coatings of intensely colored glass, whether of blue from cobalt, green from iron and copper, or ruby from gold. The more metallic coloring oxide is employed, the less lead must be used, so as to equalize the composition. Massive colors produce a shadowy blackness, which was, however, turned to account by the artists of the Middle Ages, by *leading* their tints of blue, red, yellow, amethyst, and green into windows, either thicker or thinner of solid or *cased* glass as the required effects suggested. The following are approved recipes: Prepare a very fine flint glass—*e. g.* carbonate of potash, 1 cwt.; minium or litharge, 2 cwt.; sand, washed and burned, 3 cwt.; saltpetre, 14–28 pounds; oxide of manganese, 4–12 ounces. Add to this for ruby red, to 6 cwt. of the batch or frit, 4 ounces of oxide of gold; ancient red, use protoxide of copper. The art of making this, though known to Neri and Kunckel, was entirely lost until revived in 1828 by Engelbart of Zinsweiler. Red schmelz, or smalt, is prepared by a very long and intricate process, given by Laboulaye. Azure blue: to 6 cwt. of batch add 6 pounds of oxide of copper; cobalt blue, by adding oxide of cobalt or smalt. The cobalt forms a transparent glass. Amethyst or purple: 6 cwt. of batch, 20 pounds of oxide of manganese (and a little nitre—*Laboulaye*). Yellow common topaz, add to the glass charcoal in powder. Common orange, 6 cwt. of batch, 12 pounds of iron ore, and 4 pounds of manganese. Gold topaz, 6 cwt. of batch, 3 pounds of oxide of uranium. Gold yellow, to a composition for dark violet (peroxide of manganese) add a little oxide of iron, giving a brown violet; increase the iron, it will become a fine yellow, such as is used to spin into gold threads in woven glass. Green (grass), protoxide of chrome, or a mixture of antimony glass and oxide of cobalt. Emerald, to 6 cwt. of batch add 12 pounds of copper scales and 12 of iron ore. A far more beautiful emerald is made with the oxides of nickel and uranium. Black, peroxide of manganese, oxide of copper and of cobalt, equal parts, or with a mixture of iron filings, peroxide of manganese and oxide of copper or of cobalt. Soft white enamel, opaque, to 6 cwt. of batch add 24 pounds of arsenic and 6 pounds of antimony. Hard white, 200 pounds of tin and lead-putty. Hyalith is a black glass, so hard that it may be used freely to contain boiling liquids. It is made from the slag of forges, added to the batch of common white glass, and charcoal dust in excess. Basalt or lava may be used for the scoria or slag. It may be made in different colors, but is always brilliant and susceptible of a high polish.

Manufacture.—There is perhaps no manufacture in which every successive stage requires so much care as glass, and none in which results on so large a scale involve such delicate skill. A puff of smoke or a sudden draught of air, imperceptible to an invalid, may ruin an immense quantity of "metal;" and when the wares are made they are, so to speak, in their infancy, and must be carefully conducted through the process of annealing or tempering by judicious cooling. There are six kinds of glass, each requiring a peculiar fabrication and a peculiar building and furnace. These are bottle, crown, sheet-window, plate, flint, and colored glass. As a rule, glass-houses are conical, from 60 to 100 feet high, and from 50 to 80 in diameter at the base. With the exception of the pot-rooms and cutting-shops, all the processes are conducted on one floor, the prompt removal of the glass in its different stages being a matter of the utmost importance. The whole should be so planned that the crude materials in the course of preparation shall always be moving upward to the fusing-furnace, and when manufactured be drawn downward to the warehouse or packing-shop. All furnaces are buildings of circular or rectangular form, four different kinds being needed, which are built together or separately. Of these one is the main furnace, employed for supplying the melted glass from the pots in which it is contained; of the others, one is the annealing furnace, in which the wares are annealed or tempered when made or while making; and the other is employed for baking the raw materials combined, and called frit or batch. Having to furnish a temperature between 1800° and 2700° F., these furnaces are entirely constructed of fire-brick made of infusible clay and a cement obtained from the fusion of old pots made from the same clay. In addition to these is the flashing-furnace, where articles being made are rewarmed or restored to sufficient softness as they cool. The furnace for baking and partly fusing the frit is called a calcar, and that for annealing, a leer. For window-glass there is also the spreading-furnace, in which cylinders while soft are expanded into plates, while in a crown-glass factory the blowing-furnace is the principal. A flint-glass furnace is between an air-furnace and an oven—*i. e.* it must not have too much draught, and yet must be very hot. A large cave extending through the subterranean area of the glass-house, connected with the open air at each end, under the bars of the furnace, receives the fallen cinders, and supplies the oxygen for the combustion of the fuel. At right angles from the large cave are smaller caves, communicating so as to catch the wind from as many aspects as possible. A flint-glass furnace is reverberatory—*i. e.* with no heat or flame issuing from its centre. If the furnace contains ten pots, it will have as many flues or chimneys, and the flames escape through "linnet-holes," of which there is one in each flue. The smoke passes into the outer brick dome of the building, and thence through the funnel and great chimney. The

bottom part of the furnace is called the *siege*, or seat. The fire never goes out in a glass house; if a part of the arch or crown of the furnace is destroyed by heat, the repairs are made by cramming the entire furnace with coals and cinders, which stops the draught, and on this the workmen rebuild with arch-bricks and fireproof clay. A furnace in England lasts from three to ten years; in France, but one or two years. Between every two adjacent flues in the furnace is an aperture called the working-hole, opposite to and a little above each pot, for the purpose of putting in raw material or taking out melted glass. The pots are from 18 inches to 3 feet high, 2 or 3 inches thick, the bottom 4 inches. They are either round, oval, or rectangular. For crystal made at the coal-mine they are shaped like a retort with a very narrow neck, or are hooded—having a mouth in front. Large pots cost £10 - $50, each. When a pot wears away or splits in the furnace, it is repaired as it remains by different methods, and may thus be preserved for several weeks. The breaking away of an old pot and setting a new is a very difficult and sometimes dangerous process. After being kept for nearly a year free from change of air, the pot is annealed or tempered at a red heat for five days, and then carried to and placed in the main furnace. This requires much skill. Filling the pot with new glass is *founding*. It requires constant skimming—an operation only confided to a very skilful workman. The process of making up the hot glass or metal is called a journey (French, *journée*, a "day"). It is from 30 to 40 hours. The shorter the time for preparing the glass, the better. It is, if good, quite liquid. If by delay it becomes thick, it is spoiled, and must be turned into cold water and used as cullet. The men generally work in England from Monday to Friday, by piece-work. In France their labor is by the day.

Annealing is an important process with glass-ware. If not well done, the articles will, it may be months afterwards, break suddenly. An unannealed bottle will be shivered if grains of sand or a bit of flint are shaken within it, and the writer has seen a massy glass tube separate with light blows into evenly-divided rings. This results from a different arrangement of the molecules through the whole mass, caused by sudden cooling. The furnace for annealing is fed for *plate* with coke, and has different degrees of heat. The time required is from 6 to 60 hours, according to the size of the articles. Much depends upon the wind. Great losses result when a sudden contrary current drives back the heated air. Very large objects are annealed in heated sand.

Working.—The ordinary tools of the glass-house are nearly the same to-day as those described by Blancourt in 1699. They consist of the pucellas, which resembles a pair of wool-shears, but with dull edges. The spring tool is like sugar-tongs, but straight and without bowls. The shears are exactly what the name indicates. The battledore is a square trowel. The punty, ponty, or pontil is a solid rod used to support the glass while working, and the blowing-iron is a hollow tube about four feet long, which is enlarged at the end to be dipped into the metal. The marver (French, *marbre*, so called from the material once used) is an iron plate one inch thick, highly polished, on which the glass is rolled into even shape. Two kinds of ladles are used to transfer or skim the glass, and also a rake to stir the frit or metal. The chair on which the workman sits is a low flat seat, with two long projecting arms. These are faced with iron, on which the blowing-iron is rolled to give a rotatory motion, while the hand with the pucellas shapes the article. If the workman now wishes to make a wine-glass, he puts the blowing-iron through a working-hole, dipping the end into the liquid metal. It is removed with a ball of hot glass sticking to it, which is at once blown by the breath into a large bubble, which has one end flattened on the marver to make the bottom of the vessel. In this condition it resembles a bottle without a neck, stopped by an iron rod. On the middle of the flat surface, which is the bottom of the wine-glass, a small ball of hot glass is now put. From this soft ball the stem is shaped with the pucellas while the whole is rolling up and down on the arms of the glass-maker's chair. The moment the glass hardens by cooling the action of the pucellas must cease or the surface will be rough. Another bubble of glass is now blown and attached to the end of the stem, to make the flat disk or foot on which the glass rests. This second bubble or globe is now cut open and flattened out with the pucellas, while the whole is being turned as before on the arms of the chair. In this condition the whole resembles a champagne bottle without a neck, but stopped with the blowing-iron tube, while on its flat bottom are the stem and foot of a wine-glass, the other iron rod, a pontil, which has been used to make the foot, in a line with the blowing-iron and stem. The pontil from this time supports the glass, for with a touch and a tap from the cold pucellas a crack is made in and around the bottle or bubble at the place where the rim is to be. This at once makes of it a wine-glass, but with a bowl of the shape of a barrel. The rim is then sheared smooth, and the glass is *flashed*, or rewarmed, at a furnace made for this purpose, and rolled into the ordinary form on the marver or iron slab. When thus finished and ready for annealing, it is knocked off from the end of the pontil by a sharp blow. This process is, with few variations, exactly that which is followed in making all articles of blown glass, whether tumblers, pitchers, dishes, salts, lamp-shades, or jugs. Bottles, vials, and all objects covered with projections, bulbs, letters, ornaments, or, as it is called, "pillar-moulding," receive this from being pressed while soft into a mould. These moulds are made of metal in two or more pieces, and open and shut. By blowing the glass is pressed against the hollows which form the ornaments or mouldings. Workmen acquire great accuracy in taking out on the irons exactly the quantity of glass required—a very important matter in making articles to be of the same size. Tubes for thermometers, etc. are made by drawing out to an incredible length, sometimes 70 feet, the bubbles of glass. *Casing* glass is the laying one very thin coat of colored glass on another, generally white. It is simply effected by blowing a bubble, cutting off one-half of it, and capping it on the white ball of hot glass. The American invention of pressed glass consists in forcing hot metal into a mould, not by blowing, but by mechanical pressure. Great practice is required to determine the exact quantity of metal, and to keep the moulds at a regular temperature just short of red heat. Glass-cutting or grinding is simply effected on the lathe and wheel with sand and water, pumice, etc. Beads are made by cutting tubes into segments. The Venetians are still unrivalled in this branch of the manufacture, and supply the greater part of the markets of the world, though immense quantities are made in Germany. The tube is cut into bits, which are filled with a paste of ashes and sand. They are then put with sand into a cylinder which is heated and turned. The motion renders the soft beads globular, the sand keeps them from adhering, and the paste preserves the bore. The wonderful skill which the workmen attain is best shown in making crown-glass in sheets. In this so much as nine or ten pounds of melted glass are sometimes taken out at once on the blowing-pipe. This is blown into a long ball, and reheated to expand it. At this stage a solid iron rod charged with glass is made to adhere to the centre opposite the blowpipe, which is now detached, leaving an orifice. This orifice enlarges as the ball is *flashed* or heated and rapidly revolved, until it expands suddenly with a flap into a large round plate four or five feet in diameter, and of uniform thickness except at the centre, where it forms, of course, with the pipe a lump or "bull's eye." It is then cut into panes. When the workman's breath is insufficient to enlarge the glass, the growth is effected by blowing in water, which as vapor at once expands the ball, or sometimes by a blowing-machine. Plate-glass is simply made by pouring the metal on a table covered with copper. On either side is an iron rod or bar the thickness of the proposed sheet, and on these an iron roller passes, reducing the metal to the exact thickness required. In grinding plate-glass, two plates are ground, one on another; one, imbedded in plaster of Paris, lies on a table, while the other, also cased in the same substance and heavily weighted, is moved uniformly and rapidly over its surface. Sand and water, emery of different grades, and finally tripoli and putty, are employed to polish it. When blown, sheet-glass is expanded into cylinders, which are while warm cut along their entire length with a steel point or glazier's diamond, and thus made into sheets which are flattened. As such glass cannot be perfectly flat like plate, neither can it be polished to perfection, as it would break under pressure. To obviate this, Mr. James Chance invented the process of laying a sheet on soft leather, while it was polished with another sheet. The elasticity of the glass prevented its fracture. Every year now sees great improvements in manufacturing large sheets of glass, and some of the most important and recent are of American origin. As regards all glass-ware made by hand, success depends entirely on the skill of the individual workman, and the simple description which we have given of the making of a wine-glass applies to every object. The formation of the infinite variety of wares produced in flint-glass houses depends more upon skill, adroitness, and tact than upon the ingenuity of the tools; in truth, the perfection of the product of the furnace, as regards its workmanship, depends chiefly upon the tact and intuition of the glass-blower, avoiding as much as possible the use of tools. Iron tools should only be employed in the earlier processes to produce the crude form, and the wooden tool used but sparingly; whilst the finishing and intermediate shaping depend chiefly upon the application of centrifugal force by

rapid hand-rotation; upon the expansion given to air to widen the forms while reheating at the aperture of the furnace, technically termed "flashing;" and upon a skilful final throw.

Iridescent Glass.—Pieces or objects of ancient glass dug from the ground are often exquisitely beautiful. Sometimes they are like the richest and most varied wings of butterflies or the feathers of peacocks, presenting every shade of every color known, and at other times they resemble metal. The writer has found in the Palace of the Cæsars pieces of a cup which resembled intensely burnished silver, but with a pearl like tint. This is caused by decay, or, more accurately speaking, by the action of ammonia. In fact, it has been imitated by using this agent. The rainbow-like film which is often seen in glass in stables indicates the beginning of the process. The iridescent scales are a mixture of silica and earthy silicates, the alkaline silicates having disappeared.

Soluble or water glass is a simple silicate of soda which is perfectly soluble in hot water, but which becomes hard when exposed to the air. It may be obtained by dissolving pure silica, obtained by precipitation, in a boiling solution of caustic potash; but this process is too inconvenient and costly to be practised on a large scale. It may be made by mixing 30 pounds of pearl-ash, 45 of sand, and 12 of powdered charcoal, to be heated for five or six hours. It is then powdered and dissolved in boiling water; 1 part of glass requires 4 or 5 of water. It is boiled until no more glass dissolves. Carbonate of soda may be substituted for potash, and a better kind of glass results from mixing the two thus made. It is used for many purposes—as a glazing which resists water and fire, as a cement for glass, and as glue or isinglass in coloring. It requires to be mingled with aluminous or other bodies when used as a protective glazing.

Works on Glass.—*L'Arte Vetraria distinta in libri sette*, by ANTONIO NERI, Florence, 1612; German version, with additions, in the *Ars Vitraria experimentalis*, by J. KUNCKEL, Baron von Lowenstein, 1697; translated into English, with curious additions, by A. MERRET, in 1662; re-edited and privately printed by SIR T. PHILLIPPS, 1826; a French version, with very curious additions, by M. ZIMMERMAN, 1756; *De l'Art de la Verrerie*, by FRANÇOIS HANDICOURT DE BLANCOURT, Paris, 1697; the English translation of 1699 is full of useful information, and written in so quaint a style as to make it interesting to the most general reader; *Vitreous Art in the Art Treasures of the United Kingdom, Manchester Exhibition 1858, and Exhibition of Works of Industry of All Nations 1851; Curiosities of Glass Making*, by APSLEY PELLATT, 1849; *Marvels of Glass Making in all Ages*, by A. DE SAUZAY; English translation, 1870; *L'Histoire des Arts industriels au Moyen Age et a l'époque de la Renaissance*, by M. J. LABARTE, Paris; *Inquiry into the Treaty of Commerce with England* (French), Paris, 1861; *La Manufacture de St. Gobain*, by M. A. COCHIN, Paris, 1866; PELIGOT, *Douze Leçons sur l'Art de la Verrerie*, Paris; *Il Museo di Murano*, Venice; HOWELLS' *Familiar Letters from Venice*; *Notes on the History of Glass Making*, by ALEXANDER NESBITT; *An Introduction to the Catalogue of the Collection of Glass formed by Felix Slade and presented to the British Museum*, privately printed, 1871.

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Glass, American Manufacture of. The manufacture of glass was commenced in the American colonies at a very early period, though probably in a rude way, and confined to the manufacture of coarse black bottles. The production of crude potassa from the ashes of the forest trees felled by the early settlers, and the presence of a clean, sharp sand on or near the shores and river-banks, probably suggested this manufacture. We find in Howe's *Historical Collections of Virginia* a quotation from Capt. John Smith's *History of Virginia*, under date of 1615, in which he states that "the labor of the colony had been misdirected in the manufacture of ashes, soap, glass, and tar, in which they could by no means compete with Sweden and Russia." In 1622 a new building which had been commenced for glass works in Jamestown, Va., was abandoned in consequence of the Indian invasion and massacre. Other glass-houses were undoubtedly established during the seventeenth century, and probably some along the Hudson River or its vicinity. In the eighteenth century there were a considerable number in existence, though all, we believe, confined to the manufacture of bottles and coarse hollow glass-ware. One of the earliest of which there is any definite or particular account was established about 1754 in Brooklyn, N. Y., by a wealthy Dutch gentleman by the name of Bamper. Stiles, in his *History of Brooklyn*, vol. i. p. 309, thus refers to it: "Mr. Bamper was largely interested in the establishment of a glass-factory on almost the identical spot lately occupied by the glass-works on State street. The first bottle ever made at this factory, having blown on it a seal bearing the name of Mr. Bamper and the date 1754, is still preserved among the curiosities of the Long Island Historical Society." A glass-factory of considerable extent, and remarkable for its employment of Hessians and Waldeckers who were deserters from the British army, was established 1779 or 1780 at Temple, N. H., by a Mr. Hewes of Boston, but was burned down in 1780–81, and was not rebuilt; some of its products, a glass plate, etc., are in Harvard University. There was a glass-factory established by Albert Gallatin and his associates at New Geneva, on the Monongahela River above Pittsburg, in 1787, and it is supposed one at New Haven, Conn., in 1789 or earlier. In 1795, the first glass factory in Pittsburg, Pa., was erected by Gen. O'Hara and Major Craig, and the manufacture of window-glass commenced. This was the first manufactory which attempted the production of window-glass in this country. Soon after this other glass-works were established in Pittsburg and its vicinity, in Boston and elsewhere in Massachusetts, in Rensselaer co., N. Y., in New Jersey, in the vicinity of Philadelphia, and in Kings co., N. Y. In 1802, Gen. O'Hara added the manufacture of flint-glass in a separate establishment to his other works, and in 1807 a second flint-glass factory was erected at Pittsburg. In 1813 there were five glass-works at Pittsburg, producing glass to the value of $160,000, and probably about 25 in the entire country. We have not the statistics of the number in 1820, but in 1830 there were 21 furnaces for manufacturing crown-glass, having 140 pots, averaging 100 "tables" of crown-glass each every three days; of these, 6 were in Boston. There were also 23 flint-glass-works in the country, of which 10 were in Pennsylvania, 2 at Wheeling, Va., 2 in Maryland, 2 in New York, 2 in Ohio, and 1 each in Massachusetts, New Hampshire, Vermont, Connecticut, and the District of Columbia. The whole value of flint-glass produced annually was estimated at $1,350,000. Eight of the ten Pennsylvania factories were at Pittsburg, and their product was over $500,000 per annum. Of these, one-half were manufacturing flint-glass and the others window and green glass, or, as it was then called, crown-glass. In 1840 there were 81 glass-houses in the U. S., employing 3236 men and a capital of $2,014,100. The annual product is not stated, nor did the census report distinguish between the different kinds of glass. In 1850 there were 94 glass-works, employing 5571 men, with an estimated capital of $3,402,350, and producing to the value of $4,641,676 per annum. In 1860 the number of glass-works had increased to 112, the employés to 9116, the capital to $6,133,666, and the annual product to $8,775,155. Of these factories, 36 were credited to Pennsylvania (Pittsburg alone had 33 in 1857), 22 to New Jersey, 23 to New York, 18 to Ohio, 11 to Massachusetts, 3 to Connecticut, and the remainder were distributed among half a dozen other States. In 1870 the statistics of the glass manufacture were given much more minutely than in any previous census, though in this, as in the previous censuses, they were very imperfect, and far below the truth. According to the census, there were 201 glass works of all descriptions, employing 15,822 hands (11,505 men, 715 women, 3602 children); the capital invested was $14,111,642; the wages paid $7,846,425; the raw material used, $6,133,168; and the annual product, $19,235,862. Of these, 35 establishments, producing annually $3,811,308, were devoted exclusively to window-glass; of which 11 were in New Jersey, 10 in Pennsylvania, 7 in New York, and the remainder in Massachusetts, Maryland, and Illinois. One hundred and fourteen establishments, producing annually $14,300,949, were devoted to glass-ware not specified, including bottles, vials, hollow ware, lamp chimneys, as well as tableware, glass dishes, etc. Of these, 42 were credited to Pennsylvania, 32 to New York, 11 to Massachusetts, 8 to New Jersey, 6 to Ohio, 4 to Missouri, and the remainder to Connecticut, Indiana, Kentucky, New Hampshire, and West Virginia. Eighteen establishments were engaged in the manufacture of stained glass, producing wares to the value of $297,480. Of these, 4 each were in Pennsylvania and New York, 2 each in New Jersey, Kentucky, and Illinois, and 1 each in Ohio, Michigan, Maryland, and the District of Columbia. Twenty-nine establishments manufactured cut glass, producing $470,875. Of these, New York had 15, producing three-fifths of the whole amount; Massachusetts 8, producing $171,000; Pennsylvania and California, each 2, producing but a very small amount, and Illinois and Maryland, each 1. There were 5 plate-glass factories reported, with an annual product of $355,250, of which Ohio had 3, producing $[illegible]2,000; New York and New Hampshire each 1. In all, 58 establishments were credited to Pennsylvania, with an annual product of $8,409,000; yet in 1869 Pittsburg alone had 71 glass-factories, producing annually a little more than $7,000,000 of glass; and the production was but 71 per cent of that of the entire State; so that the entire product of the State in 1870 could not have been less

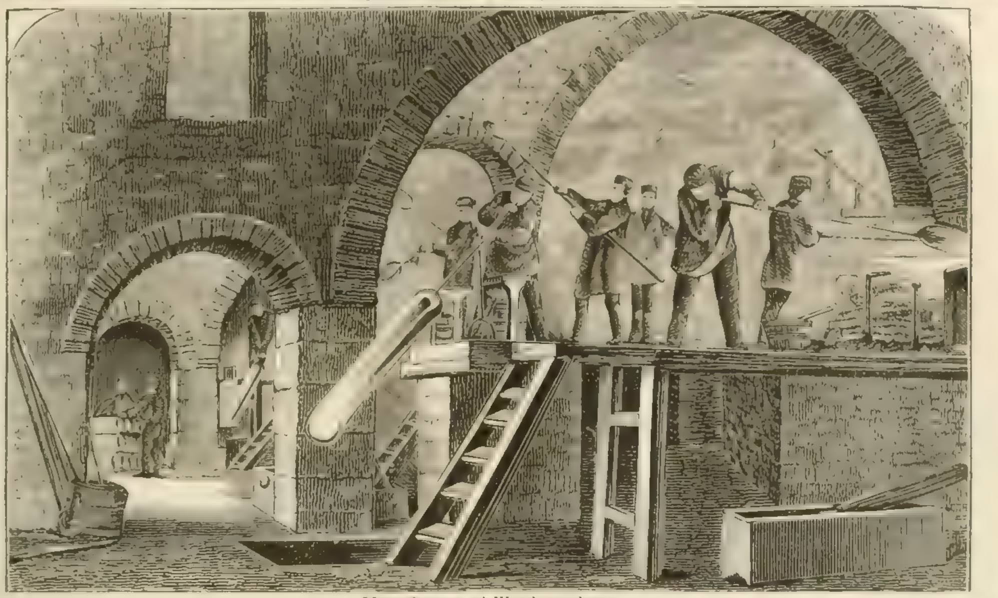
than $9,000,000, and the number of factories not far from 90. New York is credited with 44 glass-factories (aside from the cut-glass establishments, which are not properly glass-works), and a production of $2,121,000: yet in 1865 there were 34 factories, producing $1,664,000 of glass, and in the next five years the business almost doubled; Kings co., N. Y., now has 16 glass factories, and the whole number in the State is not less than 70.

The processes of glass-making are much the same the world over; one of the largest of our American manufacturers asserts that there has been very little change in glass-blowing since the Syrians practised it 2500 years ago. These processes have been detailed with sufficient minuteness in the preceding pages. We shall notice, therefore, only such improvements as have been made by our American glass-houses in some of the details. The various departments or classes into which glass-making is divided are—*Green glass*, which may be subdivided into the coarse and ruder bottles usually known as black glass, and the better grades of vials, champagne bottles, etc., which are now of elegant forms and much stronger than any other glass-ware; *flint-glass*, which embraces a wide variety of articles, mostly of hollow and table ware, and differing widely in its composition, some of it containing oxide of lead or zinc, which would more properly be called metallic glass; *window-glass*, of which there are two varieties, crown and cylinder or sheet glass; *plate-glass*, which is cast instead of being blown and moulded, as are the other kinds; and *optical glass*, such as is used for lenses of telescopes, microscopes, cameras, etc., and to some extent for eye-glasses; this may be either flint or crown glass, or of a different composition from either. *Cut glass* is merely flint-glass of the best quality which has been either cast or blown, and then ground on emery-wheels or grindstones of fine grain till it assumes the desired form. The drops of chandeliers and many of the finer bottles or articles for table use are cut in this way. The German glass-makers have of late introduced cut glass made from the better qualities of their green glass, and which are blown rather than cast. These are not quite free from the greenish tint, but are a very fair substitute for the English cut-glass goods. Our American manufacturers of glass have preferred to improve as far as possible their processes of casting and moulding, and have brought these to such a state of perfection that the best qualities of pressed glass are scarcely distinguishable from cut glass. Glass is cut, however, in this country to a considerable extent, the principal establishments being in New York and Massachusetts, but this is done rather by the decorators of china and glass than at the glass-works. Colored or stained glass may be made at the glass-works, as is the case with the Bohemian glass and its imitations, where glass of a particular color being blown very thin, a mass of glass of another color or white glass is introduced and blown till it fills the cavity and unites with the first, so as to form a homogeneous mass. This process may be repeated, and the outer color removed at some points by grinding, and a very beautiful effect is produced. The more usual process, however, is to make a paste or coating of such metallic colors as are desired, and, covering plate or flint glass with it, expose it to a heat sufficient to vitrify it and incorporate it with the glass. By this process, which is conducted by the decorator rather than the glass-manufacturer, any design may be put upon glass, and in any required colors. Crown and sheet window-glass of the better qualities are made of different colors as required, the colors being always metallic, and as readily fusible as the glass itself. The second and third processes are those used exclusively for the stained glass windows of churches and other public buildings. While there has been no considerable change in the processes of glass-blowing, our American manufacturers have acquired a greater deftness and skill in some of the departments of the manufacture than any of the foreign glass-makers. While the methods vary but little from the English, French, or Bohemians in the production of green-glass or flint-glass bottles, vials, and other hollow-ware, and in the manufacture of pressed glass table-ware, the American goods of these descriptions are so perfect, and of such admirable quality and finish, that they are largely exported to England and to some of the continental countries.

Manufacture of Glass Bottles.

The manufacture of window-glass, though conducted here for more than 70 years, was for many years conducted under difficulties from the alleged superiority of the English crown-glass. After a time such improvements in the manufacture of cylinder or sheet glass were made in England that it was regarded as equal in quality and brilliancy to the crown-glass, and could, of course, be made of larger sizes; but the Pittsburg manufacturers have far surpassed in size and in uniform thickness the English. The largest size of sheet-glass ordinarily made in England is 50 by 30, or possibly 35, inches. At Pittsburg sheets 70 by 40 inches, and of uniform thickness of 7 to the inch, are not uncommon. These are called "double strength," and so uniform is their thickness that they are commonly known as "American plate." In the dexterous handling of these immense cylinders, the process for making which has been described on a preceding page, and so managing them as to make them of uniform thickness and freedom from blemishes (a very difficult matter), the American manufacturers have been remarkably successful. They are said also to be free from the liability to rust or devitrification, caused by the excess of alkali in the glass, which has been so serious an objection to much of the German and some of the English window-glass. In the manufacture of plate-glass American glass-makers have not, at least till within the past five years, been very successful. One of the most famous of the American plate-glass factories (that of Lenox, Mass., originally at Cheshire, Mass.) has, after being in operation nearly twenty years, been given up. This establishment made what was called "rough plate" (used for domes, skylights, etc.), as well as the polished article. A similar factory in Brooklyn, N. Y., established in 1855, was also relinquished after three or four years. In 1870 there were but 5 plate-glass factories in the U. S., 3 of them in Ohio, and the only one of large size was in Cincinnati. The production of all at that time was about $355,000; the amount has since considerably increased. Some plate-glass is imported, mainly

for mirrors, from England, and a moderate quantity from Germany—the latter, however, having a greenish tinge which is unpopular—but the great bulk of the importation of plate-glass (which is the largest item of imported glass) is from France, the French plate being far superior to any other in quality. Having in this country the best possible material for making plate glass, and fuel abundant and cheap, skilful workmen, and an almost limitless market, there



Manufacture of Window-Glass.

seems to be no good reason why this fragile luxury should be imported. The bending or rounding of plate-glass to adapt it to corner windows, etc. is done at Newark, N. J., and, we believe, also at Cincinnati. There are also several establishments in New York and elsewhere for cutting, drilling, and etching it by means of the newly-discovered sand-blast. Enamelled glass, of which there are two or three varieties, is now manufactured in Newark, N. J., by two or three of the Pittsburg glass works, and by several other makers in Ohio, New York, and Massachusetts. It is largely used for the ornamentation of churches, school-houses, public halls, and private residences. The glass used for this purpose is usually the double-strength cylinder of the Pittsburg manufactories, which is well adapted for it. A paste of metallic powder is spread over the surface of the glass, which has been previously polished, the ornamental devices etched out by machinery or by hand, and the glass is then thrust into the reverberatory furnace till the enamel is thoroughly vitrified and incorporated with the glass, when it is withdrawn and put into the annealing oven, and kept there for a week, cooling very gradually. The flocked enamelled glass is prepared by a similar method, though the glass itself is previously rendered opaque by another process. A large demand has sprung up for these enamelled sheets of glass, which are not surpassed in beauty by any of the foreign manufactures.

The immense extension of the use of petroleum and coal-oils for illuminating purposes has given a great impulse to the manufacture of lamp-chimneys, which had previously been limited to argand gas-burners, argand, solar, and students' lamps. A number of glass-factories confine themselves to this specialty; others manufacture mainly ground-glass globes and lamp shades.

The flint glass factories use now feldspar, finely ground quartz, or the finest white sand, in the place of flint, for the silica, and some of the Pittsburg and Philadelphia factories at one time tried cryolite, a spar found native in large quantities in Greenland, to furnish the alkali, but it was found not to answer the purpose. Some years since an attempt was made to manufacture lamp-shades and chimneys, plates, dishes, vases, bisque figures, statuettes, etc. of a material called hot-cast porcelain, which was really an opaque glass, and for which the cryolite and certain earths found in New Jersey were used. The wares were very beautiful and offered at low prices, but the enterprise failed after a short time. The carbonate of soda used in the best glass-works is imported from England, being better adapted to the manufacture than that made elsewhere. The glass used for optical purposes is made here for the smaller lenses for cameras, microscopes, spy-glasses, and some of the opera and field glasses, but as yet our glass-makers have not attained to the homogeneousness of structure necessary for the largest telescopic lenses. These, as stated elsewhere, are produced in their perfection only in West Bromwich, near Birmingham, England. They are made both of crown and flint glass, but by peculiar processes and great care and skill. The two points of greatest importance seem to be constant stirring of the molten liquid at a high heat, to produce homogeneousness of structure, and the annealing in the same pot in which it is melted, to avoid the admission of air into the mass in pouring off. The mass of glass is subjected to subsequent very careful manipulation in grinding, shaping, and polishing to fit it for its purpose. The largest perfect lens yet produced by this enterprising house is, we believe, not quite thirty inches in diameter. Several of their larger lenses have been imported in the rough, and finished with immense and protracted labor by Messrs. Clark, the celebrated telescope-makers.

In conclusion, the present condition of the glass manufacture in the U. S. is as follows: the annual production of glass of all kinds is from $21,000,000 to $23,000,000; in articles of hollow-ware, except a few styles of fancy cologne bottles and cut-glass caster bottles, decanters, etc., there is not only no competition, but we are exporting largely to England, and to some extent to France, the druggists' ware, prescription bottles, stoppered bottles, and graduated bottles of several manufacturers being of better quality and greater perfection of finish than any produced in Europe. Of table-glass we are producing articles fully equal to the English and French, except in a few styles, and our best grades of pressed glass ware vary so little from the finest foreign cut glass that, in the language of an eminent authority, "only experts in the trade can distinguish between them." In window-glass (not plate) the American manufacturers command the market, except where the old prejudice in favor of English crown-glass has not died out, and except also in the very cheapest styles of German window-glass. In plate-glass, glass for optical purposes, and in the specialties of Bohemian glass-ware our manufacturers acknowledge their present inferiority to European glass-makers; but this inferiority is fast disappearing. The statistics of the importation of glass of all descriptions for the fiscal years 1873 and 1874 are as follows. There was imported of cylinder, crown, and common window glass in the year ending June 30, 1873, the value of $2,7[illegible]9,728; in the year ending June 30, 1874, the importation had fallen off to $1,881,378; the importation of cylinder and crown polished glass in 1873 was $21,217; in 1874, $14,[illegible]. Of fluted, rolled, or rough plates of glass there were imported in 1873, $31,180; in 1874, $71,2[illegible]7. Of cast polished plate, not silvered, in 1873, $1,[illegible]0,8[illegible]7; in 1874, $1,[illegible],969. Of cast polished plate, silvered, in 1873, $823,076; in 1874, $961,512. Of other manufactures of glass in 1873, $2,230,986; in 1874, $1,710,069—a reduction in these branches of $520,000. The total importation of glass of all sorts in the year ending June 30, 1873, was $7,420,044; for the year ending June 30, 1874, $6,257,978—a reduction in a single year of $1,163,066.

The invention of the sand blast and its value in carving, etching, and drilling glass has added greatly to the re-

nomical uses of glass. Though easily manageable in its viscid condition, glass was very refractory in its solid and cold state; it could only be cut by a diamond or very hard steel point, and some of the choicest and heaviest plates would develop a crack or flaw which would render them worthless even under these agencies; but it can now be cut in any form, holes drilled in it, figures etched or carved on it in low or high relief, and it can be cut in any desired shape without difficulty. As a consequence, plate-glass from one-fourth to one-half an inch in thickness is largely introduced into our modern furniture and articles *de luxe*. We find it used for small shelves at the tellers', cashiers', and bookkeepers' desks in banks, insurance offices, and stores, in hand-mirrors, parlor summer-pieces, for covering the dial-plates of fine clocks, for library doors, vestibule floors, etc. The demand for the finer qualities of glass is thus very greatly increased, and we may expect a corresponding increase in its manufacture. (We acknowledge our obligations for many facts and statistics to R. Pearsall Smith of Philadelphia, and to Messrs. Barr and Myers's volume on *Pittsburg, its Industry and Commerce*.)

L. P. BROCKETT.

Glass (HENRY), U. S. N., b. Jan. 7, 1844, in Kentucky; graduated at the Naval Academy in 1863; became a master in 1865, a lieutenant in 1866, a lieutenant-commander in 1868; served in the South Atlantic squadron from July, 1863, to the close of the civil war, where he was conspicuous for energy and gallantry. Commended by Lieut.-Com. Richard W. Meade in his report of Dec. 28, 1863, for "coolness and good service." FOXHALL A. PARKER.

Glass-Blowing. See GLASS, by CHARLES G. LELAND, A. M.; and GLASS, AMERICAN MANUFACTURE OF, by L. P. BROCKETT, A. M., M. D.

Glass'borough, post-v. of Clayton tp., Gloucester co., N. J., on the West Jersey R. R., at the junction of the Bridgeton branch, 18 miles S. of Philadelphia. It has manufactories of glass, and is in a fertile region.

Glasschord. See HARMONICA.

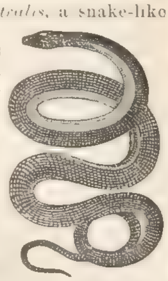
Glass-Cloth and **Glass-Paper** are prepared by sprinkling powdered glass upon paper or cloth, one side of which is moistened with thin glue. They are used like sand-paper.

Glass Crab, the name of several transparent crustaceans, but chiefly given to those of the genus *Phyllosoma*, family Phyllostomidæ and order Stomapoda. They are so perfectly transparent that as they float on the water only the eyes are visible. The carapace is flat, and formed of two bucklers. There are several species, found chiefly in warm seas. The name might well include the transparent Erichthidæ, which approach closely to the above.

Glass Slip'per. The fairy tale of Cinderella is known in all civilized countries. It is of French origin. The prince presents Cinderella with a pair of slippers lined with miniver or petit ver, a fur which was the prerogative of royalty, as ermine was that of the highest officer of the law. The story was translated into English, and "petit ver" was rendered "little glass." It was afterwards retranslated into French, and the "little glass" was retained. In the German version it is only the small size of the slipper which serves as a means of recognition; the glass is left out.

WILLIAM DETMOLD.

Glass Snake, the *Ophisaurus ventralis*, a snake-like lizard of the U. S. It completely resembles a serpent at first sight, but has eyelids (which no snake possesses), and other anatomical peculiarities which associate it appropriately with the lizards. It is variously colored, and is often two or three feet long. It is harmless, and is found in woods, and especially in sweet-potato fields in the South. When smartly struck with a stick, it often breaks into several pieces, whence the name.



Glass Snake.

Glass, Soluble. See WATER GLASS.

Glass Sponge, a name of various sponges of the genera *Hyalonema*, *Holtenia*, *Rossella*, *Pheronema*, *Euplectella*, etc., of which the typical forms have the siliceous sponge-spicules prolonged into a flexible, loosely-twisted cable of glassy threads. Whether this cable serves to moor the sponge or not is a point on which various opinions have been expressed. The first-mentioned genus is remarkable for having upon the sponge a mass of horny elevations, by some considered as consisting of polyps parasitic upon the sponge; by others as a polyp-mass upon which the sponge is parasitic and by still others as a part of the sponge itself.

Glass Staining and Painting. See GLASS, by CHARLES G. LELAND, A. M.

Glas'tenbury, tp. and post-v. of Hartford co., Conn., on the E. bank of the Connecticut River, 7 miles S. E. of Hartford. The township contains several villages, and has important manufactures. Pop. 3560.

Glastenbury, post-tp. of Bennington co., Vt. P. 119.

Glas'tonbury, town of England, in the county of Somerset, with some interesting remains of its once celebrated Benedictine abbey. Many writers believe that the mythical isle of Avalon was originally identical with the peninsula where Glastonbury stands; but this is doubtful. The river Brue flows by the old town, which was anciently an episcopal city. Pop. 3670.

Glatz, or **Glaz,** town of Prussia, in the province of Silesia, on the Neisse. It is a strong fortress, and has extensive manufactures of damask, linen, ribbons, and plush. Pop. 11,541.

Glau'ber's Salt [named from J. R. Glauber, its discoverer (1604–1668)], called formerly *sal mirabile*, the neutral sulphate of soda ($SO_4Na_2 10OH_2$), a salt found native in sea-water, in mineral springs, and especially in the alkaline soils and waters of the Western plains and mountains of the U. S. It was formerly much used in medicine as a cathartic, but is now so employed chiefly in veterinary practice. In the arts its formation takes place on a very extensive scale during the production of carbonate of soda from common salt. The sulphate is converted into the carbonate of soda by various methods. (See SODA.)

Glau'chau, town of Saxony, on the Mulde. It is picturesquely situated, and has very extensive manufactures of cotton, paper, and different kinds of hardware. P. 22,036.

Glau'cias [Γλαυκίας], a statuary of Ægina, flourished about 490–476 B. C., celebrated for his statues of combatants in the games. He cast the chariot and a statue of Gelon, conqueror in the chariot-race Olympiad 73; made statues of the wrestlers Philo of Corcyra and Glaucus of Carystus, and also of Theagenes the Thasian, conqueror at the Olympic games Ol. 75. H. DRISLER.

Glaucias [Γλαυκιας], a distinguished physician of the Empiric school, teacher of Heraclides of Tarentum, and one of the earliest interpreters of the writings of Hippocrates, to which he drew up a sort of lexicon of the difficult words in alphabetical order, but too much in detail, as Erotian implies in referring to the work in his own glossary, still extant. H. DRISLER.

Glauco'ma [from the Gr. γλαυκός, "light green," alluding to the greenish, bluish, or reddish tint sometimes seen upon the eye in this disease], a disease characterized by a general inflammatory action in the different parts of the eye, attended by increase in the bulk of the fluids contained, and marked by a gradual loss of sight and by pain, often very intense. It is acute or chronic. The ophthalmoscope affords the surest tests of its existence. It is a disease of advanced life, and very frequently leads to complete blindness. The best treatment begins in the early performance of iridectomy, which sometimes arrests, and almost always palliates, the symptoms.

Glau'conite, a mineral of green color occurring abundantly in Secondary and Tertiary greensands and chloritic marls, and composed of silica 46 to 56 per cent., ferrous oxide 20 to 25 per cent., potash 5 to 13 per cent., alumina 4 to 14 per cent., and water 0 to 10 per cent.

Glau'cus [Γλαῦκος], an artist of Chios, said to have invented the art of soldering metals. His most famous work was the celebrated iron base on which was placed a silver vase, dedicated by Alyattes II., king of Lydia (617–561), to the god at Delphi, spoken of with admiration by Herodotus, and so superior in workmanship as to have given rise to the proverb Γλαυκου τεχνη. (See SILLIG, *Dict. Artists*, s. v.) H. DRISLER.

Glaucus [Γλαῦκος], the name of several personages who figure in the Greek heroic traditions. The most important was a Bœotian fisherman, who by luck ate of a divine herb which made him immortal. He built the Argo, was helmsman for the Argonauts, and became a sea-god whose oracles were very famous.

Glaux [Gr.], a genus of primulaceous plants, represented on the North Atlantic shores of Europe and America by the *G. maritima*, a little fleshy perennial, which also grows beyond the Mississippi, to the north-westward. Its fleshy leaves make good pickles.

Glebe [Lat. *gleba*, "arable soil"], in English ecclesiastical law the land which belongs to a church. It constitutes a part of the revenue of a benefice, and is vested in the parson or vicar. By a recent statute certain commissioners have power to ascertain and define the boundaries of the glebe-lands of any benefice, or, with consent of the ordinary

or patron, to exchange them for other lands, either in the same or an adjoining parish.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Glede. A bird mentioned in the authorized English version of the Bible under this name is generally believed to be the common kite (*Milvus regalis*) of the Old World, though some authorities make it some species of vulture.

Gledit'schia (named from J. G. Gleditsch (1714–86)), a genus of trees of the order Leguminosæ, represented in the U. S. by the honey locust (*G. triacanthos*) and the water-locust (*G. monosperma*). Although it shares the name of locust with the *Robinia Pseudacacia*, it differs widely from that tree, especially in its more compound leaves, small leaflets, compound thorns, large flat pods filled when ripe with a sweet honey-like substance, and its inconspicuous flowers. It is a good hedge plant and an ornamental tree. Its timber is very heavy, resembling that of the common locust, but coarser. The water locust is a small tree growing in swamps in the West and South-west. There are one or two North Asiatic species. (See LOCUST.)

Glee, a species of musical composition in three or four parts, and usually of two or more movements, originally written for voices without instrumental accompaniment. The term "glee" is supposed to be a modification of the Anglo-Saxon word *gligg*, signifying music generally, but popularly applied to those pieces which were ordinarily of a social, cheerful, and even convivial character, though at times glees were more grave and serious, both in the drift of the words and the style of the music. The glee is of English origin, and appears to have sprung from the old "part-songs" and madrigals which were furnished in abundance by the composers of the sixteenth and seventeenth centuries, and were commonly used on occasions of joy and festivity, as well as for social entertainment in private circles. By degrees, the distinctive marks of these several classes of compositions have been more or less obliterated, and the name *glee* is now given, in a broad sense, to almost any secular part-song of two or three movements. For the most part, also, the modern glee has an instrumental accompaniment, of equal importance with the voice-parts for the full expression of the composer's ideas. Among the most distinguished writers of glees may be named Dr. Arne, Dr. Cooke, Dr. Calcott, Dr. Hayes, Dr. Nares, Lord Mornington, Paxton, Danby, Spofforth, Stevens, and Webbe.

WILLIAM STAUNTON.

Gleet. See GONORRHŒA.

Gleig (GEORGE ROBERT), M. A., b. at Sterling, Scotland, Apr. 20, 1796, son of the bishop of Brechin, was educated at Glasgow and Balliol College, Oxford; entered the army in 1812; served against Napoleon and in the U. S., and was badly wounded near Washington, D. C.; took orders in the Church, and after receiving several preferments was made chaplain-general of the British army in 1846, which position he still holds (1875). In 1848 he became a prebendary of St. Paul's. Author of many historical and other works, among which are *The Subaltern* (1825); *Hist. of British India* (4 vols., 1831–33); *Family Hist. of England* (3 vols., 1836–54); a 1 volume *Hist. of England*; a laudatory *Memoir of Warren Hastings* (1841); *Military Hist. of Great Britain* (1845); *Campaigns of Washington and New Orleans* (1847); *Life of Clive* (1848); and *Life of Wellington* (1859), besides tales, devotional and didactic works, sermons, etc.

Glei'witz, town of Prussia, in the province of Silesia, on the Klodnitz. It has large iron-foundries, breweries, and leather manufactories. Pop. 11,038.

Glen Ar'bor, post-tp. of Leelanaw co., Mich. P. 405.

Glen'burn, post-tp. of Penobscot co., Me. Pop. 720.

Glencoe', a valley of Scotland, in the county of Argyle, famous both for its wild scenery and for the massacre of the Macdonalds which took place here in 1692.

Glencoe, post-v. and tp., cap. of McLeod co., Minn., is situated on the Buffalo River, 60 miles W. of St. Paul, on the Hastings and Dakota R. R. It has several good hotels, 2 grain elevators, 3 churches, 1 weekly news-paper, and a seminary. It is in the centre of a rich farming country, and has an abundance of timber and water. Pop. 487.

L. HALL, ED. "GLENCOE WEEKLY REGISTER."

Glencoe, post-tp. of Buffalo co., Wis. Pop. 676.

Glen Cove, post-v. of Oyster Bay tp., Queens co., N. Y., has a fire insurance company, a corn-starch factory, 3 churches, and 2 weekly newspapers. It is on the Locust Valley branch of the Long Island R. R.

Glen'dale, post-v. of Stockbridge tp., Berkshire co., Mass., on the Housatonic River and R. R., 18 miles S. W. of Pittsfield, has important manufactures of paper, woollens, etc.

Glendale, tp. of McLeod co., Minn. Pop. 527.

Glendale, tp. of Scott co., Minn. Pop. 387.

Glendale, a v. of Washoe co., Nev. Pop. 129.

Glendale, post-v. of Hamilton co., O., on the Cincinnati Hamilton and Dayton R. R., 15 miles from Cincinnati. It is the site of a female seminary. Pop. 1780.

Glendale, post-tp. of Monroe co., Wis. Pop. 679.

Glendale, Battle of. See FRAZIER'S FARM, BATTLE OF.

Glen'don, a b. of Northampton co., Pa., on the Lehigh River, 2 miles S. W. of Easton, on the Lehigh Valley R. R. and the Central R. R. of New Jersey. It has manufactures of iron. Pop. 707.

Glendora'do, tp. of Benton co., Minn. Pop. 129.

Glen'dower (Sir OWEN), (*Owen Glyndwr Dw*), b. in Merionethshire, Wales, about 1350, great-grandson of Llewellyn, the last Welsh monarch; studied law, was made a barrister of London, became an esquire of Richard II.'s guard, and in 1387 was knighted. Suspected of disloyalty by Henry IV., a part of his estates were given to Lord Grey of Ruthin (1399), and having appealed in vain for redress to Parliament, he in 1400 took arms, declared himself monarch of Wales, and carried on war with general success, though opposed by Henry IV. in person, Lord Talbot, and other able leaders, among whom was Sir Edward Mortimer, whom he won to his side. He then entered into an alliance with the Percies, after whose final defeat he still carried on the war with varying fortunes, with the aid of the French. Henry V. finally offered him full pardon: shortly after which he d. at Monnington, Herefordshire, Sept. 20, 1415.

Glen El'der, post-tp. of Mitchell co., Kan. Pop. 25.

Glenelg', a river of Australia, in Victoria, where it rises in the Grampian Mountains. It passes into South Australia, and falls into the Southern Ocean E. of Cape Northumberland.

Glengar'ry, the most easterly county of Ontario, Canada, bounded on the S. E. by the St. Lawrence River, and on the E. by the province of Quebec. Area, about 440 square miles. It is judicially united with Stormont and Dundas cos. Cap. Cornwall, Stormont co. It is traversed by the Grand Trunk Railway. Pop. 20,524.

Glen'ham, post-v. of Fishkill tp., Dutchess co., N. Y., on the Dutchess and Columbia R. R., 5 miles E. of Newburg. It has important woollen manufactures. Pop. 924.

Glen Ha'ven, tp. and post-v. of Grant co., Wis., on the Mississippi, 20 miles S. of Prairie du Chien. Pop. of v. 163; of tp. 1177.

Glenmore, tp. of Brown co., Wis. Pop. 730.

Glenn, post-v. and tp. of Montgomery co., N. Y., on the S. side of the Mohawk. The village has a cheese factory and other industrial interests. The tp. contains FULTONVILLE (which see) and other villages. P. 145; of tp. 2782.

Glenn Spring, post-tp. of Spartanburg co., S. C., 86 miles N. W. of Columbia, has saline sulphur springs, resorted to for the cure of dyspepsia and other complaints. The scenery is pleasant and the climate delightful. Pop. 1814.

Glenrock', tp. of Nemaha co., Neb. Pop. 582.

Glen Rock, post-v. of Shrewsbury tp., York co., Pa., on the Northern Central R. R., 15 miles S. of York. Has manufactures of cordage, woollen goods, etc., a national bank, and a weekly newspaper. Iron ore is found in the vicinity. Pop. 537.

Glen Rose, post-v., cap. of Somerville co., Tex.

Glenroy', a valley of Scotland, in the county of Inverness, along the Roy, which runs into the Spean. On each side of this valley, and at exactly the same elevation, appear three roads or shelves running parallel with each other, the first at an elevation of 1159½ feet above the level of the sea, the second 80 feet lower, and the third 212 feet lower than the second. This most remarkable phenomenon was caused, it is said, either by the subsidence of a lake or by the rising of the land. The popular explanation declares the shelves to be the roads of the heroes of Ossian.

Glen Roy, post-v. of Howard co., Ia.

Glen's Falls, post-v. of Warren co., N. Y., is on the Rensselaer and Saratoga R. R., 50 miles by rail N. of Albany, on the Hudson between Saratoga Springs and Lake George, 9 miles from the latter. It is noted for its cave, water power, mills, lime, black marble, canal, water works, beautiful fountain, and handsome soldiers' monument. It has a large iron foundry, machine shop, gasworks, paper mill, 2 grist-mills, 1 stone-sawing mill, 9 large saw mills run by water power with a total of 12 gates, 6 lath mills, 2 steam saw and planing mills, 2 plaster mills, 28 lime kilns, which turn out over 180,000 barrels of lime annually, 3 carriage manufactories, a sewing machine factory, 2 gun shops, 3 banks, 2 weekly newspapers, a ladies' seminary,

academy, insurance company, 2 opera-houses, 7 churches. Pop. 4500. ED. "GLENS FALLS MESSENGER."

Glen'ville, tp. of Russell co., Ala. Pop. 1712.

Glenville, tp. and post-v. of Schenectady co., N. Y., on the N. side of the Mohawk, here crossed by the iron railroad bridges of the New York Central and the Saratoga branch of the Rensselaer and Saratoga R. R., and by two other bridges. Pop. 2975.

Glenville, tp. and post-v., cap. of Gilmer co., West Va., 33 miles S. of West Union. Pop. 174; of tp. 1422.

Glen'wood, city and tp., cap. of Mills co., Ia., on the Burlington and Missouri River R. R., 20 miles S. of Council Bluffs. It has 1 national bank, 1 foundry, 1 soap-factory, 1 furniture manufactory, 4 churches, 2 newspapers, 2 hotels, 1 livery stable, and the usual number of stores, etc. Pop. of city, 1291; of tp., exclusive of city, 842.

G. M. MCBRIDE, MANAGER "OPINION" OFFICE.

Glenwood, tp. of Winneshiek co., Ia. Pop. 1196.

Glenwood, post tp. of Aroostook co., Me. Pop. 185.

Glenwood, post-v. and tp., cap. of Pope co., Minn., is situated in a beautiful wooded glen 100 feet below the level prairie, overlooking Lake Whipple. It has good hotel accommodations, excellent schools, stores, mill, shops, water-power, 1 weekly newspaper, and a substantial trade. Pop. of tp. 214. ED. OF "EAGLE."

Glenwood, post-v. and tp. of Schuyler co., Mo., 120 miles N. of St. Louis, on St. Louis Kansas City and Northern R. R., 65 miles W. of the Mississippi River, on the Missouri Iowa and Nebraska R. R., and 2 miles from the county-seat. It has a woollen-factory, a foundry, a machine-shop, a flouring-mill, a hub and spoke factory, 2 wagon factories, 2 churches, 2 hotels, 1 newspaper, a $10,000 school-house, 1 bank, etc. Principal business, manufacturing and shipping. Pop. of tp. 1101.

H. D. B. CUTLER, ED. "CRITERION."

Gles'son, tp. of Duplin co., N. C. Pop. 481.

Gleyre (GABRIEL CHARLES), a French painter, b. at Chevilly, canton de Vaud, Switzerland, in 1807; studied at Lyons and at Paris under Hersent; went to Italy, and made close study of Italian art; thence to the East, Egypt, Abyssinia, Turkey, Greece. His pictures are not numerous. *St. John at Patmos, Evening, The Departure of the Apostles, The Nymph Echo, Bacchantes, Pentecost, The Execution of Major Duval,* are the best known; but all his work is remarkable for the combination of severe study with strong imagination and freedom from conventional rules. An attack of ophthalmia which threatened loss of sight interrupted his activity, and perhaps gave to his later pieces the tone of melancholy which pervades them; but, though exhibiting less than becomes his fame, he still produces works which museums and churches are proud to obtain. Paul Delaroche, no longer able to teach himself, advised his pupils to pursue their studies in the studio of Gleyre, the "poet-painter," as he was called at the beginning of his career. O. B. FROTHINGHAM.

Glid'den, tp. and post-v. of Carroll co., Ia., on the Chicago and North-western R. R., 100 miles N. E. of Council Bluffs. Pop. of v. 177; of tp. 438.

Glid'den (GEORGE D. B.), U. S. N., b. Apr. 15, 1844, in Maine; graduated at the Naval Academy in 1863; became a master in 1866, a lieutenant in 1867, a lieutenant-commander in 1868; served in the Seminole at the battle of Mobile Bay (Aug. 5, 1864), and received the commendation of his commanding officer, Com. Edward Donaldson, for behaving "with the utmost coolness" during the action.

FOXHALL A. PARKER.

Glid'don (GEORGE ROBINS), b. in Devon, England, 1809, was the son of John Gliddon, the U. S. consul to Egypt, in which country the son lived twenty-three years, and was long U. S. vice-consul at Cairo; lectured in the U. S.; became agent of the Honduras Interoceanic Railway, and d. at Panama Nov. 16, 1857. Author of *Memoir on the Cotton of Egypt,* 1841; *Appeal to the Antiquaries on the Destruction of the Monuments of Egypt,* 1841; *Egyptian Archæology,* 1841; *Otia Ægyptiaca,* 1849; *Ancient Egypt,* 1850; and, with Dr. J. C. Nott, wrote *Types of Mankind* (1854), and *Indigenous Races of the Earth,* 1857, etc.

Glio'ma [Gr. γλία, "glue"], plu. GLIOMATA, a tumor of the brain-substance, believed to be produced by excessive growth of connective element of that substance at the expense of the proper nerve-elements. It consists of a finely reticulated material containing many roundish nuclei. It is not definitely circumscribed, and never involves the meninges. It was formerly confounded with cancer, from which it appears to be quite distinct. Its diagnosis is very obscure during life, and its treatment, when suspected to exist, can be only palliative of the symptoms, such as local or general paralysis, which may be present. It is a disease of youth, rather than of old age.

Glis'an (RODNEY), M. D., b. Jan. 29, 1827, at Linganore, Frederick co., Md.; graduated in the medical department of the University of Maryland, Baltimore, Md., Mar., 1849; passed an examination before an army medical board in Nov., 1849; commissioned an assistant surgeon U. S. A. in May, 1850; ten years' service in the army—five being on Plains, and five in Oregon during her Territorial Indian wars; has been for fifteen years in successful practice of his profession at Portland, Or.; is president of the medical society of Multnomah co. Author of various articles on *Climate* and *Medical Topography,* and a *Journal of Army Life,* published in 1874.

Glis'son (FRANCIS), M. D., b. at Rampisham, Dorsetshire, Eng., 1597; took the master's degree at both Cambridge and Oxford; took the degrees in medicine at Cambridge (M. D. 1634), and in the same year became professor of physic there; held the royal professorship of medicine in the College of Physicians, London, and in 1639 became professor of anatomy there. He wrote learned Latin treatises on the anatomy of the liver (1654), on rickets (1650), on the intestines (1676), and other works; practised at London and Colchester; had a wide fame as a subtle and profound philosopher and a skilful anatomist. His fame is perpetuated in "Glisson's capsule," a constituent of the liver first discovered by him. He was a royalist. D. in London 1677.

Glis'son (OLIVER S.), b. Jan. 18, 1809, in Ohio; entered the navy as a midshipman Nov. 1, 1826; became a passed midshipman in 1832, a lieutenant in 1837, a commander in 1855, a captain in 1862, a commodore in 1866, a rear-admiral in 1870; retired in 1871. He commanded the steamer Santiago de Cuba in both the Fort Fisher fights. Rear-admiral Porter, in his "commendatory letter" of Jan. 28, 1865, writes: "To Capt. O. H. Glisson, commanding the Santiago de Cuba, I am particularly indebted for his zeal in covering the troops, landing guns, and taking his division into action. I recommend him for promotion." FOXHALL A. PARKER.

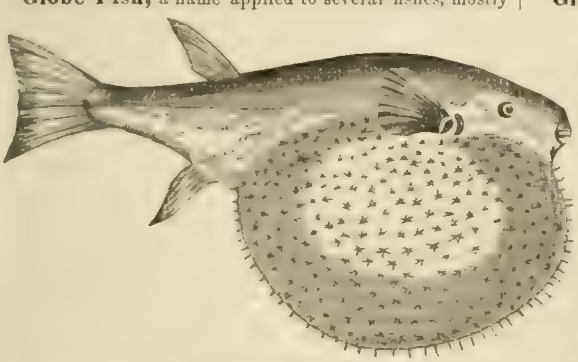
Globe, Artificial, a sphere on which is a map. Globes set forth the earth or heavens, and are called terrestrial or celestial. On the latter the stars appear as they would if seen from the centre of the earth, while the former is a literal copy of the earth itself, with the addition of lines or circles to enable us to determine the position of places and the movements of the sun and planets. The globe is thus, in reality, a spherical map, and is superior to an ordinary plane chart by giving more readily an understanding of the relative distances of places, especially as regards their position on the ball, and in determining problems in navigation and time. By its aid many important questions may be solved, if not very accurately, at least promptly, and well enough for most practical purposes. In schools, globes are invaluable as a step in "object teaching," since by familiarity with them the young obtain far better ideas of general geography than they can from plane charts, as appears from the spherical map. The oldest globe in existence is that in the Museum Borgia at Velletri, probably from the year 1225. Celestial globes of gold, on which the stars were represented by pearls, were made by the Arabs. But the impetus which the Arabs gave to astronomy and geography was discouraged by the Church, which opposed the theory that the world was round. The first modern globe-maker was Johann Schöner (b. 1477 at Karlstadt in Franconia), a distinguished mathematician and astronomer. Tycho Brahe also made many globes; one of these, 4 feet 7 inches in diameter, and made of copper, was seen by M. Picard at Copenhagen in 1671.

The process of making globes is simple, but requires great accuracy. A ball of iron or of wood, to serve as a base on which to make the globe, is first made, with stout wires projecting from the poles. It is covered with a coating of dry paper, and on this are laid as many sheets of coarse soft or hard paper, damped, as are necessary to the requisite thickness, which is generally half an inch, more or less, according to the size. This of course, when dry, makes a hollow ball of *papier-mâché* or thick pasteboard. When dry it is hung by the wires in sockets, and made to turn rapidly, and while so revolving the edge of a sharp knife cuts the globe into two hemispheres. A round stick for an axis and support is placed within, and a stout wire projecting from either end forms the poles. The two segments are then united and joined with glue. This is placed in a semicircular disk or band of steel, and being coated with whiting and size is made to revolve. The edge of the steel band removes any excess of size, the process being in fact turning. The equator and ecliptic and lines of latitude and longitude are then marked with great care. The two crossings of the equator and ecliptic, or the points of the

equinoxes, are usually the line of the first meridian, and from the point of the vernal equinox the degrees on the equator and ecliptic begin. The maps, which are generally made in twenty four pieces, with two circular pieces for the poles, are now fitted and pasted on. They are then dried and highly sized before being varnished. The brass circle in which most globes hang by their poles is called the universal meridian, since any given place on the earth's surface may come within it. This brass meridian is held within the broad flat circle of wood called the horizon by sliding in two grooves. Of late years the horizon has in some globes been so constructed as to revolve with ease. This horizon is supported by two arms and a base forming a stand, on which it rests. By sliding the meridian the poles of the globe can of course assume any point from the horizon to the vertical. The brazen meridian is divided into 360 equal parts called degrees. On one side of the meridian, or the *lower semicircle*, they are numbered from 1 to 90 from the poles to the equator, to give the elevation of the former. In the upper semicircle the same numbers from the equator to the poles are used to ascertain the latitude of any point on the earth's surface. Excellent globes are made in London, but when ordered from a distance or for the colonies they are often faulty. A globe costing £18 was supplied in 1870 by one of the best makers in London, on which the city of Chicago was not to be found: and a very large one which is now by the writer contains an incredible number of similar errors in its American geography. Excellent globes are now made by several American manufacturers. Many of them are unexcelled by any produced abroad. CHARLES G. LELAND.

Globe Am′aranth, the *Gomphrena globosa*, a flowering plant well known in cultivation for its globose purple or white heads of imperishable flowers—one of the kinds known as *immortelles*. This species is East Indian. Many of the South American species (herbs or shrubs) are prized for their medicinal virtues, especially *Gomphrena officinalis* and *macrocephala*.

Globe Fish, a name applied to several fishes, mostly



Pennant's Globe Fish.

marine, and of the genus *Tetraodon*. Like other fishes of the family, they have the power of puffing themselves up by swallowing air. In this condition they sometimes lose their balance, and float in a helpless state upon the water. They are protected by sharp spines. The U. S. coasts have one species or more; the *T. Pennantii* is European.

Globe Flow′er [so named from the almost spherical shape of the blossom], a genus (*Trollius*) of perennial herbs of the order Ranunculaceæ. *Trollius Europæus* and *Asiaticus* are cultivated ornamental plants. *T. laxus* is a rather rare plant of the U. S., and the only American species.

Globe Vil′lage, post-v. of Southbridge tp., Worcester co., Mass., on the Boston Hartford and Erie R. R., has woollen-mills and mousseline de laine print-works.

Glob′ulin, (1) a semi solid nitrogenous substance which constitutes a large proportion of the bulk of the red globules of the blood. It is coagulable by heat, insoluble in cold water, and is found intimately associated with a little fat and some inorganic salts. It is closely akin to albumen, and is called an albuminoid. Its composition is given in the art. ALBUMINOIDS (which see). But some late authorities question its existence as a distinct principle. (2) Globulin, fibrinogin, myosin, and vitellin are collectively called globulins—a name which is (3) also given to the granules ($\frac{1}{7000}$ of an inch in diameter) found in the lymph of the animal absorbent system, and regarded by some as a variety of leucocytes. From the threefold application of this word some confusion has arisen.

Globigeri′na, an interesting genus of microscopic foraminifers, each roughly globular; but masses of Globigerinæ are commonly found united in a somewhat raspberry shaped lump, the parent organism from time to time forming new animals by budding. These creatures abound in deep-sea ooze over large areas of the ocean-bottom, where their shells are gradually forming new chalk strata.

Glocester, tp. of Providence co., R. I., contains a number of manufacturing villages. Pop. 2385.

Glogau, or **Gross-Glogau,** town of Prussia, in the province of Silesia, on the left bank of the Oder. It is strongly fortified, and has large breweries and manufactures of beet root sugar, tobacco, woollen and linen fabrics, and paper. Pop. 18,265.

Glom′men, the largest river of Norway, rises in lat. 62° 40′ N. and lon. 11° 16′ E., at an elevation of 2419 feet. After joining the Vormen it is called the Stor-Elv, and falls into the Skagerack. Its course is about 400 miles long, and its volume of water very considerable, but its navigation is much impeded by falls, of which the Sarp, 10 miles from its mouth and 70 feet high, is the most remarkable.

Glonoine. See NITRO GLYCERINE.

Glo′ria, in music, one of the principal divisions of a Catholic or liturgical mass, being the music to the words of the hymn "Gloria in excelsis Deo," etc. In masses of a diversified and elaborate character the Gloria frequently embraces several movements, consisting of solos, duets, etc., and choruses. The word is also used for the doxology Gloria Patri, "Glory be to the Father," etc., and the Gloria Tibi, "Glory be to Thee, O Lord."

Glo′ria in Excel′sis De′o [Lat. for "Glory be to God on high"], the title of the greater doxology, being the first words of that formula. It is also called the Angelic Hymn, because the first words were sung by the angels on the plains of Bethlehem (Luke ii. 14). With slight differences it is used by the Greek, Latin, Lutheran, Anglican, Wesleyan, Methodist Episcopal, and some other churches, being a part of the office for the Holy Communion. It dates from the second century, and was originally the morning hymn of the Greek Church.

Glo′ria Pa′tri ("Glory be to the Father"), the lesser doxology, a very ancient ascription of praise to the Holy Trinity—a brief hymn which is believed to have taken its present form about the time of the origin of the Arian controversy.

Glorio′sa, a genus of liliaceous flowering plants (remarkable for having the leaves tipped with a short tendril or hook), of which the best known is the *G. superba*, a tuberous East Indian perennial herb, with very fine red and yellow flowers, seen in greenhouse culture.

Gloss [γλῶσσα, the "tongue," "language," because it explains verbal difficulties], an explanation written upon a MS. writing between the lines, along the margins, or upon a separate parchment, designed to explain foreign, obsolete, provincial, or technical words or obscure phrases. The Greek, Hebrew, and Vulgate texts of the Bible and the canon and civil law were the subjects of many and often important glosses. Sometimes the gloss is more than a verbal explanation, and takes the form of a logical elucidation.

Glos′sop, town of England, in Derbyshire, has iron-foundries, paper-mills, dyeworks, bleaching-fields and manufactures of woollens. Pop. 17,046; with surroundings, 20,673.

Gloucester (glos′ter), city of England, the capital of the county of Gloucester, on the left bank of the Severn. It is well built and laid out, its four main thoroughfares crossing each other at right angles in its centre, and with its docks and wharves conveniently situated for a speedy communication between the harbor and the railways. Its cathedral, commenced in 1047, is one of the finest in England, especially its square tower, 223 feet high. Its steel and iron manufactures (railway fittings, agricultural implements, cutlery, pins, etc.) are very extensive. Gloucester, Worcester, and Hereford form together a choir which gives its celebrated annual concerts alternately in one of the three cities. The see of Gloucester has since 1842 been united with that of Bristol. The see house is at Gloucester, but there are separate cathedral establishments. P. 18,[illegible]0; of parliamentary borough, 31,804.

Gloucester, the north easternmost county of New Brunswick, Dominion of Canada, bounded on the N. by the Bay of Chaleurs. It is mostly fertile, but is somewhat broken. Agriculture, shipbuilding, fishing, and lumbering are the chief pursuits. It is intersected by the Intercolonial Railway. Cap. Bathurst. Pop. 18,810.

Gloucester, county of Southern New Jersey, bounded on the N. W. by the Delaware River. The surface is generally level; the western part is very fertile. Area, 250

square miles. Grain, sweet potatoes, and garden products are the staple crops. Flour, carriages, iron, and glass are manufactured. It is intersected by the New Jersey Southern R. R. Cap. Woodbury. Pop. 21,562.

Gloucester, county of the peninsula of Virginia, bounded on the E. by Chesapeake and Mobjack bays, and on the S. by the York River. The surface is level and productive. Grain, firewood, fish, and oysters are exported. Area, 280 square miles. Cap. Gloucester C. H. P. 10,211.

Gloucester, city and seaport of Essex co., Mass., near the extremity of Cape Ann, 28 miles N. E. of Boston, with which it is connected by a branch of the Eastern R. R. It received its name from Gloucester, England, whence many of its early settlers came. It was settled in 1623, incorporated a town in 1642, and became a city in 1874. It contains a city hall, 13 churches, 21 school-houses, 3 national and 1 savings bank, a public library, 3 hotels, 6 post-offices, and 2 weekly newspapers. The business is mainly confined to the fisheries and the granite industry. It is also quite popular as a summer resort. In 1873 the valuation was $8,000,000, and the product of the fisheries for the year $1,000,000. It has a very fine harbor. Pop. in 1870, 15,389.

A. F. Stickney, Ed. "Gloucester Telegram."

Gloucester, tp. of Camden co., N. J. Pop. 2710.

Gloucester, tp. of Transylvania co., N. C. Pop. 372.

Gloucester City, post-v. of Newton tp., Camden co., N. J., on the Delaware, opposite the lower part of Philadelphia, and 4 miles below Camden, on the West Jersey R. R. It has several churches and manufactories. Pop. 3682.

Gloucester Court-house, post-v., cap. of Gloucester co., Va., 1½ miles from Ware River. It has a flour-mill, a saw-mill, 1 newspaper, 2 coach manufactories, stores, etc.

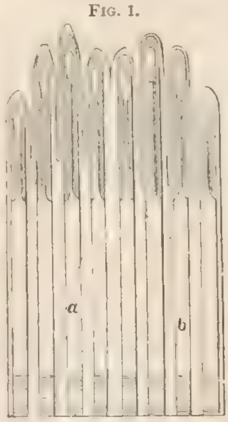
P. W. Page, Prop. "Gloucester Herald."

Gloucestershire, county of England, is situated around the estuary of the Severn. Area, 1258 square miles. Pop. 534,320. The eastern part is occupied by the Cotswold Hills. Here the soil covering the rocks is thin, yet affords excellent pastures, especially for sheep. The central part is a valley formed by the Severn, with very rich soil and a peculiar climate, which ripens all fruits very early. The western part is the Forest of Dean, of which about 20,000 acres belong to the Crown. Besides agriculture and dairying, many branches of manufacture, especially that of woollen goods, are pursued. Coal-mining and the iron industry are also extensively carried on.

Gloves [Ang Sax. *glôf*, a covering for the hands, usually of leather or textile fabric, enclosing each digit separately, and sometimes extending up the arm] were worn in ancient times by the Persians as a protection from cold, but in Greece and Rome they were only used by husbandmen during the performance of certain kinds of field-labor as a protection from thorns. In the early Middle Ages they became quite common. Knights, priests, and ladies used them, and they received different symbolical significations of love, challenge, submission, etc. It was not, however, until the age of Louis XIV. that they became part of elegant dress in general, but after that time their use has become more and more common. During the reign of Louis XIV. the glovers of Paris became a very important community; the king renewed their statutes, dating from 1190; in these they were styled marchands-maîtres-gantiers-parfumeurs, and alone had the right to sell or prepare gloves. Between 1644 and 1680, Louis XIV. issued several edicts prohibiting the use of gloves embroidered with gold or silver. Gentlemen's gloves at this period were made with gauntlets; those worn by ladies covered the arm.

Gloves are made of leather, fur, and cloth, of silk, linen thread, cotton, and worsted, generally woven in the same manner as stockings. Leather, being most used of these materials, is of chief commercial importance. The principal kinds are doe, buck, and calf skin; reindeer skin; sheep skin, for military gloves; lamb skin, of which much so-called kid is manufactured; and veritable kid, used for the best and finest gloves. Dog skin is much used; and the skins of the rat and the kangaroo are reported to be employed as material for fine gloves. Calf skins are imported from the Baltic; lamb skins, from the south of France, Italy, Spain, Turkey, and Austria; kid skins from the south of France, Italy, Switzerland, Ireland, and the East Indies. Great care is required in tawing or preparing kid leather for gloves, and it is necessary that the animal shall be killed young, because so soon as it begins to feed on herbage its skin is injured for this purpose. The skin is cleaned in running water; then, having been slacked with cream of lime, or lime and orpiment, the hair is removed from it with pincers. It is next steeped for ten or fifteen days in lime-water, then washed in pure water, and soaked in fermented bran-liquor. Alum, salt, yolks of eggs, and flour are used to soften it, a larger proportion of salt being necessary in hot weather to prevent putrefaction. It has been calculated that over 60,000,000 eggs are used to prepare glove leather in France and England. The skin is next dried, worked upon the softening-iron, stretched, and rubbed with pumice to render it smooth. The best kid leather is manufactured at Armonay, 40 miles S. of Lyons. Lamb skins in great quantities are prepared at Yeovil in Somersetshire, England. The next process is dyeing the skins intended for colored gloves. In this the French excel, producing a great variety of delicate tints; their superiority is attributable partly to the quality of the water in certain places, partly to the clearness of the atmosphere in France. Before 1833 the method of cutting out gloves was extremely defective. It was done with long scissors by workmen who had no definite rules to guide them as to the size and shape of different hands, and who hardly calculated the stretching capacity of the leather. Half an inch more or less in length or breadth seems to have been regarded as a matter of little importance; and in a manual of glove-making, published about 1828, the workman is directed to use his own middle finger as a standard by which to cut the fingers of a glove. So much being left to the judgment, it is plain that careless or inexperienced operators must have wasted great quantities of kid, while the most skilful can seldom have succeeded in shaping two gloves exactly alike. In 1819, Vallet d'Artois, a French glove manufacturer, invented punches (*emporte-pièces*) in three sizes, each of which cut out two dozen gloves at once. But economy of labor was less needed than improvement in its result, and the idea of justly calculating the lateral and longitudinal extension of leather not having occurred to the inventor, his instruments, though ingeniously conceived, were practically of little value. In 1834, Xavier Jouvin turned his attention to inventing a new method of cutting out gloves. This young man, though brought up as a working glover, possessed not only an aptitude for mechanics, but also much self-acquired geometrical knowledge, and a patriotic desire to improve and extend the manufactures of his native town, Grenoble. He set to work on a scientific basis—first, to classify the various sizes and forms of hand; next, to determine the exact stretch of leather required to cover each of them; then, to draw up a list or scale in which by means of a letter and a figure the glove-wearer should find the exact size and shape of his own hand. By careful and ingenious application of certain geometrical rules, Jouvin succeeded in deciding the amount of any quality of kid required for any sized glove. He found that 32 sizes included all dimensions of hands, the various shapes of which he classed under five heads: very slender, slender, medium, broad, very broad. Having divided each type into two dimensions, he got 10 distinct glove-forms, and multiplying these by the original 32 sizes, obtained 320 different numbers of gloves. This great variety is more than sufficient, and many numbers are very rarely required. For each of the 32 sizes he made a *calibre*, or glove-pattern of sheet iron (Fig. 1), furnished on its inferior surface with diminutive points for marking upon the kid the place for the thumb-hole, *a*, and the lines for embroidery at the back of the hand, *b*. He also made small calibres for the thumbs, and punches (*emporte-pièces*) for cutting the thumb-hole and shaping the gussets. A piece of kid having been duly stretched, the calibre was pressed upon it, and it was cut to the shape of the pattern by means of a knife invented for the purpose. Jouvin got the idea of this method while watching a glover cut kid into strips for binding with a penknife drawn along a ruler. In 1838 he replaced the calibres with punches, which cut out at once the glove, thumb-hole, button-hole, and cleft at the wrist, and traced the three rows for embroidery. The punch (Fig. 2, X) still used in the Jouvin manufactory consists of steel blades forming the outline of a glove without its thumb, and connected by iron bars, to which they are screwed. These bars are covered by a plate of sheet iron (Fig. 2, Y), beyond which the blades project about an inch. The punch is forced by a lever through several layers of kid, and thus cuts out a number of gloves at a time. Punches are also employed for the thumbs and gussets. In order to cut out with the same instrument gloves for differently formed hands, skins

Fig. 1.

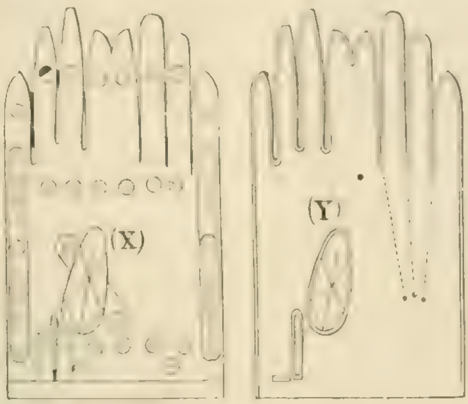


Calibre or Glove Pattern.

varying in elasticity are used, and each pair of Jouvin gloves has two marks—one, indicating the punch with which they were cut; the other, their degree of elasticity.

Glove sewing is done by women, generally in their own homes. This work requires much care, as the kid is easily soiled, stretched out of shape, or torn by the use of too

Fig. 2.



Punch (*Emporte-Pièce*).

coarse a needle. Some manufacturers employ punches which, while shaping the gloves, prick places for the stitches, but a machine of English invention is commonly used in glove-sewing. It consists of an iron vice set in a stand which is screwed to the edge of a table. Each jaw of this vice has its extremity made of brass, and is tipped with a comb of the same metal, the teeth of which, about one-twelfth of an inch long, are perfectly even and regular. The spaces between the teeth, as also the shape of the comb, vary according to the kind of sewing required; therefore sets of vices are used provided with combs of different shapes and sizes. One jaw of the vice is made fast to its stand, but the other is movable by a hinge, and is kept in its place by a strong spring. The movable jaw is furnished with a lever connected by a wire with a pedal, upon which the workwoman presses her foot when it is necessary to separate the jaws. She inserts the seam to be sewed between the two brass combs, then lifts her foot, and the jaws, closing firmly upon the kid, hold it in position. She then passes her needle successively through all the teeth of the comb, and is sure to make an even seam if she lets it graze along the bottom of each notch. When one piece is sewn she again presses the pedal, and repeats the above process with a fresh seam. The glove sewer usually begins by putting in the thumb, with its gusset; she then sews the long seam from the wrist to the tip of the little finger, puts in the finger-gussets, and sews the fingers. In a variety of gloves called *Joséphine* there is no long seam, but instead two short ones—from the thumb to the space between the first and second fingers, and from the lower part of the thumb to the wrist. The glove being sewn, the slit at the wrist is bound, the button-hole is completed, the button or other fastening added, and a binding of white kid or some other finish put round the wrist. It is then pressed and smoothed, the finger-gussets are folded back between the superior and inferior surfaces of the fingers, and the thumb is bent across the palm.

Until 1825 a law existed prohibiting the importation of foreign gloves into England. Since its repeal the quality of English leather gloves has much improved; they are manufactured at London, Ludlow, Worcester, Yeovil, and Woodstock. Limerick, in Ireland, was formerly celebrated for gloves of a peculiarly delicate kind, a pair of which could easily be packed into a walnut-shell. This manufacture has fallen into decay. Very excellent gloves are made in Italy, principally at Naples; in Belgium, Sweden, Denmark, and Germany. Austria exports many gloves of the first quality. Gloversville, N. Y., has large manufactures of gloves of many grades of excellence. France, however, supplies the world with most of the finer and more expensive kinds. The chief seats of manufacture are Paris, Grenoble, Chaumont, Milhau, and Niort. About 2,000,000 dozen pairs of gloves, of first, second, and third quality, are made annually, their price being from 35 to 75 francs per dozen, and their aggregate value from 65,000,000 to 70,000,000 of francs. Of these, at least two thirds are exported. The tanning and dyeing of glove-leather employ 20,000 persons; the manufacture and trade, 50,000. In the town of Grenoble there are 180 master-glovers, employing, in various branches of the business, 30,000 work-people, of whom 2000 are cutters. The annual manufacture amounts to 900,000 pairs of gloves, valued at 30,000,000 francs. St. Anne, mother of the Virgin, having, according to monkish legends, been accustomed to knit gloves, is the patroness of French glovers, who celebrate an annual holiday in her honor. In 1811 the glovers of Grenoble ordered a statue of their saint, represented knitting with a glove in her hand, and at her feet a basket containing several pairs of gloves.

Woollen gloves are made in Germany and England, the chief English manufactories being at Nottingham and Leicester. JANET TUCKEY.

Glov'er, tp. of Colleton co., S. C. Pop. 1102.

Glover, post-tp. of Orleans co., Vt., 35 miles N. E. of Montpelier. It has 4 churches, a liberal institute, and manufactures of lumber, leather, boxes, etc. The famous Runaway Pond, or Long Lake, which burst its banks June 6, 1810, was situated partly in this town. Pop. 1178.

Glover (JOSEPH), M. D., a physician and surgeon of Charleston, S. C.; graduated in the medical department of the University of Pennsylvania in 1806, when his thesis on digestion was published. He is reported to have performed lithotomy, tapped the head for hydrocephalus, and removed successfully a portion of the spleen and omentum. PAUL F. EVE.

Glov'ersville, post-v. of Johnstown tp., Fulton co., N. Y., 44 miles N. W. of Albany, and 9 miles N. of Fonda. It contains 2 national banks, 1 savings bank, 1 union school, 1 public library, 2 foundries, 3 large hotels, 3 newspapers, 7 church societies, 60 stores, and upwards of 150 glove manufactories. The latter is the principal business, and from it the place derives its name. It is connected with the New York Central R. R. by the Fonda Johnstown and Gloversville R. R. Companies are organized for the construction of a horse railroad and waterworks on the "Holly" plan. Pop. 4518.

J. R. ARROWSMITH, ED. "STANDARD."

Glow'worm, the wingless and nocturnally luminous female of *Lampyris noctiluca*, and other fireflies of Europe. The winged male emits a very feeble light, not at all comparable for brilliancy with the common fireflies of the U. S.; while the female has a pale bluish and rather faint luminosity, which, it is supposed, serves to attract the male. In the U. S. some luminous larvæ of various fireflies are named glowworms. (For an hypothesis as to the origin of the glowworm's light, see FIREFLY.)

Glu'chow, town of Russia, in the government of Tchernigow. In its neighborhood is found a fine sort of porcelain clay, which is sent to the imperial manufactories at St. Petersburg. Pop. 8856.

Glu'cic Ac'id, an acid prepared by the action of lime or baryta on cane or grape sugar; also by the action of baryta on gallotannic acid, as well as by sulphuric acid on cane-sugar; composition, $C_{12}H_{18}O_9$. Glucic acid is a colorless, amorphous body, very soluble in water and alcohol. It decomposes when dry on being heated to the temperature of boiling water. Boiled with acids, it forms apoglucic acid by absorption of oxygen, the solution turning brown. The basic lead salt is insoluble in water; the other salts, as far as studied, have been found to be soluble.

E. WALLER.

Gluci'num [Gr. γλυκύς, "sweet," from the taste of some of its salts], called also **Beryl'lium** (symbol, G; atomic weight, 9.3), an artiad (dyad) earth metal, whose oxide (GO) is known as glucina, and is considered an earth. Glucinum in nature commonly occurs as a silicate of glucina, as in the beryl, of which gem this earth constitutes 14 per cent.; or as an aluminate, as in the chrysoberyl. The glucinum chloride (GCl_2), when vaporized and passed over melted sodium, yields metallic glucinum, a white malleable metal (sp. gr. 2.1) which cannot be burned, even in pure oxygen.

Gluck, von (CHRISTOPH WILLIBALD), an eminent composer, b. at Waidenwang, near the borders of Bohemia, July 2, 1714; d. at Vienna Nov. 15, 1787. His father was a huntsman and forester in the service of Bohemian nobles. Besides receiving a good school education and part of a course at the University of Prague, the boy was well instructed in music under the direction of the Jesuits, who cultivated the art for religious purposes. At the age of eighteen, being forced to work for his support, he gave lessons in vocal and instrumental music, sang and played in church, and in leisure time entertained villagers with his accomplishments. At the age of twenty-two his ability had attracted the attention of a noble patron, who gave him opportunity to study music at Vienna under the most favorable auspices. A Lombard prince, hearing him there at his patron's house, took him to Milan and placed him under the tuition of the then celebrated Sammartini. He was but

twenty-six years old when he received an order to compose an opera for the court theatre. This was the *Artaserse*, and it was a triumph, in spite of the innovations of style which the author introduced; for the new spirit which later effected a complete reform in operatic compositions was already born in the young master. Other operas followed—*Demofoonte, Demetrio, Ipermnestra, Artamene, Siface, Fedra, Poro*—all for Italian cities. Invited to the Haymarket, London, he produced there, in 1746, *La Caduta dei Giganti*, which was not a flattering success. In London he became acquainted with English composers and with Handel. In Paris he was attracted to the works of Jean Philippe Rameau, then at the height of his fame. Full of new ideas, Gluck gave his whole mind to his new theory of opera, and after producing many pieces more or less significant at Paris, Vienna, Rome, Naples—two of which, *Il trionfo di Camillo* and *Antigono*, won for him from Pope Clement XIII. the order of Knight of the Golden Spur—he returned to Vienna and established himself as Capellmeister of the imperial opera. During the whole of this period, lasting till 1762, Gluck's genius, though copiously and variously productive and widely recognized, had not fully unfolded its powers or justified itself to its possessor. He was forty-eight years old when, from a libretto by a new author, Calzabigi, poet and statesman, he composed the *Orfeo ed Euridice*, which was first performed in Vienna Oct. 5, 1762. This opera marked a new era. The fame it acquired at once it has never lost. It was followed shortly by the *Alceste*, and in 1769 by the *Paride ed Elena*, the texts for the three being by the same author. Still, Gluck was not satisfied without the ratification of the judgment of Paris. This, after great effort, he was able to secure in 1774. On Apr. 19 of that year the *Iphigénie en Aulide*, finished at Vienna in 1772, was brought out in Paris under the direction of the composer himself, who had bestowed immense labor on all the details of its scenic production. A ferocious controversy raged over it between the champions of the old and new schools. Gluck carried the day, and five years later, he being then in his sixty-fifth year, he enjoyed the triumph of witnessing the successful representation of his great opera, the *Iphigénie en Tauride*, in the French capital. He was sixty-four when he wrote it, but it ranks among the foremost of his compositions; by many is deemed his very best, as being the most complete and splendid vindication of the new school. The aim of this school was to make music expressive of the emotions implied in the action of the drama. The opera, according to this theory, was to be a musical drama, not a concert in costume. The text must be descriptive of real passion, intense and elevated. The notes must voice fully the spirit of the text, giving to the poetry the light and shade and color by which the painter imparts life to his outlines. The instruments must be subservient to the voices, while sustaining and aiding them. The overture must foreshadow the sentiment of the piece, and a conscientious simplicity, forbidding useless decoration, discouraging vanity and affectation, and submitting sound to sense and soul, must be the composer's law. Gluck, though possessing immense industry, energy, and determination, the mind of a critic and the soul of a reformer, lacked the affluence of genius that distinguished his immortal successors in operatic composition, Mozart and Beethoven. His aims were lofty, his ambition was great. He demanded a theme of deep sentiment and elevated character. A tender dignity and pathos were native to his mind, and were enhanced by the simplicity and singular purity of his method. His greatest compositions are penetrated with a feeling religious in its character, yet his religious compositions are very few and of small account. Schiller, after witnessing a representation of the *Iphigénie en Tauride* at Weimar, wrote: "Never has any music affected me so purely, so supremely, as this; it is a world of harmony, piercing straight to the soul, and dissolving it in the sweetest, loftiest melancholy." Gluck was a man of attractive social qualities, but keen and somewhat acrid in controversy. His married life was childless, but otherwise happy.

O. B. Frothingham.

Glück'stadt, town of the German empire, in the duchy of Holstein, on the Elbe. It has a school of navigation and a good harbor. Pop. 5752.

Glu'cose, the name applied to a class of sugars similar in chemical composition, but differing in some of their properties. The glucoses are thus classified: 1, ordinary glucose, dextro-glucose, or dextrose; 2, Lævulose or lævo-glucose; 3, Maltose, produced by the limited action of diastase on starch, and having a high dextro-rotatory power on light; 4, Mannitose, from the oxidation of mannite by platinum black; 5, Galactose, the result of the action of acids on milk-sugar; 6, Inosite, existing in muscular flesh; 7, Sorbin, obtainable from mountain-ash berries; 8, Eucalyn, existing in Australian manna. The first four exhibit but little difference in their properties except in their action on polarized light. The last three are fermentable only under peculiar conditions. The others ferment readily when in contact with yeast.

Glucose in its more limited signification is applied to dextrose and lævulose, which occur naturally together in acid fruits of various kinds, in honey, and in diabetic urine. These sugars are known as fruit-sugar, grape-sugar, honey-sugar, diabetic-sugar, and, when produced in the laboratory or in commercial processes from other substances, as inverted sugar, starch-sugar, potato-sugar, rag-sugar, etc., according to the substances from which it is made. The various fruits contain them in the following proportions:

Peach	1.57	per cent.	Gooseberry	7.15	per cent.
Apricot	1.80	"	Cranberry	7.45	"
Plum	2.12	"	Pear 8.02 to	10.8	"
Raspberry	4.00	"	Apple	8.37	"
Blackberry	4.44	"	" 7.28 to	8.04	"
Strawberry	5.73	"	Sour cherry	8.77	"
Bilberry	5.78	"	Mulberry	9.19	"
Currant	6.10	"	Sweet cherry	10.79	"
Plum	6.26	"	Grape	14.93	"

Inverted sugar is produced by long boiling of solutions of cane-sugar, and hence is formed incidentally in the manufacture of refined sugar from the cane and beet, being found in considerable quantities in the molasses. It may also be more readily produced by adding a little acid to a solution of cane-sugar, and then boiling. From grape-juice glucose is obtained by neutralizing the free acid, principally tartaric, with some form of lime or baryta carbonate, allowing the precipitate to stand, clearing with blood (2 to 3 per cent. by volume), evaporating down, and crystallizing out: 1000 parts of grapes yield about 60 to 70 parts of pure glucose when thus treated.

By far the largest proportion of glucose used in the arts is made by boiling starch for some time with dilute sulphuric acid in lead or wooden pans. The starch is first converted into dextrine and glucose, the dextrine being then changed to glucose:

$$\underset{\text{Starch}}{2C_6H_{10}O_5} + \underset{\text{Water.}}{H_2O} = \underset{\text{Dextrine.}}{C_6H_{10}O_5} + \underset{\text{Glucose.}}{C_6H_{12}O_6}$$

$$\underset{\text{Dextrine}}{C_6H_{10}O_5} + \underset{\text{Water}}{H_2O} = \underset{\text{Glucose.}}{C_6H_{12}O_6}$$

For this purpose one to two parts of sulphuric acid are diluted with three or four times their bulk of water, and 100 parts of starch are mixed with sufficient water to make a milky fluid. These two are then run into 300 to 400 parts of water heated to boiling, and the boiling is continued. When a portion of the mixture ceases to turn blue with iodine, the starch has all been converted into dextrine and glucose, which is the intermediate stage. The boiling is continued until a large amount of absolute alcohol fails to produce a precipitate of dextrine in a sample of the mixture, when the conversion into glucose is complete. The sulphuric acid is then neutralized by addition of lime or baryta carbonate in slight excess, and the insoluble lime or baryta sulphate is separated by settling and decantation; a portion is removed in the screens. The solution is then filtered through bone-black, concentrated by evaporation, and the sugar is crystallized out, which takes from 8 to 10 days, or concentrated to a certain point. It is put on the market under the name of starch syrup, corn syrup, or maltine. Sawdust and wood chippings from the refuse of wood-paper manufactories is sometimes treated in the same way, an inferior quality of glucose being thus obtained. The chemical formula for the different varieties of glucose above enumerated is $C_6H_{12}O_6$. Dextrose rotates the plane of a ray of polarized light to the right, while lævulose rotates the ray much more strongly to the left. Hence a mixture of equal parts of each has a left-handed rotation. Lævulose by itself is an uncrystallizable syrup. The glucoses, when heated in contact with metallic oxides, have the power of reducing many of them to lower degrees of oxidation or to the metallic form. They form compounds with various oxides. One part of cane-sugar sweetens as much as two or two and one-half parts of glucose. With alkalies and their carbonates, glucose alters to melassic acid, a brown substance which is used for artificial coloring of wines, brandies, and other liquors and beverages under the name of sucre-couleur. Glucose is also used in wine-making, either to sweeten wines or to give them a larger proportion of alcohol by fermentation. In brewing it is also used, as much as 1 hundredweight of sugar being sometimes used to 3 hundredweight of malt. It is also used in confectionery. The inferior qualities, such as are prepared from wood, are used for making alcohol.

Originally, cane-sugar and glucose were considered as identical. In 1792, however, Lowitz showed the difference

between them. Kirchhof was the first to prepare it from starch, and Braconnot first showed that it could be obtained by boiling linen threads and other forms of cellulose with acids. Dubrunfaut investigated the difference in optical properties of the various kinds of glucose. (See LOWITZ, *Crells Ann.* vol. i. pp. 218 and 345; KIRCHHOF, *Schweigg. Journ.* vol. xiv. p. 389; BRACONNOT, *Ann. de Chim. et de Phys.*, [2] vol. xii. p. 181; DUBRUNFAUT, *Comptes Rendus*, xvii. 228. Also articles BEER, BREAD, SUGAR, FERMENTATION, and DIASTASE.) E. WALLER.

Glu'cosides, a term applied to substances yielding when treated with dilute acids (or certain ferments) glucose or a sugar of similar composition, and another substance not belonging to the group of carbohydrates. They occur in various plants, most frequently in the bark. None have been formed artificially. A series of bodies, however, called artificial glucosides, has been prepared by heating glucose with some organic acid for several hours, but these yield glucosan, and not glucose, on being decomposed. Alkalies and some organic ferments also decompose some glucosides to glucose and some other body. Among the most important glucosides may be mentioned amygdalin from bitter almonds, chitin from the wing-cases of insects and from the carapaces of crustaceans, gallo-tannic acid from gall-nuts, myronic acid from the seed of black mustard, salicine from the leaves and bark of the willow and poplar, and solanin from the nightshade, tobacco, potato, tomato, and other plants of the family of Solanaceæ. (See ALMONDS, OIL OF.) E. WALLER.

Glue [Lat. *glus*], a hard, brittle, glassy form of dried gelatine, containing impurities which give it a brownish color. It is the most important of the animal cements, and is usually obtained from the scraps of hides, the hoofs of animals, etc., by first thoroughly cleansing with lime, then washing and airing so as to slake the remaining caustic lime, and then boiling in rain-water, by which the albuminoid elements of the animal matter are changed into gelatine. The latter is removed and carefully dried in nets, care being taken to avoid too much or too little heat, for the first will melt the glue, while cold may cause the pieces to crack. Bone-glue (bone-gelatine) is prepared from fresh bones, either by digesting them with superheated steam, or with dilute hydrochloric acid, followed by boiling, the latter process affording the best results. "Fish-glue" is an inferior isinglass made from the offal of the fisheries. Glue is used in joinery, cabinetmaking, in preparing size for dressing paper, silk goods, etc., in calico-printing, in making rollers for inking type, in fresco-painting, in paper-hanging, in stiffening hat-bodies, and for many other uses in the arts. For use as a cement, glue is generally dissolved with a gentle heat in a water-bath, and is then fit for use. "Prepared" or liquid glue is the ordinary solution kept liquid by the addition of a fluid ounce of strong nitric acid for every pound of dry glue; or commercial acetic acid, 3 parts to 1 of the dried and powdered glue is used, for this acid will dissolve the glue without heat. Six parts glue, 16 parts water, 1 part hydrochloric acid, and 1½ parts sulphate of zinc also give excellent results as an imputrescible liquid glue.

Glue, Marine, a cement formed by dissolving 1 pound of India rubber in 5 gallons of oil of turpentine, or preferably in coal naphtha, and then adding after some days a quantity of shellac equal, or sometimes much exceeding, the previous solution in weight. The mixture is heated over a gentle fire and thoroughly mixed by stirring. It is then run into plates and dried. When used, it is melted by heating. It is insoluble in water, and will hold pieces of tough wood together so strongly that they may be broken across the grain sooner than parted at the place where glued. Glass and metals may also be glued with it.

Glü'mer, von (ADOLF), Prussian lieutenant-general, b. June 6, 1814; became a lieutenant in 1832; served for some time on the staff and became commander in 1861 of the 1st West Prussian Grenadier regiment. He took part as major-general in the campaign of 1866 against Hesse, Hanover, and the South German States. At the beginning of the Franco-German war of 1870–71 he received the command of the 13th division of infantry, and he decided the battle of Saarbrücken, Aug. 6, 1870, by his circuitous manoeuvre at Forbach. He took part in the battle of Metz, and received Sept. 30 the command of the division of Baden. He was wounded in the encounter at Nuits, Dec. 18, 1870, but continued to command, and he distinguished himself both in the encounter of Villersekel, Jan. 9, and in the battle of Belfort, Jan. 15, 16, and 17, 1871.

AUGUST NIEMANN.

Glu'ten [Lat. for "glue"], a nitrogenous and highly nutritive substance found in many of the cereal grains in variable proportions. It is generally regarded as a mixture of vegetable fibrin with a small proportion of a very adhesive principle called gliadine or glutine, which imparts to the gluten some of its own adhesive quality; but the proportion of gliadine is extremely variable, it being almost entirely absent from rye-gluten. Caseine and a thick oil also exist in most gluten in small proportions. The gluten of wheat varies from 9 to more than 35 per cent. of the grain, according to the soil where grown, the manure used, and the other conditions of growth. The article FLOUR in the present work gives an instructive account of the structure of the gluten-coat of the wheat-grain, and conveys some impression of the great importance of this element in bread-making. Gluten is by most authorities stated to exist in rye, oats, and barley in proportions but little inferior to that in which it exists in wheat; while in maize and buckwheat, and especially in rice, its proportion is much smaller. But some of the best authorities give the name *vegetable fibrin* to the gluten of the grains other than wheat, because it lacks the *gliadine* or glutinous element of wheat-gluten. When wheat flour is kneaded under a gentle stream of water (which washes out the starch, sugar, mucilage, albumen, etc.) a pasty, grayish lump is left. This is gluten. It is a ferment, and is capable of turning starch into dextrine, and dextrine into sugar. It is so highly nutritious that animals can live upon it probably longer than upon any other single nutritive material. Gluten bread, made from carefully washed flour, has been found useful in some cases of *diabetes mellitus*, in which disease its use was suggested by the fact it is not capable of being converted into sugar.

Glut'ton (the **Wolverine** or **Carcajou** of the French Canadians). The genus *Gulo* belongs to the family of Mustelidæ, closely resembling its members in dentition and anatomical details, though differing so much from them in external appearance as to have been placed by many authors with the Ursidæ, or bears. The wolverine of North America, one of the greatest pests of the fur-regions, robbing the traps of the hunter with unceasing pertinacity, and the glutton of Europe and Siberia, belong to one far-ranging species, the *Gulo* (*Ursus*) *luscus* of Linnaeus. EDWARD C. H. DAY.

Gly'cas [Γλυκᾶς], MICHAEL, a Byzantine historian who lived after A. D. 1118, but the precise time is not known. Composed a history of the world (βίβλος χρονική), in four books, comprising the period from the Creation to the year 1118. The work was first published in a Latin translation by Leunclavius, Bâle, 1572; then the first part in Greek by Meursius, 1618; the whole Greek text by Labbé, Paris, 1660; best edition by Bekker, Bonn, 1836. H. DRISLER.

Glyc'erine [Gr. γλυκύς, "sweet"], the propenyl alcohol; a sweet principle obtained by the action of alkalies upon fixed oils and fats, which are regarded as propenylic ethers of fatty acids. Thus, stearine (propenyl tristearate), $C_3H_5(OC_{18}H_{35}O)_3$, *plus* potash (3KOH), gives potassium-stearate or soap ($3KOC_{18}H_{35}O$), *plus* glycerine ($C_3H_5(OH)_3$). Pure glycerine is a colorless, syrupy liquid, unctuous to the touch, sweet to the taste, and without odor. Sp. gr. 1.27. It is very miscible with water (of which it always contains some), cannot be crystallized or evaporated (except when mixed with water and steam at a great heat and pressure), and when heated alone undergoes dehydration, and produces the pungent ACROLEIN (which see) and other compounds. Treated with strong nitric and sulphuric acids, nitro-glycerine or glonoine is produced. (See EXPLOSIVES and NITRO-GLYCERINE.) Glycerine was first discovered by Scheele in 1789. It was formerly obtained for pharmaceutical use by boiling lead plaster (a salt of fatty acids with lead), and then throwing down the lead with sulphydric acid, after which the solution was filtered and evaporated to a syrupy consistence. Large quantities of glycerine were wasted in the soap-manufacture; but at present it is utilized by first saponifying the fats with lime, and then distilling out the glycerine by means of superheated steam. Glycerine as prepared from soapmaker's waste is very liable to retain an offensive odor and an acrid quality (partly from the acrolein present), in spite of the observance of great care in refining and deodorizing it. In medicine, chemistry, and the arts glycerine has a wide range of uses. It is an important ingredient of cosmetics, toilet soaps, unguents, and pomades. Its solvent and antiseptic powers are great, and its non-drying quality adds much to its usefulness. It has nutrient qualities, and is useful in many diseases of the skin and the mouth. But its chief use in medicine is as an excipient, solvent, and preservative for more active medicines. It is used for filling gas-meters, for various purposes in brewing, calico-printing, photography, and in the preparation of objects for microscopic examination, and for innumerable purposes in chemical and pharmaceutical laboratories and in the other arts.

Gly'cogen ("sugar producer"), a white, amorphous, starch-like, tasteless, odorless substance, found by Claude

Bernard in the liver of man and the lower animals, and now known to exist in other tissues, especially during fœtal life. It may be dissolved out of the tissues where it exists by water, and then precipitated with alcohol. The mere contact with blood or the secretions converts it into liver-sugar, which differs from glucose only in the fact that it is more readily fermented. The composition of glycogen is rather doubtful. (The glycogenic function of the liver is discussed in the article LIVER, which see.)

Gly'con [Γλύκων], a statuary of Athens (date unknown, but probably under the early Roman emperors), by whom the celebrated colossal statue of Hercules, known as the Farnese Hercules, was made. This was probably brought to Rome in the time of Caracalla, and placed in his baths, where it was discovered. The statue is supposed to be a copy from an original by Lysippus, and represents Hercules leaning on his club. (See OTF. MÜLLER, *Hist. Greek Art*, § 129, 2). H. DRISLER.

Glycyrrhiza. See LIQUORICE.

Glyn'don, post-v. of Clay co., Minn., at the junction of the St. Paul and Pacific R. R. with the Northern Pacific, 241 miles W. of Duluth and 10 miles E. of the Red River of the North. It is the head-quarters of the Red River Colony. It has a church, a public library, 3 hotels, round-house and machine-shops, a weekly newspaper, and a number of stores and shops. Pop. about 400.
E. B. CHAMBERS, ED. "GAZETTE."

Glynn, county of Georgia, bounded on the N. by the Altamaha, and on the E. by the ocean. Area, 280 square miles. It includes several of the sea-islands. Its surface is partly pine woods and partly marsh. Rice and lumber are exported. The county is traversed by the Brunswick and Albany and the Macon and Brunswick R. Rs. Cap. Brunswick. Pop. 5376.

Glyp'todon [Gr. γλυπτός, "carved," and ὀδούς, ὀδόντος, a "tooth," referring to its fluted teeth], a gigantic extinct armadillo of South America, whose length was from eight to fourteen feet. Its carapace was of horny material. There have been remains of several species discovered in Post-Tertiary strata, chiefly in the Argentine Republic. (See HOPLOPHORIDÆ.)

The Glyptodon, according to the designs of W. Hawkins.

Glyp'tothek [Gr. γλυπτός, "carved work," and θήκη, a "receptacle"], a collection of sculptures, a name especially given to a famous building at Munich containing the collection of ancient sculptures brought to Bavaria by the crown prince, afterwards King Louis I. The sculptures are mostly Greek, partly Egyptian and Roman, and partly modern—the latter chiefly classic in style. The Glyptothek was built in 1816–30, and contains twelve halls, the sculptures in each illustrating a distinct epoch in the art.

Gme'lin (JOHANN GEORG), M. D., b. at Tübingen, Germany, June 12, 1709; was educated in the University of Tübingen, and took his medical degree in 1727; became professor of chemistry and natural science at St. Petersburg 1731; journeyed in Siberia 1733–43; was made professor of botany at Tübingen 1749; d. there May 20, 1755. Author of *Travels in Siberia* (4 vols. 1751–52) and *Flora Sibirica* (4 vols. 1749–70). His nephew, JOHANN FRIEDRICH GMELIN, M. D., b. at Tübingen Aug. 8, 1748; graduated in medicine 1769; became professor of botany, etc. at Tübingen 1771, of medicine 1775; professor of medicine at Göttingen 1778. Author of many works on botany, chemistry, and toxicology. D. at Göttingen Nov. 1, 1804.—SAMUEL GOTTLIEB GMELIN, M. D., also a nephew of J. G. Gmelin, was b. at Tübingen June 23, 1745; took his medical degree 1766; became botanical professor at St. Petersburg, and travelled (1768–74) in S. and S. E. Russia; was taken prisoner in the Caucasus, and d. July 27, 1774, in consequence of the ill-treatment he received. His *Historia Fucorum* (1768) and some volumes of travels have been published.—LEOPOLD GMELIN, M. D. (son of J. F. Gmelin), b. at Göttingen Aug. 2, 1788; studied at Göttingen, Tübingen, Vienna, and in Italy; was chemical and medical professor (titular and ordinary) at Heidelberg 1817–51. Author of *Handbuch der Theoretischen Chemie* (3 vols. 1817–19) and a *Lehrbuch der Chemie* (1844), and also made famous experiments upon digestion. D. at Heidelberg Apr. 13, 1853.—Other distinguished members of this family were JOHANN CONRAD (1707–59), a physician, author, and pharmaceutist of Tübingen, elder brother of J. G. Gmelin; and PHILIPP FRIEDRICH, younger brother of the same (1721–68); held professorships of botany, chemistry, and medicine in Tübingen, and was author of many scientific monographs. The botanists of this name are commemorated by the Linnæan genus *Gmelina*, plants of the order Verbenaceæ.

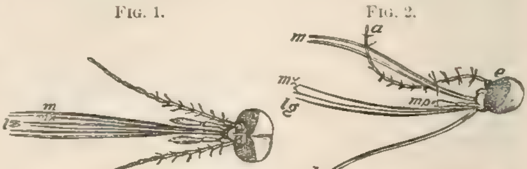
Gmünd, town of Würtemberg, on the Rems. It has an asylum for the blind and for deaf mutes, and celebrated manufactures of jewelry. Pop. 10,739.

Gmun'den, town of Austria, in the province of Upper Austria, is beautifully situated at the Lake of Traun or Gmunden, where the Traun issues from it, and is the seat of several civil, ecclesiastical, and educational institutions. The salt-works of the vicinity are important. Pop. 6533.

Gna'denhütten [Ger., "tents of grace"], a post-v. of Clay tp., Tuscarawas co., O., on the Pittsburg Cincinnati and St. Louis R. R. This was once a celebrated Moravian village of Christian Indians, of whom 100 were cruelly slain by the whites Mar. 8, 1782. Pop. 284.

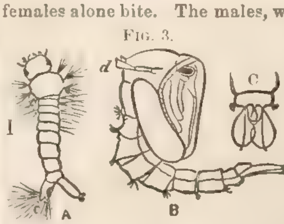
Gnat. The gnat or mosquito differs from other two-winged flies (Diptera) by the long and slender mouth-parts (Figs. 1 and 2). These are adapted for probing and puncturing the flesh of its victim. The young, or larvæ (Fig. 3), are aquatic, living in pools. They are cylindrical, with the head and succeeding segment much enlarged, and breathe by means of a bunch of hairs radiating from a long tubercle situated at the end of the body, and connecting with the internal respiratory tubes (tracheæ). They remain most of the time at the bottom, feeding upon decaying matter, and are thus very beneficial as scavengers. In the pupa state they take no food, and breathe by a respiratory tube (Fig. 3, B, *d*) situated on the greatly enlarged thorax. They are very active in this state, jerking up and down in the water, aided by a pair of broad caudal leaves (Fig. 3, C). The long cylindrical eggs are laid in little packets which float on the surface of standing water. In four weeks after hatching the insect passes through its transformations and arrives at maturity. The females alone bite. The males, which may be distinguished from the other sex by their bushy antennæ, seldom visit our houses, and do not bite. It is a question whether the bite of the mosquito is poisonous. No poison-gland has yet been found in the head, and it is generally thought that the inflammation and swelling following the bite of one of these insects are due to the irritation set up by the slightly barbed jaws, and perhaps the saliva is slightly acrid. About

FIG. 1. FIG. 2.



Dorsal (Fig. 1) and side (Fig. 2) view of the head of the female, enlarged: *a*, antennæ; *m*, mandibles; *mx*, maxillæ; *lg*, lingua; *l*, labium, in which the other parts are ensheathed.

FIG. 3.



A, larva; *e*, respiratory tube and radiating hairs; B, pupa; *d*, thoracic respiratory tube; C, lamellæ at end of body of the pupa, enlarged.

thirty American species of *Culex*, the genus to which the gnat belongs, are described in various works.

A. S. PACKARD, JR.

Gnei'senau, Neidhart von (AUGUST), COUNT, b. at Schilder, Saxony, Oct. 28, 1760; served with the German mercenaries in the American Revolutionary war; became in 1789 a captain of Prussian troops; defended Colberg against the French 1806; was dismissed in 1809 at the suggestion of Napoleon I.; was chief of staff and chief quartermaster to Blücher; conducted the retreat after Lützen 1813, and after the Leipsic campaign was made lieutenant-general; served in France 1814, and was made a count; contributed much to the final success at Waterloo by his strategic skill after the affair at Ligny; was made governor of Berlin 1818; general field-marshal 1825; led an army in Prussian Poland during the Polish insurrection of 1831. D. at Posen Aug. 24, 1831. He was an able officer and a man of liberal principles.

Gneiss, a metamorphic, stratified rock, crystalline-granular in texture and foliated in structure, composed essentially of quartz, feldspar, and mica; the latter ingredient is often replaced by hornblende, thus giving rise to hornblendic or syenitic gneiss.

Gne'sen, town of Prussia, in the province of Posen. It has a cathedral, and is the residence of the archbishop of Gnesen-Posen Roman Catholics. Pop. 7995.

Gnome [Gr. γνώμων, "wise"], in the Rosicrucian and cabalistic doctrine, a spiritual being residing within the bowels of the earth, guarding mines of precious metals, gems, and hidden treasures. There were male and female gnomes, generally grotesque dwarfs, who were rarely seen by men.

Gnom'ic Poets [Gr. γνώμη, a "sentiment"], in Greek literature, a name applied to those didactic poets whose compositions are characterized by aphorisms and short, proverb-like moral precepts (*gnomai*). Pre-eminent among the gnomic poets are Theognis, Solon the lawgiver, Phocylides, and Simonides of Amorgos. Among the best-known editions of the gnomic poets (of some of whom considerable fragments remain) are those of Boissonade (1832), Bekker (1815), Brunck (1784), and Sylburg (1651).

Gnos'tics ("men of knowledge;" Gr. γνῶσις), a name applied to numerous schools of heretics in the early Christian Church. In the New Testament *gnosis* is simply (as in 1 Cor. xii. 8) the more profound apprehension of Christian truth. In Pseudo-Barnabas (107–120 A. D.) it means allegorical interpretation. Finally, it came to denote a system of excessive and fanciful religious speculation. As to its origin, it was in part a reaction of the freer pagan mind against the narrowness and poverty of Ebionism, but also, and more essentially, an inevitable product of the speculative genius of the Gentile world in its first exciting contact with the stupendous facts and doctrines of Christianity. Its elements were derived from three sources: Hellenistic idealism, Oriental pantheistic naturalism, and the Christian revelation. It did not begin as a heresy, but soon became such in undertaking to answer unanswerable questions. These questions are suggested by Tertullian (*De Præscriptione Hæreticorum*, § 7): "Unde malum, et quare? et unde homo, et quomodo? et quod proxime Valentinus proposuit, unde Deus?" Its grand leading question was in regard to the origin of evil: πόθεν τὸ κακόν? But, as Niedner says, this question was only one of several. Its theme was really the whole "world-process." This process embraces the three problems of creation, sin, and redemption. The solutions offered were in form exceedingly diversified; the systems many and various. In classifying these systems the ingenuity of critics has been severely taxed. The more noted classifications are as follows:

I. GIESELER'S.—(1) The Alexandrian Gnostics: Basilides, Valentinus, Ophites, Antitactes, Prodicians; (2) Syrian: Saturninus, Bardesanes, Tatian; (3) Marcion and his school. This geographical classification is not at all felicitous.

II. RITTER'S.—(1) Dualistic: Saturninus, Basilides, Hermogenes, and others; (2) Idealistic: Valentinus, Marcus, Ptolemæus, and others.

III. NEANDER'S.—Originally, (1) Judaistic; (2) Anti-Judaistic. Subsequently modified by subdividing No. 2, so as to stand, (1) Judaistic: Cerinthus, Basilides, Valentinus and his school, Heracleon, Ptolemæus, Marcus, and Bardesanes; (2) Anti-Judaistic: (a) in sympathy with Paganism, the Ophites, Pseudo-Basilidians, Cainites, Carpocratians, Prodicians, Antitactes, Nicolaitans, Simonians; (b) dissevered from all earlier systems, Saturninus, Tatian, the Encratites, Marcion and his school.

IV. BAUR'S.—(1) Those who brought Christianity into closer connection with Judaism and heathenism: Basilides, Valentinus, Saturninus, Bardesanes, the Ophites; (2) those who made a strict separation of Christianity from Judaism and heathenism: Marcion and his school; (3) those who identified Christianity with Judaism, and opposed both to heathenism in the form of gnosis: the Pseudo-Clementines.

V. NIEDNER'S.—(1) Those who gave Christianity at once a place, and the highest place, among the religions of the world: (*a*) in its original form, Basilides, the Ophites, and the closely-allied Cainites and Sethites; (*b*) in its perfected form, Valentinus, Heracleon, Ptolemæus, and Marcus; (2) those who separated Christianity from its historic connection, and made it the first true revelation of God: (*a*) Marcion and his school; (*b*) the Syrians, Saturninus, Bardesanes, Tatian, and Apelles; (3) those who identified Christianity (*a*) with heathenism, the Carpocratians, Antitactes, and Prodicians, all licentious; (*b*) with Judaism, the Pseudo-Clementines.

On four points these systems all, or nearly all, agree: (1) God is incomprehensible. (2) Matter is eternal and antagonistic to God; or, as Basilides taught, if created by God, still conditions and limits the divine efficiency. (3) Creation is the work of the Demiurge, according to some, only subordinate—according to others, totally opposed to God. (4) The human nature of Christ was a mere deceptive appearance. The most elaborate system was that of Valentinus. The historic order was as follows: (1) the Simonians, 37 A. D. (Acts viii.); (2) the Nicolaitans, 96 A. D. (Rev. ii. 6); (3) Cerinthus, near end of first century; (4) the Ophites, very early; (5) Basilides at Alexandria, 125–140 A. D.; (6) Valentinus, 138–160 A. D.; (7) Marcion, 150 A. D.; (8) Bardesanes, 170 A. D.; (9) Hermogenes, about 200 A. D. Gnosticism reached its highest bloom about 150 A. D. In the third century its creative energy was gone. In the fourth century it was powerless. And in the sixth century only remnants of it remained. Severe laws against the Gnostics were enacted in 530 A. D. (See *Cod. Just.* 1 : 5 : 18, 19, 21.) The rapidity with which the system waxed and waned is explained by the fact that it was an aristocratic heresy. The masses neither relished nor understood it. It was only a speculation of the few, and the aim was not to found sects, but schools. Only the Marcionites organized separate churches. (The principal original sources of information are—IRENÆUS, *Adversus Hæreses*, 182–188 A. D.; TERTULLIAN, *Adv. Marcionem* and *Adv. Valentinianos*, c. 200 A. D.; HIPPOLYTUS, *Philosophoumena*, 222–235 A. D. (the greater part of it recently recovered); EPIPHANIUS, *Panarium*, c. 400 A. D.; also quotations in EUSEBIUS, and the *Pistis Sophia*, a recently (1853) discovered Gnostic poem. Able monographs on the subject have come from NEANDER (1818), BAUR (1835), MATTER (1828–45), ROSSEL (1847), LIPSIUS (1860), and others.) R. D. HITCHCOCK.

Gnu [a Hottentot word], or **Horned Horse,** the *Connochætes gnu*, the **Wildebeest** of the colonists, an antelope which approaches in character the ox tribe, and has a flowing mane and tail of white hair, resembling

The Gnu.

those of the horse. This species is found in South Africa but other species of the genus abound probably almost as far N. as the Great Desert. They have clumsy curved

horns and bristly hairs about the mouth. The name *wildebeest* is given on account of the habit the animal has of frantically rushing about in a most violent manner. It is very fleet and timid.

Go'a, the name of a territory of Hindostan, on the Malabar coast, situated between lat. 14° 54′ and 15° 45′ N., and belonging to Portugal. Area, 1066 sq. m. Pop. 313,262. It produces rice and pepper, but requires an annual support of £71,920 from Portugal. Cap. Panjim, or New Goa.

Goa, town of Hindostan, on the Malabar coast, in lat. 15° 30′ N. It was formerly the capital of the Portuguese dominions in India, and a magnificent city, but it is now decaying. In the beginning of the eighteenth century it was deserted on account of cholera. Pop. 4000.

New Goa, 6 miles W. of Goa, is the residence of the Portuguese governor-general and of the archbishop of Goa. It has handsome churches and other public buildings, and has been the capital since 1758. Pop. 10,000.

Goalpa'ra, a district of the Bengal presidency, British India, lying W. of Assam, N. of the Garrow Hills, S. of Bootan, and traversed by the river Brahmapootra. It has a hot, wet, and sickly climate and a productive soil. Area, 4430 square miles. Cap. Goalpara. Pop. 442,761.

Goat (*Capra*), a genus including the goats proper. It is characterized by hollow, annulated horns, which are directed upward and backward. There are eight cutting teeth in the lower jaw, and none in the upper. The chin is bearded in the male. This genus has no representative in America, though in the domestic state the goat is found in all parts of the world. The single American species which so long was regarded as the Rocky Mountain *goat* is properly an antelope. The wild goat (*C. ægragus* Gm.) roams in extensive herds on the Persian and other mountains of the eastern hemisphere; it is regarded as the parent-stock from whence all the domestic varieties have sprung. The ibex (*C. ibex*) is a notable example, distinguished by its large, square, and transversely ridged horns. The Caucasian ibex (*C. Caucasica*) has similarly large horns of a triangular form. The Cashmere goat of Thibet is the most valued; a delicate gray wool grows under the longer silky hair: about two ounces of this is obtained from one individual, and is the much-prized material of the cashmere shawls. The goat exhibits a striking difference of habit as compared with the sheep. Buffon has given a graphic description, in which he regards the former as being "superior both in sentiment and dexterity." The milk of the goat is sweet, nutritive, and is also esteemed as medicinal. In ancient times the skin was valued for clothing; at present it is a favorite and familiar item in the manufacture of the best turkey or morocco leather, and, in the young state, of the better class of gloves. J. B. Holder.

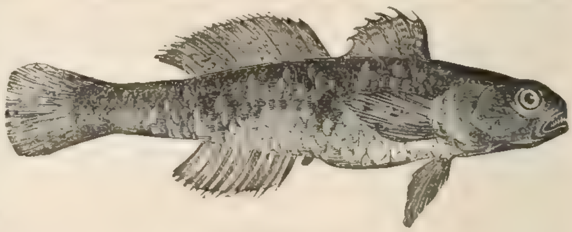
Goat Island, an island which divides the current of the Niagara River at the Falls. It belongs to Niagara tp., Niagara co., N. Y. Area, 70 acres. It is 900 feet distant from the American and 2000 from the Canadian shore. It is connected with the former shore by a substantial bridge.

Goat'sucker, the *Caprimulgus Europæus*, a passerine bird of the Old World, the type of the family Caprimulgidæ, to which belong the whip-poor-will, the chuck-wills-widow, the night-hawk, and several other birds of the U. S., all of which are sometimes collectively called goat-suckers. The first bird mentioned above gets his name from the popular belief that he sucks the cow's and the goat's milk, infecting the animal with a deadly disease. It is also called fern-owl, dor-hawk, night-jar, etc.; the latter name coming from a jarring or purring sound which it utters. It is the subject of many popular superstitions in the folk-lore of many nations.

Gobelins Tapestry, the most highly valued grade of carpet, manufactured only in the Gobelins factory, in the Faubourg St. Marcel, Paris, in the Rue Mouffetard. The carpets are all of rug-like make, and are works of art, not of artisanship. Many of the designs are pictured scenes in colors. The workmen (or rather artists) are about 120 in number. The colored silks and wools which they employ are passed into the work by means of wooden needles. The result is a faithful copy of the pictured pattern. Each artist averages less than 1¼ square yards per annum. Some Gobelins carpets cost from $30,000 to $40,000, and require from five to ten years for the completion. Since 1791 none have been sold. They are mostly presented by the French government to foreign courts. The Gobelins factory was first called *Gobelin's folly*. It was an unsightly structure, built by a Belgian wool-dyer of the fifteenth century, one Jehan Gobeelen. Here the brothers Cannaye, and afterwards others, carried on carpet-making with success. In 1662, Louis XIV. made it a royal manufactory. In 1826 another royal carpet-factory, La Savonnerie, established in 1615, was joined to it. May 24, 1871, the Communists burned a part of the factory.

Go'bi, Co'bi, or **Sha'mo,** is a wide tract in Central Asia, between lat. 40° and 50 N., and lon. 90° and 120° E. It forms a table-land 3000 feet above the level of the sea, between the mountain-ranges of Altai and Kuen-Lun, with only small depressions and elevations. Its western part is mostly covered with fine sand, drifting before the wind, and forming an undulating surface which reminds the traveller of the waves of the ocean. The eastern part is mostly naked rocks. It is a desolate region where the winter is nine months long; frost and snow may occur in July, and the short summer, with its intense heat, creates but an oppressive atmosphere. Extensive steppes, rising towards the mountainous borders, afford pasture for the flocks of the nomadic tribes of Mongolians who wander in these wilds.

Go'by (*Gobius*), a genus of small marine fishes of the family Gobiidæ. They have no swim-bladder, and live mostly upon muddy bottoms, where they burrow in holes. Some of them build nests for their young. The *Gobius carolinensis* is a typical species found on our Atlantic coasts. The black goby (*Gobius niger*) and other European species are rather larger. These fishes are prized for the aquarium, in which their nesting can be readily observed. More than 100 species are known.



The Black Goby.

God. It is proposed to state briefly what is known of God under the following heads: (1) Definition of the term; (2) proofs of his existence; (3) his names; (4) attributes; (5) existence as Three Persons; (6) relation to the world; (7) works; (8) prevalent antitheistic theories.

I. In consequence of the predominance of Christian ideas in the literature of civilized nations for the last eighteen centuries, the word *God* has attained the permanent and definite sense of a self-existent, eternal, and absolutely perfect free personal Spirit, distinct from and sovereign over the world he has created.

II. Proofs of His Existence.—The word nevertheless continues to be used with a wide latitude of meaning. The full conception associated with it by Christians is of course largely the product of revelation. On the other hand, the general idea of God as a being upon whom we depend, and to whom we are responsible, and for whose communion we long, is innate in human nature—*i. e.* it is universally generated and sustained in human consciousness by the laws of our nature. This fact is by some attributed to a "God-consciousness" (*Schleiermacher*); by others to a direct intuition of God (*Schelling, Cousin*); and by others to an innate religious sentiment or instinct. It bears all the marks of an intuitive truth or first principle of reason—*e. g.* universality and necessity—since it reappears and persists in all normal conditions of consciousness. (See Cicero, *Natura Deorum*, and Gillett, *God in Human Thought*, etc.) This general idea of God, native to the human soul, has been moulded into various forms by tradition and speculation, and perfected by revelation. All the "arguments" for the being of God are intended either to quicken and confirm this innate idea, or to expand and render it definite by showing *what* God is, as well as proving *that* he is. (See Dr. McCosh's *Intuitions of the Mind*, pt. 3, b. 2, ch. 5, § 2.)

A. *The Ontological Argument* has been presented in various forms: 1. Anselm, archbishop of Canterbury (1093–1109), in his *Monologium and Proslogium*, states this argument thus: We have an idea of an infinitely perfect being. But real existence is a necessary element of infinite perfection. Therefore, an infinitely perfect being exists, otherwise the infinitely perfect as we conceive it would lack an essential element of perfection. 2. Descartes (1596–1650), in his *Meditationes de prima philosophia*, prop. 2, p. 89, states it thus: The idea of an infinitely perfect being which we possess could not have originated in a finite source, and therefore must have been communicated to us by an infinitely perfect being. He also, in other connections, claims that this idea represents an objective reality, because (1) it is pre-eminently clear, and ideas

carry conviction of correspondence to truth in proportion to their clearness; and (2) it is necessary. 3. Dr. Samuel Clarke in 1705 published his *Demonstration of the Being and Attributes of God.* He argues that time and space are infinite and necessarily existent, but they are not substances. Therefore, there must exist an eternal and infinite substance of which they are properties. 4. Cousin (*Elements of Psychology*) maintained that the idea of the finite implies the idea of the infinite as inevitably as the idea of the "me" implies that of the "not-me." (Dr. Shedd's *Hist. Christ. Doc.*)

B. *The Cosmological Argument* may be stated in the form of a syllogism: Every new thing and every change in a previously existing thing must have a cause sufficient and pre-existing. The universe consists of a system of changes. Therefore the universe must have a cause exterior and anterior to itself. It has been objected that our "causal judgment" rests solely on experience, which gives only invariable sequence, and not efficiency. (See MILL'S *Logic*, p. 203, and HUME'S *Treat. on Hum. Nature*, pt. 1, § 1.) On the contrary, the "causal judgment" is a self-evident or intuitive truth or law of reason, presupposed in all experience, bearing the marks of universality and necessity. Moreover, an endless series of effects supported by no absolute cause is infinitely less rational than any single uncaused effect. The mind can rest only when it has reached ultimately an uncaused first cause. (DR. MCCOSH'S *Intui. of the Mind*, pt. 2, b. 3, ch. 2, § 8.)

That the universe is a system of changes is proved and illustrated by all the sciences, especially by geology, zoology, and anthropology. John Stuart Mill, in his *Essay on Theism*, argues that the conclusion from the recently established doctrine of the "conservation of force" is, that the matter and force of which the universe consists are a constant quantity, assuming various forms, but themselves without beginning or cause. But the fact is, that the theory of cosmical development from the days of Laplace to the present involves the constant dispersion of physical energy, the sun and planets passing from a state of heated gas to frozen and lifeless solidity; and since this dispersed and lost energy is finite, it must have commenced in a spontaneous cause—*i. e.* a personal volition.

C. *The Teleological Argument*, or argument from design or final causes, is as follows: Design, or the adaptation of means to effect an end, implies the exercise of intelligence and free choice. The universe is full of traces of design. Therefore, the "First Cause" must have been a Personal Spirit. This argument has been elaborated ever since the time of Socrates. (*Memorabilia*, b. 4.) Bacon says: "I had rather believe all the fables in the Legend, and the Talmud, and the Alkoran than that this universal frame is without a mind." "Final causes" have been repudiated as a principle of interpreting nature by Hume, and under his influence by a class of modern naturalists. He maintained (see *Dialogues on Nat. Relig.*) that the judgment which infers a designing cause from adjustments adapted to effect an end rests wholly upon experience; and as we have no experience of world-making, we have no right to infer a world-maker. But this judgment is intuitive, universal, and necessary. Its force is admitted by J. S. Mill. (*Essay on Theism.*)

The new doctrine of the "survival of the fittest" is urged by Herbert Spencer, Darwin, and many naturalists as an alternative more rational than that of "design." This at present is admitted by its advocates to be a bare hypothesis, demanding many postulates, and leaving many broken links; *e. g.* the "first germs," the introduction of sensation, the beginnings of organs, intelligence, volition, moral obligation, *necessary* ideas, etc. (See arts. A CRITICISM ON DARWINISM, by J. H. SEELYE, and EVOLUTION, by HENRY HARTSHORNE.) (See WALLACE, *Natural Selection;* MIVART, *Genesis of Species;* ULRICI, *Review of Strauss;* ALEX. WINCHELL, *Evolution;* J. W. DAWSON, *Earth and Man;* DR. MCCOSH, *Christ. and Positivism.*) The design everywhere manifest in the inorganic, organic, instinctive, and rational provinces of the universe has been fully demonstrated in the *Bridgewater Treatises*, Paley's *Nat. Theol.*, Butler's *Analogy*, McCosh's *Typical Forms*, etc., Buchanan's *Faith in God*, etc., Tulloch's *Theism*, etc.

D. *The Moral Argument* derived from the constitution and history of man, and his relations to the universe: 1. All our knowledge rests upon consciousness. We begin with the knowledge of self as a conscious, intelligent, spontaneous cause; and this is involved in every act of sense, perception, reflection, recollection, etc. From knowledge of self as (1) spontaneous cause, (2) intelligent, we come to recognize the absolute cause discovered by the "cosmological" and "teleological" arguments as a personal spirit. We are under the necessity of referring all the phenomena of the cosmos ultimately to mind. 2. The phenomena of conscience necessarily imply a sovereign personal will which binds ours. The hypothesis of the associationists (Spencer, Mill, etc.), that all our intellectual and moral judgments are transformed sensations, is absurd, because (1) they are universally the same, (2) incapable of analysis, (3) necessary, (4) sovereign over all impulses, etc. 3. Man is a religious being. The instinct of prayer and worship, the longing for and faith in divine love and help, are inseparable from human nature under normal conditions as known in history. 4. The entire history of the race, as far as known, discloses the presence and influence of a wise, righteous, and benevolent moral ruler and educator of men and nations. 5. The compact and mutually supporting system of divine interventions and culminating revelations recorded in the Christian Scripture, reaching through 2000 years, is the true vertebrate column of human history, upon which all human progress in civilization or science rests.

III. THE NAMES OF GOD: Goth. *Guth;* Ger. *Gott;* Per. *Choda;* Hind. *Khoda.* Some derive the English word from "good," from its similarity of form, and make it an expression of the divine goodness. Since, however, its various cognates could not have this origin, others derive it from the Persic *Choda—dominus*, "possessor." The Latin *Deus* and Greek Θεος have been commonly derived from the Sanscrit *div*, "to give light." But Curtius, Cremer, and others derive it from θεσ in θεσσασθαι, "to implore." Θεος, then, is "He to whom one prays." The Hebrew *El*, of pre-historic Semitic origin, is from אול, "to be strong." From this (or, as some say, from the obsolete אָלַה, "to worship") come *Elohim* (pluralis *excellentiæ*) and *Eloah* (poetic form), and Arabic *Al* or *Allah*. *Elohim* is used by Moses consistently as a general name for God, as the God of all nations, and applied to false gods, while *Jehovah* (of doubtful etymology, perhaps from הָוָה, "to be") is always used for the peculiar covenant God of Israel, the revealed God and Redeemer. In reading the Scriptures the Jews always substituted *Adonai, dominus*, κυριος, for *Jehovah*. Hence, the English Bibles always substitute for it LORD in capitals, and the French *L'Eternel*, and the German HERR. In the Christian Scriptures God also calls himself "Spirit" (John iv. 24), "Light" (1 John i. 5), "Love" (1 John iv. 8), and "Father" (Rom. viii. 15, 16).

IV. THE ATTRIBUTES OF GOD are to be distinguished (1) from "predicates" of God in the concrete, marking his relation to his creatures as Creator, Preserver, etc.; (2) from "properties," which belong to each divine Person in distinction from the others. The attributes are the modes of existence and of action of his substance. They are the very substance itself, existing and acting in the various modes determined by its nature. They differ among themselves, not as distinct things, but as distinct tendencies and modes of existence and action of the same thing.

The sources of our idea of God are found in his revelation of himself in the human soul, in physical nature, in history, and in the Scriptures. From these materials we construct our idea (1) by the way of negation, denying all imperfections; (2) by the way of eminence, affirming of him the possession of every excellence in absolute perfection; (3) by way of causation, attributing to him all the perfections discovered in his works. The attributes of God have been variously *classified:* (1) According to the order in which we arrive at the knowledge of them—*e. g.* by way of negation, or by way of eminence, or by way of causality, etc.; (2) according as they pertain to the substance, the intellect, or the will of God; (3) according to their nature as moral or natural (non-moral); (4) as communicable or incommunicable; (5) as absolute or relative.

1. *The Divine Unity.* Monotheism, the primitive religion, traces of which are found in the Hindoo Veds, soon gave place through nature-worship to pantheism and polytheism. It has been recovered only imperfectly by philosophers of the first rank like Plato, and has been established as a popular faith only through the Mosaic and Christian revelations. It is proved (1) There can be but one necessarily existent being, and but one infinite and absolute of the same order. (2) The unity of the cosmos proves the unity of presiding intelligence. (3) Our moral consciousness testifies that the source of all moral authority must be single and unique.

2. God is an *infinite* and *absolute* being. The transcendentalists, on the one hand, and Sir W. Hamilton, Mansell, and H. Spencer, on the other, understand by these predicates a being including all being, and excluding all relation to other being. Hence, the infinite and the absolute can neither be a person, nor conscious, nor a cause nor an object of knowledge, all of which imply limitation and relation. But the true idea of the "absolute" is the finished, and that which exists in no relation to anything not determined by its own will. And the true idea of the "infinite" is that which admits of no increase after its kind. (SIR W. HAMILTON, *Discussions and Lectures;* MANSELL, *Lim. of Rel.*

Thought; McCosh, *Intuitions;* Mill, *Review of Hamilton;* Porter, *Human Intel.*, pt. 4, ch. 8; Hickok, *Creator and Creation*, ch. iii.) *Anthropomorphism* is right and necessary when limited to the application to God in an infinite degree of the spiritual excellencies of man. But it is used in a bad sense when we attribute to God any likeness of our bodily parts or passions, or conceive of him as subject to our imperfections or limitations.

3. God is an absolute, perfect, *personal* Spirit. This, as shown above, is the result of the whole convergent testimony which establishes the fact of his existence. If not this, we have no evidence that he is anything.

4. He is *eternal.* His existence transcends all the limits of time. Eternity conceived of by us, as either *a parte ante* or *a parte post*, is really *una, individua, et tota simul.*

5. Absolutely, God is infinite in his *immensity*, transcending all the limits of space; relatively, he is *omnipresent* in his essence, as well as his knowledge and power to all his creatures.

6. He is *immutable,* as to his essence, his perfections, and his will.

7. His *knowledge* has no limits. He knows himself and all things possible by the light of his pure reason. He knows all things actually existent, whether past, present, or future, in the light of his purpose. He knows all things in their essential being, and in all their relations, by one all-comprehensive, timeless intuition. Wisdom is the perfect use which he makes of his knowledge and his power to effect his ends.

8. He is *omnipotent* —that is, the causal efficiency of his will has no limit other than his own perfections. Second causes are necessary to him only relatively to his own purpose.

9. The *goodness* of God, existing in the forms (1) of benevolence to all sentient creatures, (2) love to persons, (3) mercy to the miserable, and (4) grace to the ill-deserving, has no limit outside of his own perfections. This is as good a world as was consistent with the end God had in view. (Pascal's *Thoughts;* Leibnitz, *Theodice.*) J. S. Mill in his *Essay on Theism* objects that if God is infinitely good, he cannot in consistency with facts be infinitely powerful. But he forgets (1) the glory of the Creator, and not the good of the creature, must be the last end; (2) the *ultimate* reasons of facts known to us lie out of our reach, except they are revealed; (3) the grand fact of sin, when once admitted, overthrows all his objections.

10. God is absolutely *true—i. e.* self-consistent and reliable.

11. He is absolutely *righteous.* This involves (1) holiness, or absolute subjective moral perfection; (2) justice, when he is regarded as standing to his intelligent creatures in the relation of moral governor. It is distinguished as rectoral and distributive, and is the immutable ground of rewards and punishment.

12. God's *will* is the organ of his infinite perfections. It is free, in the sense of being a rational spontaneity. It is sovereign, inasmuch as it is conditioned upon nothing save his own all-perfect nature. Hence, God is an absolute sovereign, having an unconditioned power to dispose of and command his creatures as his own perfections suggest. His will is to them an ultimate rule of right, in his "positive" commandments creating obligation, and with respect to essential morality expressing and giving effect to the law of absolute right resident in his own nature. (See Cumberland, *De Legibus Naturæ;* Cudworth's *Intellectual System.*)

V. The One God Exists as Three Hypostases or Persons.—Schelling says: "The philosophy of mythology proves that a trinity of divine potentialities is the root from which have grown the religious ideas of all nations of any importance;" *e. g.* the Hindoo Trimurti, Brahma, Vishnu, and Shiva. This shows that the Christian doctrine of the Trinity, however original and unique, has a basis in man's religious nature. Abstract Mohammedan and Unitarian monotheism conceives of an isolated, unsocial God, existing from eternity alone, whose urgent affections and infinite energies remain inactive until the advent of creation affords them an object. On the other hand, the Tripersonal God of Christian revelation has within the infinite depths of the Godhead been eternally exercising upon adequate objects those unbounded perfections which can have only an inadequate field of demonstration in a created universe. If God *is* love, he must have an eternal and infinite object to love. (Christlieb's *Modern Doubt.*)

A. *The Biblical Doctrine of the Trinity.*—1. *There is but One God.*—The monotheism of the Old and New Testaments is unquestionable (Deut. vi. 4; 1 Cor. viii. 4). This is expressed by saying the Three Persons are the same in substance, numerically. 2. Father, Son, and Holy Ghost are each that one God. To each divine names, attributes, works, and worship are applied (Jer. xxiii. 6; John ii. 24, etc.). 3. Nevertheless, they are always set forth in speech and action as distinct persons. They use reciprocally the personal pronouns (John xi. 41, etc.). They regard each other objectively, loving, speaking to, and acting through and upon each other as personal agents (John xiv. 31, and xvii.). 4. The Father is the fountain of Godhead, self-existent as person as well as substance. The Son is eternally springing from the person of the Father, and the Spirit from the persons of the Father and of the Son, in virtue of the spontaneous yet necessary constitution of their nature, whereby they receive the indivisible common nature in its fulness. (1) The terms Father and Son are reciprocal. The Son is eternally "begotten" by the Father, his "word," "image," "form," the "radiance of his glory." (2) The term "Spirit" expresses the personal, not the substantial, nature and relations of the Third Person. He is the personal Breath of the Father and of the Son, proceeding from and returning to both. (3) They eternally love one another, take mutual counsel, and act together, as the coexecutors of their common purpose, in a system of distributed yet correlated functions. 5. In the economies of creation, providence, and redemption the order of procedure is always *to* or *from* the Father, *through* the Son, *by* the Spirit. All actions *ad extra* may be affirmed of either person or of the Godhead absolutely. But by way of eminence creation is ascribed to the Father, redemption to the Son, and sanctification to the Spirit. The Father is the absolute from and to whom all movement originates and ends. The Son is the Revealer and Mediator, the Spirit is the Executive of God.

B. *The Historical Definition of the Trinity.*—The Ante-Nicene Church was united in believing that Father, Son, and Holy Ghost are each eternal, supernatural divine Beings, and yet the Son as decidedly inferior to the Father, and the Spirit to the Son. Origen admitted the eternal generation of the Son, but held he was different from and dependent upon the Father. Irenæus, the disciple of Polycarp, and the Western Church generally, followed more faithfully the doctrine of the apostle John. The two antagonist principles, (*a*) the unity of God and (*b*) the distinct personality and the perfect equality of the Three divine Hypostases, were never accurately adjusted and defined before the great œcumenical councils of Nice (325) and Constantinople (381 A. D.). Each principle determined a tendency, and developed heresies.

1. *The principle of the divine unity* was maintained at the expense of the denial of the complementary elements of the revealed doctrine: (1) By the Humanitarians, who held that Christ was a mere man—*e. g.* the Ebionites, an heretical Jewish-Christian sect; the Alogians; the Theodotians and the disciples of Paul of Samosata (260), who denied the personality of the Logos, or divine principle dwelling in the man Jesus. (2) By the Patripassians (Praxias, Noetus, etc.), whose doctrine was matured by Sabellius (268), who held that the Godhead, existing with no intrinsic distinctions, manifests itself externally and successively in different forms; as the Father under the old dispensation, the Son in the incarnation, and the Spirit in inspiration, etc.

2. *The principle of the distinct personality* of the divine Persons, at the expense of their unity and equality: (1) By the Arians (from Arius of Alexandria, 336), who held that the Son is the first and greatest being created by the will of the Father, and his instrument in creating the Spirit, and subsequently all other beings. They expressed this by saying the Son was *hetero-ousion*, of a different nature from the Father. (2) The Semi-Arians, or Eusebians, represented by Eusebius of Cæsarea (270–340), held that the Son was eternally begotten by the Father, but that he is of a different though similar essence—*homoi-ousion.*

3. *The principle of distinct personality and equality,* at the expense of the divine unity, was maintained by the Tritheists, John Philoponus and John Ascunages (about 550), and Dean Sherlock (1690) in his *Vind. Doc. Trin.*

The Council of Nice was convened by the emperor Constantine in 325 to settle these questions by a thorough analysis and definition of the doctrine. There were present three parties: The Arians, led by Arius, who maintained the difference of essence, *hetero-ousion;* the Semi-Arians, led by Eusebius, who maintained the likeness of essence, *homoi-ousion;* the orthodox, led by Athanasius the Great († 373), who successfully maintained that Father and Son were of the same numerical substance, *homo-ousion.* This decision was expressed in the Creed of Nice, afterwards completed at Constantinople (381) and Toledo (589). The points defined were: (1) There is but one numerical substance, *οὐσία, φύσις, substantia,* in the Godhead. (2) This substance eternally exists as three equal *hypostases, subsistentiæ, persons.* (3) Each person is distinguished from the others by a *character hypostaticus,* or personal property peculiar to himself. (4) The Father eternally begets the Son, and the Spirit eternally proceeds from the Father and the Son. The clauses relating to the Holy Ghost ("the Lord, the giver of life, who," etc.) were added by the Coun-

cil of Constantinople. The "Filioque" clause was added by the Western Church at the Council of Toledo, and rejected by the Eastern Church. The doctrine was restated with consummate skill in the Creed, "*Quicumque vult*," falsely ascribed to Athanasius, and has been adopted by all historical churches. Through political intrigues, Arianism prevailed widely in the East, partially in the West, from 325 to the accession of Julian (361), and was finally expelled upon the accession of Theodosius I. (379). (See BISHOP BULL's († 1710) *Defensio Fid. Nicænæ*; DORNER's *Hist. Per. Christ.*, Clark, Edin.; NEANDER and SCHAFF's *Church Histories*; DR. SHEDD's *Hist. of Ch. Doc.*; BISHOP HEFELE's *Hist. of Christian Councils to 325*, Clark, Edin.)

VI. GOD'S RELATION TO THE WORLD.—In opposition to the pantheistic and deistic false views (below defined), the Christian view of God's relation to the universe includes the following points: 1. That God is a free moral person, transcending the universe, and acting upon it *ab extra* in the exercise of his *potestas libera*. 2. God is nevertheless personally present to every atom of creation through each moment of duration, in his essence and in the free exercise of all his perfections, sustaining and co-working with every creature in every event in the exercise of his *potestas ordinata*. 3. The capital distinction is made between the physical and the moral order. The former, God administers in the mode of fixed laws and forces inherent in the things themselves. The latter he administers through ideas, motives, and other moral and spiritual influences, brought to bear on the moral natures and free wills of his subjects. 4. As an infinitely perfect intelligence, God has formed a plan from eternity, immutably determining in general and in particular the being, the attributes, and the relations of all creatures, and hence the fixed laws of the physical order, and the course of events in the moral order, and his own actions concurrent therewith. In this universal plan he has established a fixed subordination of parts to the whole, and of order to order. The end of the whole he has placed in the manifestation of his own glory. The end of the natural order is the perfect development of the moral order. "In him we live and move and have our being" (Acts xvii. 28); "Of him and through him and to him are all things" (Rom. xi. 36); "Thou madest man to have dominion over the works of thy hands; thou hast put all things under his feet" (Ps. viii. 6).

VII. THE WORKS OF GOD.—As an eternal, immutable Spirit, God is essentially active. His actions are distinguished as

A. *Those which are Immanent.*—These are (1) his purposes, technically called "decrees," which relate to all events, and are infinitely wise, righteous, and certainly efficacious; and they subordinate all his works, and all their forces, laws, and historical development in time, to a purpose or final end. (2) The actions peculiar to each person of which the other persons are the objects—*e. g.* eternal generation, procession, etc.

B. *His Emanent Actions*, or those which terminate *ad extra*.—These are—1, *Creation*, which is a free act of God in time, executing an eternal purpose. Some, as Origen among theologians, and Cousin among philosophers, have held that creation is a necessary and eternal (timeless) act of God. The latter says (*Psychol.*, p. 11): "God is no more without a world than a world without God." The Church has always held otherwise. Creation is of two kinds: (1) *Creatio prima seu immediata*, the immediate creation by God of the elements of things *ex nihilo*. This was denied by all ancients and by pantheists, and first taught by revelation. (2) *Creatio secunda seu mediata*, or the origination by God, out of and by means of pre-existing material, of new genera and species—*e. g.* the body of man (Gen. ii. 7). This distinction was admitted by St. Augustine (*De Genesi ad Lit.*, v. 45), and by all theologians since. In the method of this "mediate creation" God has been evidently executing law, creating according to types in an ascending series. (ARGYLL's *Reign of Law*, ch. 5; McCOSH, *Typical Forms*; MIVART, *Gen. of Species*, ch. 12.)

2. *Providence*, which includes (1) *Preservation*. This some make identical with a continual creation. By some, as Strauss and other pantheists, preservation is regarded as a necessary unconscious eternal act. By others, as by Heidegger (*Corp. Theol.*, 7, 52) and by Pres. Edwards (*Orig. Sin*, pt. 4, ch. 3), the design of such language is only to emphasize the dependence of the creature. The Scriptures teach that while second causes have real being and efficiency, "they have their being in God." (2) *Government*. This (*a*) extends to all creatures and all their actions. (*b*) Its method is consistent with the perfections of God, and congruous to the nature of each creature and action concerned. (*c*) Its end is God's glory through the execution of purpose. (*d*) It comprehends every particular as a means to a general end; it is therefore for the same reason both general and special. (*e*) It extends to the sinful acts of men, to forbid, control, punish, and overrule them for good. (*f*) This universal government God accomplishes partly by means of the original properties of second causes and their primal adjustments, and partly by a present *concursus* of his own energy with them, guiding them in the direction predetermined by his purpose. Leibnitz (*New System of Nature*) taught the doctrine of pre-established harmony, whereby all events were predetermined from the creation by fixed sequences, alike in the separate spheres of the physical and spiritual. All theories of pantheistic tendency imply the sole agency of the Creator in all actions, the second cause being only the mode in which God appears, or the instrument by which his energy is immediately exerted. This is the tendency of Emmons, of the ultra-Calvinists of a former age, and of the extreme wing of the school of Schleiermacher.

3. *Redemption* of course involves from beginning to end supernatural intervention with the physical order for the sake of the moral order perverted by sin. It includes (1) the incarnation; (2) expiatory sacrifice; (3) resurrection; (4) dispensation of the Holy Ghost, including inspiration of Scripture, the regeneration and sanctification of individuals, and the preservation and historical development of his Church.

4. *Miracles*. (See art. MIRACLES.)

VIII. VARIOUS PREVALENT ANTI-THEISTIC THEORIES.—A. *Atheism*, according to its etymology, signifies the denial of the being of God. It was applied by the ancient Greeks to Socrates and other philosophers to indicate that they failed to conform to the popular religion. In the same sense it was applied to the early Christians. Since the usage of the term "theism" has been definitely fixed in all modern languages, "atheism" necessarily stands for the denial of the existence of a personal Creator and Moral Governor. Notwithstanding a belief in a personal God is intuitive, atheism is possible, as an abnormal state of consciousness induced by sophistical speculation or animal indulgence, as subjective idealism is possible. It exists in the following forms: 1, practical; 2, speculative. Again, speculative atheism may be—1, *Dogmatic*, as when the assertion is made either (1) that God does not exist, or (2) that the human faculties are positively incapable of ascertaining or of verifying his existence—*e. g.* Herbert Spencer. (*First Principles*, pt. 1.) 2, *Skeptical*, as when it simply doubts the existence of God, and denies the conclusiveness of arguments generally relied upon. 3, *Virtual*, as when (1) principles are maintained essentially inconsistent with the existence of God, or with the possibility of our knowing him—*e. g.* by materialists, positivists, absolute idealists; (2) when some of the essential attributes of the divine nature are denied, as by pantheists, and by Stuart Mill in his *Essays on Religion*; (3) when explanations of the universe are given which exclude (*a*) the agency of an intelligent creator and governor, and (*b*) the moral government of God and the moral freedom of man. Such explanations are made by Darwin, H. Spencer, and by necessitarians generally. In ancient times Epicurus (341–270 B. C.) and his school were really, though not professedly, atheists, and Lucretius (95–52 B. C.) was openly so. In modern times the deism of Voltaire and the Encyclopædists degenerated into the atheism of D'Holbach: at present, Moleschott, Feuerbach, the English secularist Holyoake, the disciples of Comte, and the extreme left of the Evolution school generally. (See ULRICI, *God and Nature* and *Review of Strauss*; STRAUSS, *Old and New*; BUCHANAN, *Modern Atheism*; TULLOCH, *Theism*, etc.)

B. *Dualism*, the opposite of *Monism* in philosophy, is the doctrine that there are two generically distinct essences, matter and spirit, in the universe. In this sense, the common doctrine of Christendom is dualistic. All the ancient pagan philosophers held the eternal independent self-existence of matter, and consequently all among them who were also theists were strictly cosmological dualists. The religion of Zoroaster was a mythological dualism designed to account for the existence of evil. Ormuzd and Ahriman, the personal principles of good and evil, sprang from a supreme, abstract divinity, Akerenes. Some of the sects of this religion held dualism in its absolute form, and referred all evil to ὕλη, self-existent matter. This principle dominated in the various spurious Christian Gnostic sects in the second century, and in the system of Manes in the third century, and its prevalence in the Oriental world is manifested in the ascetic tendencies of the early Christian Church. (See J. F. CLARKE, *Ten Religions*; HARDWICK, *Christ and other Masters*; NEANDER's *Church Hist.*; PRESSENSÉ, *Early Years of Christianity*; TENNEMANN, *Manual Hist. Philos.*)

C. *Polytheism* (πολύς and θεός) distributes the perfections and functions of the infinite God among many limited gods. It sprang out of that nature worship seen in the earliest Hindoo Veds, so soon and so generally supplanting

primitive monotheism. At first, as it long remained in Chaldæa and Arabia, it consisted in the worship of the elements, especially of the stars and of fire. Subsequently, it took special forms from the traditions, the genius, and the relative civilization of each nationality. Among the rudest savages it sank to fetichism, as in Western and Central Africa. Among the Greeks it was made the vehicle for the expression of their refined humanitarianism in the apotheosis of heroic men rather than the revelation of incarnate gods. In India, springing from a pantheistic philosophy, it has been carried to the most extravagant extreme, both in respect to the number and the character of its deities. Whenever polytheism has been connected with speculation it appears as the exoteric counterpart of pantheism. (CARLYLE'S *Hero-Worship;* KEIGHTLEY, *Mythol. Greece and Italy;* MAX MÜLLER, *Compar. Mythol.*, in *Oxford Essays*, 1856; PROF. TYLER, *Theology of Greek Poets.*)

D. *Deism* (from *deus*), although etymologically synonymous with theism, has been distinguished from it from the middle of the sixteenth century, and used to designate a system admitting the existence of a personal Creator, but denying his controlling presence in the world (*concursus*), his immediate moral government, and all supernatural intervention and revelation. The movement began with the English deists, Lord Herbert of Cherbury (1581–1648), Hobbes († 1680), John Toland († 1722), Woolston († 1733), Tindal († 1730), Shaftesbury, Bolingbroke (1678–1751), Thomas Paine († 1809). It passed over to France, and was represented by Voltaire and the Encyclopædists. It passed over into Germany, and was represented by Lessing and Reimarus (*Wolfenbüttel Fragmentist*), and, invading the Church and theology, it was essentially represented by the old school of the naturalistic rationalists, who admitted with it a low and inconsequent form of Socinianism—*e. g.* Eichhorn (1752–1827), Paulus (1761–1851), and Wegscheider (1771–1848). It has been represented in America by the late Theodore Parker and the extreme left of the party known as "Liberal Christians." In Germany mere deistical naturalism gave way to pantheism, as the latter has recently given way to materialistic atheism—*e. g.* Strauss. (See LELAND'S *View of Deistical Writers;* VAN MILDERT'S *Boyle Lectures;* FARRAR, *Crit. Hist. Free Thought;* DORNER, *Hist. Protest. Theol.;* HURST, *Hist. Rationalism;* BUTLER'S *Analogy*, admitted by J. S. Mill to be unanswerable as against deism.)

E. *Pantheism* (πᾶν, θεός) is absolute monism, maintaining that the entire phenomenal universe is the ever-changing existence-form of the one single universal substance, which is God. Thus, God is all, and all is God. God is τό ὄν, absolute being, of which every finite thing is a differentiated and transient form. This doctrine is of course capable of assuming very various forms. (1) The one-substance pantheism of Spinoza. He held that God is the one absolute substance of all things, possessing two attributes, thought and extension, from either of which respectively the physical and the intellectual world proceeds by an eternal, necessary, and unconscious evolution. (2) The material pantheism of STRAUSS'S *Old and New Faith.* (3) The idealistic pantheism of Schelling, which maintains the absolute identity of subject and object; and of Hegel, which maintains the absolute identity of thought and existence as determinations of the one absolute Spirit.

It is obvious that pantheism in all its forms must either deny the moral personality of God or that of man, or both. Logically, pantheism does render both impossible. God comes to self-consciousness only in man; the consciousness of free personal self-determination in man is a delusion; moral responsibility is a prejudice; the supernatural is impossible, and religion is superstition. Yet such is the flexibility of the system that in one form it puts on a mystical guise, representing God as the all-person absorbing the world into himself, and in an opposite form it puts on a purely naturalistic guise, representing the world as absorbing God, and the human race in its ever-culminating development the only object of reverence or devotion. The same Spinoza who was declared by Pascal and Bossuet to be an atheist is represented by Jacobi and Schleiermacher to be the most devout of mystics. The intense individuality and the material science of this century has reacted powerfully upon pantheism, substituting materialism for idealism, retiring God and elevating man, as is seen in the recent degeneration of pantheism into atheism in the case of Feuerbach and Strauss.

The most ancient, consistent, and prevalent pantheism of the world's history is that of India. As a religion, it has moulded the character, customs, and mythologies of that people for 4000 years. As a philosophy, it has appeared in three principal forms—the Sankhya, the Nyaya, and the Vedanta. In Greece, pantheistic modes of thought prevailed chiefly with the Stoic and New Platonic schools—Zeno (340–260 B. C.), Plotinus (205–270 A. D.), Porphyry (233–305), Jamblichus († 333). It reappears in John Scotus Erigena († 883) and with the Neo-Platonists of the Renaissance—*e. g.* Giordano Bruno, burnt at Rome in 1600. Modern pantheism began with Benedict Spinoza (1632–1677), and closes with the disciples of Schelling and Hegel.

Besides the pure pantheism above referred to, there has existed an infinite variety of impure forms of virtual pantheism. This is true of all systems that affirm the impersonality of the infinite and absolute, and which resolve all the divine attributes into modes of casuality. The same is true of all systems which represent providential preservation as a continued creation, deny the real efficiency of second causes, and make God the only agent in the universe—*e. g.* Edwards (in *Original Sin*, pt. 4, ch. 3) and Emmons. Under the same general category falls the fanciful doctrine of emanations which was the chief feature of Oriental theosophies, and the hylozoism of Averroes († 1217), which supposes the coeternity of matter and of an unconscious plastic *anima mundi.* (See HUNT'S *Essay on Pantheism*, London, 1866; SAISSET, *Modern Pantheism*, Edinburgh, T. T. Clark, 1863; COUSIN, *Hist. Modern Philos.;* MORELL, *Hist. Modern Philos.;* RITTER'S *Hist. Ancient Philos.;* BUCHANAN'S *Faith in God, etc.;* DOLLINGER'S *Gentile and Jew*, London, 1863; MAX MÜLLER, *Hist. Anc. Sanscrit Lit.*)

A. A. HODGE.

Goda'very, the largest river of the Deccan, rises from the Western Ghauts, within 50 miles from the Arabian Sea, and crosses the Deccan in a south-eastern course of about 900 miles. After passing through the Eastern Ghauts it separates into several arms, in lat. 16° 57′ N. and lon. 73° 30′, forms a delta, and falls into the Bay of Bengal. It is navigable for some distance above its passage through the Eastern Ghauts.

God'dard (JOSIAH), a Baptist missionary, b. at Wendell, Mass., in 1813; graduated at Brown University in 1835, and at Newton Theological Institution in 1838; labored among the Chinese of Siam with success, and afterwards, for six years, at Ningpo, China, where he d. in 1854. His principal work was an excellent version of the New Testament in Chinese, but he also preached with much energy and effect, though in feeble health.

Go'derich, port of entry and cap. of Huron co., Ont., Canada, on Lake Huron, is the western terminus of the Buffalo and Goderich division of the Grand Trunk Railway. It has a good harbor, and has extensive communication by steam with the various lake-ports. It has a large elevator for wheat, extensive lake fisheries, 8 valuable salt-wells, and 2 weekly newspapers. It is rapidly increasing in importance. Pop. of town, 3954; of Goderich tp., outside the town limits, 3615.

Godfather, Godmother. See SPONSORS.

God'frey, post-v. of Monticello tp., Madison co., Ill., on the Mississippi River and the Chicago Alton and St. Louis R. R., 29 miles from St. Louis, at the junction of the Jacksonville branch. It is the seat of Monticello Seminary.

Godfrey of Bouillon, king of Jerusalem and the sixth duke Godfrey of Brabant, or the Lower Lorraine, b. at Nivelle, Lorraine, in 1061; became governor of Bouillon 1076; fought with conspicuous valor in Germany and Italy on behalf of Henry IV. against the pope; slew Rudolph, the rival emperor, with his own hand, and was the first to mount the walls of Rome on Henry's successful attack, 1084; succeeded as duke 1089; took the cross for the Holy Land 1095, in order to expiate his sin of fighting against the pope (first crusade); led 80,000 men to the East by way of Constantinople; captured Nicæa 1096; defeated Soliman at Dorylæum 1097; took Antioch 1098, and stormed and took Jerusalem July 15, 1099; was declared king of Jerusalem, but declined to wear a crown of gold where his Lord had worn a crown of thorns; defeated the Egyptians at Ascalon, conquered Galilee, promulgated the *Assize of Jerusalem*, a system of feudal law; d. at Jerusalem July 15, 1100, and was succeeded by Baldwin I. In 1244 the Carismians tore up and burned his remains. Godfrey's strength, valor, piety, and virtue were favorite themes of mediæval poetry. He is the central figure of TASSO'S *Jerusalem Delivered.*

Godi'va, The Lady, wife of Leofric, earl of Mercia and master of Coventry in England, who about 1040 imposed upon that town heavy exactions, by reason of which the people all complained. The lady Godiva entreated her lord to spare the town; and at last he consented on condition that she should ride naked by daylight through Coventry, to which proposal she readily agreed, notwithstanding her well-known and extreme modesty. The earl could do no less than order the people to keep within their houses, and not look out. This (so the story goes) they all did excepting one tailor, the Peeping Tom of Coventry (some say he was a baker), who looked out at a window as the lady rode by veiled with her flowing hair only; but the poor

tailor was at once struck blind, and, as some tell us, was shortly after hanged by the earl. A yearly pageant, in which a young woman enacted the part of Godiva, was long kept up at Coventry, and is still occasionally performed.

God'kin (EDWIN LAWRENCE), b. at Moyne, county Wicklow, Ireland, Oct. 2, 1831; was educated at Queen's College, Belfast; was war-correspondent in Turkey and the Crimea for the London *Daily News* 1854–56; travelled in the U. S. as a correspondent of the same journal; was admitted to the New York bar 1858; corresponded with the *Daily News* and the New York *Times* in the late civil war; became editor of the *Nation* 1865, and its proprietor 1866.

God'man (JOHN D.), M. D., the son of a Revolutionary soldier, was b. at Annapolis, Md., Dec. 30, 1794; d. Apr. 7, 1830, when (as has been said) there "fell from the firmament of the medical profession, before he had reached his meridian splendor, one of the brightest stars which ever rose above the horizon." At two years old he was motherless, then fatherless, friendless, homeless. He said himself, "I have eaten the bread of sorrow and drunk the cup of misery." At the bombardment of Fort McHenry he fought as a common sailor. When asked, as he applied to study medicine, if he could read Latin, he replied, "No, sir, but if I live I will make a Greek, Latin, and French scholar." After taking his first course of lectures in the University of Maryland, the professor of anatomy had his thigh fractured, and the faculty unanimously appointed young Godman to complete his course. But not only had he to contend with poverty all his life; his constitution was frail and health never robust. On the organization of the Ohio Medical College in Cincinnati he was its first professor of anatomy, 1824. Subsequently he was called to the same chair in Rutgers Medical College, N. Y., where he became the associate of Mott, Hosack, etc. Dr. Godman contributed largely to the *Western Quarterly Reporter*, Philadelphia *Journal of the Medical Sciences*, *Physical and Pathological Anatomy*, *Encyclopædia Americana*, etc. As a lecturer few were more gifted; he (almost alone in this country) has taught anatomy successfully with the scalpel in hand to the class in the amphitheatre. In his early death the profession lost one of its brightest ornaments. Author of *American Natural History* (3 vols., 1823–28); *Rambles of a Naturalist*, and other works. PAUL F. EVE.

Gödölö, small town of Hungary, a few miles E. of Pesth. On the neighboring heights the Austrians under Windischgrätz were wholly defeated by the Hungarians under Görgei; which victory led to the famous declaration of independence issued by Gov. Kossuth Apr. 14, 1849.

Godol'phin (SIDNEY **Godolphin**), EARL OF, b. in Cornwall (date unknown); took the master's degree at Oxford 1663; became a secretary of state 1664, and first commissioner of the treasury; was envoy to the Netherlands 1678; a lord of the treasury and one of the chief ministers 1679; a secretary of state 1684; chamberlain to the queen 1685; commissioner of the treasury 1686–90; first lord of the treasury 1690–97, 1700–01; lord high treasurer 1702–10; was made a baron 1684; K. G. 1704, Viscount Rialton and Earl Godolphin 1706. D. at St. Albans Sept. 15, 1712. Godolphin was a man of few words and decided talents for public business. Political or moral principles he had none. When chamberlain to James II.'s queen he conformed to the Roman Catholic rites; was in turn Tory or Whig as best served his interest in times when these party names carried meaning with them. His only conspicuous vices were gambling and inordinate fondness for the turf. In demeanor he was exceedingly modest and retiring.

Go'don (SYLVANUS W.), U. S. N., b. June 18, 1810, in Pennsylvania; entered the navy as midshipman Mar. 1, 1819; became a passed midshipman in 1827, a lieutenant in 1836, a commander in 1855, a captain in 1861, a commodore in 1863, a rear-admiral in 1866; retired in 1871. He commanded the Powhatan at the battle of Port Royal, and the Susquehanna in both the Fort Fisher fights; commended by Rear-admiral Dupont for zeal and ability, and thus spoken of by Rear-admiral Porter in his "commendatory letter" of Jan. 28, 1865: "Com. S. W. Godon, commanding the Susquehanna, is an unusually intelligent officer, who does not need to be told a second time where to go in time of action. This is the second important affair in which he has been engaged during the war, in both of which he has acquitted himself in the most handsome manner. His ship was beautifully handled, and impressed me with her good discipline and accurate firing. To me personally he has given his warmest support, and I should fail in my duty if I did not give him the full credit he deserves. His conduct throughout this harassing affair has met my warmest approbation, and I think he is one of those who merit promotion." D. May, 1879. FOXHALL A. PARKER.

Godoy', de (MANUEL), duke of Alcudia, Albufera, and Soto Roma, and prince of the Peace, b. at Badajoz, Spain, May 12, 1767, of a noble but reduced family; entered the body-guard at Madrid 1787; became an officer 1790; major and adjutant-general and knight grand cross of Charles III. 1792. His beauty had by this time won him the favor of the queen and her ladies, and with the former he lived in most intimate relations under the very eyes of the king, who nevertheless loaded him with honors. In 1795 he was made a grandee of the first rank, having in 1792 been made first secretary of state, and in 1793 captain-general. His treaty of Bâle (1796) won him the title Prince of the Peace. In 1797 he married Maria Theresa, the king's niece, although he was already secretly married to another wife. In 1798 he was declared grand major-domo, and in 1799 grand admiral. In 1801 he reassumed the power which in 1798 the popular will had forced him to abdicate, and soon after, by the treaty of Badajoz, he agreed to divide Portugal between France and Spain, for which service he received a large sum from France. In 1804 he was declared generalissimo. He assisted Napoleon in gaining possession of Spain, and Napoleon in turn released him (1808) from the prison into which the nobles and people had thrown him. Godoy never again returned to power. Hated by nobles, priests, and people, all of whom he despised and had braved so long, he followed the fortunes of the king and queen, who still clung to him. In 1835 he went to Paris, where he lived a pensioner of the French government. In 1842 the Spanish government confirmed to him his former honors. D. at Paris Oct. 4, 1851.

God Save the King! (*Domine salvum fac Regem!*), a formula repeated upon occasions of solemnity and appended to state proclamations in Great Britain. The same words give name to a well-known British national air, the authorship of which was long ascribed to Dr. John Bull (1563–1622), but it is generally conceded that his "God save great James, our king!" was not the national anthem of the present day. The authorship of both words and music of this piece, nearly as it now stands, is now generally assigned to Henry Cary, who d. in 1743; but some antiquaries claim that it was adapted from Jacobitic words and melody of that day. The expression "God save the king!" occurs several times in the historical books of the Old Testament.

The "God save the king!" of the public proclamations has been changed to "God save the Commonwealth of Massachusetts!" in that State, and to "God save the Commonwealth!" in Pennsylvania.

God's Truce. See TRUCE OF GOD.

Godt'haab, the first Danish colony in Greenland, established in 1721 by Hans Egede on Davis's Strait, in lat. 65° N. Pop. 740.

God'win (MARY **Wollstonecraft**), b. at Beverley, Yorkshire, England, Apr. 27, 1759; started in 1783 a day-school at Islington, near London, from philanthropical motives, and on a more rational system of education than that then accepted; was subsequently governess to Lord Kingsborough's daughters, and published *Thoughts on the Education of Daughters* (1786), *Mary*, a tale, *Original Stories*, some translations from Salzmann and Lavater, and the famous *Vindication of the Rights of Woman* (1791), a presentation of the woman-suffrage ideas. From 1792 to 1795 she resided in Paris, where she wrote her *Moral and Historical View of the French Revolution*. In Paris, Gilbert Imlay, an American author and merchant, espoused her according to the requirements of French and American law, but after the birth of a child he left her in great distress. The marriage being invalid according to English law, she married in 1797, in London, William Godwin, the novelist and political writer, but died in the same year (Sept. 10, 1797), giving birth to a daughter, the future Mrs. Shelley. Mrs. Godwin was a woman of attractive manners and of singular courage and independence. Kegan Paul, in his *Life of William Godwin*, and later writers, have cleared her from unjust stigmas. Full justice to her character is done by her husband in her *Memoirs* (1798), in which, however, some details of her life are thought by some to have been represented with unnecessary minuteness.

Godwin (PARKE), b. at Paterson, N. J., Feb. 25, 1816; graduated at Princeton, N. J., 1834; was called to the bar in Kentucky. Since 1837 he has been for a great part of the time connected with the New York *Evening Post*, of which his father-in-law, Wm. C. Bryant, was so long the editor-in-chief. Of the *Post*, Mr. Godwin was at first a contributor, and then managing editor. In 1843 he for a time conducted the *Pathfinder*, a weekly; was a prominent contributor to the *Democratic Review*, and was for a time one of the editors of *Putnam's Magazine*. Under Mr. Polk he was deputy collector in the New York custom-house; was an early member of the Republican party, but always an advocate of free trade. Author of a *Popular View of*

the Doctrines of Fourier (1844); *Democracy, Pacific and Constructive* (1844); *Vala*, a romance (1851); *Handbook of Universal Biography* (1851); *Political Essays* (1856); the first vol. of a *History of France* (1860); *Cyclopædia of Biography* (1865); *Out of the Past* (1870); and other works from his pen are announced. He has also translated tales from Zschokke, and a portion of Goethe's *Autobiography*.

Godwin (William), b. at Wisbeach, Cambridgeshire, England, Mar. 3, 1756, son of a Presbyterian minister; studied at the Hoxton College; was a dissenting minister at Stowmarket 1778–83, when his new religious and political views led him to leave his profession. His *Sketches of History* (1784) was a pecuniary failure; but his *Political Justice* (1793), with its eloquent language and its generous though impracticable theory of universal benevolence, attracted wide attention, and in spite of its levelling doctrines was widely approved. The same doctrines are set forth in *Caleb Williams*, a novel (1794), his most powerful work. In 1797 he married Mary Wollstonecraft, whose memoirs he published in 1798. His other novels (*St. Leon, Fleetwood, Mandeville, Cloudesley, Deloraine*) and his tragedies (*Antonio, Faulkner*) are now forgotten. He wrote useful *Lives* of Chaucer, John and Edward Phillips, Chatham, and others; an *Essay on Sepulchres* (1808); a valuable *History of the Commonwealth* (4 vols., 1827–28); *On Population* (against Malthus, 1820); *Thoughts on Man* (1831); *Lives of the Necromancers* (1834), and many political pamphlets, besides several works for the young, published under the assumed name of "Edward Baldwin." His posthumous *Genius of Christianity Unveiled* (1873) and *Autobiography*, etc. (1874) have recently somewhat revived the public interest in him and his works. Mr. Godwin was for some time a bookseller of London. By a second marriage he had a son of brilliant talents, who died before him. He was always poor, but in old age was appointed yeoman-usher of the exchequer. Late in life his anti-marriage views were abandoned. D. in London Apr. 7, 1836.

God'wit, a popular name for various wading birds, having long bills, like those of snipes. They mostly belong to the genus *Limosa*. In the Old World are found the black-tailed and bar-tailed godwits (*L. melanura* and *rufa*), seashore birds which are good for the table. The great marbled godwit and Hudsonian godwit (*L. fedoa* and *Hudsonica*) are North American species; the tell-tale godwit is the *Gambetta melanoleuca* of the U. S.

Goe'ben, von (August), Prussian general of infantry, was b. at Stade, Hanover, Dec. 10, 1816, and entered the Prussian service in 1833 as a lieutenant. Of a restless and adventurous spirit, he soon resigned his position and went to Spain, where he took service with the Carlists in the corps of Cabrera. But fortune did not favor him much; he was wounded several times, taken prisoner, thrown into jail in Cadiz, thence carried to Saragossa, and treated so ill that his health, especially his eyes, suffered thereby. After the end of the Carlist war he was liberated, returned to Germany, wrote an able book on his Spanish experiences, and re-entered the Prussian army, where he served chiefly on the staff. He took part in 1849 in the campaign against the revolution in Baden; was on this occasion, and also on others in the subsequent years, attached to the staff of the prince of Prussia, the present emperor, and became in 1855 chief of the staff of the 6th army corps. In 1860 he was ordered, together with several other officers, to follow the army of the Spanish general O'Donnell in order to observe the campaign in Morocco, on which he published an able work. In 1863 he became commander of the 26th brigade of infantry; in 1864 he took part in the war against Denmark, and became commander of the 10th division; and in 1865 he became lieutenant-general and commander of the 13th division. At the head of this division he entered Hanover in 1866 and fought on several occasions with distinction. In the Franco-German war of 1870–71 he was appointed commander of the 8th army corps, and played an important and conspicuous part in the battles of Saarbrücken and Metz. When Gen. von Manteuffel received the command of the army of the South, in Jan., 1871, Goeben was appointed commander of the army of the North, and defeated Gen. Faidherbe in the decisive battle of St.-Quentin, Jan. 19. August Niemann.

Goes, or **Tergoes,** town of the Netherlands, in the province of Zealand, on the island of South Beveland, 15 miles by rail from Berg-op-zoom. It has considerable trade in corn, hops, and salt. Pop. 6313.

Goess'mann (Charles Anthony), Ph. D., b. at Naumburg, Hesse-Cassel, Germany, June 13, 1827; was educated at Fritzlar and Göttingen, where he graduated in 1852; came to the U. S. in 1858; resided for a time at Syracuse, N. Y., and since 1867 has been professor of chemistry in the Massachusetts Agricultural College at Amherst, and in 1873 was appointed chemist to the State board of agriculture. Author of numerous and valuable papers upon chemical subjects, among which his nine articles upon salt and the chemistry of natural brines, those upon sugar and the sugar manufacture, and his reports upon commercial fertilizers, have special interest.

Goe'thals (Henry), or Henry of Ghent (*Doctor Solemnis*), b. near Ghent 1217; studied under Albertus Magnus at Paris, and taught the scholastic philosophy with great applause at the Sorbonne. He was an acute and sagacious Realist, and qualified the Aristotelianism of his day by an attempt to blend with it some of the doctrines of Plato. He became archdeacon of Tournay, where he d. in 1293.

Goe'the, von (Johann Wolfgang), was b. Aug. 28, 1749, at Frankfort-on-the-Main, of a rich and highly respected family, and enjoyed a careful and very varied education, rich in the acquisition of knowledge and rich in impressions. The father was a peremptory and somewhat pedantic character, proud of his family connections and personal acquirements; he held no office, but had an imperial title. The mother was a bright and quick-witted woman, with very decided opinions and very vivid sympathies; she stood greatly in awe of her husband, and Wolfgang and she formed a little group of their own within the family. Under the father's superintendence the boy was taught drawing, music, grammar, rhetoric, foreign languages—Latin, Italian, French, Hebrew—and natural history; from the mother he learned to judge characters as they presented themselves in social intercourse, to understand life as it appeared in the streets, and to make small excursions into Fairyland. But his religious impressions were defective; he knew the Bible very well, but it was, and always remained to him, an object of intellectual and æsthetic interest only. It had no authority over his heart, and when, in his great novel, *Wilhelm Meister*, he tried to bring the development of a human soul to a final and, so to speak, typical close, the hero was made to settle down in a sort of mystical Freemasonic institution, which, compared with what a truly religious spirit has proved itself able to work out both in individual and social life, appears very puerile and utterly disappointing. Much more genuine and truly productive of great ideas was the influence he received from the political events of the Seven Years' war—on the one side, the old idea of the emperor, so deeply rooted in the feeling and imagination of the German people, so magnificent, and at this moment represented by a beautiful young woman: on the other side, the new idea of the unity of the German nation, awakened by a young hero who stood unconquered among the heaviest calamities, and who had wrung from fate what Germany had not seen for centuries, a victory over a foreign nation, the battle of Rosbach. During one period of the war Frankfort was occupied by French troops, and young Goethe learned to speak French, to look at pictures, and to feel the strange charm of theatrical representations. In 1768, in the nineteenth year of his age, he went to the University of Leipsic, where he made the acquaintance of Gottsched and Gellert; in 1770 he moved to Strasburg, where he formed intimate friendships with Herder, Jung Stilling, and Lenz. After taking his degree in law at the latter university, he returned in 1771 to Frankfort and began to write lyrical poems and minor critical essays for periodicals, incited to do so by his intercourse with Merck. While in Leipsic he had written two dramas, *Die Laune des Verliebten* and *Die Mitschuldigen*, which were published then, but anonymously and without any effect. In the spring of 1772 he received a position at the imperial chancellery at Wetzlar, but returned home in the fall utterly disgusted with diplomatic affairs, and determined to concentrate himself on some poetical subject.

Personally, the young Goethe made a most extraordinary impression. His bearing was very reserved, even a little haughty; his manners were stiff, sometimes even a little awkward. But the beauty of his countenance was so irresistible, and the impression of courage, independence, nobleness, and kindness so powerful, that when he entered an inn conversation would stop and the guests look surprised at each other. And on nearer acquaintance, in spite of some occasional rashness and arrogance, he quite intoxicated people with the richness, originality, and grasp of his ideas, and with the wonderful freshness and enchanting enthusiasm of his feelings. Everybody expected that something great would come from him, and yet everybody was surprised when in 1773 he published his drama, *Götz von Berlichingen*, and in the following year his famous novel, *Werthers Leiden*. They not only opened a new period in the German literature, but they inaugurated a new epoch in the German civilization. The most striking quality of these two great works is their artistic truth, the magical vividness of their pictures, their objectivity. In order to represent any character or event with such perfect truth it is necessary that the poet shall paint nothing but that which

falls within his own consciousness, and which at least as a possibility, as a danger, forms part of his own soul. Goethe fulfilled this condition, and the secret of the immense success of his works was that in writing out of his own heart he wrote out of the heart of his time. Shakspeare has painted greater characters than Goethe, but the exuberance of his style, which was the style of his time, throws a veil over his characters which aggrandizes the figure, but weakens the outline. No poet has ever reached Goethe in the magic of his representations. Every sentence in his dramas is a portrait. But although the explanation of this excellency, of his method of production, of the relation between his personal life and his poetical creations, is a question of the highest interest, it requires too minute biographical and psychological researches to be treated here. The absolute objectivity of his descriptions raises other questions, however, which, through *Werthers Leiden*, became of historical consequence. Werther is a man who can do nothing ignoble, but the noble, that which is duty, he can only half do. Halfness, however, in the fulfilment of duties deprives a man as absolutely of his moral freedom and spiritual happiness as a total denial of duty through crime and vice. It only conceals the fact to the person himself by entangling his soul in a morbid feeling of being misunderstood and wronged by the world. Such halfness was the disease of the time, produced partly by an imperfect enlightenment which furnished no motives to the volition, partly by a sentimental pietism which represented resignation as the highest form of the will. Every one who reads *Werthers Leiden* reads something about himself, but only those in the first stage of the disease understand the poet. To them the book becomes a help, a cure. Napoleon read it over and over again. Those, on the contrary, who are very far advanced in the disease understand only the hero, and, like him, they blow out their brains. The book was prohibited by law in several countries, and although we now may laugh at such measures, the question still remains, Is objectivity the highest goal of art? or shall there be something behind the picture which shines through it and explains it?

In 1775 the duke of Saxe-Weimar, Charles Augustus, invited Goethe to take up his abode at his court. After some hesitation the invitation was accepted, and from 1776 Weimar became his residence. A warm and noble friendship sprang up between the duke and the poet; and as Goethe possessed much practical administrative talent and great business tact, he occupied at different times many different positions in the ducal government; at last that of a minister of state, which he held from 1815 to the death of the duke in 1828, when he resigned all his offices and retired into private life. A house was built for him, small enough according to the ideas of our times, but magnificent for those days, and containing an excellent library, a fine collection of scientific instruments, and many precious objects of art. During the first two years of his residence in Weimar the court-life seems to have occupied his whole time, but by degrees he began to take part in practical business and to engage in severe scientific studies of botany, comparative anatomy, mineralogy, and optics. Great men, such as Wieland, Herder, Fichte, Schelling, and Schlegel, gathered around the court of Weimar, and made it a German Athens. And in spite of all its easy grace and its somewhat Epicurean aspect, Goethe's life during this period contains both efforts and results. With respect to poetry, the results were small enough. For the twelve years after the publication of *Werthers Leiden* nothing but *Stella* (1776), *Clavigo* (1778), and some other still less important works were produced. But much was prepared, and after his journey to Italy (from 1786 to 1788) masterpiece followed after masterpiece in rapid succession: *Egmont* (1788), *Iphigenia* (1786), *Römische Elegien* (1788), *Tasso* (1789), *Faust I.* (1790), *Wilhelm Meister* and *Hermann und Dorothea* (1796). The variety of these works is not more astonishing than their perfection. In *Tasso* Goethe reached a simplicity and limpidity of form which makes the words disappear behind the ideas they convey, and transforms the metrical movement of the language into a melody of the thoughts: and thus he succeeded in representing the most refined and delicate movements of the human soul with perfect clearness and great dramatical impressiveness. In strong contrast to the antique harmony and classic repose which distinguishes *Iphigenia* and *Tasso*, stand the romantic exuberance and picturesque disorder of *Faust*. The wildest and coarsest outbursts of passion and the most sublime and touching innocence of the heart, the flattest and most trivial stages of intellect and the highest aspirations and innermost longings of the soul, combine in this drama, and form a picture of human nature to which probably no literature has an equal. In 1794 the intimate and noble friendship began between Goethe and Schiller which lasted to the death of the latter in 1805. The influence of this friendship on Goethe was hardly favorable to the full and free exertion of his powers; his poetical productivity stopped. But to Schiller his friendship with Goethe was the baptism of his genius, and Goethe was during the whole period very active. His studies were comprehensive and assiduous; his critical sallies on the extravagances of his own pupils were most effective; and through his direction of the ducal theatre in Weimar from 1790 to 1817 he exercised a lasting and ennobling influence on the theatrical art of Germany. After the death of Schiller, on the day of the battle of Jena (Oct. 19, 1806), he married Christiane Vulpius, by whom he previously had a son.

Goethe had now ceased to be merely an influence; he had become an authority. Civilized life in Germany—and in foreign countries too—was deeply indebted to him. He had unlocked the narrow ties of the old order, and in the wild fermentation of all the elements of civilization he had established a law which prevented chaos from breaking in. He had brought freedom into the German civilization. There was in German life and character a hardness and narrowness which, although intimately allied to energy and honesty, hindered the free movement of human nature, and constrained it within the boundaries of the most singular prejudices. These were melted down by Goethe's influence, and human nature breathed freer. Lessing had proclaimed in his criticism the right of nature against conventionalities, but it was Goethe who demonstrated the truth of the doctrine by his poetical creations. And with him it received a most important expansion. Lessing had said that truth to nature was the first condition of beauty, thus confining himself within the merely theoretical sphere. Goethe said that everything natural was true as far as it was beautiful, thus breaking into actual life with a new and almost revolutionary issue. This view of human life as composed merely of two agents—nature, giving the force, and beauty, giving the law—is the key to that grand phenomenon in the history of mankind which is called Goethe. It explains the vagaries of his pupils, the Romanticists; it explains the defects of certain of his works, *Wilhelm Meister's Wanderjahre* and *Faust II.*; it explains certain not amiable singularities in his life—why he did not marry Frederike Brion; why his first words on hearing that Charles Augustus had died were a scolding to the footman because he had not kept back the news till dinner was over. To us, in our days, it is apparent that such a view of human life is far from being exhaustive. We know that human nature contains elements which beauty is too weak to master—elements which even morality cannot bring to full development—elements which only religion can grapple with. But to the time of Goethe, curbed and almost mutilated under the tyrannical constraints of pedantic prejudices, this view was a gospel of freedom, progress, power, and happiness. It will hold a certain authority in every age, because it contains a certain proportion of truth. It was followed by Goethe himself with a sincerity and honesty on which there probably is not one spot, and which in many cases certainly cost him unspeakable sufferings. Its effect on civilized life was most wonderful; it gave much more than it promised. Thus, it was quite natural that the whole age bowed to its bringer with the deepest gratitude and reverence.

The most remarkable of Goethe's poetical productions during the last period of his life are—*Die Wahlverwandtschaften*, a romance (1808), *West östlicher Divan*, a collection of lyrical poems (1813), *Faust II.* (1831), and the exceedingly interesting autobiography *Aus meinem Leben* (1830), which he calls a blending of facts and fiction. Most of his time, however, was given to practical business and scientific researches. In this last respect he has been very severely criticised by several scientific men of second rank, while all scientists of first rank have acknowledged that his discoveries in botany and comparative anatomy are valuable, and his studies and observations interesting and suggestive, even when the theories which he formed and endeavored to maintain proved untenable. He d. in Weimar Mar. 22, 1832, and lies interred in the ducal burial-vault beside the duke, Charles Augustus, his friend through many years. The best biography of him is that by G. H. Lewes, London, 1855; the fullest impression of his personal character is given by the numerous collections of his correspondence with Schiller, Mad. von Stein, Lavater, Herder, Merck, Humboldt, and others. CLEMENS PETERSEN.

Goettee', tp. of Beaufort co., S. C. Pop. 2319.

Goet'tling (KARL WILHELM) was b. at Jena in 1793; began his studies in that place; served as a volunteer in the war with France 1814; finished his university course in Berlin; appointed in 1815 professor in the gymnasium at Rudolstadt; in 1819 director of the gymnasium at Neuwied; in 1822 professor extraordinary; and in 1832 pro-

fessor in the University of Jena; in 1826 was appointed also university librarian, and later associate director of the Philological Seminary. In 1828 he visited Italy and Sicily; in 1840, and again in 1852, Greece, in connection with historical and archæological studies. He wrote *Das Geschichtliche im Niebelungenliede* ("The Historical in the Niebelungenlied"), Rudolstadt, 1814; *Nibelungen u. Ghibellinen*, ib. 1817; *Lehre von Griech. Accent*, 5th ed., Jena, 1835; translated as *Elements of Greek Accentuation*, London, 1831; *Geschichte der römischen Staatsverfassung* ("History of the Roman Constitution from the Founding of the City to Cæsar's Death"), Halle, 1840; edited *Theodosii grammatica*, Leipsic, 1822; *Aristotelis Politica*, Jena, 1824; *Œconomica*, 1830; *Hesiodi Carmina*, Gotha, 1831; 2d ed. 1843; published *Gesammelte Abhandlungen aus dem Classischen Alterthum*, vol. i., Halle, 1851; vol. ii., Munich, 1863. His *Opuscula Academica* were collected and edited by Kuno Fischer, Leipsic, 1869, after his death, which took place Jan. 20, 1869. (See KUNO FISCHER'S *Charakteristik*, prefixed to the *Opuscula;* C. NIPPERDEY, *Memoria C. Goettlingii*, Jena, 1869.) H. DRISLER.

Goffe (WILLIAM), b. in England about 1605; was a devout Puritan and an able major-general in Cromwell's army, and with Whalley, his father-in-law, came to Boston, Mass., in 1660. Having been among the regicide judges, they were not included in the general amnesty at Charles II.'s restoration. From 1661 to 1664 they lived in concealment near New Haven, Conn., and were several times in very great danger of capture. In 1664 they went to Hadley, Mass., where, with Dixwell, another regicide, they were long residents in the family of the Rev. Mr. Russell. The narrative given by Dr. Dwight of Goffe's taking command of the men of Hadley, and repulsing the Indians in 1675, is now regarded as incorrect. Goffe d. at Hadley in 1679.

Goffs'town, post-tp. of Hillsborough co., N. H., on the Manchester and North Weare R. R., 8 miles W. by N. of Manchester. It contains 3 villages, has 2 post-offices, 2 churches, a town-hall, a fine central school-house, 2 large sash and blind factories, 2 hotels, a machine-shop, a flouring-mill, a large lumber and wood establishment, besides minor industrial enterprises. P. 1656. S. H. KEELER.

Gog and **Ma'gog** [of doubtful etymology, perhaps indicating something great or gigantic; in Arabic, *Yajuj* and *Majuj*]. In the Mosaic Table of Nations (Gen. x. 2), Magog is the second of the seven sons of Japhet, representing a people, probably the Scythians. In Ezekiel (xxxviii. 2 and xxxix. 1) Gog is the prince of the people Magog. In Revelation (xx. 8) both Gog and Magog are peoples, opposing, as in Ezekiel, the people of God, and doomed to destruction.—GOG and MAGOG are also two images of giants standing in the Guildhall, London. The present giants were made in 1708 by Richard Saunders, the old ones having been burned in the Great Fire. They are mentioned as early as 1415, and are probably much older. Many European towns have, or have had, their old corporation giants. The origin of the custom is obscure.

REVISED BY R. D. HITCHCOCK.

Gogra. See GHOGGRA.

Gohanuh, town of British India, in the Bengal presidency, on the Delhi Canal. Pop. 6668.

Go'ito, town of Italy, on the right bank of the Mincio, in the province of Mantua. From its position it frequently suffered from military operations during the Middle Ages, and in modern times has given name to two battles—one between the Austrians and Italians in 1814; the other between the Austrians and Piedmontese, 1848. Pop. 5274.

Goître (*gutter*, the "throat"); synonyms, **Bronchocele, Derbyshire Neck.** This is an enlargement of the thyroid gland, which lies across the front of the windpipe. It probably originates in hypertrophy of the natural gland-structure, and the concurrent formation of cysts in the interstices of the gland-tissue. These cysts are of varying size, and generally contain a more or less solid glairy matter, blood, earthy concretions, etc. The disease has been supposed to be due to the drinking of snow-water, but it occurs where there is no snow. Although manifesting itself to a greater or less extent in all parts of the world, it is more prevalent in the chalky parts of England, especially Derbyshire and Nottingham, and in mountainous districts, among which may be named the Himalayas, Andes, Alps, the Tyrol, and the valley of the Rhône. It is seen upon almost all cretins. Goître is also a symptom of a peculiar affection known as Grave's or Basedow's disease, which consists, besides the enlargement of the thyroid gland, of an unusual prominence of the eyeballs and a very rapid action of the heart. This tumor, called exophthalmic goître, is not goître at all, and usually disappears with the general disease. (*Niemeyer.*) Unless it be very large, goître causes but little inconvenience, but it often attains to such a size as to produce serious trouble by pressure on the neighboring important parts—the large veins, trachea, œsophagus, etc. The treatment usually adopted is iodine, both applied externally and administered internally, to cause absorption. Extirpation is sometimes performed. In India, powerful mercurial inunctions are successfully employed. EDWARD J. BERMINGHAM.

Golcon'da, town of Hindostan, in the dominion of the Nizam. It is famous for its diamonds, which, however, are only cut and polished here; but it was the treasury of the Nizam, and as such fortified and jealously guarded; which two circumstances have given it an almost fabulous fame. In its neighborhood are the mausolea of its former sovereigns, stupendous buildings of granite, with roofs of porcelain tiles of the most brilliant blue color.

Golconda, post-v., cap. of Pope co., Ill., on the Ohio River. It has 4 manufactories, 3 mills, 4 churches, 1 newspaper, 1 high school, a new court-house, a lead and a kaolin mine, and 4 hotels. Principal business, farming, mining, and manufacturing. Pop. 858.

M. GOWN & BRO., EDS. "HERALD."

Golconda, post-tp. of Humboldt co., Nev., on the Central Pacific R. R., 479 miles N. E. of San Francisco. P. 80.

Gold, one of the heaviest, softest, and the most malleable of metals, is widely distributed, being found in the metallic state in nearly all of the great mountain-chains of the globe, and in solution in minute quantity in sea-water. It was probably the earliest known metal, and it has been prized through all ages for its beauty and indestructible qualities. It is rarely found pure, it being alloyed with silver in varying quantities in different regions. The silver ranges from 0.16 to 16 per cent. of the native metal. California gold averages 88 per cent. of pure gold and 12 per cent. of silver. Australian gold contains on an average 92.5 of gold and 7.5 of silver. New Zealand gold has about the same average of fineness. The percentage of silver varies at different localities in the same gold-region. In Nova Scotia gold is found nearly pure. The gold found on the Chaudière in Canada contains from 10 to 15 per cent. of silver. Alloys are found, however, with a much larger quantity of silver. The *electrum* of the ancients contained from 26 to 36 per cent. of silver. A mass of this nature weighing 25 pounds was found at Vöröspatak, and contained 25 per cent. of silver. A pale yellow alloy occurs in the rich ores of the Comstock Lode in Nevada, and according to an analysis by Mr. Attwood contains 55.37 per cent. of gold and 42.87 of silver. In U. S. gold coin there are 90 parts of pure gold and 10 parts of alloy, which consists chiefly of copper, with a little silver. Silver gives a lighter yellow color or whiter shade to the gold, and copper imparts a reddish color. The red gold used for watch-chains and jewelry is alloyed with copper. The mixture, whether formed by the addition of silver or of copper, or of both, is harder than pure gold, which is too soft and easily worn away to be used for coin or ornaments. In jewelry the quantity of alloy added to the gold varies from 12 to 50 per cent., or even more. The ratio of the quantity of gold to the other metals, called the *fineness*, is usually expressed in "thousandths" or "carats." Pure gold is 1000 fine; half gold and half silver would be 500 fine. California gold as mined averages 880 thousandths, being 880 parts of gold in 1000. It ranges from 870 to 890 thousandths. U. S. gold coin is 900 fine. The expression of fineness by carats is an older form, and is still in general use by jewellers and at the British mint. Pure gold is said to be 24 carats fine. When there are equal parts of gold and of other metals the mixture is said to be 12 carats fine. Six parts of alloy give 18-carat gold, and so on. Common gold jewelry is often 14 carats fine, but the superior qualities are 18 carats. In Great Britain bullion accounts are rendered in carats, carat grains, and eighths or thirty-seconds of a carat, the carat being divided into thirty-two equal parts. One carat is equivalent to $41\frac{2}{3}$ thousandths. The U. S. standard gold, 900 fine, is equivalent to 21.6 carats. The British standard is 22 carats, equivalent to $916\frac{2}{3}$ thousandths. The range of gold above the standard is designated in England as "*betterness*," and below the standard as "*worseness*."

The specific gravity of native gold and of artificial alloys of the metal varies with the fineness. Native gold ranges from 15 to 19. When quite pure, and after pressure in a die, the gravity is 19.34. One cubic inch of pure gold weighs 10.12883 ounces troy, and is worth $209.38. In the calculation of tables of value 387 ounces troy are considered to be worth $8000; hence one ounce is worth $20.6718+. The metal is not so hard as silver, being from 2.5 to 3 upon the mineralogical scale, but its hardness is slightly increased by hammering. Its extreme malleability is best shown by the thinness of gold-leaf as used in gilding. One ounce of gold may be beaten out so as to cover 160 square

feet of surface, but the leaves are seldom made so thin, 100 square feet to the ounce troy being the usual extent. The average thickness of common leaf is $\frac{1}{282000}$th of an inch: thus 282,000 sheets would be required to make a pile one inch in height. When so thin, green light is transmitted. One grain will yield leaf sufficient to cover 56.75 square inches, or may be drawn into a wire 500 feet in length.

The value of gold in the arts for ornamentation and for money rests in great part upon its unalterability by any ordinary agencies. It cannot be easily rusted or dissolved, nor does it tarnish by exposure to the weather or to foul gases for ages. Gold ornaments found in Egyptian and other ancient tombs are unchanged. The proper solvent of gold is chlorine, and fluids containing free chlorine or evolving chlorine will dissolve it. The mixture of the two acids, nitric and hydrochloric, known as *aqua regia*, is commonly employed. Selenic acid acts upon it. Its solution in sea-water is referred to the presence of iodate of calcium. Experiments by Prat show that under certain conditions gold can be oxidized and salified by oxacids; that two oxides can be formed capable of giving a new series of salts; and that there is a carbonate and a sesqui-iodide. A sulphate may be formed by heating gold with solid permanganate of potash and concentrated sulphuric acid for a few minutes. Gold may be obtained in a powdered state by precipitating an aqueous solution of the chloride by green vitriol. Spongy gold, according to Dr. C. T. Jackson, is obtained by adding oxalic acid to a concentrated solution. Gold fuses at a temperature of 2016°. It may be volatilized by solar heat concentrated by a glass, or by the oxyhydrogen jet, and rises in purple vapors. In solidifying from fusion it contracts greatly. The presence of $\frac{1}{2000}$th part of lead, bismuth, or antimony destroys the ductility of gold. It is also made brittle by sudden cooling. Its tenacity is next to that of silver. Atomic weight, 196.71. There are many interesting alloys of gold besides those already mentioned, as, for example, with palladium, and artificially with platinum, the latter giving a hard and highly elastic mixture. A native alloy of gold and palladium contains nearly 10 per cent. of the latter and 4 per cent. of silver.

As regards the nature of the rock-formations in which gold is found, it may be said, in general, that it occurs in formations of nearly all geological periods, from the earliest rocks to the latest Tertiary. It is chiefly, however, in the uplifted and partially altered slates and shales of the Middle Secondary and the Palæozoic periods that the great deposits occur. The principal veins and placers in California follow a belt of Jurassic and Triassic slates on the western slope of the Sierra Nevada. In all this region there are large areas of serpentine and magnesian slates. The metal also occurs in granite, syenite, limestone, and sandstone. Quartz is the almost universal veinstone, but the metal is sometimes found penetrating seams of calc-spar or dolomite in hornblendic slates without much quartz. Beautiful crystallizations of gold are occasionally found in cavities of the veinstone. They belong to the cubic system, and in California are generally distorted octahedra. In Australia dodecahedral crystals are more common. Very large irregular masses are sometimes taken from veins, but they are more common in placer-deposits, and are generally known as *nuggets*. The famous Blanch Barkly nugget in Australia weighed 146 pounds, and one from Ballarat weighed 184 pounds 8 ounces, and was worth over $41,000. A mass weighing about 160 pounds, consisting partly of quartz, was reported in the early days of California mining as having been taken from the quartz-vein on Carson Hill. A mass weighing 28 pounds, and about the size of a smoothing iron, was found in Cabarrus co., N. C. A highly crystalline mass, weighing about 17 pounds, was dug up near Georgetown, Cal., in 1865, and was valued at $4000. A great number of masses of considerable weight have been found in California of which no special record has been kept, but the Australian placers appear to have afforded the largest number of heavy nuggets.

The almost universal distribution of gold is not so surprising when we consider its presence in sea-water. Sonstadt has shown that there is nearly one grain to each ton of water, and that it can be separated so as to be recognized from a quantity of water so small as 150 to 200 cubic centimètres; and as regards distribution in the soil, it is known, for example, that the ordinary brick clay which underlies the city of Philadelphia contains gold.

The suitability of gold for money rests not only on the general estimation in which it is held, its unalterability, and its beauty, but from the fact that while so generally distributed over the globe, it cannot be obtained without labor. To extract an ounce of the metal from the earth requires a certain amount of work which differs somewhat in different places, but is approximately the same in all great gold-fields. The average quantity which a man can wash out in a day appears to determine the price of a day's labor for that locality. Thus, when a man can conveniently wash out half an ounce of gold per day for himself, he will not work for less than its value. But placer-deposits are soon exhausted, and such exceptional yields do not last long. Vein-mines are not subject to such sudden fluctuations. The tenor of auriferous quartz and the force required to extract the gold are about the same in all countries. Hence, gold is an excellent measure of labor performed, and represents labor. It is at once the measure and the reward of labor.

The value of gold relatively to silver has varied in time and in locality according to their relative abundance and the estimation in which they have been held. In the year 1546 in England, and all countries where values have been more or less equalized by commerce, the ratio was as 10 to 1; in 1849, as 15.63 to 1; in 1871, as 15 to 1. This is probably the simplest and the most convenient ratio, but it is constantly changing, having increased in 1875 to nearly 16 to 1, from various causes. (See SILVER.) In the far East, however, there has been a long-established preference for silver. When Japan was forced open by Com. Perry the relative value there of gold to silver was much below the European standard, and advantage was soon taken of it by traders, who exchanged silver for gold and depleted the empire of millions. Enormous quantities of gold are consumed annually in the arts and are lost by wear of coin and jewelry. The consumption for gilding alone is very large, for although the films are exceedingly thin, they are spread upon a variety of manufactures, such as frames, furniture, signs, pottery, jewelry, books, etc., to a far greater extent than is generally supposed. Electro-gilding has increased the waste. Since the discovery of gold in California in 1848 the annual production of the metal has greatly increased. The average product of the California mines up to 1870 was about $45,000,000 annually. The discovery was followed by the opening of new fields in Australia, in New Zealand, and other regions. At the date of the discovery in California the aggregate annual production of the metal, exclusive of Asia, was not over $30,000,000 in value. In 1853 the aggregate annual production reached its maximum, and was valued at $160,000,000. The production in California alone for that year was about $60,000,000. The total production of gold in the U. S. from 1847 to 1873 inclusive was approximately $1,240,000,000. The yield in California for 1873 is estimated as worth $17,000,000. The aggregate value of the gold of domestic production deposited at the mints and assay offices of the U. S. from their organization to July, 1874, was $871,265,517. The greater part of the gold of the world is obtained by washing from detrital deposits in and along the beds of rivers. (See GOLD-MINES and MINING.) A smaller quantity is obtained from veins by crushing and washing the quartz. W. P. BLAKE.

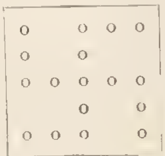
Gold, tp. of Bureau co., Ill. Pop. 392.

Gol'dau, village in Switzerland, in the canton of Schwytz, was buried on Sept. 2, 1806, by a tremendous landslip, together with the villages of Busingen and Rothen. A part of the southern side of the Rossberg, consisting of rock resting on light soil, became detached from the ground by rain, and rushed down into the Lake of Lauerz, burying three villages and killing 400 persons.

Goldbeaters' Skin, a thin material prepared from the peritoneal coat of the large intestines of the ox. The mucous coat is scraped away, and the remaining part undergoes a long and complicated process of preparation before it is fit for use. It is tanned with alum and softened with isinglass and white of egg, and after thorough beating, and drying under pressure between sheets of paper, it is ready for use. It is very costly, and is used by goldbeaters and sometimes in surgery.

Gold-Beating. The thin leaves of gold used in gilding and by dentists in filling teeth are prepared by beating thin sheets of the metal placed between the leaves of what is technically called a "book." The first step in the process is to prepare the gold. For dentists' use this must be perfectly pure—1000 fine. Common mint gold is dissolved in aqua regia, separated from the copper and silver it contains, precipitated by iron salt, and melted. For gilders' use alloys are prepared of silver and gold for the pale shades, and of copper and gold for the darker tints. "Light gold" contains from 4 to 12 pennyweights of silver to the ounce. "Extra deep gold" has 10 grains of copper and 12 grains of silver to the ounce, and "Red" or "extra deep gold" has 16 grains of copper to the ounce. In addition to these, leaf is made which has gold on one side and silver on the other. It is made by casting one metal upon the other in a mould, and is subjected to the processes described below. The gold is cast in an ingot of about 1000 grains weight, and rolled to a ribbon a little more than 1½

inches wide, and so thin that about 700 would go to the inch. In this form it is delivered to the beater, who receives 50 pennyweights, which he cuts up, after annealing, into squares a little more than an inch wide. These are placed in a book called the "kutch." Kutch is a kind of parchment-paper made in Germany, and possessing great toughness combined with evenness of surface. The kutch is about $3\frac{3}{4}$ inches square. One ribbon of 50 pennyweights weight makes about 170 squares, the number depending upon the "number" or thickness of the leaf which is to be made from it—a detail which is determined by the master in rolling the ribbon. The squares are laid precisely in the centre of the kutch, and with their edges in an exact vertical line. Two envelopes, also of kutch, are drawn over the book in opposite directions, so as to enclose it on all four sides. It is then placed on a solid stone anvil, and the workman beats it with a sixteen-pound, round hammer with a broad and slightly rounded face. At first the blows are all directed toward the centre, but as the gold flattens out the hammer is first struck upon the centre and then a little toward the edge which is farthest from the workman. The book is then turned one-fourth round; the centre is struck again, and then the second blow towards the farther edge follows. This is repeated, turning the kutch one-fourth round, until eight blows have been struck—four on the centre and four toward the edge. The book is then turned over, and the same process is repeated on the other face. When the gold has spread so as nearly to fill the whole book, the workman strikes one blow on the centre, one between the centre and the edge, one on the edge in its middle line, one on the edge toward the right, and finally one on the upper right-hand corner. These five blows are repeated at each one-fourth turn, and the other face of the book is treated in the same way. The circles in the accompanying diagram indicate the position of the hammer at each blow. Sometimes a different succession is chosen, but whatever system is pursued must be continued until the book is finished, or the expansion of the gold between the leaves of kutch will not be uniform. The workman is careful not to strike on the extreme margin, and also to moderate the force of the blow as he nears the margin, the object being to keep the centre of the leaf thinner than the edge. In the final operation of "booking" the edge is cut off and returned by the beater as scrap. If he has carelessly made the edge thin and the centre thick, the result may be the loss of his week's wages in "short gold." Every three minutes the book is taken out of its covers and "riffled." Riffling consists in shaking up the leaves, so as to loosen the whole and prevent the gold from clinging to the parchment, which would cause an uneven spread of the metal. The kutch is beaten about half an hour, and is then "skewed." This consists in taking out the gold, and lasts another half hour. The leaves are then cut into quarters and laid in a "shodar." The shodar is a book made up of leaves prepared from the cæcum (one of the intestines) of the ox. This is stretched and cleaned, and the two mucous surfaces are pressed together, adhering strongly. It is then treated with some preparation which, so far as the best makers are concerned, is a secret, though isinglass, white of egg, and similar substances have been mentioned as dressings of more or less excellence. It is then cut into leaves five inches square, and made up into moulds of 900 leaves. The cæca of nearly 600 oxen are required to form one mould, which is of course very expensive, costing in New York (1873) about $71 in gold. These membranes have a perfectly smooth, even surface, free from veins and knots, and their fineness is indicated by the fact that a "mould" of 900 membranes, containing also 900 sheets of gold-leaf, is only one inch in thickness. The membranes become dry and stiff by use, and are also sensitive to the hygrometric condition of the atmosphere. When too dry, they are moistened; when too moist, they are heated to dry them, both operations requiring great care. The shodar, which is four inches square, is not made of fresh membranes, but of old moulds cut down. The filling of the shodar requires one hour, and it is then beaten two hours with a lighter hammer, say 7 pounds in weight, and with the same precision as before. The leaves of gold are then cut into quarters and transferred to the "mould," which is made of new membranes in good condition. The leaves have now only $\frac{1}{16}$th the thickness of the ribbon, are partially transparent, and very fragile. The succeeding operations must consequently be performed with great care. The filling of the mould occupies two hours, and it is then beaten one hour with a five-pound hammer, after which it is annealed. Annealing is performed in a small screw-press of iron which is heated on a fire. After its removal from the fire the mould is placed between two plates, shoved into the hot press, and screwed down. It is evident that the least excess of temperature will ruin the delicate membranes of the mould, and this is the most hazardous part of the beater's work, for the mould is far more costly than the gold it contains. Beating, annealing, and cooling are performed four times in all. The whole operation of reducing 50 pennyweights of gold to leaf occupies 24–30 hours, average 27, or nearly three working days. After the last beating the gold is taken from the mould by girls and "booked," while the membranes are rubbed with "brime" or burnt talc, laid on with a hare's foot, to preserve their smoothness. Booking is the operation of placing the gold-leaf in books of tissue-paper, the leaves of which are rubbed with red ochre to keep the gold from sticking. The girl lifts the leaf by means of light wood pincers, lays it on a leather cushion, and blows it flat with her breath. She then cuts a piece $3\frac{1}{4}$ inches square from the centre, by pressing down a wooden frame with sharp edges, and transfers the leaf to the book. Each of these holds 25 leaves or $5\frac{1}{2}$ grains of gold. In this extremely attenuated condition gold exhibits the phenomenon of malleability in the cold. Torn leaves are mended by laying a second torn leaf on top of the first and cutting them in two near the centre by means of a thin and sharpened strip of reed. The leaves unite perfectly along the line of the cut, the scrap is removed, the double leaf blown out flat, and the centre is cut out as usual. Sometimes no trace of the welding is visible. Holes are patched by merely pressing a bit of scrap on them. The malleability of the ordinary leaf is not, however, sufficiently perfect for the purposes of dentistry. Dentists' foil is accordingly annealed by floating the leaf for an instant over the flame of an alcohol lamp. A gas-flame will not answer, as it lessens rather than heightens the malleability of the leaf, probably by depositing a film of sulphur over it. After this process the leaves unite with the slightest touch, and adhere to any rough substance, as the finger.



It costs about $500 to stock a workman, of which not more than $150 is represented by gold, and the rest by his tools, books, etc. He must account by weight for all the gold he receives, the books of 25 leaves being taken at $5\frac{1}{2}$ grains, and all the scrap cut from his leaves being returned to him for melting down. Allowing that he cuts his ribbon into 170 pieces, this number is increased by 4, or to 680 leaves, in the shodar, and this again to 2720 in the mould. Were he able to return this number of whole leaves, his pay would be very good, but the waste is such that the rate of wages is based upon the return of 2000 whole leaves, or 80 books of the standard weight of 17 pennyweights. This is really under the average return of a good hand. If he beats his leaves beyond the standard thinness, he will of course have an excess of gold, for which he receives pay as scrap. Workmen earn from $14 to $22 a week. By the census of 1870 there are in the U. S. 23 establishments of goldbeaters, employing 226 hands. The capital invested amounts to $140,000, the materials cost $300,000, and $78,000 is paid in wages. The finished product has a value of $481,000. The system of gold-beating here described is that pursued by Mr. W. Valleau, Jr., New York. Slight variations are found in different establishments and different countries, but the art appears to have been practised in a very similar way to that given above for thousands of years. Even the more peculiar details, such as the use of the cæca of oxen, have been in use so long that the date of their introduction is not known. Gold-leaf is found in ancient monuments of Egypt and other countries. An increasing skill appears to have been used in its manufacture, for the thinnest leaf mentioned by the ancients was fully three times the thickness of what is now ordinary leaf. The reduction of the gold from a foil $\frac{1}{700}$th of an inch thick to a leaf $\frac{1}{254248}$th of an inch thick is the common work of the goldbeater. But this is by no means the limit of his skill, for sheets have been made of which 367,500 would go to the inch. Though the goldbeater receives credit for $5\frac{1}{2}$ grains on every 25 leaves he turns in, the real weight is not more than $5\frac{1}{10}$ grains; and as the book contains 264 square inches of leaf, 1 grain of gold has been beaten out to a surface of 52 square inches. Though gold-beating as an art remains almost as simple as it was centuries ago, the modern use of gold by dentists has given rise to a number of patented articles which are prepared by goldbeaters. "Carbonized foil" is one of these. It is made by interleaving gold-foil of more than usual thickness with coarse-grained paper, and setting fire to the latter while the book is placed in a press. In burning it contracts, and gives the gold a peculiar and very beautiful corrugated appearance. "Pack's crystal pellets" are made of ordinary leaf made into a mash by stirring the leaves in alcohol, and pouring them lightly into a mould. The alcohol remaining on the gold is then fired, and the heat causes the whole to weld to a very porous mass, which is cut into small square blocks. "Kiersing's blocks" are made of carbonized gold, the sheets

being piled one above the other and the mass then cut into blocks. Dentists' gold is known by the name of "foil," which is heavier than the leaf. Machines have been invented to take the goldbeater's place, but they have not come into use. Simple as the work appears, it requires the exercise of discretion. Other metals than gold are beaten, as silver, aluminum, and certain alloys of the baser metals made in imitation of gold. Silver-leaf is about four times as thick as gold leaf. The price of labor hardly permits the beating of silver in the U. S., while aluminum and the alloys cannot be beaten at all with a profit in this country. Aluminum foil is used by hat-makers for the stamp on the inside of the hat, where the vapors rising from the head would tarnish silver. JOHN A. CHURCH.

Gold'beck (ANNA MARY FREEMAN), a miniature-painter, the daughter of George Freeman, also a miniature-painter, b. in New York in 1833; d. in New York Feb. 17, 1874. About the year 1857 she married R. W. Goldbeck, a musical composer, by whom she had a son.

Gold'berg, town of Prussia, in the province of Silesia, on the Katzbach. In ancient times it was famous for its gold-mines, from which it has its name; it now thrives by its manufactures and its trade. Pop. 6716.

Gold Branch, tp. of Tallapoosa co. Ala. Pop. 680.

Gold Coast, a part of UPPER GUINEA (which see), Western Africa, from the river Volta to the river Assinie. It receives its name from the gold sand which is found often in considerable quantities, not only along the coast, but also along the shores of the Ashantee. In 1846, 100,000 ounces of gold were exported. The British have a colony known as the Gold Coast Settlements, of which Cape Coast Castle is the capital. In 1872, Elmina and Dutch Guinea on the same coast were also transferred to the British crown, the Danish forts having been ceded in 1850. The area of the whole is said to be 16,626 square miles, and the pop. 408,070, mostly uncivilized natives, over whom the British exercise protection rather than government.

Gold-crested Wren, a name given in Great Britain to the *Regulus atricapillus*, and in the U. S. to the *R. satrapa*, the former the smallest British bird, but neither of them wrens. Both are extremely active and playful, and take their names from the yellow feathers upon their heads.

Gol'den, post v., cap. of Jefferson co., Col., the initial point of the Colorado Central R. R., main line to Denver, 17 miles; the Julesburg branch, completed to Longmont, 42 miles; the mountain division, narrow gauge, completed to Black Hawk, 22 miles; the Georgetown branch, narrow gauge, completed to Floyd Hill, 16 miles; and the Golden and South Platte R. R., narrow gauge, graded to the junction with the Denver and Rio Grande R. R., 21 miles. It has 2 banks, 2 newspapers, 5 churches, 1 college, public schools, 3 flour-mills, 1 paper-mill, 1 iron-foundry, 2 smelting works, 2 coal mines, good hotels, stores, etc. It is in a good farming country. Pop. about 2500.
GEORGE WEST, ED. AND PUB. "TRANSCRIPT."

Golden, tp. of Oceana co., Mich. Pop. 335.

Gol'den Age, in the traditions of many nations, the supposed period of primeval happiness and innocence, from which mankind have departed. The ancients referred this time to the reign of Saturn. A favorite dream of some modern reformers is that the golden age is in the future instead of in the past. The "golden age" of Roman literature is reckoned from the time of Livius Andronicus, about 240 B. C., to the time of Augustus Cæsar's death, A. D. 14. Plautus, Terence, Lucretius, Catullus, Cæsar, Cicero, Sallust, Propertius, Virgil, Tibullus, Livy, Ovid, and Horace are the principal writers of the golden age.

Gol'den Bull. See BULL, GOLDEN.

Gol'den Calf, a golden image of a bullock formed for idolatrous worship by the Israelites at Mt. Sinai. It was of cast metal, and is believed to have stood for Mnevis or Apis, the Egyptian god. It was destroyed by Moses, but in later times golden calves were set up by King Jeroboam at Bethel and Dan, where they became favorite objects of popular worship.

Gol'den Ea'gle, the *Aquila chrysaëtos* of Europe and Asia, and the *A. Canadensis* of North America, now regarded by most authorities as mere varieties of a single species. It is the typical eagle, the imperial emblem of ancient Persia and Rome. It is chiefly of a brown color, and about thirty-five inches long. (See EAGLE.)

Gol'den Eye, the *Fuligula clangula*, a wild duck of Europe and North America, nineteen inches long. It builds in hollow trees near the water or on the ground. The Laplanders place boxes near the water, and the golden eye lays her eggs in them. The hunters visit the boxes day after day and abstract the eggs.

Gol'den-eyed Fly, a name applied to the troublesome horse-flies of the genus *Chrysops;* also to the neuropterous insects of the genus *Chrysopa*, important as an active destroyer of plant-lice.

Gol'den Fleece, in Greek mythology, the golden wool produced by the ram Chrysomallus. The fleece was suspended in an oak tree in the grove of Ares in Colchis, and was guarded by a dragon. When the ARGONAUTS (which see) came to Colchis for the fleece, being sent thither by Pelias, Medea put the dragon to sleep and Jason carried the fleece away. Various attempts have been made at explaining the origin of this legend, which probably arose from accounts of the commercial enterprises of the early Greeks on the coasts of the Black Sea.

Golden Fleece (*Toison d'Or*), **Order of the,** a famous order of knighthood, reckoned, next to that of the Garter, the most illustrious in Europe. It was founded at Bruges in 1429 by Philip III. of Burgundy. Charles VI., emperor of Germany, as possessor of the Netherlands, transferred the seat of the order to Vienna, as the Spanish monarchs had already done to Madrid. Thus there arose two branches, a Spanish and an Austrian, the latter having the original archives, but the former being the more exclusive. Neither order recognizes the other's existence.

Gol'den Grove, tp. of Barton co., Mo. Pop. 405.

Gol'den Horde, a band of Tartars who appeared at Khipsah in 1235; in 1240 invaded Russia and burnt Moscow and Kiov; destroyed Lublin and Cracow 1240, burnt Breslau in 1241, and defeated Henry, duke of Silesia, at Liegnitz; ravaged Moravia and Hungary, and massacred the Magyar army 1241. A crusade was preached against them in that year; their siege of Neustadt was unsuccessful; they crossed to the S. of the Danube 1242; marched eastward in 1243; made Russia tributary 1243–1477; made Alexander Newski grand duke in 1252; were attacked by Timour in 1392: and were overthrown by Ivan III. and the Nogay Tartars at Bielawesch 1481. Their first leader, Batou, was a grandson of Genghis Khan, and their invasion was ordered by Octai, the great khan.

Gol'den Le'gend (*Aurea Legenda*), a celebrated work composed in the thirteenth century by James de Voragine, archbishop of Genoa. It is a collection of legends concerning the saints, and for many years maintained a wonderful popularity. It was translated from the original Latin into most of the vulgar tongues.

Gol'den Num'ber, the number of the year in the Metonic cycle, otherwise called the lunar cycle. (See CYCLE.) As the times of holding the Grecian games were dependent on the state of the moon, this number was of prominent importance in the Grecian calendar; and hence is said by some to have been inscribed in characters of gold on the columns of the temple of Minerva at Athens; whence its name. Others say that it is thus called because it was written in gold in the calendar tables publicly suspended in the Grecian cities; and later in the portable calendars in use among the early Christians. At present, the golden number is only useful in finding the day upon which Easter (and consequently the other movable feasts of the Church) will fall. (For the explanation of this, and also of the mode of finding the golden number, see EASTER.)
F. A. P. BARNARD.

Gol'den Rod, a popular name originally belonging to the *Solidago Virga aurea*, an extremely variable plant of North America and Europe, once in repute as a vulnerary. The name is in this country extended to the very numerous herbs of the same genus (order Compositæ), which are mostly tall, stiff annuals with yellow flowers. They are chiefly American. One species, the *S. odora*, is often fragrant, abounding in a volatile oil. It has a limited use in medicine, being carminative, aromatic, and diaphoretic.

Gol'den Rose, a rose made of gold and set with precious stones which is blessed by the pope annually on the fourth Sunday in Lent, and then presented to some prince or other dignitary (usually to a lady). Pope Innocent IV. has the credit of originating the Golden Rose about 1250, and Pope Urban V. in 1366 first sent one as a present, Joanna I., queen of Naples, being the recipient. The Golden Rose seems to refer to Christ, the "Rose of Sharon."

Gol'den Val'ley, tp. of Rutherford co., N. C. P. 1122.

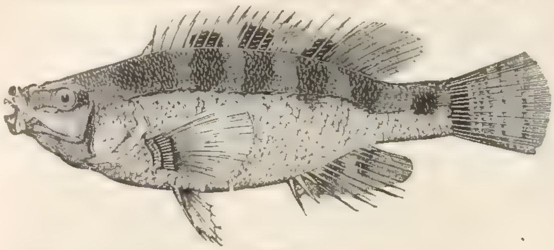
Gol'denville, Guysborough co., N. S., is the most productive gold region in the extensive mining districts of Nova Scotia. The greatest annual yield has been nearly $200,000. Pop. about 900.

Gold Eye, the name of certain North American fresh-water fishes of the genus *Hyodon*, family Hyodontidæ, having teeth on the jaws, palate, and tongue. The fishes are small, and will rise to a fly like the trout or grayling.

Gold'finch, the *Carduelis elegans*, a favorite European

song-bird, beautifully colored with yellow, white, black, and red. It is readily domesticated, sings very well, and is intelligent and affectionate. It breeds freely with the linnet, canary, and other finches, and the mules or hybrids are prized for their song. The *Chrysomitris tristis*, American goldfinch or yellow-bird, has more yellow in its plumage. It much resembles the foregoing. The green goldfinch is the *Fringilla melba*, from Brazil.

Gold'finny, or **Goldsinny,** the *Crenilabrus Cornubilus*, *Norregicus* and others of the genus, small European fishes of the family Labridæ. They are generally yellowish, and have a large back fin.



Goldfinny.

Gold Fish, the *Cyprinus auratus* or golden carp, a Chinese fish now naturalized in many streams and lakes of Europe and the U. S. From its beautiful orange color and its tenacity of life it is often kept in glass globes and aquaria. When very young its color is dark, and when very old it sometimes fades to a silvery hue. It is of fair quality for the table.

Gold Hill, an incorporated town of Storey co., Nev., 328 miles by rail from San Francisco, Cal., and 1 mile S. of Virginia City, at the head of Gold Cañon, a large ravine 8 miles in length emptying into Carson River. The famous Comstock Lode, passing through Virginia City along the eastern slope of Mt. Davidson, passes also through Gold Hill. Beneath the town lie some of the richest mines known, including the Belcher and Crown Point, which yield about $2,000,000 in silver and gold bullion monthly. Within the limits of the town are about a dozen large quartz-mills, but most of the ore is transported some 15 miles over the Virginia and Truckee R. R., which runs through the town, to still more extensive and powerful mills on Carson River. Gold Hill contains 3 churches, excellent public schools, and 1 newspaper. It received its name from a small rocky hill at that point rich in gold, which was soon discovered to be merely a prominent portion of the surface croppings of the now world-renowned Comstock Lode. The mines have been worked to a depth of 1900 feet, and show no signs of failing. Mining is the chief occupation. Pop. 4311.

ALF. DOTEN, ED. "DAILY NEWS."

Gold Hill, post-tp. of Rowan co., N. C. Pop. 959.

Gold Lace, a material used for decorating the uniforms of officers in armies and navies, and for other similar purposes. The best gold lace is made by winding extremely thin gilded and flattened silver wire around threads of silk. There are other but quite inferior methods of making the gilded thread of which this expensive lace is woven.

Gold-Mines and Mining. Gold mines may be grouped in two broadly marked divisions: (1) vein mines, and (2) placer mines. Gold-bearing veins are generally of quartz, and they penetrate solid rocks to considerable depths. Placer mines are the comparatively superficial detrital deposits formed by the action of rivers and floods upon the veins. In veins the gold is firmly fixed in the gangue or veinstone, and is in irregular, ragged masses or crystalline particles; but in placers the gold is detached from the gangue, and is worn and rounded by attrition, having been rolled and tumbled in the beds of creeks and torrents together with pebbles and boulders until all the asperities have been removed. Placer gold can thus be easily distinguished from vein gold. The gold so broken out from veins is distributed through the gravel and sand, but, owing to its high specific gravity, it gradually finds its way down to the lowest layers of gravel, and accumulates upon the surface of the underlying rock, generally known among miners as the "bed-rock." There is thus a kind of concentration of the gold in a layer under the gravel and soil, having more or less lateral extension, and comparatively near the surface; while in veins the gold is distributed through a layer of quartz traversing the rocks in a vertical or nearly vertical plane to great depths. This great difference in the mode of occurrence of the metal of course necessitates a great difference in the methods of mining. The operation of collecting the gold is in both cases essentially a mechanical one, based upon the superior gravity of the gold, which permits it to be readily separated from the rocky and earthy substances in which it is found.

Gold-bearing veins are found in rocks of various ages and kinds: argillaceous, talcose, and chloritic slates appear, however, to be peculiarly favorable to the occurrence of the metal. In some regions hornblendic slates are more highly auriferous than the other rocks. Veins vary in width from a few inches or less to several feet. As a general rule, veins are larger, broader, and more extensive in slate regions than in granite or the hard rocks. This seems to result from the fact that slates are more readily and deeply fissured in one direction than in any other. This direction is the plane of stratification or of highly developed cleavage, and veins generally conform to it in their direction and depth. There is a remarkable uniformity in the characteristics of gold-bearing veins all over the world. The veinstone is generally the opaque or translucent, milky-white variety of quartz, without distinct crystallization or cleavage. In some veins, however, it is very much harder than in other veins, and requires great labor and much powder to break it out. Sometimes it is readily excavated by the pickaxe; as, for example, in some parts of the great Comstock Lode in Nevada, yielding silver and gold, the white quartz is in a fragmentary or powdered condition. It is usually, in all veins, much softer at considerable depths and when freshly mined than at the outcrops or after it has been exposed to the air for a long time. In some veins the bulk of the quartz exists in hard, rounded, nodular masses, surrounded more or less by softer cellular quartz, in which the gold is chiefly found associated with pyritous minerals, while the hard boulder-like masses of quartz are comparatively barren. These veins are known in California as "boulder-veins." A distinctly marked, banded structure, with a more or less crystalline medial plane, is not uncommon where veins traverse a hard, homogeneous rock, such as granite or syenite. This is a structural arrangement of the gangue which is regarded as one of the characteristics of true fissure veins. A banded structure, due chiefly to the parallel arrangement of the pyrites or to enclosed films of slate, is often seen in veins traversing slates. Such veinstone is often known as "ribbon-quartz," and is considered by miners as favorable to the richness of the ore. There is a class of veins known as "slate-veins," in which a belt of slates is traversed by thin seams of quartz so much divided up into films and mixed with the layers of slate as scarcely to be recognized. Such seams, perhaps not thicker than a card or knife-blade, are sometimes highly charged with gold. It is very rare to find gold in rocks without quartz, but it sometimes occurs in seams of calcspar, dolomite, or steatite. The decomposition of such minerals would leave the gold in the rock apparently without gangue. Large amounts of gold have frequently been taken out of such seams in the rocks in a short time, and without finding any distinct evidence of the existence of a vein.

The gold in almost all veins is associated with pyritous minerals, varying in quantity from 1 to 3 per cent. Sulphuret of iron is most common, though yellow copper ore, galena, and arsenical pyrites are common. Tellurium and telluret of bismuth are also abundant in some veins. Such minerals in the upper portions of veins, where exposed to air and moisture, become decomposed by oxidation, and impart a rusty, ochery condition to the veinstone. As a general rule, all of the upper portions of veins above the line of the permanent level of the subterranean water have lost their pyritous minerals by decomposition, and present a very different appearance from the portions protected by water from the access of air. By such decomposition any gold that was enclosed or covered by pyrites is left free and in a condition to be easily collected. The extraction of gold from such ores is therefore more simple and less costly than from the unchanged ore obtained at greater depths. The difference is so great that many mines are abandoned so soon as the naturally decomposed or "rotten ores" are worked out. The rusted vein-stuff is not only more easily worked, but it is likewise mined with more ease, than the undecomposed ores below the water-level. In many veins the gold is not visible to the naked eye, except where the pyrites is decomposed. The distribution of gold in the mass of the veinstone is a very important matter practically. Many quartz veins exist even in gold-regions without gold having been found in them; and in those known to be gold-bearing there are extensive portions without gold. The metal is thus not equally distributed along the vein; it is more abundant in some places than in others. Sometimes one side of a vein contains gold, while the other side is quite barren. Each vein has some distinctive peculiarity, which only becomes known to those who work it after long experience and observation. The metal, it is to

be remembered, is not always visible, and to an unpractised eye the quartz from all parts of a vein may appear of equal value. Gold conforms to the general law of distribution of ores in veins. It is found in "chutes" or "chimneys," so called, having a vertical rather than a horizontal extension upon the plane of the vein. The gold bearing portion may thus be only a few feet in length horizontally, but may extend downward hundreds of feet. The length of the chute is the distance it extends horizontally along the vein; its depth is the distance it extends downward; and its breadth or thickness is at right angles, horizontally, to its length. The vein may continue unchanged in size for some distance beyond the paying ground, but be too poor to be worked, or be absolutely free of gold. The length of a vein does not therefore determine its value; it is the length and thickness of the ore-chute which are of the greatest consequence. Several chutes often occur in succession, separated by barren vein-stuff. Such chutes generally maintain an approximate parallelism in depth. They are rarely exactly vertical, being generally inclined upon the plane of the vein, partaking in inclination not only of the dip of the vein in the rocks, but having an independent inclination or "pitch" upon that dip.

The origin of these chutes of "pay quartz" is explained on the theory of the ascent, along certain channels, of the thermal waters or vapors by which the gold was deposited as soot is deposited in a chimney. Such a distribution of the precious metal of necessity affects the position and extent of the operations for mining it. The shafts and levels must be located with reference to the extent and pitch of the chutes as well as the dip of the vein. Mining upon gold bearing veins does not differ materially from mining on veins of ores of the ordinary metals. The same kind of machinery for drilling, hoisting, pumping, and tramming is brought into use. The great value of the metal, compared with its bulk, often permits extremely narrow veins to be followed with profit, although necessitating the excavation of a large amount of wall-rock on one side or the other. On the other hand, in some large veins only one side of the veinstone contains gold enough to pay for extraction. In general, it is difficult or impossible to determine the value of the quartz by mere inspection, and it is therefore not safe to select the paying portions too closely. The extraction of gold from the quartz veinstone is in the main a mechanical operation, but requires great special skill, and the details of the work vary with the condition in which the gold occurs, whether in coarse or fine grains, in thick or thin particles, or whether associated with much or little heavy pyrites or other minerals. The bulk or weight in all cases is extremely small compared with the veinstone. The pyritous minerals associated with it, generally known as "sulphurets," rarely exceed 5 per cent. of the mass; the gold is but a fraction of this amount. An ounce to a ton, equivalent to .0034 per cent., is a large yield. If it were not for the high gravity of gold compared with quartz, about as 16.5 to 2.5, satisfactory mechanical separation would be impossible. The operation consists in crushing the quartz to a fine powder, so as to detach every particle of gold, and in washing away the quartz with water, leaving the gold behind. Quicksilver is used to aid in arresting the fine particles of gold by uniting them in an amalgam. The crushing to powder is effected in stamp-mills (see Stamp Batteries), the large masses being first broken up in a rock breaker, so that no mass larger than the fist is thrown under the stamps. Quicksilver is used either in the battery mortars, or only outside in riffles or on amalgamated metal plates which present a broad surface, over which all the gold coming from the batteries must pass. A great advantage in using quicksilver in the mortars is the immediate amalgamation of the coarse particles of gold when broken out from the quartz, thus removing them from the action of the stamps and preventing their being further reduced in size. Amalgamated copper plates placed inside the mortars serve to catch and retain the amalgam, which accumulates to a thickness of half an inch or more. In cleaning up, such amalgam has to be removed by chisels; it is dissolved or softened in quicksilver to separate all impurities. The excess of quicksilver is then removed by straining through a cloth or buckskin, leaving balls of pasty amalgam. The residue of the quicksilver is expelled by heating the amalgam in an iron retort, from which the gold is taken in a spongy, cavernous condition, known as "retorted gold." It is then fused and cast into ingots.

The sulphurets, which enclose more or less gold, are usually saved by concentrating machinery or by thick woollen blankets with a long hairy nap made expressly for the purpose. The battery sand in passing over such a surface deposits the greater part of the sulphurets, which are removed from the blankets by rinsing in water at short intervals. Such concentrated sand is usually worked by the chlorination process, which consists in dissolving out the gold by chlorine after a preliminary roasting to remove all of the sulphur, arsenic, etc. The value of sulphurets varies with the richness of the ore and at different mines. It ranges ordinarily between $50 and $250 per ton. The average value during the year 1873 at the Eureka mine, Grass Valley, Cal., was $80.57 per ton. This is one of the most noted and typical gold-mines of California, and a few facts regarding it and other prominent mines will fairly illustrate vein gold-mining generally. The thickness of the Eureka quartz-vein is about 4 feet, and the length of the pay-chute about 1000 feet. The main shaft has been sunk to a depth of 1250 feet. There are eight levels, with an aggregate length of 9000 feet. From Oct. 1, 1865, to Sept. 30, 1874, gold bullion valued at $4,273,148 was taken out, and an aggregate of $2,054,000 was paid in dividends. The quartz in the bottom levels is not as rich as it was above, and explorations in search of better ore are in progress. The cost of sinking in exploring is $65 per foot; of drifting, $25; and of stoping, about $10.50 per ton of quartz. Quantity extracted, 8130 tons; average yield of gold, $25; percentage of sulphurets, 1.5. The cost of milling the ore is $2.61 per ton. In 1873 it averaged $2.70. The Idaho mine is another good example of a first-class mine. It adjoins the Eureka, but is not worked to so great a depth. In five years fifty-three dividends, aggregating $1,284,950, were paid. In 1873, 27,624¾ tons of ore were worked, and averaged $37.91½ per ton. The average cost of mining and milling is $8.61⅓ per ton. At the Empire mine, worked to a depth of 1250 feet, 11,000 tons were extracted in 1874 from a vein averaging only 15 inches in thickness. The cost of extraction is stated at $8, and of milling $1.75 per ton; average yield, $16.75; percentage of sulphurets, 2½. With the exception of the last-mentioned mine the yield is above the average in gold-mines. Some of the most profitable mines pay much less per ton. At the Sierra Buttes, in Sierra co., Cal., the average value per ton of 40,035 tons worked in 1873 was $9; cost of mining, $3.60; and of milling, only 80 cents. Favorable conditions for mining, and the use of water-power instead of steam, make a great difference in the expense of working a mine and extracting the gold. At the Benton mills, run by water, on the Merced River, Mariposas estate, quartz can be crushed and stamped for less than 60 cents a ton, and the total cost of milling is about $1. At Hayward's Eureka mine, in Amador co., worked to a depth of nearly 1700 feet (1874), 22,465 tons were worked in 1873, and yielded an average of $17.91 per ton. The vein in some places was found to be not less than 55 feet thick, and in others only 8 feet and 4 feet. Some portions are quite barren. The cost of extraction averaged $2.50 per ton for the higher levels. The famous Princeton mine on the Mariposas estate yielded from $13 to $25 per ton at different times, the average, generally, being about $16. In the year 1872 there were over 311 gold quartz-mills in California, crushing about 575,000 tons of quartz annually.

Gold-bearing veins are often found by tracing the placer gold up the valleys to the side of the vein. When rough and ragged masses of gold are found in placers, it is good evidence that they have not been transported far from the original source. There are frequent examples of detrital deposits being barren of gold above certain veins, and rich in gold below them. Quartz veins which appear to be perfectly barren sometimes seem to have been the source from which large stream-deposits of the metal have been supplied. In seeking an explanation, the unequal distribution of gold in the mass of the veinstone is to be considered, as well as the enormous amount of erosion which most veins have undergone. The wearing away and natural mining by rivers and floods through long ages of time far exceed in extent any human efforts. Valleys in California transverse to the direction of gold-bearing veins are from 1000 to 3000 feet deep, and all of the gold which existed in the veins eroded to that depth is collected in the detrital deposit of the valley below. Nature has performed on a gigantic scale the very operations required to obtain the gold from veins. The quartz is mined, crushed, and the gold is rudely separated and concentrated on the bed-rock of rivers and alluvial deposits. Placer mining may thus be considered a *collective* operation, and it affords a more rapid and abundant harvest of gold for a short time than can be expected from veins. The rivers and brooks of a gold-region are in fact natural sluices, in which the gold broken from the vein is gradually concentrated; but the distribution of the metal in such valleys is extremely irregular, depending upon the supply, the nature of the current and of the bed-rock. As a general rule, where the bed of a stream is hard and the current is swift the bed-rock is swept clean, and no gold remains, except perhaps in deep holes and crevices, where it accumulates out of reach of the force of the water. In the process of ages streams cut their channels to greater depths, and the drain

age of the country changes; valleys are drained and terrace-like deposits are left upon the hills. These deposits are generally rich in gold, and are more accessible to the miner than the beds of rivers. Placer mining is thus conducted not only in the beds of existing but of ancient streams. Such stream-deposits have been traced for long distances, apparently across the existing drainage of the mountain-region of California, and have been mined with great profit. The gravel in many places, being deeply buried and excluded from the air, has a bluish color, due to the presence of protoxide of iron, contrasting strongly with the ordinary deposits. This blue gravel, wherever found in the higher parts of the gold-region, is generally regarded as the deposit of one great river which formerly flowed in a south-easterly direction. It is known as the "blue lead." But there may have been, and probably were, several ancient streams, each leaving deposits having a general similarity.

There are other classes of deposits than those mentioned. Some appear to have been formed in lakes, inasmuch as the coarser materials at the bottom carrying the gold are overlaid by horizontal beds of clay and sand hundreds of feet in thickness. Other extensive deposits of enormous boulders seem to have resulted from ice-action, and may be the medial or terminal moraines of ancient glaciers. This variety in the conditions of occurrence necessitates a variety of methods for securing the precious metal.

In placer gold-washing, as in collecting the gold from crushed quartz, the separation from earthy substances is effected by a current of water flowing over inclined surfaces. The materials presenting the greatest surface and having the least gravity are swept forwards most rapidly, while the heavier and smaller objects are left behind at or near the upper part of the incline. All apparatus and methods are based upon this principle; the difference is in degree, not in kind. Formerly, nearly all auriferous earth and gravel was washed by throwing it into "rockers" or "long toms," so called, which were essentially inclined troughs made of boards and set at such an angle that the current of water flowing through would be strong enough to sweep away the earth and gravel and leave the gold. A coarsely perforated plate or grating at the lower end allowed the water and gold to fall through into a box provided with riffles and charged with quicksilver. The coarse gravel was removed by shovelling. Such apparatus, with the pick and shovel and a pan, is sufficient for operations on a small scale in ordinary alluvial deposits, where the upper and barren layers of sand and gravel are shovelled off, and only the comparatively small amount of pay gravel at the bottom is washed. For such operations only one or two men are necessary, and but little or no capital, but for the more extensive deposits hundreds of feet below the surface, and overlaid, perhaps, by thick outflows of basaltic lava, extensive mining operations requiring combined effort and large capital are necessary. The great bulk of the gold of California and Australia is now obtained from the deep placers worked by associated capital on a stupendous scale. A large portion of the richest gravel deposits are found in trough-like channels or basin-shaped depressions with a rocky rim, which must be pierced to reach the paying substratum and to afford the requisite drainage for successful working. This piercing is effected by running a tunnel from some adjoining valley, so as to reach the lowest depression of the deposit and give an outlet for the flood of water used in washing. The grade or "fall" must be such as to convey away the earth, gravel, and boulders, and there must be room enough at the final outlet for the accumulation of tailings. In some cases the pay gravel on the bed-rock is removed by mining, in the same manner as a coal-bed is taken out, and is washed in sluices outside of the mine; but the most economical and expeditious method of excavation, when water can be had under pressure, is what is known as "hydraulic mining." This is a process which originated in California in 1852, and has since been greatly improved. Water is conveyed in ditches for many miles to the hills above the deposits, and is carried down in iron pipes and delivered in large streams, under a pressure of from 100 to 300 or even 500 feet of height of column, against the base of the gravel deposit to be washed. The end of the pipe is furnished with a nozzle from 5 to 8 inches in diameter. A 6-inch nozzle, under a pressure of 275 to 300 feet of column, will deliver 1579 cubic feet of water in one minute with a velocity of 140 feet per second. This mass of water striking in a solid column against the base of a bank of gravel excavates it with great rapidity. Boulders weighing hundreds of pounds are tossed right and left. The upper portion of the bank is soon undermined, and caves in. This brings down huge masses of the overlying deposits, which, under the continuous force of the jet, are in their turn broken up and carried off in the currents of water flowing in sluiceways converging to the tunnel leading through the rim-rock. When the gravel-bank is so hard that it will not yield readily to the force of the jet, it is broken up or loosened by blasting. From 100 to 600 kegs of powder are used at a time, and as much as 2000 kegs in one instance.

The iron used for the pipes varies in thickness from No. 16 to No. 11, and the diameter of the pipes ranges from 22 inches to 30 inches. Specially-constructed nozzles, with goose-necks or universal joints, and moved by levers and strong tackle, are requisite to control the jets. They are usually placed at a distance of 200 feet from the bank. Danger from caving usually prevents a nearer approach. The grade or "fall" should be about 6 inches in 12 feet. Sluice-boxes are laid in the tunnel, and are from 4 to 6 feet in breadth, and 36 to 40 inches high. These are paved with hard flat stones set on edge, so as to catch the gold and to prevent the wear of the bottom by the rapidly-moving gravel and boulders. Blocks of wood, set with narrow spaces between them, are also used. At the lower end of the sluice iron gratings are so arranged as to separate the large boulders from the gravel and water. Large derricks are required at the upper end for moving the heavier rocks which cannot be washed down the sluice. An invention known as the "under-current sluice" is largely used to withdraw the finer portions of the gravel with the gold from the main current, and spread them over a broader and less inclined surface, so that they move in a shallower current. These conditions are more favorable to the deposition of the gold than a deep and rapidly flowing stream, such as the coarse materials require.

The operation of hydraulic washing is a continuous one, and requires very little manual labor compared with the amount of material disintegrated and moved. The washing continues for months, and no gold is seen until the cleaning-up, which in one of the large sluices is an operation of considerable magnitude. Some of the bed-rock tunnels are thousands of feet in length, and require several years for their completion. The works of the North Bloomfield Co., in Nevada co., Cal., may be cited as an example. Ditches and reservoirs for the water-supply have been constructed at an expense of over $1,250,000, and with an aggregate length of more than 100 miles. The pay channel is supposed to be half a mile in width, and to reach and work it a tunnel nearly 8000 feet is required. This tunnel is for part of the distance 6 by 6½ feet, and for the remainder 8 feet by 8 feet. Nozzles 8 inches in diameter will be used, delivering a stream of water of that size under a pressure of 500 feet. It is estimated that there is material enough to furnish work in this way for many years. W. P. BLAKE.

Gold of Pleasure, or **False Flax**, the *Camelina sativa*, an annual herb of the order Cruciferæ. It grows in Europe and Asia, and has been sparingly naturalized in the U. S., where it is a worthless weed. But in some parts of Europe it is cultivated for the oil obtained from its seed. This oil is of rather poor quality. The oil-cake is acrid, and not much relished by cattle. The green plant is sometimes ploughed in for manure. It has the advantage of growing well and rapidly on sandy land.

Goldo'ni (CARLO), father of the modern Italian comedy, was b. at Venice in 1707. From his father and grandfather he inherited a strong passion for theatricals, but as he was unfit for the stage, he studied law, and he had even commenced practising as a lawyer in his native city when the success of a play he wrote for a troop of strolling actors induced him to give up his business and become a playwriter. In 1761 he went to Paris to write for the Italian theatre in that city. He was appointed teacher in the Italian language to the three daughters of Louis XV., and received a pension of 4000 francs yearly, which was taken from him at the outbreak of the Revolution, but restored to him by the efforts of André Chenier. He d. in 1795. He wrote about 200 comedies, of which a few—for instance, *Le Bourru Bienfaisant*, as well as his *Mémoires pour servir à l'Histoire de sa vie et à celle de son Théâtre*—are written in French; the rest are written in Italian, often in the Venetian dialect, which makes them difficult to enjoy, at least to foreigners; but the liveliness, gracefulness, and wit of his dialogue, especially in pieces picturing low life in his native city, are still highly appreciated by his countrymen, and his influence on the history of the Italian theatre was very great. From his time the *commedia dell' arte* disappeared from the stage. In his earlier plays—for instance, in *The Servant of Two Masters*—he still employed the stock characters, the so-called masks of *commedia dell' arte*, Harlequin, Pierrot, Pantaleon, etc., and the interest of the play centred in the comicality of the situations. But the improvisation ceased, the dialogue was written out in full, and the clown became an artist. In his later plays—for instance, in *A Curious Accident*—he discarded even the masks; and as his observation of human character

such as reveals itself in every day life, was as acute and lively as his power of representing it in dialogues was brilliant and charming, the transformation from the *commedia dell' arte* to the present form of modern comedy was happily achieved. In Italy his plays are still given very often, and enjoyed very much, and many of them—as, for instance, the three mentioned in this article—would be seen with great pleasure on any stage. CLEMENS PETERSEN.

Gold-purple, known as the precipitate of Cassius, was described by Andreas Cassius and his son in 1685. It is used chiefly for giving a pink or violet color to glass and enamels. It is formed by adding a dilute mixture of protochloride and perchloride of tin, drop by drop, to a dilute neutral solution of the chloride of gold; a purple precipitate is formed. Its separation from the liquid is promoted by adding a little salt and boiling it. W. P. BLAKE.

Golds'berry, post-tp. of Howell co., Mo. Pop. 349.

Golds'boro', post-v. and tp., cap. of Wayne co., N. C., on the great southern thoroughfare of travel, 142 miles S. of Petersburg, Va., at the junction of the Central R. R., leading from the sea-coast through the mountains of North Carolina westward. It has 2 newspapers, 5 churches for white and 2 for colored, a large female college, a bank, a free school, a fine hotel, and several manufacturing enterprises. Its railways make it a very important town. Agriculture is its chief support. Pop. of v. 1131; of tp. 3886.
JULIUS A. BONITZ, ED. "CAROLINA MESSENGER."

Golds'borough, borough of York co., Pa., on the Northern Central R. R., 16 miles N. of York, on the W. bank of the Susquehanna. Pop. 310.

Goldsborough (LOUIS M.), U. S. N., b. Feb. 18, 1805, in Washington, D. C.; entered the navy as a midshipman June 18, 1812; became a lieutenant in 1825, a commander in 1841, a captain in 1855, a rear admiral in 1862; retired in 1873. In 1827, while serving in the Mediterranean on board the schooner Porpoise, Lieut. Goldsborough was given the command of the boats of that vessel with orders to rescue an English brig called the Comet, captured by Greek pirates at night in the Doro Passage, while one of a convoy in charge of the Porpoise. The pirates numbered 200, while Goldsborough's little band, all told, did not exceed 40; yet, notwithstanding this disparity of force, the Comet was boarded without hesitation, many of the pirates slain, and the rest forced to take to their boats, and the English restored to liberty. This gallant affair was particularly mentioned by the Liverpool *Advertiser* as reflecting great credit upon Goldsborough and the American navy. After long years of faithful service this experienced officer had risen to the rank of captain when the government conferred upon him the command of the North Atlantic blockading squadron. This was in Sept., 1861, and he had hardly hoisted his flag as commander-in-chief when from a report sent to him by Lieut.-Com. (now Capt.) W. N. Jeffers, commanding a gunboat off Hatteras Inlet, he inferred that possession of the sounds of North Carolina might be obtained by a joint army and navy expedition, the objective point to be the stronghold of Roanoke Island. His views being approved by the navy department, he was summoned to Washington to hold a conference with Gen. McClellan, Assistant Secretary of the Navy, Fox, and the superintendent of the Coast Survey, Prof. A. D. Bache, as to the best means of carrying them into execution. The parties met one night just after dark at Goldsborough's house on K street, and remained together until midnight, by which time every point involved had been thoroughly canvassed and discussed, and it was agreed that Gen. Burnside's division, then unemployed, should be detailed to cooperate with the naval force under the command of the acting rear-admiral. When the combined forces were almost ready to start another meeting took place at night at the quarters of Gen. McClellan, the President, the secretary of state, the acting secretary of war, Gens. McClellan and Burnside, Mr. Fox, and the acting rear-admiral being present. Here the whole subject was again entertained and most carefully examined, and the conclusion arrived at was that success was certain to attend the Union arms. Goldsborough was closely questioned by Mr. Lincoln and Mr. Seward, but having well studied the whole matter, he answered all questions without difficulty, and confidently expressed the opinion that the end in view would be accomplished. The event justified his most sanguine anticipations, for it was not long afterward when the "Burnside expedition," as it was popularly styled, was in possession of not only Roanoke Island and the sounds, but of many important positions in North Carolina. Goldsborough was now made a full rear-admiral, and received the thanks of Congress, and at the close of the civil war was complimented by the navy department with the command of the European squadron. Up to his retirement in 1873 no officer in the navy had had a more varied experience of naval life than the rear-admiral; and he was universally regarded as a man of the highest intelligence and attainments, and an undoubted authority on all matters relating to the naval profession. D. Feb. 20, 1877. FOXHALL A. PARKER.

Gold'schmidt (HERMANN), b. of Jewish stock at Frankfort, Germany, June 17, 1802; studied painting under Cornelius, and practised that art with some success at Paris 1836–47; then devoted himself to astronomy, and discovered (1852–61) fourteen asteroids; the names and dates of discovery of these are given in the art. ASTEROIDS in this work. He also detected thousands of stars not given on the best atlases before his time, and announced the discovery of several new companion stars revolving around Sirius. D. at Fontainebleau Sept. 11, 1866.

Goldschmidt (JENNY **Lind**), b. at Stockholm, Sweden, Oct. 6, 1821; displayed in very early life a fine talent for singing, and even went upon the stage when ten years old, to the delight of all Stockholm; but her voice failing to some extent, she was withdrawn from the stage for three or four years, when, having taken some inferior part in an opera during the absence of one of the company, it was found that her voice had more than regained its former power and sweetness. She was for some years after a favorite singer, not heard of out of Sweden until in 1841 she became a pupil of Garcia in Paris. She soon became well known throughout Europe. She appeared in Berlin in 1844, in London in 1847, and in New York in 1850; married Mr. Otto Goldschmidt in 1851; returned to Europe in 1852, having won all hearts, not only by the sweetness of her voice and the great versatility of her dramatic powers, but also by the simplicity and excellence of her character. She has long been distinguished by liberal benefactions to the poor classes. Since her marriage she has seldom appeared as a singer, and then only for charitable purposes. She resides principally in London.

Goldschmidt (MEYER AARON), an eminent Danish novelist, was b. at Vordingborg, a small town of the island of Seeland, in 1819. He received a careful education, and studied at the University of Copenhagen. In 1840 he founded a weekly journal, *The Corsair*, which made a great sensation in sedate and somewhat old-fashioned Copenhagen by its brilliant wit and audacious satire. In 1848 he founded another weekly paper, *North and South*, which was well patronized on account of the criticism, generally sound and always fine and elegant, which it exercised both in the literary and the social and political fields. But, although a very able and successful journalist, it was as a novelist that M. A. Goldschmidt became dear to his countrymen. Danish life—how in its smallness and quietness it receives and develops in its own manner the greatest historical impulses—he describes with truth and exquisite fineness. His style has sparkling wit and considerable pathetic power, but its highest excellence is its wonderful simplicity, as fit for the description of nature and character as for the expression of sentiment and ideas. What Goldschmidt's eyes see is generally seen with love, and what his lips tell is always told with grace. Some of his novels are well known to English readers—*A Jew*, *The Homeless One*, *The Heir*, and *The Raven*.
CLEMENS PETERSEN.

Gold'smith (OLIVER), M. B., b. at Pallas, co. Longford, Ireland, Nov. 10, 1728, the son of a poor Anglican minister; graduated A. B. at Trinity College, Dublin, after five years as a sizar, during which he was subject to most humiliating indignities and much distress, partly the result of his own characteristic improvidence. A rejected applicant for holy orders, he tried the study of law, but having wasted his scanty means in gaming, he 1752–53 spent eighteen months as a medical student in Edinburgh, out of which town he was hunted by creditors; lived abroad 1754–56, chiefly at Leyden, and afterwards wandered over a large part of France, Germany, and Italy, taking his medical degree at Padua, and supporting himself by his musical talents, which entertained the kind peasants, and by the gratuities given by the universities to wandering students. In 1756 he went to London, where, after some years of hard experience as a chemist's assistant and practitioner of medicine, he became a proof-reader for the novelist Richardson. Still later, as usher in a school and as hack-writer for various journals, he earned a scanty living. His *Inquiry into the Present State of Polite Literature in Europe* (1759) was chiefly important as leading to opportunities for better work. The admirable *Citizen of the World* (1760) won him the friendship of Johnson and a membership in the Literary Club. The *Life of Beau Nash* was followed by the *History of England* (1764; revised ed. 1771), a work still read, too, though not of high critical value, its style is delightful. *The Traveller* (1764) established his place as a poet. *The Vicar of Wakefield* (1766), his only novel, is one of the choicest treasures of literature.

The Good natured Man (a comedy, 1767), *Roman History* (1768), *The Deserted Village* (1770), his best poem, *She Stoops to Conquer* (1773), his best comedy, were followed by the *Grecian History* (1774), one of the least meritorious of his works, though long highly popular. The rest of his quite numerous works we need not enumerate. The highest and emptiest of the honors received by Goldsmith (1770) was the professorship of ancient history in the Royal Academy, which brought him no pay. The unfinished *Animated Nature* (1774) was his last undertaking, a well-written and pleasing work, but one without any scientific value. Goldsmith d. at London Apr. 4, 1774. His last days were rendered miserable by the pressure of debt, incurred partly at the gaming-table, partly by his thoughtless improvidence, and in no small degree by his liberal benefactions to the poor; for this awkward man, ugly in features, ludicrously uncouth in manners, so self-conscious and so sensitive that he could hardly talk for fear of being ridiculous, was nevertheless the kindest and most affectionate of men, and his death was as truly lamented by the poor and unlettered as by those who knew and appreciated the charms of his books. For style, his writings take place in the first rank, and their gentle humor and the indescribable charm of his genius win the heart of every reader. His own character was not without serious moral defects, but there was in him much more to love and respect than to condemn. Forster's *Life of Goldsmith* is the best, but that of Irving is good and appreciative. C. W. GREENE.

Gold Stick, a title given to colonels of the British Life Guards, and to the captain of the Gentlemen-at-arms, so called from the gilded bâtons which they carry on state occasions. (See SILVER STICK.)

Gold'thwaite (GEORGE), b. at Boston, Mass., Dec. 10, 1809; removed to Alabama at an early age, where he studied and practised law; was judge of circuit court and of supreme court, and of the latter chief-justice for several years; adjutant-general of Alabama during the civil war; elected to the U. S. Senate Dec. 7, 1870. D. Mar. 16, 1879.

Goldthwaite (HENRY), b. in Boston, Mass., was liberally educated, and became a law-partner of Gov. Fitzpatrick at Montgomery, Ala., a journalist, and a State legislator; became soon after the acknowledged leader of the Mobile bar. He was for some eight years a judge of the supreme court of Alabama. D. in 1847.

Golf [Dutch, *kolf*, a "club"], a game of skill played chiefly in Scotland. It is played upon a piece of grassy ground (called a *link*). Upon this a ball is driven by blows of a club through a "round" or succession of holes arranged in a circle. The object is to put the ball into each of the holes successively with the smallest possible number of strokes of the golf-club, a heavy curved bat.

Gol'fo Dul'ce, a lake of Central America, in the republic of Costa Rica, is 25 miles long, 10 miles broad, and communicates with the Gulf of Honduras by a small stream. The entrance into the river is impeded by sandbars, but the river itself and the lake are deep, and promise to be a road of commercial importance.

Golgotha. See CALVARY.

Goliad', county in the W. of Texas. Area, 900 square miles. The climate is dry and healthful. Cattle and wool are the principal products. The county is traversed by the San Antonio River. Timber is rather scanty, but building-stone abounds. Cap. Goliad. Pop. 3628.

Goliad, post-v., cap. of Goliad co., Tex., is situated on the San Antonio River opposite La Bahia, where Fannin and his followers were massacred in 1835. It has good schools, several churches, a salubrious climate, rich lands, and plenty of water-power. It is the seat of Aranama College (Presbyterian), and has one weekly newspaper. It is 28 miles from a railroad. PUBLISHERS "GUARD."

Goli'ath Bee'tles, a name given to a group of immense beetles from Western Africa, belonging to the Scarabæidæ, and living in the tops of trees, where they suck the juice of succulent stalks and devour the blossoms. The *Goliathus Goliathus* is considered the largest of all Coleoptera. It is sometimes four inches long. Some of these insects are most gorgeously colored.

Go'lius (JACOBUS), b. in 1596 at The Hague; was educated at Leyden, and was for a time Greek professor of La Rochelle; was attached to the Dutch embassy in Morocco 1622, and in 1624 became professor of Arabic at Leyden; was in the East 1625–29; became professor of mathematics at Leyden 1629; d. there Sept. 28, 1667. Published many translations from the Arabic, and a folio *Lexicon Arabico-Latinum* (1653), and left a MS. Persian dictionary and other works.—His brother PETER, a learned Orientalist, joined the Barefooted Carmelites, went as a missionary to the East, and founded the Carmelite convent of Mt. Sinai.

Göll'nitz, town of Northern Hungary, has important iron and copper mines, and manufactures of nails, wire, and cutlery. Pop. 5200.

Goll'now, town of Prussia, in Pomerania, on the Ihna, has manufactures of ribbons, paper, and tobacco. P. 7273.

Golomyn'ka, the *Comephorus Baikalensis*, a fish of the family Comephoridæ, caught in Lake Baikal for its abundant oil, which is extracted by pressure. It is one foot long, without scales, and is not edible.

Golosh'es [Fr. *galoche*; Sp. *galocha*, a "wooden shoe"], a name applied in Great Britain to overshoes, and especially, at present, to India-rubber or gum-elastic overshoes. (See INDIA-RUBBER, by PROF. C. F. CHANDLER, PH. D., LL.D.)

Golov'nin, or **Golownin** (VASILI or BASIL), b. in the Riazan government, Russia, 1776; became distinguished as a naval officer; was sent in 1807 to survey the shores of Asiatic and American Russia in command of the Diana sloop of war; was engaged in this work until 1811, when, having been driven by lack of food and water to land upon the Japanese island of Kunashir, he was seized and imprisoned (1811–13), but finally set at liberty. He afterwards led an exploring expedition around the world (1817–19), and was promoted to be vice-admiral and general overseer of the navy. D. at St. Petersburg, of cholera, in 1832. His *Observations upon Japan* and *Memoirs of a Captivity in Japan* have been translated into most modern languages, and were long the most valuable sources of knowledge regarding that country. He also wrote *A Voyage Round the World* (in Russian, 1822), and a book giving accounts of remarkable shipwrecks, etc.

Go'marists, or **Contra-Remonstrants,** the followers of Francis Gomar (1563–1641), a former ultra-Calvinistic party in the Dutch national Church, distinguished by their opposition to the Remonstrants or Arminian party, whose expulsion their leader secured at the Synod of Dort. (See DORT, SYNOD OF.)

Gombroon', or **Ben'der Abbas',** town on the Persian coast, at the Strait of Ormuz, belonging to the imamat of Muscat, in Arabia. On the island of Ormuz existed a flourishing town of the same name, established by the Portuguese. In 1622 the Persian Shah Abbas and the English disturbed this town, thereby transferring its commerce to Gombroon on the opposite shore. Gombroon rose immediately, and is said to have had 30,000 inhabitants. But under Persian rule it soon lost its commerce; the Europeans went away, the factories fell into decay, and the place is now insignificant.

Go'mer, tp. of Caldwell co., Mo. Pop. 558.

Gom'era, one of the Canaries, 12 miles long, 9 miles broad, and with a pop. of 11,742. It has two towns—St. Sebastian and Villa Hermosa.

Gomm (Field Marshal Sir WILLIAM MAYNARD), G. C. B., D. C. L., b. about 1782; entered the English army as ensign in 1794; served in Holland in 1799; in the Peninsula; at the battle of Waterloo was quartermaster-general of a division. At the close of the latter campaign for distinguished services he was made a K. C. B., transferred from the line to the Guards, and commanded the troops in Jamaica. In 1842 he was appointed governor and commander-in-chief of Mauritius, which post he held till 1851, when he succeeded Sir Charles Napier as commander-in-chief of India. In 1859 he was made a G. C. B., and in 1868 was created a field marshal. He held the coloneley of the Coldstream Guards, and in 1872 he succeeded Field-Marshal Sir G. Pollock as constable of the Tower of London, a post of honor reserved for distinguished veteran soldiers. D. Mar. 15, 1875.

Gomu'ti Palm, the *Saguerus saccharifer*, a very valuable palm tree of Anam and the Malay Islands. It produces sago, palm wine, palm cabbage, sugar, *baru* (a substance used in caulking ships), and especially a large amount of COIR (which see), more durable than that of the cocoanut, but less flexible and not so good for the manufacture of running rigging for ships. Cables of the gomuti coir are very strong indeed, but rough and stiff, so that sailors dislike to handle them.

Gonaives, or **Les Gonaives,** town of Hayti, on the bay of the same name. It has an excellent harbor and a good trade. Pop. 4000.

Gon'dar (properly *Guendar*), city of Abyssinia, is situated in lat. 12° 35′ N. and lon. 37° 31′ 57″ E., on the ridge and slope of a southern spur of the Wogara Mountains, at an elevation of about 7000 feet above the sea and 1200 feet above Lake Tsana. In the beginning of the seventeenth century, under the government of the negus Fasilidas, whose name as king was Aslem-Seged, Gondar was made the capital, and is said to have had 50,000 inhabitants, while in the period between 1852 and 1862 Th. von Heuglin estimates its population at 6000 or 7000 only.

It consists of several extensive quarters, separated from each other by barren commons and mounds of rubbish, but at a distance it presents from all sides an imposing and wonderful aspect, with its picturesque groups of trees, its churches with their high conical roofs, and its royal palace, built, according to the Portuguese taste of the Middle Ages, with high walls, pinnacles, and towers. Limpid mountain-streams flow down the slopes. The northernmost quarter of the city, called Abun-Bed, contains the residence of the patriarch (*abuna*), and is separated by a brook flowing westward from the politically free state, Etsege-Bed, where the higher clergy and the religious orders live. A church, called by Rüppell, Telout, and containing two bells, which the Dutch presented to the negus Adjams Seged, stands to the E. of both these quarters on an elevated place. The quarter of Debra Birhan (the "church of the light"), with a church of the same name, extends to the S. and E.; and that of Gempsa Bed (the palace quarter) meets Etsege-Bed to the N. W. and Debra Birhan to the E. Here the royal palace, Gemp, arises among miserable huts thatched with straw, a high, towering castle, encircled with walls surmounted by towers and pinnacles. The main building is quadrangular, two stories high, with flat roof and stone ramparts. A tower with a cupola arises at each corner, and in the centre of the western façade another still higher, with tall pinnacles instead of the cupola. Several halls, galleries, chapels, bridges, and kiosks are connected with the main building. The material employed is chiefly basalt, with frames for windows and doors of red sandstone, and those parts of the main building in which these materials are used are in good repair, while the rest is generally crumbling and overrun with briers. A small citadel with tower and flat, crenellated roof, called Michael Gemp, lies to the N. W. of Gemp. At some distance, and to the S. W. of Gempsa-Bed, the large market-place is situated; on the slope to the S. the Mohammedan quarter, Islam-Bed; and directly S. W. the Jewish suburb, Felasa Bed. The streets are narrow and crooked, partly paved with basalt, but partly covered with dirt and rubbish. The finer dwellings are low circular houses of two stories, built of unhewn stones, cemented with lime. The widely projecting, conical roof rests on a wooden framework, and consists of thatch covered with a thick layer of long grass. The lower story is not inhabited, but serves as store-room; the upper story is entered by a flight of stairs on the outside. Except the bed, some drinking horns, and wooden pegs on which to hang arms and saddles, no furniture is found in the interior. Leopards, hyænas, foxes, genets, and ichneumons appear not unfrequently in the city. At some distance several other interesting buildings are situated, as, for instance, the church Fasilidas, a small temple with a cupola and a frieze, erected in the midst of a beautiful park, and a Portuguese church. Gondar contains 44 churches, with 1200 ecclesiastics. AUGUST NIEMANN.

Gon'dola [diminutive of It. *gonda*, a kind of boat], a boat about 30 feet long and 4 feet wide, used on the canals of Venice and in other parts of Italy. The Venetian gondolas have pointed ends, which rise out of the water. The gondola is propelled by from one to four rowers, who stand at their oars. In parts of the U. S. flat boats used for heavy merchandise are called gondolas (vulgarly pronounced *gundelos*).

Gonds (*Gónd*), a non Aryan or Dravidian race of Central India, whose name is seen in Gundwana, the principal district where they dwell. They are small, strong, hardy, and brave, totally distinct from the Hindoos in language, religion, and habits; have no caste, except so far as they have adopted Hindoo customs, for the Raj-Gonds are partly of Rajpoot descent, and have some elements of Hindoo civilization, and some Gonds have attached themselves as pariahs to Hindoo society. The name appears to be identical with that of the Khonds, a Dravidian people of Orissa. The Gonds number 1,151,578.

Gon'falon, or **Gon'fanon** [It. *gonfalone*, *gonfanone*], in mediæval Italy the banner or standard of a city, a monastery, or a church. The bearer of this, and in some cases the chief magistrate of a town, was called a gonfalonier.

Gong [Javanese], an East Indian and Chinese instrument, a sort of cymbal, which emits a loud sound on percussion. A bronze with 78 parts of copper and 22 of tin (*Klapmetal*) is a common material for gongs. It is stated that gongs are at first brittle, and have to be annealed and then hardened before use. A leather-covered wooden mallet is used for striking the gong.

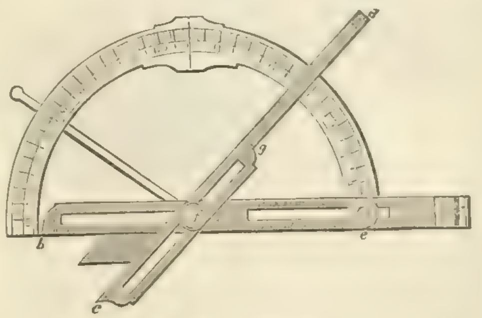
Goniati'tes [Gr. γωνία, an "angle"], a genus of fossil cephalopods of the family Ammonitidæ. Some 150 species are described from Palæozoic strata.

Gon'ic, post-v. of Strafford co., N. H. It is in Rochester township, on the Dover and Winnipiseogee R. R., 8 miles N. W. of Dover, and has a national bank.

Gonid'ia [pl., from the Gr. γονή, "generation," and εἶδος, "appearance"], in some of the cryptogamous plants a cell-mass which serves to reproduce the plant, not, like the true spores, as the consequence of a generative act, but, it is believed, by a process analogous to the budding of the higher plants, or the gemmiparous reproduction of many of the lower animals. The term is somewhat vaguely applied to bodies of this supposed character.

Goniom'eter [from the Gr. γωνία, an "angle," and μέτρον, a "measure"] was originally the instrument for measuring angles. Its use is now almost entirely restricted to those instruments used in measuring the angles of crystals. Goniometers are divided into two classes—goniometers of application and goniometers of reflection. The first consist of two strips of steel, which can be applied to the faces of the crystal. The second are constructed so as to make use of the reflection of an image seen successively in different faces of a crystal. The first application goniometer was invented by Caringeau in 1783. It was the one used by Haüy in his researches, and afterwards received the name of "Haüy's goniometer." It is founded upon the principle that if any two straight lines cut one another, the opposite angles are equal. This instrument (Fig. 1), as Caringeau

FIG. 1.



Caringeau's Goniometer.

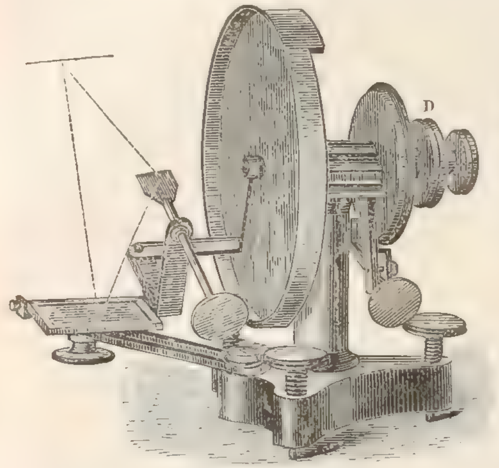
constructed it, is composed of a semicircle hinged at 90°, to which two arms of steel are attached, which are applied directly to the angle to be measured. One of these has no movement of rotation, but moves horizontally on the pins *e* and *f*, its upper edge always remaining at zero. The other is movable on the pin *f*, and can be made to assume any angle with the horizontal arm. One of its edges is bevelled to facilitate reading the angle. The arms can be lengthened or shortened at will. The operation of measurement consists in applying one end of the arms to the faces of the crystal, and reading the angle shown on the circle by the other. When the crystal is engaged in a gangue, and the extremity of the semicircle prevents the application of the arms, it can be turned back on its hinge. The instrument so arranged is heavy, and requires great skill in use. For this reason Brongniart proposed to have the arms detached from the semicircle, so that they can be applied independently of the circle, and the instrument so constructed is called "Brongniart's goniometer," and is the modification in general use. This goniometer gives rapidly an approximation to the real angle when it is necessary to determine it within half a degree. The defect of such an instrument is, that it is impossible to verify whether it has been well adjusted. It requires great skill to place the plane of the arms perpendicular to the surface of the crystal, and the edge parallel to it. Sometimes the nature of the crystal prevents it, as when the faces are rough or are unequally laminated. Generally, the crystals to be measured are quite small, and the surfaces too small to obtain an exact measurement of the angle, so that any imperfection of manipulation is necessarily magnified. In most cases approximate measurements are sufficient both to recognize the nature of the mineral and to describe it. But when its physical properties are to be studied, these values are not sufficiently exact, and a reflecting goniometer must be used.

The idea of using the reflecting property of the faces for measuring angles was first suggested by Malus, but Dr. Wollaston first applied it. His goniometer was first called the reflecting goniometer, but afterwards, when several based upon the same principle had been invented, "Wollaston's goniometer." It gives measurements within a few minutes; its use is quite as easy as that of the application goniometer, and the errors which a skilled person may commit are very much less. But it is necessary to its applicability that the faces of the crystal should be brilliant, and when that is the case their small size is no obstacle, as crystals can be measured which are only a millimètre square. An angle is measured with these in-

struments by causing the crystal to rotate around the edge of the angle, from a given position of one of the faces, until the other has taken the same position; which position is determined by the coincidence of images observed in each of the two faces successively, the eye remaining fixed. The value of the rotation is measured upon a graduated circle placed perpendicularly to the edge of the crystal, which gives the complement of its angle.

Wollaston's goniometer (Fig. 2) is the simplest, and for

FIG. 2.

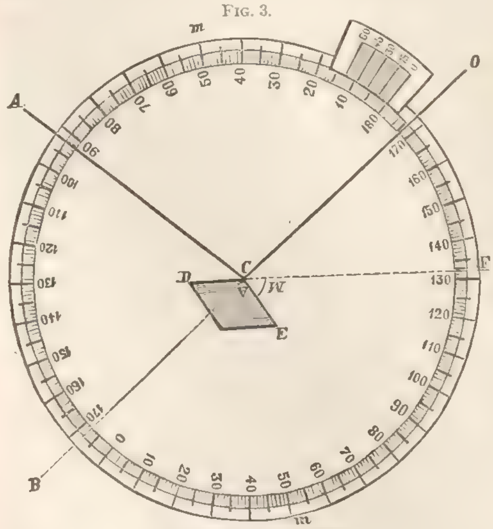


Wollaston's Goniometer.

many reasons the best. It will give within a minute the inclination of planes which are almost invisible. It is composed of a vertical graduated circle, divided upon its edge to half degrees. Through its centre two arms are arranged, supported in a fixed upright. One of them carries the circle, and is made to turn both the circle and crystal-holder. This arm is hollow, and carries in its interior another arm, which moves independently of the circle, and upon which the support for the crystal is placed, which consists of two arms with a joint which allows a rotation of 180°. The whole arm has a rotation of 360°. Through one end, at right angles to it, a piece of round steel is passed, which is slit to receive a plate of thin brass, on which the crystal is placed. Attached to the fixed support of the circle is a vernier.

The instrument is placed for use on a table five to six mètres from an open window, so that two horizontal lines A B of some distant building may be seen, or two window-bars, or lines drawn for the purpose. The circle is made vertical. To facilitate adjustment the foot of the instrument is provided with thumb-screws and small glass levels. The crystal is then fixed on its support with wax, so that one of the faces D C (Fig. 3) of the angle D C E, and

FIG. 3.



Wollaston's Goniometer.

their edge, is at right angles to the plane of the circle, and as near as possible in the prolongation of the axis of the instrument. The eye is now brought so near the crystal that the reflection of the lines A and B may be seen, and the image of the upper line is brought, by turning the crystal, to the lower line as seen directly, with which, by proper adjustment, it must be made to coincide. The crystal is then turned until the reflection of the image at A is seen in the second face C E, and a similar adjustment is made with this. The 0 of the circle and vernier are then brought together by turning the large thumb-screw D (Fig. 2); when the circle is at zero the small thumb-screw is turned until the line is seen as before in the first face. The eye remaining fixed, the circle and crystal are turned together until a new coincidence is observed in the second face. The number of degrees and minutes which measure the rotation of the crystal is then read. It is essential that the eye should remain fixed—a condition which is easily fulfilled, since the faces of the crystal are usually very small, and it sometimes happens that they are not distinctly visible, although the reflected line is.

Dr. Kupfer published in Berlin in 1825 a treatise on the theory of Wollaston's goniometer, in which he details the possible causes of error attending its use. He shows that the conditions necessary for exact measurement are—(1) That the crystal must be small, and that its edge must be as near the axis as possible, and parallel to it, and if possible in its prolongation, or at least must have a very small eccentricity. (2) That the reflected lines shall both be as far as possible from the instrument, and at exactly the same distance from the crystal. As this can seldom be, the instrument must be so placed that the plane of the circle shall cut the reflected lines at right angles. (3) The axis of rotation of the circle must be in the plane which divides the angle to be measured into two equal parts. Thus, the two normals of the faces start from a point of the axis, turn round their point of intersection, and are brought so that the two faces occupy successively the same position. If the axis is at a distance from the bisecting plane, the normals drawn from a point of this axis to the faces will be unequal, and one of the faces will not take the place of the other. It can only become parallel to it. The error which this may occasion will be less in proportion as the fixed lines are more distant, and by taking them far enough off may be practically eliminated.

By numerous repetitions made by turning back the crystal after each observation without turning back the circle, personal errors or the errors of graduation may be nearly or quite eliminated, and a result reached within a minute of the truth. When observations are repeated, though with great care and under the most favorable circumstances, variations in the readings are observed, which may attain the value of some minutes. It is only by taking the mean of many that it is possible to get the exact value of the angle.

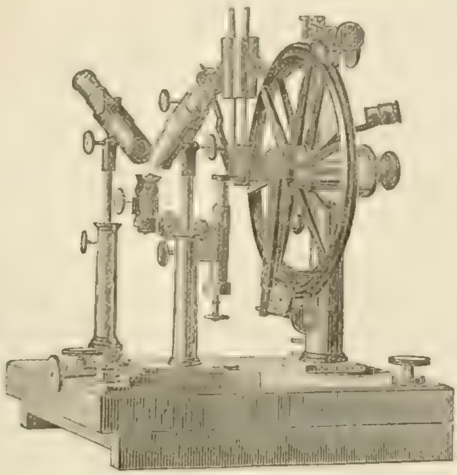
As it is difficult to find two lines at exactly the same distance, most crystallographers choose only one, and have this reflected in a mirror attached to the foot of the instrument. This mirror reproduces the image of the upper line at the same distance below that the line itself is above, and with this the one reflected from the crystal is made to coincide. In this way the equality of the distances of the two lines with regard to the crystal is fulfilled. The cross-hairs of a telescope would answer equally well. The telescope has the advantage of giving very exact results, but it is difficult to use when the reflecting power of the crystal is small. Sometimes a single point, instead of a line, is taken, and its image, reflected, is made to coincide with the intersection of two cross-hairs of a telescope.

The principal mistakes which can arise in using Wollaston's goniometer are—(1) The errors of adjustment of the crystal, caused by the eccentricity of the edge. This may be eliminated by two readings, turning the instrument so that they are made alternately on the right and left hand. Besides this error, others arise from the imperfection of the instrument, both as to its divisions and its centering, and from the fact that the position of the observer is not absolutely fixed. These may be made exceedingly small by repeating the measurement.

Mitscherlich's Goniometer.—Mitscherlich has avoided the inconvenience of keeping the eye fixed by adding a telescope to the instrument. The graduation of the circle is so fine that readings can be made within 10″. The light falls on the vernier and on the graduations of the circle through a screen of oiled paper. The microscopes are fixed to a movable support, so that the whole line of the vernier can be overlooked. The hollow axis, as in Wollaston's, carries the circle. The inner solid axis carries the crystal and the apparatus for holding it. The instrument carries a telescope of very small magnifying power, with cross-hairs, which moves in a vertical plane on pivots. It has also a movement of rotation to the right and left, on the rod which fits into the pillar. The pillar has a lateral motion by means of the slide upon which it rests. Mitscherlich recommended the

use of an eye-piece and objective whose foci are about 33 m.m., both of them alike or very nearly so. In order to

FIG. 4.



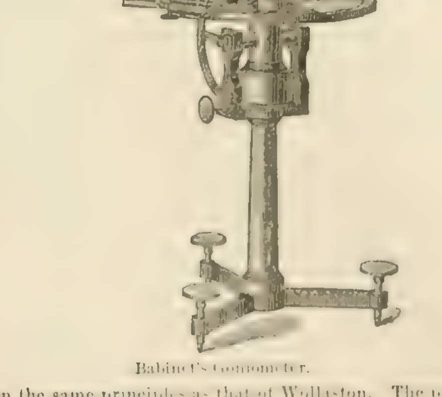
Mitscherlich's Goniometer.

eliminate parallactic errors the cross-hairs must be made to coincide with the reflected image seen through the objective. The adjustments must be such that the movement of the observing telescope shall be in a plane parallel to that of the graduated circle. As, during observation, the movements of the hand are apt to be brusque, it is difficult to bring the image of the reflected line into perfect contact with the line seen directly. The support for the crystal carries for this reason a number of adjusting screws, and a knife-edge which is in the exact prolongation of the axis, and so arranged that after the edge of the angle has been brought into contact with it, it can be turned back out of the way. The crystal is fixed with wax on the small plate. It can then be raised or lowered, or rotated to the right or left, or vertically and horizontally, by the adjusting screws.

In measuring with Mitscherlich's goniometer exactly the same conditions are to be fulfilled as in using Wollaston's. The telescope allows, however, of using a single point, which is made to coincide with the point of intersection of the cross-hairs of the telescope. The instrument as constructed by Mitscherlich had only a single telescope. Recently, a second has been added. The objective of the second telescope is turned towards the crystal, and its cross-hairs serve as an object whose reflection is seen by the first. When it is used in a dark room the light of the sun is directed through a small aperture on to the eye-piece, or a light is placed before it, to illuminate the cross-hairs. When these are in the focus of the objective they answer the purpose of a line at an infinite distance. The instrument is really only a perfected Wollaston goniometer.

Babinet's Goniometer.—Babinet's goniometer was invented to measure indices of refraction, but can be used quite as well for the measurement of angles. It is founded

FIG. 5.



Babinet's Goniometer.

upon the same principles as that of Wollaston. The plane of the circle may be either horizontal, inclined, or vertical. The direction of the lines of reference is determined by the inclination of the circle. The circle carries two movable telescopes, and a movable arm, with a vernier attached. Both telescopes are movable, but one of them is fixed at the commencement, and the other during the observation. This last one carries a vernier. The lines are cross-hairs at right angles to each other in the foci of the eye-pieces of the telescopes. One of these lines in the fixed telescope is parallel to the plane of the circle; the other, consequently, perpendicular. The telescope is arranged to see at a distance. The light which is to illuminate the lines is placed beyond its eye-piece, at a distance greater than its focus. The light may be either that of the clouds or of a lamp. With this disposition all the light by which the lines are illuminated leaves the telescope through the objective in parallel rays, and a point or line is obtained which produces exactly the same effect as if it were really at an infinite distance. In the Wollaston goniometer we judge that the two faces of the angle are perpendicular to the plane of the circle when each of them shows reflected lines parallel to the real ones. The same is true in the Babinet goniometer, but here the image seen directly is the intersection of the lines of the movable telescope, and is only a point. The image observed by reflection on the crystal is the reflection of the horizontal line in the fixed telescope. If the face under observation is perpendicular to the circle, the image of the point will appear to move parallel to the horizontal line when the movable telescope is made to change its position. For further details as to the adjustments and use of this instrument, the reader must consult systematic treatises on optical instruments or on mineralogy. It is convenient in use, but has the disadvantage of all instruments requiring the use of lenses, that the sharpness of the images is diminished, which renders its use impossible when the crystals are very small or their faces not very brilliant. It is therefore impossible for the mineralogist to do away with the Wollaston goniometer, which, having been arranged for almost microscopic crystals, is the one most applicable to general cases.

Moh's Goniometer.—Moh's goniometer has a horizontal circle, and is really Wollaston's goniometer in a different position. It is used in the centre of a room in which four perpendicular lines equally distant from the crystal, and at the same height, can be seen. Those usually selected are the bars of two windows upon different sides of a room. By turning the back to the two windows successively, the lines upon the opposite sides can be made to coincide. The methods of adjustment and verification are the same, and the instrument does not seem to offer any advantage over the usual form of Wollaston's goniometer. It sometimes carries a telescope with cross-hairs, when it requires only a single line. THOMAS EGLESTON.

Gonorrhœ'a [Gr. γονή, "semen," and ῥέω, to "flow," a misnomer], acute catarrh of the urethra, a disease which is usually of impure venereal origin. It is a painful disease, and may result in the chronic catarrh called *gleet*, or may lead to stricture, epididymitis, enlarged prostate, and other serious evils. Its treatment should be entrusted only to practitioners of the highest character. Quacks extort large sums of money from persons suffering from this disorder and its consequences. (See STRICTURE.) by F. ZINSSER, M. D.

Gonsal'vo de Cór'dova (*Gonzalo Hernandez de Córdova y Aguilar*), duke of St. Angelo and of Sessa, "the Great Captain," b. at Montilla, Spain, Mar. 16, 1453; became one of the brightest ornaments of the court of Ferdinand and Isabella; was distinguished in the Portuguese war of 1479 and the Moorish war in 1481–92; took command in Italy 1495; drove the French from Naples 1496; suppressed the Moorish rebellion 1500; commanded with success against the Turks 1500–01; was made lieutenant-general of Calabria and Apulia 1501; served against the French in Italy 1502–07; was besieged by Bayard and the duke de Nemours at Barletta 1502–03, but destroyed the French army in a great battle (Apr. 28, 1503); won the great victories on the Garigliano (Nov. 6, Dec. 28–29, 1503); soon after which Gaeta fell and the French gave up their claim upon Naples. He was viceroy in Italy until 1507; retired to his estates at Loxa, and there lived in great state, venerated by the people, but hated by the king, who was jealous of his fame. D. at Granada Dec. 2, 1515.

Gonza'ga, town of Italy, about 22 miles from Mantua, in which province it lies. It was formerly well fortified and possessed a strong castle, but is chiefly remarkable as the cradle of the Gonzaga family, who ruled Mantua from 1328 to 1707. Pop. 17,526.

Gonzaga, a famous Italian family, to which belonged the captaincy of Mantua [illegible]; the marquisate of Mantua [illegible]; the dukedom of the same city [illegible] 1708; the duchy of Guastalla [illegible] 1729; the duchy of Montferrat 1536–1707; and that of Nevers 1565–1659; other honors held at various periods by the heads or cadet

lines of the house being the duchy of Solferino, the duchy of Rethel, the county of Toreth, the duchy of Sabbionetta, the principality of Bozollo, the marquisate of Medola, etc. Many illustrious generals, statesmen, churchmen, and men of letters sprang from this stock.

Gonza'les, county in S. W. Central Texas. Area, 1026 square miles. The country is fertile, well watered, and well timbered. Cattle, maize, and cotton are leading products. Coal and iron are reported to exist abundantly. Cap. Gonzales. Pop. 8951.

Gonzales, one of the oldest towns of Texas, cap. of Gonzales co., is on the Guadalupe River, 70 miles S. by W. of Austin. It is the seat of Guadalupe College, and has 2 weekly newspapers. Pop. 1255.

Gooch'land, county of E. Central Virginia. Area, 260 square miles. It is bounded on the S. by the James River. The soil is productive. Tobacco and grain are leading products, and flour is manufactured. Good Triassic coal abounds, and some gold has been found. Cap. Goochland Court-house. Pop. 10,313.

Goochland Court-house, post-v., county-seat of Goochland co., Va., 28 miles W. of Richmond, has commodious public buildings.

Good (JOHN MASON), M. D., b. at Epping, Eng., May 25, 1764; was apprenticed to a surgeon of Gosport; began surgical practice at Sudbury in 1784, in London 1793; received the medical degree from Aberdeen 1820; d. at Shepperton, Middlesex, Jan., 1827. Dr. Good was an able and successful practitioner and an accomplished linguist and literary critic. He compiled and edited the "Junius" letters, and among his numerous works are poems (*Triumph of Britain*, 1803, etc.), translations of Canticles (1803), Job (1812), Lucretius's *De Natura Rerum* (1805–07), besides a translation of the *Basia* of Johannes Secundus, made in his youth and not recognized by him in his maturer years. His chief professional works were *Diseases of Prisons*, etc. (1780), a *Hist. of Medicine*, etc. (1795), *System of Nosology* (1817), *The Study of Medicine* (4 vols., 1822). His *Book of Nature* (3 vols., 1826) is also noteworthy. (See his *Life* by OLINTHUS GREGORY, 1828.)

Good'ale (GEORGE LINCOLN), M. D., b. Aug. 3, 1839, at Saco, Me.; graduated at Amherst College in 1860, and at the Harvard Medical School in 1863; practised medicine in Portland after receiving his degree, and was a lecturer on anatomy in the medical school of that city until 1869, when he was appointed lecturer on materia medica in the medical school of Maine, and professor of natural sciences in Bowdoin College. He is now assistant professor of vegetable physiology in Harvard University.

Good'by's, tp. of Orangeburg co., S. C. Pop. 719.

Goodell' (WILLIAM), D. D., b. at Templeton, Mass., Feb. 14, 1792; graduated at Dartmouth in 1817, and at Andover Seminary 1820; labored for the American Board as a collecting agent, and in 1822 went to Syria as a missionary, having (1822) been ordained to the Congregational ministry; labored 1823–31 at Beiroot, Syria, and 1831–55 at Constantinople; returned in 18[illegible] to the U. S., worn out with toil. D. at Philadelphia Feb. 18, 1867. His great work was the translation of the entire Bible into Armeno-Turkish.

Goodell (WILLIAM), M. D., b. Oct. 17, 1829, in the island of Malta; graduated at Williams College in 1851, and at Jefferson Medical College in 1854. For several years he practised his profession in Constantinople, Turkey, and afterwards in West Chester, Pa. In 1865 he was appointed physician in charge of the Preston Retreat, Philadelphia. In 1874 he was elected president of the Obstetrical Society of Philadelphia, and in 1875 president of the Philadelphia County Medical Society. After lecturing for three years in the medical department of the University of Pennsylvania, he received in 1874 the appointment of clinical professor of the diseases of women and children. On these subjects he has been a prolific writer.

Good'farm, tp. of Grundy co., Ill. Pop. 803.

Good Friday, the Friday before Easter Sunday, celebrated by many Christian churches as a fast in commemoration of the passion and death of our Lord. It is preceded by Holy Thursday and followed by Holy Saturday.

Good Ground, post-v. of Southampton tp., Suffolk co., N. Y., on Shinnecock Bay and on the Long Island R. R. Pop. 504.

Good Hope, post-v. of Fayette co., O. Pop. 118.

Good Hope, tp. of Hocking co., O. Pop. 986.

Good'hue, county of Minnesota, separated from Wisconsin by the Mississippi River. Area, about 690 square miles. The surface is somewhat uneven, and is productive. Cattle, grain, and wool are leading products. It is crossed by the Milwaukee and St. Paul R. R. Cap. Red Wing. Pop. 22,618.

Goodhue, tp. of Goodhue co., Minn. Pop. 750.

Good'land, post-tp. of Lapeer co., Mich. Pop. 811.

Goodland, tp. of Orangeburg co., S. C. Pop. 955.

Good'man, post-v. of Holmes co., Miss., on the Mississippi Central R. R., has 1 church, 1 Masonic lodge, and 10 stores. It ships 8000 bales of cotton annually.

R. WALPOLE, PROP. "THE WEEKLY CENTRAL STAR."

Goodman (JOHN), A. M., M. D., b. at Frankfort, Ky., July 22, 1837; graduated at Georgetown College 1856, and took his medical degree in the University of Louisiana 1859; became in 1868 professor of obstetrics in the Louisville Medical College, and in 1875 took in addition the professorship of obstetrics in the Kentucky School of Medicine; author of many professional papers.

Good'rich (CHARLES AUGUSTUS), brother of S. G. Goodrich, b. at Ridgefield, Conn., 1790; graduated at Yale 1812; pastor of the First Congregational church, Worcester, Mass., 1816–20, and afterwards was settled in Berlin and Hartford, Conn. Chiefly known by his books: *History of the U. S.*, *Lives of the Signers*, *Universal Traveller*, *Geography*, *Family Encyclopædia*, and others. D. at Hartford, Conn., Jan. 4, 1862.

Goodrich (CHAUNCEY ALLEN), D. D., b. at New Haven, Conn., Oct. 23, 1790; graduated at Yale in 1810; was college tutor 1812–14; pastor of a Congregational church at Middletown, Conn., 1816–17; professor of rhetoric at Yale College 1817–39; became in 1839 professor of the pastoral charge in Yale Divinity School. Published a Greek grammar (1814), and Latin and Greek lessons (1832); *British Eloquence* (1852); was editor of the *Quarterly Spectator* (1829–38); was largely engaged from 1828 till his death upon the dictionaries of Noah Webster, his father-in-law. D. at New Haven Feb. 25, 1860.

Goodrich (ELIZUR), D. D., grandfather of Dr. C. A. Goodrich, b. at Wethersfield, Conn., Oct. 26, 1734; graduated at Yale in 1752; was tutor there in 1755; pastor of the Congregational church 1756–97; was for many years also an instructor of youth; was an able astronomer and mathematician. D. at Norfolk, Conn., Nov. 22, 1797.

Goodrich (ELIZUR), LL.D., father of C. A. Goodrich, was b. at Durham, Conn., Mar. 24, 1761; graduated at Yale in 1779; was tutor there two years; became a lawyer 1783; was in Congress 1799–1801; was long a judge in the county and probate courts, mayor of New Haven, and law-professor in Yale College. D. at New Haven Nov. 1, 1849.

Goodrich (FRANK BOOT), son of S. G. Goodrich, was born in Boston, Mass., Dec. 14, 1826; graduated at Harvard in 1845; was Paris correspondent ("Dick Tinto") of the New York *Times* for some years; author of *Tri-colored Sketches* (1854); *Court of Napoleon* (1857); *Man upon the Sea* (1858); *Women of Beauty* (1859).

Goodrich (SAMUEL GRISWOLD), the famous "Peter Parley," a brother of Dr. C. A. Goodrich, b. at Ridgefield, Conn., Aug. 19, 1793; became in 1824 a book-publisher of Hartford, Conn.; removed to Boston, Mass., and edited 1828–42 *The Token*, and 1841–54 *Merry's Museum;* wrote, edited, and compiled 170 volumes, of which 116 bear the name of "Peter Parley;" was consul in Paris under Mr. Fillmore. His works are histories, geographies, and tales, mostly for children, besides *Recollections of a Lifetime* (1857); *Fireside Education* (1838); *Sketches from a Student's Window* (1841), and other works. The most extensive and valuable of all his writings is *Johnson's Natural History*, published by A. J. Johnson & Son, New York, in two vols. 8vo, finely illustrated. D. in New York May 9, 1860.

Goodrich (WILLIAM HENRY), D. D., son of Dr. Chauncey A. Goodrich, b. at New Haven, Conn., Jan. 19, 1823; graduated at Yale 1843; studied in the Yale Divinity School 1844–47; tutor in the college 1847–48; pastor of a Congregational church at Bristol, Conn., 1850–54; of a Presbyterian church in Binghamton, N. Y., 1854–58; of the First Presbyterian church, Cleveland, O., 1858–74; lived in Europe for some time on account of poor health, and d. at Lausanne, Switzerland, July, 1874.

Goods and Chattels, a comprehensive phrase used in law to designate every variety of personal property, as distinguished from real estate, which is also often referred to by the corresponding phrase *lands and tenements.* The expression is, in fact, tautological, since the single word "chattels" has a sufficiently broad import to denote everything indicated by both terms; but as a consequence of long usage it is generally employed in legal instruments in preference to either word by itself. The term "goods" has the narrower meaning, since it has no application to such forms of personal property as estates for years in land, which are known as chattels real, nor is "goods"

generally considered to include animals; and by some writers it is still further restricted in signification, since it is by them held to apply not even to all inanimate movables, but rather to articles of merchandise. This, however, is not the general legal acceptation of the word. In criminal statutes and indictments the phrase "goods and chattels" is employed generally with a different extent of signification from that which it possesses in deeds and wills. It is held in such cases not to include choses in action, as promissory notes, mortgage deeds, etc., nor, according to some authorities, anything which circulates as money. But with this exception it would embrace everything of a personal nature. (See PROPERTY.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Good'son, tp. of Washington co., Va. Pop. 3835.

Good Springs, tp. of Clarke co., Ala. Pop. 559.

Good-will, the advantage which a business establishment engaged in a particular kind of trade or existing in a particular locality, possesses, on account of the natural tendency of former customers to continue their dealings there. The probability is that former customers will continue to seek an accustomed place to make their purchases, and to deal under methods with which they are familiar; and from this circumstance the value of the business there established may be much enhanced. The good-will of a trade therefore constitutes a valuable right of property, intangible it is true, and depending largely upon mere expectancy, but capable of having its worth determined, at least approximately, upon the theory of probabilities. It is consequently often made the subject of bargain and sale, its value being usually estimated at so many years' purchase upon the amount of the profits of the business. But unless there be some specific agreement to the contrary the sale of a good-will in connection with his previous business does not prevent a vendor from carrying on a precisely similar trade in the immediate vicinity, so long as he does not profess to continue the identical business sold. Great injury may thus be done to the purchaser by the detraction of custom, and all his expectations may be unrealized; but a contingency of this nature must be guarded against by previous arrangement. When a shop or store is conveyed to another, and no reference is made to the good-will of the trade, it nevertheless vests in the purchaser as accessory to the interest thereby acquired in the premises. Questions concerning good-will frequently arise in relation to partnerships. In adjudicating upon the opposing rights and mutual claims of partners when one or more separate from the others, or a controversy arises as to their respective interests, courts of equity will generally take into consideration the value of the good-will. If one of the partners dies, it appears to be now the established rule, though after much diversity of opinion in this country, that the good-will of the business does not survive exclusively for the advantage of the remaining partner or partners, but that the estate of the deceased participates in its value. If the partnership assets be sold and the proceeds divided, each partner must be allowed his proportionate share in the price which was received for the good-will, as well as for the more tangible articles of property. The doctrines of good-will are frequently connected with a right to the *name* under which the business has been carried on, and a class of legal questions comes into consideration closely analogous to those presented in the law of trade marks. (See TRADE MARKS.)

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Good'win, tp. of Plumas co., Cal. Pop. 639.

Goodwin (DANIEL RAYNES), D. D., LL.D., b. at North Berwick, Me., Apr. 12, 1811; graduated at Bowdoin College in 1832; entered the Protestant Episcopal ministry; was professor of modern languages in Bowdoin College 1835–53; president of Trinity College, Hartford, Conn., 1853–60; provost of the University of Pennsylvania 1860–68; and in 1865 became professor of systematic divinity in the Divinity School of the Protestant Episcopal Church, Philadelphia; which position he still holds (1875).

Goodwin (ICHABOD). See APPENDIX.

Goodwin (WILLIAM W.), PH. D., b. in Plymouth, Mass.; graduated at Harvard University 1851, and is Eliot professor of Greek in Harvard University. Has been president of the American Philological Society, and published *Moods and Tenses of the Greek Verb*, and revised a translation of Plutarch's *Morals* (1871, 5 vols.).

Goodwin Sands, a range of very dangerous sand-banks in the Strait of Dover, 10 miles long and 3½ miles distant from the coast. The lighthouses of North and South Foreland and lightships stationed on the shoals guide passing ships, yet fearful wrecks often occur here.

Good'year (CHARLES), b. at New Haven, Conn., Dec. 29, 1800; became a partner with his father, a hardware manufacturer of Philadelphia. After the failure of his firm in 1830 he began to experiment on the employment of gum-elastic or caoutchouc in the arts. His nitric-acid process (1836) was in a great degree successful in fitting this material for the manufacture of shoes. It was not until 1839 that he perfected the idea of vulcanizing or ebonizing India-rubber by means of sulphur. Others have claimed priority in this discovery, and his associate, Nathaniel Hayward, certainly shares the honor of the invention. Many other improvements followed, so that over sixty U. S. patents bore the name of Goodyear. In France and Great Britain he was deprived of the fruits of his labors, and the number of infringements in the U. S. has been very great, so that Goodyear's profits were small when compared to the importance of his labors. He received numerous medals and distinctions, including the cross of the Legion of Honor. D. at New York July 1, 1860.

Gookin (Col. CHARLES), deputy governor of Pennsylvania under William Penn 1709–17. His administration was much disturbed by difficulties with the colonists. He was a man of erratic conduct and grave manners, and was subject to attacks of insanity.

Goole, town of England, in Yorkshire (West Riding), on the Ouse. Since the opening of the Knottingley and Goole Canal and the railways, which afford a direct communication with Leeds, Hull, and Manchester, Goole has sprung into consequence, and does now a considerable business. Pop., with surroundings, 17,215.

Goor'khas, the race who with the Newars occupy the dominant place in Nepaul. They are Mongols by blood, small in stature, full of courage, and were very faithful to the British in the Sepoy war of 1857–58; but they are not physically strong. In religion they are Hindoos.

Goosan'der, called also **Dun Diver, Buff-breasted Sheldrake,** and **Saw-Bill,** the *Mergus merganser*, a bird intermediate between the duck and the diver families, and common to both continents, though some regard the American bird as of a distinct species, *Mergus Americanus*. The bill is notched into numerous tooth-like processes in both mandibles. Its flesh is rank and inedible. This bird, with the mergansers, is usually assigned to the duck family.

Goose (*Anser*), a genus of anserine birds which in the arrangement of Linnæus belonged to the third order. It is now systematically placed in the order Natatores (*swimmers*) and sub-order Anseres, having the bill with transverse lamellæ, and in the family Anatidæ, which is characterized by the bill having an obtuse rounded nail on the end of the upper mandible, and a groove along the jaws to the nail. The wild-goose, or the gray lag (*Anser ferus*), as it is called in Europe, is the most interesting example of this genus, as it is supposed to be the species that gave origin to our domestic goose. It is the largest of its kind, often weighing ten pounds. Every part of the world seems to be visited by geese, but their breeding-places are in the swampy regions of the most northern latitudes, whither they migrate in the early summer. A familiar sight is the annual flight of these birds in their regular battalion-like progress to and from their breeding-places. The Canada goose (*A. Canadensis*) is a notable example, confined to the American continent. Like the gray lag, it is known as the "wild-goose," and its curious habits of flight and peculiar cry (honk! honk!) have made it familiar and easily recognizable. Wilson was of the opinion that the range of the Canada goose "extends to the utmost polar point, amid the silent desolation of unknown countries, shut out from the prying eye of man by everlasting and insuperable barriers of ice." Its weight is the same as that of the gray lag. The snow goose (*A. hyperboreus*) is nearly as large as the preceding. It is common to both continents. The swan goose (*A. cygnoides*) and bean goose (*A. segetum*) are well known species of the Old World. Several smaller species, not so familiar, are found in the western portions of North America. A few examples are known, having less weight and size than many of the ducks. Many modern systematists divide the old genus *Anser* into several genera.

J. B. HOLDER.

Gooseberry [probably from *goss* (*gorse*), a prickly shrub, and *berry*], the common name of those shrubs and their fruit which belong to the section Grossularia of the genus *Ribes* (order Saxifragaceæ), distinguished from the currants by the presence of thorns and mostly prickles on the stalk, and especially near the bases of the leaf-stalks; while in most the flower-stalks have only from one to three flowers each, though in some species the flowers are in racemes, like those of the currants, but smaller. Some gooseberries have also prickly fruit, which currants never have, though a few species of currants have hairy fruit. Thus, the distinction between gooseberries and currants is not strongly marked. North America has quite a number of wild species. Of these, *R.* [illegible], with beautiful white flowers, is cultivated for ornamental purposes, and is worthy of attention

for its fruit. Of our other species, *R. rotundifolium* is the parent of "Houghton's seedling," a very good and hardy variety for garden culture; and several of the Pacific coast species have attracted some, though insufficient, attention as fruit-bearers. The Old World has also a number of species, some of them common also to our continent. The cultivated gooseberries are principally assignable to *R. uva-crispa*, an Old World species, of which some 150 varieties have been named. In Europe, and particularly in Great Britain, great attention is paid to their culture, and some of the sorts bear fruit of surprising size and excellence. The fruit is used when unripe for making tarts and pies, and when ripe is a good dessert fruit, and is also made into jams and preserves. A pleasant drink called gooseberry wine is also produced from it, and gooseberry vinegar is prized. The European sorts almost uniformly fail in the U. S. from mildew, but our native gooseberries, with proper culture, will probably in time afford sorts as fine as any.

Goose Creek, tp. of Piatt co., Ill. Pop. 1120.

Goose Creek, tp. of Union co., N. C. Pop. 2207.

Goose Fish. See ANGLER.

Goose Lake, in Jackson co., Or., and Siskiyou co., Cal., is 30 miles long and 10 miles wide. Its waters have no outlet. It lies W. of the Warner Mountains.

Go'pher [corrupted from the French *gaufre*, "honeycomb," and applied originally by French settlers to animals burrowing into and "honeycombing," as it were, the earth], the vernacular designation of various species of burrowing rodent mammals, land-tortoises, and a snake in different portions of the U. S. The only feature in common between these forms is the habit of burrowing excavations into the earth for habitations and other purposes, and the natural inference is therefore that the name has been applied on account of preconceptions based upon the similarity of the dwelling, the connection with the indwellers themselves being an afterthought. The name is specifically restricted in different regions, and the diverse applications are characteristic of distinct sections; and thus, if the residence of the speaker is known, the animal intended may be inferred. In the extreme Southern States the name is used for the land-tortoises (*Testudo*, *Xerobates*, or *Gopherus Carolinus* and *Berlandieri*) which are peculiar to them, but in Georgia it is applied to a colubroid snake. In the Western States it is given to certain rodents, chiefly those of the family Geomyidæ and genera *Geomys* and *Thomomys*, but also (at least in some parts of Illinois and Wisconsin) to species of the genus *Spermophilus*. On the other hand, in the Southern States the species of Geomyidæ are termed salamanders (a name originally given to certain batrachians), although other names are conferred, as "hamster," "pouched rat," "muloes," etc. (For further information see SPERMOPHILE and TORTOISE.) THEODORE GILL.

Go'pher-wood, mentioned in the Bible as the material of Noah's ark, is generally thought to be the CYPRESS (which see).

Göp'pingen, a well-built and handsome town of Würtemberg, on the Fils, with mineral baths. Pop. 8649.

Go'ral, the *Nemorrhedus Goral*, a large antelope of Nepaul, inhabiting rocky heights and lofty table-lands. It is also called the Nepaul bouquetin, and is hunted for its excellent flesh.

Gordian Knot. See GORDIUS.

Gordia'nus Africa'nus (M. ANTONIUS), known as the elder Gordian, a Roman emperor, a descendant of the Gracchi and Trajan, b. 158 A. D., was consul 213 and 231; proconsul in Africa 232; and when eighty years old was invested with the purple at Tisdrus, without his consent, in place of Maximinus, but in less than two months was compelled by the victories of Capellianus to commit suicide (238 A. D.). He was a man of venerable character, and his death caused wide-spread grief.—His son, M. ANTONIUS GORDIANUS (b. 192), was declared Augustus jointly with his father, and fell in battle just before his father's death. He was a man of loose morality, but was a popular favorite, an able magistrate, and the author of writings in prose and verse, none of which are extant.

Gordianus (M. ANTONIUS), a grandson of the elder Gordian, b. about 226; was declared emperor in 238, after the death of Balbinus and Pupienus; set out for the East (242), where he won important advantages over the Persians and others, but in consequence of the machinations of Philip the Arab he was murdered by his own soldiers in Mesopotamia in 244 A. D. The younger Gordian was highly popular throughout the empire, and possessed many engaging qualities.

Gor'dius [Γόρδιος], a half-mythical king of Phrygia, father of Midas, was a peasant upon whose oxen an eagle alighted as he was ploughing. He repaired to Telmissus to consult the soothsayers regarding the occurrence, and was instructed by a prophetess whom he took to wife. Years after the oracles told the Phrygians that they should find a king in a cart. Soon afterwards Gordius, with his wife and son, rode up drawn by oxen, and Gordius (or, as some say, Midas) was declared king. Gordius's cart was placed in the acropolis of Gordium, a Phrygian city, and dedicated to Zeus Basileus; and the oracle declared that he who was able to untie the knot ("Gordian knot") by which the yoke was tied to the pole of the cart should be master of all Asia. In 333 B. C., Alexander tried to untie the knot, and, failing, cut it with his sword.

Gordius [so named from the knotted appearance these worms often assume—a reference to the Gordian knot], the typical genus of the family Gordiidæ, nematode worms of very simple structure and hair-like form. They are popularly called hair-worms, hair-snakes, and hair-eels. They are vulgarly regarded as transformed hairs. In reality, they are the adult forms of which the larvæ inhabit the bodies of insects and spiders. The adult worms chiefly inhabit fresh water and mud, are the subjects of many popular superstitions, and remarkable for tenacity of life.

Gor'do, post-tp. of Pickens co., Ala. Pop. 517.

Gor'don, county in the N. W. of Georgia. Area, 330 square miles. The soil is fertile and calcareous. Grain and tobacco are leading products. It is traversed by the Atlantic and Western and the Selma Rome and Dalton R. Rs. Cap. Calhoun. Pop. 9268.

Gordon, post-tp. of Henry co., Ala. Pop. 1823.

Gordon, post-v. of Wilkinson co., Ga., at the junction of the Eatonton branch with the Central R. R. of Georgia, 22 miles E. of Macon.

Gordon, tp. of Todd co., Minn. Pop. 195.

Gordon, post-v. of Darke co., O. Pop. 87.

Gordon, tp. of Orange co., Va. Pop. 1343.

Gordon (Lieut. Col. CHARLES GEORGE), C. B., R. E., b. 1833; entered the Royal Engineers as second lieutenant in 1852; promoted to be first lieutenant in 1854; served during the Crimean war, and was wounded in the trenches before Sebastopol; in surveying and settling the Turkish and Russian frontier in Asia; and in the English expedition against Peking, remaining on service in China after the termination of difficulties. Entering the service of the emperor of China, he was made in 1863 commander of the "ever-victorious army," and was prominent in suppressing the Tai-Ping rebellion (1863–64), and recovering the great cities and silk districts from the insurgents. He was promoted captain Royal Engineers in 1859, major in 1862, and lieutenant-colonel in 1864. In Dec., 1864, he was nominated a companion of the Bath, and was afterwards appointed British consul for the Danube delta; resigned 1874, and accepted control of the force designed to continue the work (under the khedive) of Sir S. Baker's expedition in Egypt.

Gordon (Lord GEORGE), third son of the duke of Gordon, was a lord by courtesy only. B. in London Sept. 19, 1750, he served for some years in the navy, which he left in 1772; entered Parliament in 1774; became distinguished as a noisy opponent of both Whigs and Tories; was made president of the Protestant Association 1779; became at once leader of the large and turbulent No-Popery party; presented a petition (signed by 120,000 persons) for the repeal of Saville's Roman Catholic Relief bill 1780, arriving at the Parliament House at the head of 60,000 rioters, who (June 2–9) sacked the Roman Catholic chapels and the houses of papists and others, broke open the prisons, and fired London in many places. The military finally dispersed the rioters, but not till 450 were killed and wounded. Many more were afterwards hung. Gordon was tried for high treason and acquitted 1781; declared himself a Jew in religion 1786, but was without question insane; was fined and imprisoned for libel 1788, and d. in Newgate prison Nov. 1, 1793.

Gordon (JOHN B.) was b. Feb. 6, 1832, in Upson co., Ga.; graduated at the State University; studied law, and was admitted to the bar; in 1861 entered the Confederate service as captain of infantry, and rose to the ranks of major, lieutenant-colonel, colonel, brigadier-general, major-general, and lieutenant-general. At the surrender of Gen. Lee, Gordon commanded one wing of the army. During the war he was wounded eight times in battle. In 1868 he was the Democratic candidate for governor of his native State, and, as was believed, was elected by a large majority, but his opponent, Rufus B. Bullock, was awarded the office. He was a member of the national Democratic conventions in New York 1868 and at Baltimore 1872; was Presidential elector for the State at large at the elections in 1868 and 1872; was elected to the U. S. Senate in Jan., 1873, for six years, and took his seat in that body on Mar. 4, 1873, where he is recognized as an eloquent and leading member of the Democratic party. A. H. STEPHENS.

Gordon (PATRICK), b. 1664, was governor of Pennsylvania 1726–36. He was reputed a good soldier, and his administration was highly popular. D. at Philadelphia Aug. 5, 1736.

Gordon (THOMAS WINSLOW), M. D., b. at Warren, Trumbull co., O., Sept. 23, 1819; was educated at Warren Academy and at Western Reserve College, where he took his medical degree in 1846; became in 1857 professor of materia medica and botany in the Cincinnati College of Medicine and Surgery, and in 1858 professor of chemistry and pharmacy; served 1861–64 as regimental and brigade surgeon in the U. S. service; was wounded at Missionary Ridge, and in 1865 became military surgeon for Brown co., O., and from 1862 to the present (1875) has been U. S. examining surgeon. Author of many professional and other papers, and has had experience as a journalist, lecturer, politician, and artist. Resides at Georgetown, O.

Gordo'nia [named from two James Gordons, one of London, the other of Aberdeen], a genus of beautiful trees and shrubs of the order Camelliaceæ. The U. S. have two species. The *G. Lasianthus,* called loblolly bay, is a beautiful Southern tree, from 50 to 70 feet high (often a shrub in cultivation), growing in "bay swamps" in barren regions. Its bark is useful for tanning leather. Its mahogany-colored wood is extremely light, fragile, and perishable, but is recommended for some kinds of joiner-work, being quite handsome. The *Gordonia pubescens* of the Southern States is cultivated as a garden-shrub, and has large white and richly fragrant flowers. In Florida it sometimes becomes a good-sized tree.

Gor'donsville, post-v. of Orange co., Va., at the junction of the Chesapeake and Ohio with the Great Southern Railway.

Gore, tp. of Huron co., Mich. Pop. 173.

Gore, tp. of Hampshire co., W. Va. Pop. 1895.

Gore (CHRISTOPHER), LL.D., b. in Boston, Mass., Sept. 21, 1758; graduated at Harvard 1776; was appointed U. S. district attorney for Massachusetts 1789, the first to hold the office; was with W. Pinckney a commissioner to England 1796–1804; chargé d'affaires at London 1803–04; governor of Massachusetts 1809; U. S. Senator 1814–17. D. at Waltham, Mass., Mar. 1, 1827. Left a considerable legacy to Harvard University, and was one of the legal instructors of Daniel Webster.

Gore (CATHARINE GRACE), b. in Nottingham, England, 1799, the daughter of a Mr. Francis; was married to Capt. Charles Gore 1822. Author of about seventy works, mostly novels depicting English aristocratic life. She wrote also several dramas. D. Jan. 29, 1861.

Gorée, an island in the Atlantic Ocean near the western coast of Africa, belongs to France, and is situated 1½ miles S. E. of Cape Verde. It is only 3 miles in circumference, and deficient in wood and water, but it contains a well-built and fortified town, with a good harbor, from which large quantities of gold-dust, gums, resins, and ivory are exported. Lat. 14° 40′ N., lon. 17° 25′ W. Pop. about 5000, of whom 150 are Europeans.

Gor'gas (FERDINAND J. S.), A. M., D. D. S., M. D., b. July 27, 1834, at Winchester, Va.; graduated at Dickinson College in 1854, at the Baltimore College of Dental Surgery 1855, and at the University of Maryland School of Medicine in 1868. In 1864 revised Harris's *Medical and Dental Dictionary,* and in 1872 edited the operative part of Harris's *Dental Surgery;* has been since 1866 the editor of the *American Journal of Dental Science,* and has filled his present chair, that of dental surgery and therapeutics in the Baltimore College of Dental Surgery, since 1860. Author of *Lectures on Dental Science and Therapeutics.*

Gorgas (JOSIAH), A. M., b. in Dauphin co., Pa., July 1, 1818; graduated at West Point Military Academy 1841; was brigadier-general and chief of ordnance in the Confederate service 1861–65; became in 1872 vice-chancellor of the University of the South, Sewanee, Tenn.

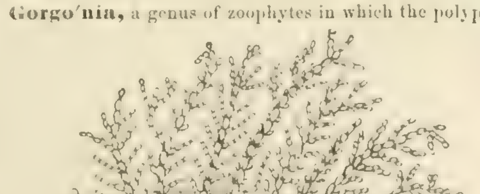
Gorgei (ARTHUR), GENERAL, b. at Topporez, in Hungary, Feb. 5, 1818; educated at the military school of Tuln, and appointed to the Hungarian body guard; promoted to be first lieutenant in the Palatinal Hussars. He resigned from the army to pursue the study of chemistry, but on the news of the rising in Hungary reaching him he hastened to place his services at the disposal of the Hungarian ministry. His conduct attracted the attention of Kossuth, and after the battle of Schwechat he assumed command of the Hungarian army. Unable to maintain himself at Raab, he was driven out by Windischgrätz; was again repulsed at Windschacht, saving his army by a bold retreat over the Sturecz Mountains. Difficulties arising between Görgei and the civil authorities, he was twice superseded in command. On the resignation of the governor and council in 1849, Kossuth made Gorgei dictator in his place. Soon after this the Hungarian forces laid down their arms. Görgei was stigmatized as a traitor for this, and in 1851 he published a volume narrating his connection with the insurrection, entitled *My Life and Acts in Hungary.* Since that time he has lived in retirement.

Gor'ges (SIR FERDINANDO), a native of Somersetshire, England, was a fellow-conspirator with the earl of Essex, against whom he was a witness, 1601; served in the British navy, and in 1604 became governor of Plymouth; was one of the leading spirits in the original Plymouth Company, sent a number of unsuccessful expeditions to the New England coast, and in 1620 obtained a charter "for the governing of New England," which was held to extend westward to the Pacific. He was also one of the original proprietors of Laconia, which was to extend from the Kennebec to the Merrimack, and in 1623 his son Robert was named general governor for New England. Gorges was soon after appointed lord-proprietary of Maine, the office to be hereditary in his family; and in 1642 he chartered the city of Gorgiana (now York, Me.). Gorges served against the Puritan armies in England, and d. in 1647. His grandson, Ferdinando (1629–1718), sold his rights in Maine to Massachusetts (1677) for £1250, and was author of *America Painted to the Life* (1659).

Gor'gias, a Greek orator, b. at Leontini, Sicily, about 485 B. C.; in 427 was sent to Athens to invoke aid in repelling the Syracusans, but remained in Athens, and attained great fame as a rhetorician and an instructor in eloquence. His style was elaborate and exceedingly artificial. Of his somewhat numerous writings fragments have been preserved, chiefly of the work on nature, in which he sets forth the dogma of the non-existence of things by arguments based upon the Eleatic philosophy. There are also two extant declamations ascribed to him, but there is no evidence of their genuineness. It is stated that he lived to be 105 years old or more.

Gor'gon [Γοργώ], the common name of three monsters of the Greek mythology, Stheno, Euryale, and Medusa, daughters of Phorcys and Ceto. Their myth is variously told. Medusa was the most dreadful of their number. They had but one eye, which each employed in turn. They wore girdles of living serpents and had serpents in place of hair. Medusa, the only mortal one, had the power of turning into stone every mortal who beheld her, but PERSEUS (which see) cut off her head, which was thenceforth fastened to the ægis of Pallas, but retaining the same dreadful power which it possessed in life.

Gorgo'nia, a genus of zoophytes in which the polypi-



Gorgonia or Sea Fan.

doms are frequently arranged in a fan-like, branching, flat growth (sea fan). Sometimes the axis is horny, sometimes calcareous, as in the corals. *Gorgonia flabellum,* a West Indian species, is often dried and preserved as a curiosity, and is called the sea-fan.

Gor'ham, tp. and post-v. of Cumberland co., Me., on the Portland and Rochester R. R., 10 miles W. of Portland, has 6 churches, a savings-bank, 2 fire-insurance companies, manufactures of woollens, powder, carpets, leather, etc. P. 3351.

Gorham, post-tp. of Coos co., N. H., on the Grand Trunk Railway, 91 miles N. W. of Portland. It is the northern gate to the White Mountains, and is a favorite place of summer resort. The scenery is admirable and the hotel accommodations ample. Considerable lumber is manufactured here. Pop. 1165.

Gorham, post tp. of Ontario co., N. Y., on the E. side of Canandaigua Lake. The town has five churches and some manufactures. Pop. 2589.

Gorham, a v. of Seneca tp., Ontario co., N. Y., at the junction of the Northern Central with the Sodus Point and Southern R. R., 11 miles S. E. of Canandaigua.

Gorham, tp. of Fulton co., O. Pop. 1655.

Gorham Controversy, The. A controversy in the Church of England touching baptismal regeneration, which grew out of the case of *Gorham vs. The Bishop of Exeter.* In 1847 the Queen presented the Rev. G. C. Gorham, then holding a cure in the diocese of Exeter, to the vicarage of Brampford Speke in the same diocese. When application was made for institution the bishop (Philpot) felt it to be his duty to ascertain by examination whether Mr. Gorham was sound in doctrine, and after examination he refused to institute. The reverend gentleman brought suit in the Arches Court of Canterbury, and the judge having pronounced that the bishop had shown sufficient cause for his refusal, an appeal was taken. The case was heard before the judicial committee of privy council. The charge against Mr. Gorham was that "he held, and persisted in holding, that spiritual regeneration is not given in baptism—in particular, that infants are not made therein members of Christ and children of God—contrary to the teaching of the Church of England in her Articles and Liturgy, and especially contrary to the divers offices of baptism, the office of confirmation, and the Catechism." The bishop did not state what, in his view, is the true doctrine of the Church of England, nor did Mr. Gorham state the particular doctrine he maintained. The only evidence presented was a report of his examination, published by Mr. Gorham. From this report it appeared to the court that the appellant held "that baptism is a sacrament generally necessary to salvation, but that the grace of regeneration does not so necessarily accompany the act of baptism that regeneration invariably takes place in baptism; that baptism is an effectual sign of grace, by which God works in us, but only in such as worthily receive it—in them alone it has wholesome effect; and that, without reference to the qualification of the recipient, it is not in itself an effectual sign of grace; that infants baptized and dying before actual sin are certainly saved; but that in no case is regeneration in baptism unconditional." To this statement of the court may be added the words of Mr. Gorham: "If baptized infants die before they commit actual sin, the Church holds, and I hold, that they are undoubtedly saved; and therefore they must have been regenerated by an act of grace prevenient to their baptism in order to make them worthy recipients of that sacrament." The court held that the doctrine as stated by him is not contrary to the Church of England as by law established, and cannot afford a legal ground for refusing institution. The sentence of the Court of Arches was reversed. This judgment was based on these considerations: *α*, The Article on baptism speaks only of the blessings conferred by it on those who receive it rightly, and it does not determine what is signified by right reception. *β*, The Articles constitute the code of faith, from which any differences are prohibited, and yet they contain expressions which unavoidably admit of different constructions. Much more must differences of opinion be allowable in the interpretation of services which were framed, not for determining points of faith, but for establishing a uniform order of prayer, etc. *γ*, The strong expressions touching baptism in the services and in the Catechism cannot be considered as unconditionally true in all cases. Even the form for private baptism, which contains no expressed conditions, and which yet speaks of the infant "now baptized" as regenerate, must be supposed to imply all that is more fully stated in the public service. *δ*, Eminent men in the Church have differed as to the efficacy of baptism. This decision of the committee of privy council was followed by the abandonment of the Church of England by not a few, on the ground that the Church did not maintain the Catholic faith. Without entering fully on the question controverted, it may be said here that the language of the Book of Common Prayer is that of the older Church. Very frequently in ancient Church writers baptism and regeneration are used as equivalent terms. In the sense of such writers regeneration is not final salvation, but the placing man in a state in which he may work out salvation—the rehabilitation of fallen man. There was no confusion consequent on the use of the term until it was taught that only those who shall be finally saved can be rightly said to have been born again. It may be also said that the line of argument on which is based the decision in the Gorham case no longer satisfies those who hold the views held by Mr. Gorham; they demand the omission of the disputed terms from the services.

WM. F. BRAND.

Goril'la (*Troglodytes gorilla*), a species of anthropoid ape which now occupies the first place among the quadrumanous mammals. Though more bestial in appearance, especially in the extraordinary prominence seen in the cranial ridges, and in the extremely carnivorous aspect of its produced snout, it nevertheless has essential characters of superiority. In the light of modern research an old narrative of the Carthaginian navigator, Hanno, respecting the great apes becomes in a measure verified. Five hundred years before the Christian era this voyager records the discovery on the western coast of Africa of "an island full of wild men," "much the greater part of them," the text continues, "being females with hairy bodies, whom the interpreter termed *gorilloi*. The males were pursued, but not captured. Three females, who bit and scratched those who led them, were not willing to follow; however, having killed and flayed them, we conveyed the skins to Carthage." The history also relates that these skins were preserved in the temple of Astarte, where they remained until the taking of that city in the year 146 B. C., as stated by Pliny, who calls them *gorgones.* It is scarcely to be doubted that this short record refers to the great manlike apes that have until recently remained almost unknown to science. In 1589 an English sailor, during a detention as prisoner in Western Africa, observed two kinds of ape—one evidently being the chimpanzee, and the other, which he learned was called *pongo*, was undoubtedly a gorilla. "The pongo," he says, "is in all its proportions like a man, except the legs, which have no calves. But he is of gigantic height," etc. A minute and circumstantial account is given by this observer, the accuracy of which has been confirmed by subsequent travellers. Buffon had a clear conviction that there existed such a creature, inclining to regard it as a large species of orang. Cuvier was so entirely incredulous, and met the subject with so much ridicule, that for a long period it was again wellnigh regarded as a myth. In 1847 the gorilla was first made known to science, and its characteristics made out by Dr. Thomas Savage (who, with Dr. Wilson, another American missionary, may be said to have rediscovered it) and Prof. Jeffries Wyman, the distinguished comparative anatomist. Their paper, in which the scientific name was first given, was published in the summer of 1847, and was followed in Feb., 1848, by a memoir by Prof. Owen. In 1849 a complete specimen, preserved in alcohol, was obtained by a surgeon of the French navy. Later yet, very perfect crania and other portions were brought to this country by Du Chaillu. Figures now extant are mostly taken from the famous stuffed specimen in the British Museum.

Considerable information of a reliable character has been recorded of late concerning the habits of the gorilla. Its food consists of the fruit of several species of palm, the "cabbage" portion of the same, the banana, and other succulent vegetables of similar character. The teeth of the animal indicate an omnivorous nature; its diet is therefore supposed to include to a moderate extent animal food; *e. g.* the eggs and the young of birds, if not that of more solid matter. It forms for itself a sleeping-place not unlike the ordinary grass hammock; the long, slender, tough and flexible stems of the climbing plants that ascend the tall trees of the forest are used very effectively by interweaving them with the thicker foliage, whereby a rude mat is formed, which they retain as a resting-place—in truth, a home, occupied, according to some observers, by pairs. It is not gregarious. The young are seen in company with the parents until they attain adult size. In walking, the natural position is on all-fours, the enormously long arms facilitating such locomotion very materially. When it chances to stand or progress as a biped, it is with an unsteadiness that betokens a lack of power and ability, and, as in the case of the spider monkey (*Ateles*), the surest-footed in bipedal movements, throws its arms back over its head to preserve a balance. All accounts agree in awarding to the gorilla a ferocity that is unmatched in the animal kingdom. The negroes fear it above all creatures of the forest. Its hideous aspect; its green eyes flashing with rage; the skin over the enormous orbital ridges rapidly moved in diabolical menace; the hair erect, and the whole body poised like a very demon, afford a full exposition of its attributes. Its strength is enormous; instances are known of its extending its long arm down upon the head of a passing negro, seizing him by the neck, and after lifting him to the branches, strangling him before any adequate resistance can be made. The male is much more formidable in appearance than his mate, his large canine teeth being a characteristic feature. It is a redeeming quality in the history of this strange creature that the male exhibits great affection in the care of his family; and the female's devotion to its young is almost heroic. In two instances only has the gorilla been taken away alive from its native wilds: a small one was shipped to Havre, but died almost immediately on landing. More recently, a young individ-

ual was kept in a menagerie in the N. of England for a few months, where it was regarded as the young of the chimpanzee; it is now preserved at Walton Hall, Wakefield. It became quite tame and tractable. J. B. HOLDER.

Go'ritz [Ger. *Görz*], town of Austria, in the duchy of Görz, 22 miles N. W. from Trieste, on the Izonzo. Its manufactures of leather, silk, and rosoglio are extensive, and its trade very lively. Charles X., the ex-king of France, d. here, in the monastery of Castagnavizza, in 1836. Pop. 11,300.

Gorkhas. See GOORKHAS.

Gor'kum [Dutch *Gorinchem*], town of the Netherlands, in the province of South Holland, on the Merwede. It is strongly fortified, has large salmon fisheries, and a very lively transit trade. Pop. 8943.

Gör'litz, town of Prussia, in the province of Silesia, on the Neisse, which here is crossed by a viaduct 1500 feet long, 115 feet high, and resting on 34 arches. It is fortified, and has large weaving and bleaching establishments and considerable manufactures of cloth and leather. Among its buildings is the church of St. Peter and St. Paul, built in the fifteenth century, a remarkable specimen of Gothic architecture. It has five naves, of which the principal one is formed by twenty-four palm-shaped pillars 77 feet high; and a bell weighing 12½ tons. Pop. 29,254.

Görlitz Process, a trial held at Darmstadt Mar., 1850, made famous by the discussion which it involved of the question whether the death of a human being can occur by the spontaneous combustion of the body. The case derives its name from the countess Von Görlitz, who was strangled by her servant, Johann Stauff, and afterwards partially burned, in the sitting-room of her own house. The eminent physician Von Liebold favored the doctrine, while the no less eminent chemists Liebig and Bischoff opposed it. It may at present be regarded as exploded.

Gor'man (JOHN BERRY), M. D., was b. in Newberry district, S. C., Feb. 22, 1793; received his degree in medicine from the University of Pennsylvania about the year 1821. In twenty years he realized a large fortune from the practice of his profession at the towns of Milledgeville and Talbotton. He was a contributor to magazines and journals, including the *North American*, and in 1845 published a work in Philadelphia styled *The Philosophy of Animated Existence*. Being fond of painting, he left a remarkable production which he called the representation of the nightmare. His library embraced works in Greek, Latin, French, and English. His correspondence was also quite extensive. D. Nov. 12, 1864, in Talbot co., Ga. PAUL F. EVE.

Gorman (WILLIS A.), b. in Kentucky Jan. 12, 1814; studied law and practised at Bloomington, Ind.; for several years member of the State legislature; major of Gen. Lane's regiment of Indiana volunteers in the Mexican war; at Buena Vista in command of the rifle battalion, and severely wounded; subsequently in command of the 4th Indiana Vols., and distinguished at Huamantla; civil and military governor of Puebla 1848; member of Congress 1849–53; governor of Minn. Ter. 1853–57. In the civil war, colonel of the 1st Minn. Vols., and Sept., 1861, appointed brigadier-general of U. S. volunteers; distinguished in the Peninsular campaign, at Antietam, etc. D. May 20, 1876.

Gör'res, von (JAKOB JOSEPH), was b. at Coblentz Jan. 25, 1776. From his early youth he was an eager student, a close observer, rich in sympathy, broad and bold in his views, but his education was somewhat diffuse, and so became his life and his ideas. Inspired by the French Revolution, he began as a radical, carrying his radicalism into all the spheres of human life, but soon felt discouraged at the development of affairs, became entangled in the dream-life and mysticism of the romantic school, was driven into bitterness and obscurity by its retrograde ideas, and ended by serving the reaction which after the fall of Napoleon pressed on Europe during a whole generation. In 1797 he founded a periodical, *The Red Paper*, which in 1798 was succeeded by *Rubezahl in Blue Garment*, both of which were suppressed on account of their radical views. In 1799 he went to Paris at the head of a deputation from the Rhenish provinces, with the purpose of effecting the incorporation of these districts with France. He arrived a few days after the revolution of 18th Brumaire, and stayed a couple of months. But the First Consul declined to receive the deputation, and the result of his own individual observations was, that he predicted for France and Europe a despotism under the rule of Napoleon such as the world had not seen since the days of the Roman empire. In despair he retired from politics, became a teacher at the college of Coblentz, studied natural science—to which he had always felt a great inclination—fell in with the writings of Schelling, and became wholly enticed by that singular scientific *fata morgana* which at that time charmed all people in Germany under the name of the philosophy of nature. In 1806 he removed to Heidelberg, where he resided for two years. Here he made the acquaintance of Brentano and Achim von Arnim, and adopted all the Oriental and mediæval—that is, quietistic and reactionary—tendencies of the romantic school. In 1807 he published *Die deutschen Volksbücher*; in 1810, *Mythengeschichte der Asiatischen Welt*; in 1813, *Lohengrin*. Once more he was allured back into politics. Under the general rising against Napoleon which followed his disaster in Russia and his defeat at Leipsic, Görres established a new periodical, the *Rhenish Mercury*, whose success was so great that Napoleon called it the fifth grand power. He was not radical now; he advocated the establishment of a German confederation of constitutional monarchies under an emperor; nevertheless in 1816 the paper was suppressed. For Görres was always a noble-hearted man, and his anger and scorn were tremendous when he saw how coolly, and even maliciously, the German princes broke those promises of liberal constitutions which in the days of their troubles they had given to their people. His book, *Deutschland und die Revolution* (1820), even occasioned the Prussian king to order his imprisonment in some fortress. He fled to Switzerland, where he lived till 1827, when he was appointed professor of history at the University of Munich. During his residence in Switzerland he published *Das Heldenbuch von Iran* (1820); *Europa und die Revolution* (1822); *Emanuel Swedenborg* (1827), etc. A new change took place with him. He had once believed in the spontaneous development of the people itself towards civilization and freedom, but that idea he had given up in despair. He next hoped to find in constitutional government a guarantee for the happiness of the people, but this confidence he now lost. He looked down on all government with contempt, and considered the Church, the Roman Catholic Church, as the only means left of salvation. In this spirit are all his later books written—*Athanasius* (1838); *Die christliche Mystik* (1842); *Die Wallfahrt nach Trier* (1845), etc. They are still of a high character, interesting and suggestive, but they are essentially reactionary. D. at Munich Jan. 27, 1848.

CLEMENS PETERSEN.

Gor'ton (SAMUEL), b. at Gorton, England, about 1600, was a linen-draper of London; went in 1636 to Boston, Mass., whence he was soon expelled for heresy; was banished from Plymouth in the following winter; went to Aquidneck (now Newport, R. I.), where he was publicly whipped for saying that the magistrates were "just asses;" removed to Pawtuxet, R. I., and was involved in lawsuits about land; went (1642) to Shawomet (now Warwick, R. I.), whence he with ten of his followers, "Gortonians," were abducted by forty soldiers from Massachusetts, and were tried at Boston as "damnable heretics," and sentenced to hard labor in irons, but in 1644 the sentence was commuted to banishment; returned to Warwick, R. I., and became a preacher, a magistrate, and a person of much consideration. Author of several religious works. D. in Rhode Island in 1677. His sect survived for many years, and his followers were called "Nothingarians," because they repudiated religious forms of every kind and recognized no ministry.

Gort'schakoff (ALEXANDER MICHAELOWITSCH), PRINCE, chancellor of the Russian empire, and generally considered as one of the ablest statesmen of Europe, was b. in 1799, and belongs to one of the oldest and most celebrated families among the Russian nobility. He was educated at the Academy of Tsarskoe-Selo, and entered the diplomatic service in 1821 as secretary to the Russian ambassador in London. In different diplomatic positions at Vienna, Florence, Stuttgart, and other cities he acquired a large experience and showed considerable dexterity, but it was his eminent success in keeping Austria neutral during the Oriental war, at which time he represented Russia at the court of Vienna, which first made him conspicuous as a diplomate. In 1856 he succeeded Count Nesselrode as minister of foreign affairs, and his notes to the Western powers during the Polish insurrection in 1863 made a most decisive impression in Europe, and no doubt prevented foreign interference. Since 1862 he has the title of chancellor.

Goruckpoor', town of British India, in the presidency of Agra, on the Raptee. It is the capital of a district of the same name, which is situated between Nepaul and Oude and contains an area of 7346 square miles, with 2,376,000 inhabitants. The city has a pop. of 51,529; most of its houses are built of clay.

Go'ry Dew, a reddish slime sometimes seen on cellar-walls and in other dark, shady places. It is caused by the growth of *Palmella cruenta* and other confervaceous plants, allied to those which produce the so-called red snow.

Gosch'en (Rt. Hon. GEORGE JOACHIM), b. in London

in 1831 of German parentage; was educated at Rugby and Oriel College, Oxford; entered mercantile life in 1853; was returned to Parliament for London (1863) as a Liberal; vice-president of the board of trade and director of the Bank of England 1865–66; was sworn of the privy council 1865; chancellor of the duchy of Lancaster 1866; president of the poor-law board 1868–71; first lord of the admiralty 1871–74. Author of *The Theory of Foreign Exchange*, 1863.

Gos'hawk (*i. e.* "goose-hawk"), properly, the *Astur palumbarius* of Europe, a bird much employed in ancient falconry, though not reckoned one of the "noble" falcons, because it flies near the ground and overtakes its prey, while the noble falcons fly aloft and stoop downward upon their victims. It is represented in America by the nearly-related species *Astur atricapillus*, called also goshawk. Many other species are known. The chief distinguishing mark is the festoon at the end of the upper mandible. The young of the goshawk is the *falcon gentle* of former days.

Go'shen is the name of the district of Lower Egypt in which Jacob and his family settled, and where his descendants were kept in thraldom by the Egyptians until delivered by Moses. The exact site of the district has not yet been ascertained. It is certain, however, that it lay between the eastern branch of the Nile and the Red Sea.

Goshen, post-tp. of Litchfield co., Conn., 20 miles W. of Hartford. It contains the highest land in the State. Its soil is fertile, and there are manufactures of leather, doors, sash, blinds, soap, etc. Pop. 1223.

Goshen, tp. of Stark co., Ill. Pop. 1270.

Goshen, city, cap. of Elkhart co., Ind., halfway between Toledo and Chicago, on the Lake Shore and Michigan Southern R. R. It has an elegant court house, 7 churches, a national and 2 private banks, 2 newspapers, 2 large flouring-mills, 2 saw-mills, 2 machine-shops, a woollen-mill, an oil-mill, wagon, furniture, sash and blind, and plough factories, stores, etc. The lumber-trade of the place is over 5,000,000 feet annually. The water-power is very great, and is afforded by the Elkhart River. Pop. 3133.

MURRAY & BEANE, PROPS. "GOSHEN DEMOCRAT."

Goshen, tp. of Muscatine co., Ia. Pop. 1381.

Goshen, post-tp. of Hampshire co., Mass., 12 miles N. W. of Northampton, has quarries of granite and flagging-stone, and manufactures of lumber. It affords many interesting minerals. Pop. 368.

Goshen, post-tp. of Sullivan co., N. H., 47 miles W. of Concord. It has 3 churches, and manufactures of leather, lumber, woolen wares, etc. Pop. 507.

Goshen, post-v. and tp. of Orange co., N. Y., on the Erie R. R., 60 miles from New York. It is half-shire town, with court-house, clerk's and surrogate's offices. First settled in 1772, and incorporated in 1809. It has 2 banks, 1 savings institution, 4 churches, schools for both sexes, 2 newspapers, 3 hotels, foundry, carriage, and sash and blind factories, drain-tile and brick works, dry-goods, grocery, hardware, jewelry, and drug stores, with all the minor branches of trade, and waterworks supplying an abundance of pure water. It has two branch railroads, the Goshen and Deckertown, 12 miles, and the Walkill Valley, running N. to Kingston, 43 miles. Principal business, dairying. Pop. of v. 2205; of tp. 3903.

CHAS. MEAD, ED. "DEMOCRAT."

Goshen, tp. of Auglaize co., O. Pop. 524.

Goshen, tp. of Belmont co., O. Pop. 2163.

Goshen, tp. of Champaign co., O. Pop. 1965.

Goshen, post-v. of Clermont co., O., is the seat of a female seminary. It is 24 miles E. by N. of Cincinnati. Pop. 274; of Goshen tp. 1876.

Goshen, tp. of Hardin co., O. Pop. 928.

Goshen, tp. of Mahoning co., O. Pop. 1475.

Goshen, tp. of Tuscarawas co., O., on the Lake Shore and Tuscarawas Valley R. R. It contains the village of NEW PHILADELPHIA (which see). Pop. 4650.

Goshen, tp. of Clearfield co., Pa. Pop. 468.

Goshen, tp. of Addison co., Vt., 6 miles N. E. of Brandon. It has manufactures of lumber. Pop. 330.

Goshen Hill, tp. of Pike co., Ala. Pop. 1268.

Goshen Hill, post-tp. of Union co., S. C. Pop. 1431.

Gos'lar, town of the German empire, in Hanover, on the Gose. It is a very old town, dating back to the time of Henry the Fowler (922), but most of its old splendor is now lost. Of its fortifications only one tower, *Der Zwinger*, remains. Of its cathedral only the porch is left. The imperial palace is now a corn magazine. It derives its present importance mostly from the neighboring mines. Pop. 7730.

Gos'nold, tp. of Dukes co., Mass., comprising the ELIZABETH ISLANDS (which see). The islands were settled in 1602 by a colony under Bartholomew Gosnold, but were soon abandoned. The Penikese school of natural science is in this town. Pop. 99.

Gosnold (BARTHOLOMEW), an English mariner, who first appears as an associate of Raleigh in his unsuccessful attempt to found a colony in Virginia. In 1602 he sailed in a ship containing twenty colonists for New England; steered directly across the Atlantic, instead of taking the circuitous southern course previously chosen by navigators. He entered Massachusetts Bay, named Cape Cod, discovered No Man's Land, and named it Martha's Vineyard (a name since given to a much more important neighboring island), and planted his colony on Cuttyhunk (now in the township of Gosnold, Mass.); but the settlers became discouraged and soon returned. In 1606 he led another colony to Virginia, which settled at Jamestown. D. in Virginia Aug. 22, 1607.

Gos'pel and **Gospels.** Gospel [Ang.-Sax. *god-spell*, "good spell"] is the English equivalent for the Greek εὐαγγέλιον (from εὖ, "well," "good," and ἀγγέλλω, to "bear message," to "bring tidings," εὐαγγελίζω, to "announce good news") and the Latin *evangelium*. It means (1) good news, glad tidings (originally a thanksgiving or sacrifice for good news); (2) glad tidings of salvation by Christ; (3) the historical records of this salvation, or of the life, death, and resurrection of Christ for the salvation of the world, or the gospel history, which we have in a fourfold form.

1. *The Canonical Gospels.*—They are properly only one and the same gospel, in its fourfold aspect and relation to the human race ("the fourfold gospel," τετράμορφον εὐαγγέλιον, according to Irenæus). Hence they are styled in ancient MSS. the Gospel *according to* (not *of*) Matthew, Mark, Luke, and John. The first and fourth are by apostles; the second and third by pupils of the apostles, and thus indirectly apostolical. Mark is closely connected with Peter (as his "interpreter"), Luke with Paul (as his companion in missionary travel and work). The first three were written between A. D. 60 and 70, certainly before the destruction of Jerusalem, to which they point as a future event. The last was probably written towards the close of the first century, at Ephesus. Before the end of the second century they were generally received and used in the churches as one collection. This is confirmed by the independent testimonies of the Ante-Nicene Fathers (Justin Martyr, Tatian, Irenæus, Tertullian, Origen, etc.), by the Gnostics, and other heretics. They are not complete biographies of Jesus, but selections of characteristic features as they seemed most important to each evangelist for the purpose of leading his readers to the faith that Jesus of Nazareth is the promised Messiah and Saviour of men.

Each Gospel has a marked individuality, corresponding to the author's education, talent, taste, and mission. Matthew wrote in Palestine and for Jews, to show them that Jesus is the fulfiller of prophecy and the true King and Lawgiver of Israel; Mark in Rome, for Roman readers, to exhibit Jesus as the mighty Wonder-worker and Son of God; Luke, for Greeks and Gentiles, to set Him forth as the univeral Saviour of all men; John, for Jewish and Gentile Christians combined, and for all future ages. Matthew (formerly a tax-gatherer and accustomed to keeping accounts) follows the topical and rubrical order; Luke (an educated Hellenist and a physician), the chronological order; John (the trusted bosom friend of Christ) combines both with an internal development of the growing antagonism between Christ and carnal Judaism; Mark gives, as from the first impressions of his master, the impulsive Peter, fresh, rapid, graphic sketches. The first three evangelists agree much in matter and language, and are, consequently, called *Synoptists* (their Gospels the *synoptic* Gospels): John stands alone, as the ideal and spiritual evangelist who introduces us into the holy of holies; his Gospel is the purest, deepest, and sublimest of all literary compositions, the Gospel of Gospels, "the one, true, tender, main Gospel," "the heart of Christ." (See Schaff's special introduction to LANGE'S *Com. on John.*) Yet the first three are just as necessary, and give the historical basis, the divine humanity of Christ, while John, going back to the eternal Logos, presents to us the incarnate divinity of Christ.

The discrepancies among the Gospels in minor details confirm the independence and credibility of the authors. The genuineness and truthfulness of these books rest on stronger evidence than that of any other historical records, ancient or modern. This has been acknowledged by eminent writers who are free from all doctrinal or sectarian bias. Goethe says: "I regard the Gospels as thoroughly genuine, for we see in them the reflection of a majesty which proceeded from the Person of Christ—a majesty which is as divine as anything that ever appeared on earth." Rousseau remarks that "the gospel history can be no fiction, else

the inventor would be greater than the hero (*l'inventeur en serait plus étonnant que le héros*);" or, as Theodore Parker says, it would take more than a Jesus to forge a Jesus. And yet the Jesus of the Gospels is admitted to be the purest and highest character conceivable. If there is no truth and reality in Him, it is nowhere else to be found. Take away the historical Christ, the Life and Light of the world, and human life and history are as dark as midnight, an inscrutable enigma. For details see arts. HARMONY OF THE GOSPELS, MATTHEW, MARK, LUKE, and JOHN.

Literature. This has immensely increased within the last thirty years, in connection with the very numerous *Lives of Jesus* by Schleiermacher, Strauss, Neander, Ewald, Lange, Keim, Ellicott, Andrews, Farrar, etc. See the critical introductions to the New Testament by De Wette, Reuss, Bleek, Davidson, Guericke, Wescott (*Introd. to the Gospels*); the commentaries on the Gospels by Olshausen, De Wette, Lücke, Tholuck (on John only), Bleek, Meyer, Lange, Nast, Alford, and Wordsworth; and monographs on the several Gospels, especially that of John, too numerous to be mentioned here. Tischendorf: *When were our Gospels composed?* (4th ed. 1866, translated into several languages, even the Russian and Turkish) makes an able plea for the genuineness of the Gospels from historical evidence. Compare the careful bibliographical lists of Hase, in his *Leben Jesu*, 5th ed. 1865, p. 22 *seq.*, and of Ezra Abbot, in Smith's *Bibl. Dictionary* (Abbot's and Hackett's ed.), vol. ii. pp. 949–961.

2. *Apocryphal Gospels.*—A number of biographies of Jesus and the holy family, purporting to come from apostles or their pupils, but written in the second, third, and later centuries by unknown authors, to fill out, for the satisfaction of an idle and morbid curiosity, the vacancies left by the chaste modesty and veracity of the evangelists, especially in the history of the infancy of Christ and His descent into Hades. They are the first specimens of religious novels, replete with extravagant fancies and unnatural miracles which the boy Jesus is said to have performed for ostentation and amusement. They are also glorifications of Mary and the holy family. They are related to the canonical Gospels as the counterfeit to the genuine coin, as caricatures to the original. They furnish indirectly a strong argument for the historical Gospels, and enable us to trace some of the traditions and superstitions of the mediæval Church to their proper source. This is their only use. They have no historical or doctrinal or literary value whatever. The principal of these apocryphal productions are the *Gospel of James* (*Protevangelium*); the *Gospel of Pseudo-Matthew on the Infancy of Mary and Jesus*; the *Gospel of the Nativity of Mary*; the *Gospel of Joseph the Carpenter*; the *Gospel of Thomas*; the *Gospel of Nicodemus*; the *Acts of Pontius Pilate*; and his *Letter to Tiberius* on the death of Christ. The references in the Koran to the gospel history are from these apocryphal sources.

Literature. THILO, *Codex Apocryphus Nov. Test.*, Leipsic, 1832; TISCHENDORF, *Evangelia apocrypha*, Leipsic, 1853; the same, *De Evang. apocr. origine et usu*, 1851; COWPER, *The Apocryphal Gospels*, London, 1867; R. HOFMANN, *Das Leben Jesu nach den Apokryphen*, Leipsic, 1851.

PHILIP SCHAFF.

Gos'port, town in England in the county of Hants, directly opposite Portsmouth. It is the seat of the Royal Clarence victualling yard, with its breweries and bakeries, and has large iron foundries for the manufacture of anchors and iron cables, and extensive storehouses for every kind of naval provisions. Pop., including Alverstoke, 22,638.

Gosport, post-tp. of Clarke co., Ala., on the Alabama River, 110 miles N. by E. of Mobile. Pop. 600.

Gosport, post-v. of Wayne tp., Owen co., Ind., on the W. fork of White River, at the crossing of the Louisville New Albany and Chicago and the Indianapolis and Vincennes R. Rs., 44 miles S. W. of Indianapolis. It has one weekly newspaper. Pop. 860.

Gosport, post-v. of Washington tp. Marion co., Ia. Pop. 108.

Gosport, tp. of Rockingham co., N. H., consists of Star, White, and Londoner's islands, belonging to the ISLES OF SHOALS (which see). The remaining four islands of the group are in Maine. Gosport Village, on Star Island, is a fishing town, 9 miles S. E. of Portsmouth. White Island light is in lat. 42° 58′ N., lon. 70° 37′ 30″ W. Pop. 94.

Gosport, suburb of Portsmouth, Va., on the Elizabeth River, 2 miles S. of Norfolk, has a large and excellent government dry dock and navy-yard. It is in Norfolk co.

Gos'samer, the long light filaments spun by certain small spiders. Some of these float in the air and carry the spider with them, perhaps in search of prey. Others are stretched upon the ground, and are believed to serve to collect the dew, of which many spiders have been observed to drink very frequently. In the folk-lore of various nations they are regarded as shreds of the Virgin Mary's neckcloth, which she cast away at the time of her assumption.

Gosse (PHILIP HENRY), F. R. S., b. in Worcester, England, Apr. 6, 1810; lived in Newfoundland 1827–35, in Canada 1835–38, and in Alabama 1838–39, when he returned to England. Author of *Letters from Alabama*; *The Canadian Naturalist*, 1840; *Birds of Jamaica*, 1847 (he was in Jamaica 1844–45), an *Atlas of Illustrations* for the foregoing work; *Naturalist's Sojourn in Jamaica*, 1851; *Natural History*, 4 vols., 1848–51; *Ocean Described*; *Rivers of the Bible*, 1850; *History of the Jews*, 1851; *Textbook of Zoology*, 1851; *Assyria*, 1852; *A Naturalist's Rambles*, 1853; *The Aquarium*, 1854, *Handbook of Marine Aquarium*, 1855; *Marine Zoology*, 1856; *Omphalos*, 1857; *Evenings at the Microscope*, 1859; *Romance of Natural History*, 1860–62; *Land and Sea*, 1865; and other works.

Gosselies, town of Belgium, in the province of Hainaut. The neighboring coal mines are important. Pop. 6757.

Gossellin (PASCAL FRANÇOIS JOSEPH), b. at Lille, France, Dec. 6, 1751; made extensive journeys (1772–80) for the observation of facts regarding ancient geography; and after this time carried on his studies for some years at the public expense. In 1790 he was chosen to the Academy. In 1799 he was made director and keeper of medals for the National Library. In 1816 he became one of the chief editors of the *Journal des Savants*. D. at Paris Feb. 7, 1830. Among his most important works are *Géographie des Grecs analysée* (1790); *Recherches sur la géographie des anciens* (1798–1813), besides a large number of valuable monographs upon ancient geography, and an *Atlas des Cartes*, with 75 maps.

Go'ta [Swed. *Göta-elf*], a large river in Southern Sweden, carrying the water from Lake Wener to the Cattegat. It is celebrated for the romantic beauty of its shores and for its magnificent cataracts, of which Trollhätta ("the witch's cap") is one of the most brilliant and imposing in the world. To make the river navigable, and to connect it with the Baltic through Lakes Wener and Wetter, a system of locks and canals (Trollhätta and Gota Canal) has been constructed, which is an admirable work of engineering art, and very costly.

Gotama. See GAUTAMA.

Go'tama, an East Indian logician, the reputed author of the *Nyâya Sûtra*, which in its present form is, however, in part the work of commentators. The time of Gotama's life is quite unknown, but most scholars assign him a high antiquity. The related events of his life are purely fabulous. It was believed by Sir William Jones that Aristotle borrowed the syllogism from Gotama's writings; but this opinion is now rejected by most critics, as is also the belief that Gotama was indebted to the Greeks.

Go'tha, town of Germany, the capital of the duchy of Saxe-Coburg-Gotha, on the left bank of the Leine. Its old walls and fortifications have been transformed into boulevards and promenades, and the whole city has a modern and elegant appearance. The ducal palace, Friedenstein, is a considerable building, and contains, besides a library of 150,000 volumes, a very fine collection of coins and medals. Gotha is the seat of much literary enterprise (the *Gotha Almanac*, the geographical establishment of Justus Perthes, etc.) and considerable industry and trade. Pop. 20,591.

Go'tha Al'manac (*Almanach de Gotha*), an annual register containing lists of government officials, genealogies of German princely families, necrology, diplomatic intelligence, statistics, etc. It is, especially of late years, a work of very great value. It is published at Gotha, in Germany. From 1764 to 1804 it was published in the German language. From that time till the present it has been published both in French and German.

Go'tham (*Gotcham*), a parish of Notts, England, whose people have been (according to Thoroton) famous ever since King John's time for their stupidity; so that "a wise man of Gotham" became a synonym for a fool. Irving in his *Salmagundi* applied the name Gotham to New York, and the appellation is still a familiar one in the U. S. (For traditional explanations of the origin of the phrase "wise men of Gotham," see W. A. WHEELER'S *Dict. of Noted Names of Fiction*.)

Goth'ic Arch'itecture has been treated of in the article on ARCHITECTURE, so far as regards its æsthetical character, and its connection with that period of modern civilization during which it originated, and whose artistic representative it is. We add here a few items of its system of construction and of its history. With the introduction of the pointed arch, which is the most prominent feature of the Gothic style and the leading principle in

its architectonic system, that somewhat heavy and gloomy aspect disappeared which still hovered over the buildings of the Romanesque style, and the organization of the dead masses was carried through with such a minuteness and harmony that the whole building looked like a living being. On entering the Gothic cathedral, with its vaults floating aloft on delicate ribs branching off from the top of its stately pillars, the modern critic feels himself so strongly reminded of the dome of the forest that he declares the building to be an imitation of nature; but, however that may be, a closer study shows that this audacious construction rests on the most subtle calculations. The first advantage which the pointed arch offered over the semicircular, and that one which probably led to its adoption, lay in the circumstance that it allowed arches of different span to be combined into the same system, as by constructing them on different radii they could be carried to the same height. Thus, it became as easy to vault an oblong as a square place, and a much greater freedom was attained for the ground-plan. But there was another circumstance which proved of still greater consequence. The tunnel-vault pressed with equal force along the whole line of its abutment, and the thrust was lateral. It consequently demanded very strong and solid side-walls to rest on. The pressure of the pointed arch was more perpendicular, and by developing the groin-ribs its whole force was gathered into the four points of abutment, which it now became sufficient to support, while the intermediate wall might be broken almost at pleasure. The nave-pier was folded together and formed into a pillar which, like a bundle of columns, arose to the sustaining point, each shaft receiving there its part of the vault to carry. And thus room was made for the large windows which, filled with stained glass, a contemporary invention, flooded the vaults with a soft, subdued light, that actually touched the sense of sight like the shadow of the forest. Also, the exterior of the building underwent characteristic changes consequent upon the introduction of the pointed arch. As the pressure became more and more concentrated in single points, it became more and more difficult to support and secure these points, especially to enable them to resist the thrust of the wall. Buttresses were carried along the exterior of the side-wall to the height of the sustaining point, but as the nave rose considerably above the aisles, the buttresses had to be carried considerably above the height of the wall of the aisle, and to be connected by arches with the wall of the nave. These flying buttresses and flying arches were highly ornamented and covered with exquisite stone carvings, which at some distance gave the building an aspect as if a veil of elegant lace had been thrown over it.

An ogival window of the last part of the fifteenth century.

The Gothic style which flourished from the middle of the twelfth to the middle of the fourteenth century, originated in Paris under the influence of the rich architectural monuments of Normandy, Burgundy, and Provence, and spread very rapidly to England, Germany, Italy, Spain, and the Scandinavian countries. The first fully-developed example is the cathedral of St. Denis, near Paris, consecrated in 1144, but it was soon followed by others more magnificent and more characteristic. The cathedral of Notre Dame in Paris was begun in 1163, Pope Alexander III. laying the first stone. In 1182 the high altar was consecrated; in 1223 the W. front was finished; in 1257 the southern transept; in 1312 the northern. The length of the interior is 390 feet; the width of the transepts, 144 feet; the height of the vaults, 105 feet; and of the towers, 224 feet. In both these buildings, however, as well as in the beautiful cathedral of Chartres, built 1195–1260, there are still some traces left of the Romanesque style, but in the cathedral of Rheims, begun in 1212, the Gothic style is carried through to the smallest detail, and the cathedral of Amiens, built 1220–88, is generally considered as representing the highest degree of perfection which the style ever reached. Its dimensions are—length of the whole edifice, 415 feet; width of the transepts, 182 feet; height of spire, 420 feet. But although it was impossible to attain any higher degree of refinement and elegance in the details without losing something of the nobleness of the general character, the French architects, in their restless eagerness after progress and improvement, pushed the audacity of their constructions farther and farther. The breadth and height of the nave of the cathedral of Amiens are respectively 42 and 132 feet; those of the cathedral of Beauvais were 45 and 146, but twelve years after its erection (in 1284) it fell, and had to be rebuilt on another plan. Stopped in this line, and yet passionately fond of novelties, the architects now subjected the details to arbitrary modifications, and the decay of the Gothic style began in France with that style of decoration which is called *Flamboyant*, and which is most conspicuous in the tracework of the windows.

In England the Gothic style was introduced by William of Sens, who built the cathedral of Canterbury in 1174. Then followed Westminster Abbey in London, built 1245–69, and the cathedral of Salisbury, built 1220–58, and generally considered the most perfect example of the *Early English* style. In the fourteenth century a movement took place somewhat similar to the Flamboyant, and the most celebrated of this, the *Decorated* style, are the cathedral of Exeter, built 1327–69, and that of York, built a little later. In the fifteenth century the Decorated style was succeeded by the *Perpendicular;* and with this movement begins the decline of the Gothic style. But Gothic architecture in England was by no means a repetition of French models; it was an independent adoption and followed an independent course of development. Not only is the general character of the French and English buildings of this style very different, but also their plan and construction show striking differences. The English cathedral is square-ended, the French semicircular; the English has large transepts, the French almost none; the English is long and low, the French short and high. The cathedral of Salisbury is 430 feet long, but its nave is only 33 feet wide and 78 feet high. Less original, and consequently less interesting, is the development of the Gothic style in Germany, though it is represented by several fine buildings, of which the cathedral of Cologne and the church of St. Stephen in Vienna are the most celebrated. The interior of the latter makes a somewhat peculiar impression, as the nave and the aisles are nearly equally high, and the nave without windows; but the exterior is very richly decorated, and the spire, 435 feet high, magnificent; finished in 1433. CLEMENS PETERSEN.

Gothic Language and Literature. See ULFILAS, by PROF. C. PETERSEN, A. M.

Goth'land, or **Gottland** [Swed. *Götarike*], the southernmost province of Sweden. Area, 37,000 square miles. Pop. 2,445,376. The northern part is mountainous, rich in iron, copper, alum, and nickel, and covered with forests of pine. The southern part is very fertile and well suited for agriculture. (See GOTTLAND.)

Goths, The, occupied originally the regions along the northern and north-eastern shores of the Black Sea, from the mouth of the Danube to that of the Don. Several centuries before our era one or more swarms of these Goths crossed through Central and Northern Europe, one portion of them invading and conquering Scandinavia, and the others settling S. of the Baltic, between the Oder and the Vistula. Here Pytheas from Marseilles, who calls them *Guttones*, visited them in the time of Alexander the Great; and they still lived here when Tacitus, who calls them *Gothones*, wrote his *Germania*. It was not until the third century of our era, however, that the original Goths became known to the Romans, who generally confounded or even identified them with their neighbors, the Getæ. Several modern historians believe that those Goths whom the Romans met at the Black Sea descended either from the Scandinavian or from the Germanic Goths; but the truth is that they were the original stem from which those two other tribes branched off. It is certain that the Scandinavian and Germanic Goths came from the Black Sea, and there is not the least proof of any one of them ever returning. On the contrary, such a movement of a people from W. to E. would at that time have been extremely difficult, not to say impossible, as it would have compelled them to face and fight the innumerable swarms which poured into Europe from Asia, all moving from E. to W. The Goths of the Black Sea never saw the Baltic, but their brothers did.

During the reign of Alexander Severus (222–235 A. D.) the Goths began to invade the Roman province of Dacia. In 250 they met and defeated the emperor Decius at Philippopolis, and the following year they defeated him a second

time, and killed him. In 258 they had procured a fleet and took Trebizond, and in 262 they came with 500 vessels before the Piræus, and took and plundered Athens. They now began to threaten Italy, but in 269 the emperor Claudius, the successor of Gallienus, defeated them, sunk their fleet, and pursued them into Mt. Hæmus, in whose ravines as many of them are said to have died of famine as had fallen in the battle. In spite of this heavy reverse, they compelled (in 272) the successor of Claudius, Aurelian, to give them the province of Dacia, where they settled, and where they kept comparatively quiet for nearly a century; indeed, one part of them, the so called Mœsogoths, who settled in Mœsia, gave up war altogether and became an agricultural people. During this period of quiet life the Goths were converted to Christianity by Bishop Ulfilas, who translated the Bible into their language, and it was also during this period that the division sprang up between the *Ostrogoths*, living along the shores of the Black Sea, and the *Visigoths*, on the banks of the Danube in the Dacian provinces—a division which maintained itself through the rest of their history. When Theodosius the Great died in 395, and the Roman empire was divided between Arcadius and Honorius, the Visigoths rose and began to wander. They first invaded Greece, then Italy. In 410 their famous king, Alaric, conquered and sacked Rome, but his successor, Athaulf, after marrying Honorius's sister, Placidia, left Italy and went into Gaul. In 412 the Visigoths crossed the Pyrenees and established a large and flourishing empire, comprising the southern part of France and the northern part of Spain, with Toulouse for its capital. Their possessions N. of the Pyrenees they lost in the beginning of the sixth century, being compelled to cede them to Clovis, the king of the Franks. But in Spain they prospered till the beginning of the eighth century, when (in 711) they were routed by the Saracens at Xeres de la Frontera, their empire broken up, and their name as a people wiped out of the map. In 386 the Ostrogoths tried to cross the Danube, but were completely routed by the Romans, and had to retreat into Lydia and Phrygia. Hence they went with Attila on his campaign into Gaul, where they fought (452) at Châlons sur Marne against their own brethren, the Visigoths. After the battle they settled for some time in Pannonia, where they grew strong and exacted a handsome yearly tribute from the emperor of Constantinople. But their greatest success they achieved under Theodoric, who ruled over them from 475 to 526. First he conquered Bosnia, Servia, Wallachia, Transylvania, and Dalmatia from the East Roman empire, and then (in 486) he descended into Italy, defeated Odoacer, and formed a large kingdom, bounded N. W. and N. by the Rhône and the Danube, and with Ravenna for its capital. Theodoric was not only a man with a natural talent as a general and statesman, but also a man of culture. Italy was better governed under him and his successors than it had been for the previous two centuries; but soon after his death the East Roman generals, Belisarius and Narses, succeeded in breaking down the Ostrogothic empire in Italy, and with the death of Teias, the last king (in 553), even the name of the nation vanished from history. CLEMENS PETERSEN.

Got'tenburg [Swed. *Götaborg*], town of Sweden, in the province of Gothland, on the Gota, near its mouth. It has an excellent harbor and a considerable trade, exporting iron, copper, timber, tar, and fish. Also as a manufacturing place it is rising; its shipbuilding and manufactures of sailcloth are important. Pop. 59,329.

Got'teschalk, or **Godescalc** (*Gothescehalcus Fulgentius*), b. at Mentz, Germany, about 806; became a Benedictine of Fulda, where, wishing (829) to return to the world, he was restrained by the abbot Raban; studied at Paris and Orbais; devoted himself to the study of Augustine and the propagation of the predestinarian doctrines; was everywhere opposed, especially by Nothingus, bishop of Verona, and by his old master Raban, now archbishop of Mentz; condemned by the Council of Mentz 848; tried by Hincmar of Rheims and Charles the Bald at Quiercy (849 A. D.); flogged in presence of the king and bishops, and imprisoned for life in the abbey of Hautvilliers, where he d. Oct. 30, 867, Hincmar denying him the consolations of the Church in his last hours. Remigius of Lyons, Fulgentius of Troyes, and Ratramn of Corby were among his defenders, and Scotus Erigena wrote a treatise against him. A *Life* of Gotteschalk by Archbishop Ussher appeared in 1631, and Mauguin in 1650 published the existing fragments of his works.

Gott'land, or **Gothland**, an island in the Baltic belonging to Sweden, and situated in lat. 56° 55′ N. and lon. 18° 10′ E. Area, 1227 square miles. Pop. 11,575. Wisby, its principal town, was once a most flourishing city belonging to the Hanseatic League; now it is in ruins. (See GOTHLAND.)

Göt'tingen, town of Prussia, in the province of Hanover, on the Leine. It has a neat and quiet appearance, and some manufactures of woollens, tobacco, and leather, but it depends chiefly on its university, with which are connected an excellent library of 400,000 vols., a museum, a botanical garden, an observatory, an anatomical theatre, a chemical laboratory, and other scientific institutions. It was founded in 1737 by George II., king of England and elector of Hanover, and the magnificent scale on which it was established and maintained made it soon one of the most celebrated universities of Germany. In this century the University of Berlin, founded in 1810, has thrown it somewhat into the shade. Its number of students, which in 1823 amounted to 1547, fell in 1831 to 1123, and in 1834 to 860. In 1837 five of its most celebrated professors—among them the two Grimms and Gervinus—were expelled for political reasons, and in 1864 the number of students amounted only to 737. It is nevertheless still an institution of great repute and influence. Pop. of town, 15,841.

Gotts'chalk (LOUIS MOREAU), an American pianist and composer, b. in New Orleans, La., May 18, 1829; d. at Tijuca, near Rio Janeiro, Brazil, Dec. 18, 1869. When but seven years old he gave a concert. At twelve his father sent him to Paris, where he had instruction in the science and art of music from the best masters. He gave concerts in France, Switzerland, and Spain, and achieved a high reputation before his countrymen knew him. Afterwards he was heard in the chief cities of the Union, in Mexico, South America, and even in Australia. His pianoforte compositions, which are numerous and peculiar, are characterized by passion, often tumultuous, but often subtle, dreamy, and tender. His own style combined dash and pathos with brilliant effect. Gottschalk was popular as a man and admired as an artist. Among other decorations, he received that of the Legion of Honor and the order of Isabella the Catholic. His death caused great lamentation and excitement, and he was buried with distinguished honors. O. B. FROTHINGHAM.

Gott'sched (JOHANN CHRISTOPH) was b. Feb. 2, 1700, at Judithenkirch, near Königsberg, Prussia; studied the languages and literature, and was professor first in eloquence and poetry, then in logic and metaphysics in Leipsic, where he d. Dec. 12, 1766. At one time he was supreme lawgiver in Germany in matters of taste, and exercised a great influence. He attacked the second Silesian school of poets, among whom Lohenstein was the most remarkable, and whose characteristic was a wild and chaotic bombast. He was himself a representative of French taste, of its order, correctness, and elegance; and although he was a poor poet (his great tragedy, *The Dying Cato*, is a miserable production), both he and his wife possessed great mastery of language, and translated with ease, and not without taste, one piece after the other from the French. His intimate connection with Mrs. Neuber, the manager of the best troop of actors at that time in Germany, afforded him a very efficacious means of inculcating his ideas on the public, and he was moreover supported by all the German courts, which acknowledged or even noticed nothing unless it came from Versailles. He actually crushed the second Silesian school, and stood for several years as the dictator of the German literature. Then he had himself to experience opposition. The Swiss school arose, headed by Bodmer. Bodmer was a man of small poetical gift, but of considerable critical talent. His taste was English, and nationality in literature was with him more than an idea; it was a principle. He attacked Gottsched very severely in a long series of criticisms, and when, shortly after, Klopstock and Lessing came forth and gave practical evidence of the soundness and correctness of Bodmer's principles, poor Gottsched tumbled from his throne, and became the laughing-stock of all Germany. CLEMENS PETERSEN.

Gou'da, or **Ter'gouw**, town of the Netherlands, in the province of South Holland, on the Yssel. Its church of St. John is celebrated for its glass-stained windows of the sixteenth century. Gouda has large manufactures of bricks, cheese, tiles, pottery, and clay pipes. Pop. 15,776.

Gough (Rt. Hon. HUGH), VISCOUNT, b. at Woodstown, Ireland, Nov. 3, 1779; joined the army 1794; served with distinction at the Cape of Good Hope 1795, and in Spain 1809–13, where he was thrice wounded; became a major-general 1830; went to India 1837; led the land-forces in the Chinese opium war 1841; was made a baronet and G. C. B. 1842; and commanded the British forces against the Mahrattas 1843, and the Sikhs 1845; was made a baron 1846; commanded in the second Sikh war 1846–49, but in consequence of the terrible losses inflicted upon the British by the Sikhs his generalship began to be criticised, although all his battles were victories; and Sir Charles Napier in 1849 took his place. Gough was created viscount and handsomely pensioned (1849), made colonel of the horse guards 1854, K. P. 1857, privy councillor 1859, G. C. S. I.

1861, field-marshal 1862. D. Mar. 2, 1869, and was succeeded as viscount by his son, Lord GEORGE STEPHENS GOUGH (b. Jan 18, 1815).

Gough (JOHN B.), b. at Sandgate, Kent, England, Aug. 22, 1817; came in 1829 to the U. S.; became a bookbinder, and after some years of poverty, caused by intemperance, he reformed, and in 1843 became a temperance lecturer, and labored with great zeal and success in the U. S. and in England (1853). He also attained great reputation as an orator upon other themes. Resides in West Boylston, Mass. (See his *Autobiography*, 1848; enlarged, 1870.)

Goulard's Cerate; Goulard's Extract. See LIME, MEDICINAL USES OF.

Goul'burn, city, cap. of Argyle co., New South Wales, Australia, 120 miles by rail S. W. of Sidney. It has an Anglican and a Roman Catholic bishop. Pop. 3500.

Gould (AUGUSTUS ADDISON), M. D., son of N. D. Gould, a famous teacher of music and writing, b. at New Ipswich, N. H., Apr. 23, 1805; graduated at Harvard 1825; was for some time scientific instructor in Harvard University, and in 1856 became one of the physicians of the Massachusetts General Hospital, Boston. Author of many scientific papers; of a *System of Natural History*, 1833; *Report on the Invertebrate Animals of Massachusetts*, 1841; reports on mollusks collected by the Wilkes and the Ringgold and Rogers expeditions; *Otia Conchologica*, 1863; translated works of Gall and Lamarck; with L. Agassiz published *Principles of Zoology*, 1848. D. at Boston Sept. 15, 1866.

Gould (BENJAMIN APTHORP), b. at Lancaster, Mass., June 15, 1787, was the son of Capt. Benjamin Gould, an officer in the war of Independence, who had borne a prominent part in the battles of Lexington, Bunker Hill, and Saratoga, as well as in the detection of the treachery of Arnold. After graduating at Harvard College in 1814, he was appointed to the charge of the Public Latin School of Boston, which soon assumed, and long maintained, the highest position of any institution in the country for thoroughness in classical teaching. He was the first American editor of any classical author, and besides his improved and revised Latin grammar, which was a novelty in America, and long remained a textbook, he prepared critical editions of Horace, Ovid, and Virgil, which, although intended as textbooks for the Boston Latin School only, found at once an extensive circulation through the country. He continued in charge of the Latin School till 1828, when his health compelled him to abandon prolonged literary occupations. He subsequently filled many important public positions in his native State, and d. Oct. 24, 1859.

Gould (BENJAMIN APTHORP), PH. D., LL.D., son of the foregoing, was b. in Boston Sept. 27, 1824. After graduating at Harvard College in 1844, he devoted himself to the study of astronomy, prosecuting this at the observatories of Greenwich, Paris, Berlin, Göttingen, and Altona, and returning home in Dec., 1848. In 1849 he established at Cambridge the *Astronomical Journal*, a periodical dedicated solely to original investigations, which he maintained, chiefly at his own expense, until 1861, when the war rendered its suspension necessary. In 1851 he took charge of the longitude operations of the Coast Survey, to which Bache and Walker had just begun the application of the electric telegraph. This method he extended and perfected, until in 1866 about twenty longitudes had been determined in the U. S. with the highest precision yet attainable by modern science. Immediately on the successful completion of the Transatlantic cable in that year, he established an observatory at Valentia in Ireland, and established its longitude from Newfoundland on the one hand and Greenwich on the other, thus completing a series of telegraphic longitude measurements from the Royal Observatory to New Orleans, and connecting these with the new European series from Greenwich to the Ural Mountains. In 1855, the Dudley Observatory at Albany having been organized, its management was committed to a scientific council consisting of Messrs. Bache, Henry, Peirce, and Gould, and its directorship was confided to Dr. Gould, who accepted it without remuneration, planning the principal instruments and superintending their construction. Here, for the first time, a normal clock, placed in a position as free as possible from atmospheric influences, gave its time telegraphically to dials in the observing-rooms. Important modifications, almost universally adopted since that time, were introduced in the meridian instruments, and the now celebrated difference-engine of Scheutz was procured, and used in calculating astronomical tables. A uranometry, containing the magnitudes to tenths of a unit for all stars visible to the naked eye between 60° N. and 2° S., was also prepared as preliminary to the sharp determination of the positions of the stars which it contained. The conflict between the trustees of the institution and the scientific council belongs to the history of American science. In addition to the management of the construction and equipment of the observatory for more than three years without remuneration, he had incurred a very large personal indebtedness for the expense of its equipment, etc., which entailed upon him the necessity of some years of subsequent labor in non-scientific avocations, and seriously interfered with the *Astronomical Journal*. In 1863, the Sanitary Commission having requested Dr. Gould to take charge of their statistics, he organized in connection with these an elaborate system of anthropological measurements, which were subsequently computed and tabulated. From the discussion of the ages of our soldiers in connection with the census, he deduced the curious formula which seems to control the distribution of a population according to ages, and which has been singularly verified by subsequent censuses of this and other countries. The law of growth in human stature was also elicited by these researches, as also the normal relation between height and weight, and the typical proportions of the human body. In 1870 he went to South America to establish a national observatory for the Argentine Republic at Cordova and complete the catalogue of the southern stars—a work which was nearly accomplished in Apr., 1874; at which date he had likewise organized a national meteorological office, and made various telegraphic determinations of longitude, and also prepared for publication a uranometry and charts of the southern heavens.

Gould (HANNAH FLAGG), b. at Lancaster, Mass., 1789. Her poems, published in 1832–36 and 1841, were much admired both in England and America. Author of *Gathered Leaves*, *The Diosma*, etc. D. at Newburyport Sept. 5, 1865.

Gould (JAMES), LL.D., b. at Branford, Conn., 1770; graduated from Yale College in 1791, and became justice of the supreme court of Connecticut; for 40 years associated with Judge Tapping Reeve as a professor in Litchfield Law School. He published *Principles of Pleading in Civil Actions* (1832). D. in Litchfield, Conn., May 11, 1838.

Goulds'borough, post-tp. of Hancock co., Me., on the Atlantic coast, 22 miles S. E. of Ellsworth. It has some excellent harbors, and has lobster and other fisheries, and manufactures of lumber, boats, etc. Pop. 1709.

Gou'ley (JOHN WILLIAM SEVERIN), M. D., b. at New Orleans, La., Mar. 11, 1832; received a classical education, and in 1853 took his medical degree at the College of Physicians and Surgeons, New York; in 1856 became professor of anatomy at the Medical College, Woodstock, Vt.; one of the surgeons of Bellevue Hospital New York, since 1859; demonstrator of anatomy in the University of New York 1859–61, 1864–66; in the U. S. army service 1861–64; professor of clinical surgery in the University of New York 1866–71. Author of *Diseases of the Urinary Organs*, 1873, and of professional papers; member of various scientific societies. Resides in New York.

Gounod (CHARLES FRANÇOIS), b. in Paris June 17, 1818. His early passion was for sacred music; his first great success was a mass performed at the church of St. Eustache in 1849. He began to write for the operatic stage in 1850, and persevered in it, in spite of the unpopularity of much of his work and the impulses of a deeply religious temperament, which, it has been remarked, has more than once nearly prevailed to make him a recluse. His compositions show a mastery of musical science, uncommon resources of melody, and affluence of ideas. The best known of them all is *Faust*, which was performed as first written nearly 200 times at the Théâtre Lyrique, and for ten years has been a general favorite. Other operas are—*La Nonne Sanglante*, *Le Médecin malgré lui* (comic), *La Colombe*, *Philémon et Baucis*, *Mireille*, *La Reine de Saba*, *Romeo et Juliette*, the last the most celebrated after the *Faust*. Gounod has written a lyric drama (*Sappho*), three symphonies, and a cantata. He is a member of the Academy of Fine Arts, was decorated with the Legion of Honor Aug. 15, 1857, and was made an officer Aug. 13, 1866. In May, 1866, he was elected a member of the French Institute.

O. B. FROTHINGHAM.

Gou'ra, or **Crowned Pigeon** (*Goura coronata*), the largest living species of the pigeon family, is about the size of the turkey. It is a native of the Eastern Archipelago, and is domesticated in Java, but in America and Europe it has failed to breed. Its flesh is highly prized.

Goura'mi, or **Goramy,** the *Osphromenus olfax*, a valuable fresh-water food-fish of Eastern Asia, introduced in the West Indies, the Mauritius, and Guiana with great success. It belongs to the Labyrinthibranchidæ, is a nestbuilder, and protects its young fry with great care.

Gourd. In Great Britain this name is applied indiscriminately to any member of the natural order Cucurbitaceæ, but in America it is restricted to the genus *Lagenaria*. This name is derived from the Latin *lagena*, a "bottle,"

and refers to a frequent shape of the fruit, of which the shell is used not only for bottles, but, after soaking to remove the bitter principle, for dishes, cups, and especially for dippers, for which the natural handles especially adapt it. At the South a gourd is almost always found suspended at a spring for the use of travellers. The *Lagenaria* climbs extensively over walls and shrubbery by means of its compound tendrils. The clammy-pubescent herbage has a powerful odor of musk. It has rounded leaves, long-stalked flowers greenish white in color, and fruit differing greatly in size and shape. Hence the great variety of purposes to which it can be applied by cutting the rind and removing the contents. The sterile flowers are on a long peduncle, the fertile on a short one, and are musk scented like the leaves. The name *gourd* is from the French *gourde*, signifying a "swelling." The plant is a native of Africa and Asia, perhaps also of America. Pumpkins, squashes, cucumbers, and melons belong to the order Cucurbitaceæ, and are valued for their useful and often delicious fruit. The vegetable marrow, a variety of squash, is largely cultivated in England for its delicate fruit. The orange gourd (*Cucurbita orifera*) grows wild in Texas, and is cultivated for its ornamental fruit. W. W. BAILEY.

Gourdon, town of France, in the department of Lot, on the Bleu, manufactures woollen fabrics and trades in wine, nuts, and truffles. Pop. 5099.

Gout [*goutte*, a "drop"], an inflammation of the fibrous and ligamentous parts of the joints, and is dependent upon mal-assimilation. It derives its name from having been thought to be produced by a liquid falling (*goutte à goutte*), "drop by drop," into the joints, and, although this theory has long since been proved to be erroneous, it still retains the name. We generally find an hereditary predisposition to this affection. It can be traced through many generations, and is found in about two-thirds of the cases. Next frequently we find it in persons enjoying the luxuries of the table, drinking wine and beer, and taking but little exercise. It was formerly considered a disease of high life, but is now just as common among the poorest people in England as among the rich. It was not so in Sydenham's time. The ballast-heavers of London have more gout than any other class in the world. They work in the water, and drink very large quantities of malt liquors daily. The principal change observed in the blood is a great excess of uric acid, and the deposit in the affected joints is made up almost entirely of urates. But "we neither know whether the uric-acid diathesis be the primary and chief anomaly in gout, and whether it be not accompanied by other and more important changes in the composition of the blood, nor do we know the disturbances of nutrition by which one of the constant products of normal nutrition, uric acid, is formed in excess." (*Niemeyer.*) We have certain symptoms premonitory to an attack of gout. The digestive apparatus is disturbed, and we find that the patient loses his appetite; he will also suffer from pain and a sense of weight or fulness in the region of the stomach, accompanied by acid eructations, heartburn, irregularity of the bowels, and flatulence. Sometimes he will vomit a phlegmy material. The patient now complains of a dull headache, and feels indisposed for any work, and becomes irascible. This last symptom is well known among the laity as a premonition of gout. The urine becomes highly concentrated; the specific gravity runs up to 1025–1030; it is of a deep amber or red color, and deposits on cooling large quantities of uric acid and the urates, which are commonly known as the "brickdust deposit." This concentrated urine often causes a burning and pain as it passes along the urethra, and has even been known to excite a muco-purulent discharge. Dr. Graves speaks of an unavoidable desire in these patients to grind the teeth, which is caused by painful sensations in the genital organs, and which seems to be relieved in no other way. To such an extent is this sometimes practised that we find gouty individuals with the teeth worn almost entirely away. The next symptom noticed is small sharp pains throughout the whole economy; this precedes the attack of gout but a few days. Now the attack begins, generally during the night, by a burning, piercing pain in the great toe, generally the metatarso-phalangeal articulation. The patients have different modes of expressing this variety of pain—some simulating it to the driving of a nail into the foot, others to the teeth of a dog crushing the bones or to having the toe squeezed in a vice. The patient tumbles and tosses from one side of the bed to the other, seeking a position in which he may get some rest; but this is denied by his visitor, who never lets go his grip for more than a couple of seconds at a time. At the end of three or four hours the pain has become almost intolerable, and is so severe that the patient cannot bear even the weight of the bed-clothes upon the affected part. Towards morning the pain diminishes, and the patient breaks out in a perspiration and falls asleep. The following day the affected joints are found to be red and swollen, but the pain is a great relief from that of the previous night; they continue in this way until evening, when the scene of the previous night is re-enacted. After a week of this suffering the patient is generally temporarily freed from his trouble; the redness and swelling gradually subside, and the upper layer of the skin peels off and itches greatly. The patient now feels better than he did before the attack. After repeated attacks the disease may degenerate into chronic gout, in which the attacks are quite frequent; there is a purplish appearance of the affected joints, and, owing to synovial effusions and deposits of lithate of soda, they are œdematous and deformed. Abscesses frequently form in or about the joints, and concretions of urate of soda may escape from them when opened.

Nervous gout, also called atonic, anomalous, or irregular gout, is a name given to a variety which occurs in persons of hereditary gouty tendencies, in whom the debilitated constitution is not in a condition to develop a normal attack of gout. It generally occurs in nervous and poorly-nourished individuals, and appears as dyspepsia, cough, etc., accompanied by palpitation of the heart, irregular pulse, dizziness, syncope, etc. It is this variety which sometimes proves fatal.

The only disease with which gout could be confounded is rheumatism, but it differs from it in the following points: "(1) Rheumatism affects chiefly the young or middle-aged; gout, the elderly. (2) Rheumatism prefers the larger joints; gout, the smaller, and especially the feet and hands. (3) Gout is attended with more obvious disorder of the digestive organs; the pain is of a more burning character, and the swelling greater and more vividly red."

The treatment may be divided into two stages—viz. that during the paroxysm, and that during the interval between the paroxysms. In speaking of the treatment during the paroxysm, Trousseau asks the question, "Should we treat it?" and comes to the conclusion that we should not use any medicinal agents if we wish to do full justice to our patient. Colchicum is the favorite drug used to cut short the attack, and it has obtained a well-deserved reputation for it; but when the paroxysm has been brought to a premature termination by the use of this drug, it invariably returns sooner and with renewed violence; whereas otherwise the intervals between the paroxysms increase and the severity decreases. Should we, then, do nothing for the sufferer? Yes: we can regulate his diet and keep his bowels open, and if the pain is excessive, it may be relieved by opiates. By this method of treatment we shall accomplish more in the long run than if we had resorted to stringent measures to cut short the paroxysm. In the treatment during the interval between the paroxysms we should likewise discard all drugs. Attention should be paid to the diet and regimen of the patient; he should take his meals regularly; should eat plenty of vegetables, meat but once a day, and should abstain from alcoholic drinks, especially ale and beer, and take a certain amount of exercise in the open air daily. Particular attention should be taken to keep the bowels regular. EDWARD J. BERMINGHAM.

Gouverneur, post-v. and tp. of St. Lawrence co., N. Y., 34 miles S. E. from Ogdensburg, on the Rome Watertown and Ogdensburg R. R. It has a bank, 2 newspapers, a seminary, several large mills and shops, 5 churches, 3 hotels, 9 stores, etc. Pop. of v. 1627; of tp. 3539. F. E. MERRITT, PUB. "TIMES."

Gov'an, town of Scotland, in Lanarkshire, on the Clyde, 2 miles distant from Glasgow, of which it almost forms a suburb, and on which all its business depends. Pop. 7636.

Gove, county in the W. of Kansas. Area, 900 square miles. It is watered by the Smoky Hill and its tributaries, and traversed by the Kansas Pacific R. R.

Gov'ernment. The first proper step in all philosophical inquiry, as well as in all discourse, of whatever character, undertaken for the elucidation of truth, is to set forth as clearly and distinctly as possible the meaning of the words and terms used in the expression of the views presented, from which successive conclusions are to be logically drawn. This is the work of definition, and it is no less essential in moral and political investigations than it is in mathematical. It is indeed the beginning of progress in every department of learning, whether moral, intellectual, or material. Government, then, in its true and most comprehensive sense, may be said to be the operation of laws. Law, in its most general and comprehensive sense, according to very high authority (Blackstone), "signifies a rule of action, and is applied indiscriminately to all kinds of action, whether animate or inanimate, rational or irrational. Thus, we say the laws of motion, of gravitation, of optics or mechanics, as well as the laws of nature and of nations."

In a like general sense, with equal correctness, we speak of the government of the mind, of the passions, of a church or a state, as well as of the government of the universe. It is in each case the operation of those laws by which action, in its every sphere whether moral, intellectual, or material, is controlled. In the restricted sense in which it is proposed in this article to treat of government, and of the laws which shape its form as well as control its action, the term is intended to be applied only to the government of men in their relations, conduct, and intercourse with each other in organized society.

By government in this restricted sense, therefore, is meant the exercise of that inherent, absolute power existing in every distinct and separate organized society or state, of self-determination and self-control for self-preservation which springs by nature from its own social forces, and the laws which control their action.

Every single individual person is a complete living organism within itself, endowed by nature with vital functions and powers of self-determination for its own preservation. But man, by nature, is less capable of self-preservation singly, by himself, than jointly, with others. Mutual protection and mutual interests, therefore, form the natural and only just basis for all organized associations of individuals of the character named. An organization when so formed constitutes a separate community, properly denominated a state, nation, commonwealth, or kingdom. It is to all intents and purposes an organism composed of the individual organisms that enter into it. It becomes a political and moral person, subject not only to its own special laws, but also to the general moral law to which all human action is subject, and which prescribes the limitations of natural justice. As each single organism in its powers of self-determination is controlled by its own internal laws respectively, so the aggregate organism is controlled in its powers of self-determination by those social forces or laws which give existence and life to the separate commonwealth, state, or kingdom so constituted. The operation of these laws in such a political organism, in its origin as well as in its after-growth and development, physically, intellectually, and morally, is what is understood by the government of such state. The controlling power—the paramount authority, the "*jus summi imperii*"—in each state so organized, is what is known as the sovereignty thereof.

Sovereignty, then, may be defined to be that inherent, absolute power of self-determination in every distinct political body, commonwealth, state, or kingdom coming into existence by virtue of its own social forces, which, in pursuit of the well-being of its own organism, under the universal moral law, cannot be rightfully interfered with by any other similar body without its consent. Sovereignty, in every such body politic, organized society, or state, is that innate attribute of the commonwealth or aggregate organism which corresponds with the will and power of self-action in the personal organisms so constituting it; and by its very nature is indivisible: just as much so as the *mind* is in the individual organisms respectively. The limitations of natural justice prescribed by the universal moral law apply as well to the political persons of organized societies as to separate individuals in a supposed state of nature. In the organization of single societies, whatever may be the form assumed, the act itself is known as the social compact. The type or form of government so instituted, at first, and in its after developments, in all cases depends upon the nature and character and relative power of the social forces from which its existence springs. These forces are threefold, to wit: moral (or religious), intellectual, and physical. As these forces relatively predominate in the formation of society, so will be the character of its organic structure. This organic structure is what in all cases is known as the *constitution* of each particular state or kingdom, whether it be written or unwritten; and the sovereign power is exercised through the channels established for it by this constitutional structure, which becomes the fundamental law of the organization until changed by the same social forces which brought it into existence. In the beginning, when the physical predominates, a monarchical form of government is almost the necessary development. When the intellectual and moral predominate or are equally balanced, mixed forms of government of some sort are the consequent development. The study of these laws and the various forms of government springing from them has occupied the attention of the profoundest thinkers from the earliest times. The subject constitutes a science of the utmost importance, as nothing of an earthly character more deeply involves the interests of every people than the government under which they live. From this chiefly spring all those institutions, moral, intellectual, and material, which mark the progress of their civilization.

It is not the purpose of this article to do more, after the foregoing premise, than briefly to set forth, (1) some general views on what should be the objects of all governments of whatever form; (2) to present some of the essential principles of governments constituted for such objects, without reference to their forms; and (3) to present an outline view of the different forms of government heretofore and now existing, with their defects so far as concerns the achievement of the proper objects of their institution.

1. It having been shown that all organized societies, and the governments resulting therefrom, are founded upon the basis of the better protection and enjoyment of the individual rights of their constituent members, the conclusion clearly follows that the chief object in every case should be the security and maintenance of all "those absolute rights which were vested in them by the immutable laws of nature." These consist of the rights of things as well as the rights of persons—the right of property as well as the rights of life and liberty.

Many writers maintain that individuals, upon entering into society, give up or surrender a portion of their natural rights. This seems to be a manifest error. In forming single societies or states men only enter into a compact with each other—a social compact—either expressed or implied, as before stated,—for their mutual protection in the enjoyment by each of all their natural rights. The chief object of all good governments, therefore, should be the protection of all the natural rights of their constituent members; or, in other words, the object in all cases should be the establishment of what may be styled civil liberty, which is nothing more nor less than natural liberty secured by the guarantee of all the powers of organized society. No person has any natural right wantonly to hurt or injure another. The object of society and government is to prevent and redress injuries of this sort: for, in a state of nature, without the superior restraining power of government, the strong would viciously impose upon the weak. Wrongs upon rights could not be so efficiently prevented nor so adequately redressed. Upon entering into society, however, for the purpose of having their natural rights secured and protected, or properly redressed, the weak do not give up or surrender any portion of their priceless heritage in any government constituted and organized as it should be.

A succinct view may here be pertinently presented of what should be the correct understanding of what is termed civil liberty. There are few themes upon which more has been said and written than this, and few, it is believed, upon which less has been distinctly and correctly stated. Many definitions have been given to the terms liberty, natural liberty, civil liberty, and political liberty. Many of these definitions, put forth by learned men, seem to be exceedingly erroneous, many more exceedingly confused, while only a few, rightly understood, express the truth. The erudite Mr. Markham, archbishop of York, for instance, defines or states his idea upon the subject in these words:

"Civil or legal liberty is that which consists in a freedom from all restraints, except such as established law imposes for the good of the community, to which the partial good of each individual is obliged to give place."

This definition conveys the idea that upon the formation of organized societies individuals give up some of their natural rights, and that the main object of such societies and governments should be the security of the greatest good to the greatest number. It clearly implies at least that the good of some must, occasionally, be sacrificed to the greater good of the greater number. Few heresies or dogmas in the science of government are more erroneous or more mischievous in their tendencies than this very specious doctrine, which to most minds seems to be so well founded. The great object of government, properly stated, should be to secure the greatest good to every member of society which can possibly be accomplished without injury to any. No ninety-nine persons whatever have any natural right to advance their interest or good by inflicting an uncompensated injury upon the hundredth, nor in any other proportion.

Another learned writer on this subject, Dr. Paley, changes the language somewhat, but gives in effect the same definition of civil liberty as that given by the archbishop of York.

Paley says: "Civil liberty is the not being restrained by any law but what conduces in a greater degree to the public welfare."

This implies that the state may, by just enactment, inflict a positive, unrequited injury upon one or more of the community, if the general "public welfare" can be promoted thereby. This definition, therefore, from what has been just stated, requires no further notice here.

Judge Blackstone's definition is in these words:

"Political, therefore, or civil liberty, which is that of a member of society, is no other than natural liberty so far restrained by human laws (and no further) as is necessary

and expedient to the general advantage of the public." This definition more nearly approximates the truth than either of the others; and yet it is defective, not only in this, that it embraces the same erroneous implication, but also confounds political and civil liberty, or treats them as the same. These words, when accurately applied, express very different and distinct ideas, which should ever be kept in mind in all investigations or reflections upon the subject. A member of society may be in full possession of perfect civil liberty, and yet without any political right whatever in the proper sense of that term; as is the case with women and minors generally, as well as mere denizens in most free states. This error of the great commentator on the laws of England, in his definition of civil liberty, by leaving in it the implication stated, seems to have crept in more from an indisposition on his part openly to assail or depart from authority, than from his own deliberate judgment. For it is inconsistent with what he affirms should be the principal aim of all governments. This, he says, "is to protect individuals in the enjoyment of those absolute rights which were vested in them by the immutable laws of nature." Of course no human laws can rightfully be set up for any purpose against any of the "immutable laws of nature." The error of this definition is also not a little remarkable from the fact that the author cites, as authority for it, what is given as the substance of the definition set forth in the Justinian or Roman code. That definition, as it stands in a foot note to the author's text, certainly excludes the implication referred to, when rightly construed. As it there stands it is in these words: "*Facultas ejus, quod cuique facere libet, nisi quid jure prohibitur:*" the proper meaning of which clearly is, "the faculty of each one to do what each one pleases except what is rightfully prohibited." Dr. Paley and those of his school seem to construe *jure* in this definition, as if the Latin word had been *lege*, hence their ideas that civil liberty consists in all the members of society doing what they please except in so far as they may be restrained by any law of the commonwealth that "conduces in a greater degree to the public welfare," whether such law be founded upon natural justice or not. This yields the whole question of right to might. *Jure* in Latin has a very different meaning from *lege*. If the draftsman of the definition under consideration had had the same idea of it which Dr. Paley and others seem to have entertained, he would doubtless have used the word *lege* instead of *jure*. As it stands the definition was evidently intended to convey the idea that where civil liberty is enjoyed every member of society is permitted to do everything which he or she pleases, except what is "rightly prohibited;" and, by the laws of nature, most manifestly no one can be rightly prohibited from doing anything except what interferes with the rights of others. Burlamaqui's definition of liberty, in the sense in which it is now treated, seems fully to cover the whole ground with clearness as well as accuracy. He says, "Moral or natural liberty is the right which nature gives to all mankind for disposing of their persons and property after the manner they judge most consonant to their happiness, on condition of their acting within the limits of the law of nature, and that they do not any way abuse it to the prejudice of any other men."

The great truth that all men are created equal must ever be borne in mind in investigations upon this subject. This equality, as is manifest, does not consist in size, form, or any personal characteristics, in a physical, moral, or intellectual view. It does, however, consist in an equal right in the administration of justice. Justice is the great regulator in the government of human affairs, as gravitation is in the government of the material universe. The same simple law of gravitation which moulds an atom also shapes a world. To the silent but potent influence of the same magic principle are due that harmony and concord which pervade the planetary and stellar spheres. In like manner, justice, rightly administered, stays discord and produces peace, quiet, order, and happiness in communities, states, and kingdoms. The rule of justice is the divine injunction, applicable alike to all: "As ye would that men should do to you, do ye also to them likewise."

An inquiry into what particulars certain classes, such as are to be found in all communities, from want of sufficient mental and moral development can be rightly and therefore justly restrained in their volitions and actions for their own good as well as that of the rest of society, and which their natural rights in point of fact require (as in the case with children, to say nothing of others), would lead to the gravest problems which ever engaged the attention of philanthropists, lawgivers, and statesmen. That, however, lies not within the scope of this article. The *principle* which should govern in every case is all that is at present intended to be set forth.

II. In considering the essential principles upon which all governments should be founded, with a view to the objects of their formation, as before stated, and without regard to their peculiar or specific types, the following may be set forth as a few of the most prominent of them to which attention should be directed: 1st, The basis should be the fundamental principle or truth that the sovereignty or governing power is an attribute of the entire aggregate organism where it existed in the beginning and ever remains in every case, and can never be justly assumed to become vested in any one or more of its constituent members. 2d. From this follows another essential principle or truth, that all governments derive their "just powers from the consent of the governed." 3d. These principles or truths being established, it further follows that all exercise of governmental power is a trust, and can be justly exercised only for the benefit of the governed.

The exercise of all powers with which any rulers are clothed or vested are held by delegation from the ruled, either tacitly given or formally expressed. Office so called therefore in all cases in kingdoms or republics is matter of trust and not of inherent right on the part of any one who performs its functions. 4th. Another of the essential principles or truths referred to, and the only remaining one which will be here mentioned, is this, that while sovereignty itself is indivisible, as has been shown, yet its powers are divisible. It is a point of no inconsiderable importance in discussions of this kind to bear constantly in mind the difference between the powers of sovereignty and the great source itself from which these powers emanate. The three chief powers of sovereignty when properly divided may by appropriate classification be termed the law-making power, the law-expounding power, and the law-executing power. In all properly constituted governments the exercise of these powers should be confided to distinct, separate, independent, coequal, and co-ordinate departments, known as the legislative, judicial, and executive. The powers exercised by each of these separate and distinct departments are equally sovereign, and when so divided and exercised they constitute the trinity in unity of organized society and present the grandest feature in governmental structures.

III. In the last view proposed to be taken of the subject in this article it is not intended to go into minute details concerning the different forms and various types of governments as exhibited in the history of mankind. An outline sketch of their general character only is intended. The most marked differences between them are those which indicate the propriety of their being arranged generically into two classes—single and confederated. A single government is that of a separate and distinct state or kingdom founded upon the social compact. A confederated government is that of a union of two or more single governments founded upon what is known as the federal compact. Writers usually divide single governments into five general kinds—to wit, monarchies, aristocracies, or oligarchies, as they are sometimes styled, democracies, republics, and mixed governments, or those partaking of the qualities of several of the others respectively. Monarchies are usually subdivided into various kinds, such as absolute, limited, hereditary, and elective. Democracies are also subdivided into several kinds. Two only of these kinds of the latter will be here mentioned—pure and representative. (See DEMOCRACY.) A pure democracy is where all questions pertaining to public affairs are decided by the body of the people in general assembly convened. A representative democracy is where the functions of government are performed by agents, deputies, or delegates selected by such electors from the body of the people as may be empowered to make the choice by the fundamental law or constitution. The power of choosing such deputies is what is known as the franchise. It is an office conferred by organized society, and therefore a matter of trust and not a matter of natural right.

Republics are but a species of democracy, and may be subdivided into various kinds. The two most general of these kinds are those which distinguish all governments—single and confederated. The great and leading object of confederation of any sort, applicable alike to republics and all other forms of government, is the better to protect and maintain the great inherent right of self government or self determination possessed by each of the parties entering into it, just as the great and leading object of all single governments formed by the social compact is the better to protect and maintain inviolate the innate, absolute, and indestructible rights of the individuals entering into organized society. What is known as the natural rights of individuals corresponds with what may be characterized as the sovereign rights of states or kingdoms.

Confederated republics, of some kind, organized for these purposes, have existed from the earliest times of which history has taken any notice. A characteristic feature of all of them, until recently, was that under the federal com-

pact no power was conferred, by the parties to it, upon the conventional state thereby created, to act directly in the execution of the powers that were conferred, upon the individual members of society or citizens of the several republics so confederating respectively. This was left to the good faith of each of the parties severally, and it was found to be a great defect in the workings of this kind of confederations. This form of confederation is what, by the German publicists, is styled a Statenbund or States' union. To remedy these defects in some degree, another form of confederation has been resorted to, characterized by the same writers as a Bundeestaat, or federative union, in which the entire sovereignty of the separate states is merged in the new and conventional state so created. It was reserved for American statesmen in the latter part of the last century to remedy the evils of both the Statenbund and Bundeestaat systems, under what is known as the federal constitution of 1787, with the amendments subsequently ratified in pursuance of its provisions. Space will not allow any extensive consideration of the striking and wonderful new features in this model of federal republics. Suffice it to say that, anterior to 1789, when the new constitution of 1787 went into operation, the U. S. of America, after the declaration of their independence, was a confederated republic upon the model of that set forth by Montesquieu, Vattel, and others: or, in other words, they constituted what the Germans style the Statenbund. The defect or "vice" of this system was the want on the part of the general government of the power to execute, by its own functions and machinery, the many other specific powers which had been conferred upon it under the first Articles of Confederation. The great fundamental changes made in the constitution of 1787 or 1789 were the clothing of the Federal government with this additional power; and the creation of the necessary machinery for its execution. This required a subdivision of all powers conferred upon the general government, limited and specific as they were, into legislative, judicial, and executive departments, and by the arrangement the Federal government is now empowered within its limited sphere to act as directly upon the citizens of the States respectively as the States are on all other matters reserved to themselves and not confided to the general government. Another peculiarity of the American systems, applicable alike to the general and State governments, is that in the subdivision of the sovereign powers before referred to, the judicial power is co-ordinate and coequal with the others. No one of them, in its assigned sphere, is superior to the other, in either the Federal or State governments. This is another new feature in American politics. In all other countries where a judiciary exists it is held to be subordinate to what is called the political power of the state. This is not so under American institutions. (See CONSTITUTION, Vol. I.)

In conclusion of this article, suffice it to say in reference to the new American model of a confederated republic that it is far in advance of anything ever before developed in the annals of history. It presents an entirely new species of confederated republics. It rests, as the French philosopher, De Tocqueville, said, upon "a wholly novel theory, which may be considered as a great discovery in modern political science," and for which there is as yet no specific name. His language is:

"This constitution, which may at first be confounded with the federal constitutions which have preceded it, rests, in truth, upon a wholly novel theory, which may be considered as a great discovery in modern political science. In all the confederations which preceded the American constitution of 1789, the allied states, for a common object, agreed to obey the injunctions of a federal government; but they reserved to themselves the right of ordaining and enforcing the execution of the laws of the Union. The American States which combined in 1789 agreed that the Federal government should not only dictate but should execute its own enactments. In both cases the right is the same, but the exercise of the right is different; and this difference produced the most momentous consequences." "The new word," said he, "which ought to express this novel thing does not yet exist. The human understanding more easily invents new things than new words, and we are hence constrained to employ many improper and inadequate expressions." (See CONSTITUTION U. S., Vol. I.)

Lord Brougham seems to have been similarly impressed with the novel character of our confederate republic in its specific differences from all others which had preceded it, when in speaking of it he said: "It is not at all a refinement that a federal union should be formed; this is the natural result of men's joint operations in a very rude state of society. But the regulation of such a union upon pre-established principles, the formation of a system of government and legislation in which the different subjects shall be, not individuals, but States, the application of legislative principles to such a body of States, and the devising means for keeping its integrity as a federacy, while the rights and powers of the individual States are maintained entire, is the very greatest refinement in social policy to which any state of circumstances has ever given rise, or to which any age has ever given birth." (See idem.)

From this exposition very clearly appears the proper solution of the vexed question whether the U. S. constitute a nation or not. It is clearly seen not only that they do constitute a nation, but also what sort of a nation it is. It is not a nation of individuals blended in a common mass, with a common sovereignty springing from the whole, but a nation, the constituent elements or members of which are separate and distinct political organizations or States united under a federal compact, on a model never before exhibited. It is a nation of States, or what is the same thing, a nation of nations—a nation of the highest and grandest type ever before known among men.

Among the works upon this subject which readers can consult with profit may be cited — Aristotle's *Politics;* Plato's *Republic;* Cicero *On the Commonwealth;* Grotius on the *Rights of War and Peace;* Puffendorf on the *Elements of Universal Jurisprudence;* Montesquieu's *Spirit of Laws;* Rutherford's *Institutes of Natural Law;* Machiavelli, and the works of Filmer, Locke, Mackenzie, and Sidney on government; Rousseau on the *Social Compact;* Vattel on the *Law of Nations;* Guizot on *Representative Government* and his *History of Civilization;* Hallam and Creasy and De Lolme on the *British Constitution;* De Tocqueville's *American Democracy;* Lord Brougham's *Philosophy of Government;* William Smith O'Brien and John Stuart Mill on *Representative Government;* Tucker's and Sharswood's editions of Blackstone; John Taylor, in a work entitled *Constructor Construed;* Calhoun on *Government;* Calhoun's, Webster's, and Hayne's speeches in the Senate of the U. S. in 1830 and 1832; Stephens's *Constitutional View of the Late War between the States;* Dawson's edition of the *Federalist;* the *Madison Papers;* Elliott's *Debates on the Ratification of the Constitution in the Several States;* and Jamison's *Constitutional Convention.* ALEX. H. STEPHENS.

Gov'ernment's Isl'and, properly **Rock Island,** an island in the Mississippi River, lying between Rock Island, Ill., and Davenport, Ia. The island belongs to the U. S. government and contains splendid U. S. armories and arsenals. It was used as a military prison during the civil war. The island is reached by several excellent bridges. It is 3 miles long, and has a very fertile soil. Area, 960 acres. It is in Rock Island co., Ill. Pop. 165.

Gov'ernors. 1. Governors [Ger. *der Regulator, der Gouvernator, der Moderator;* Fr. *moderateur,* m., *regulateur,* m.) are instruments attached to prime movers for the purpose of preserving regularity of motion by adjusting the amount of power exerted to the resistance to be overcome, where the latter is variable. They are a more economical class of regulators than brakes, which accomplish a similar result by absorbing and wasting an excess of power, which must always exist where the speed is intended to remain invariable under a variable load.

2. Governors differ, as regulators, from fly-wheels in preserving uniformity of motion without necessarily permitting change of mean speed. The latter form of regulator necessarily permits variation, which becomes greater as the weight and speed of the wheel are smaller in proportion to the changes of energy, and is rarely so small as to make the governor unnecessary.

3. Governors are usually intended to produce, as nearly as possible, absolutely uniform speed. None do so perfectly, but the approximation to uniformity is frequently very close. A good governor should not permit a variation of 5 per cent., even when the load is entirely thrown off, and 10 per cent. is generally considered the maximum range. Marine-engine governors are usually intended to prevent very sudden and very great fluctuations of velocity, rather than to preserve an exact rate of speed. Rankine designates the latter class "fly governors," to distinguish them from the other forms called *governors proper.*

4. Governors proper are divided into three classes—*position governors, disengagement governors,* and *differential governors.* Position governors are those in which the position of the regulating valve or regulating piece is determined by rigid connection with the governor; as, for example, the common fly-ball governor used upon the steam-engine. Disengagement governors are those which, when the speed rises above a certain fixed maximum, throw into gear a train of mechanism which shuts off the supply of impelling fluid, and causes a diminution of speed; and, when the speed falls below a stated minimum, it throws into gear another train producing the reverse effect. When at proper speed, neither train is in operation. The usual forms of water-wheel governors are examples of this class.

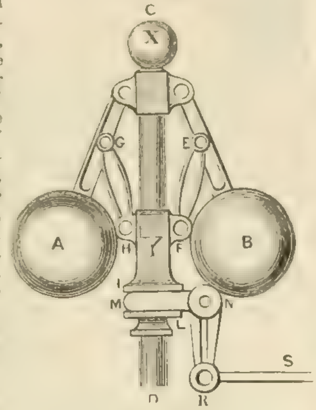
Differential governors are those which move the regulating mechanisms with a speed proportional to the difference between the actual and the proper speed of the engine.

5. A second classification divides governors into gravity governors—in which gravity and centrifugal force are opposed—and balanced governors, in which centrifugal force is balanced by a spring or by other force than gravity.

6. Pendulum governors are the oldest and most common class of governors. The conical pendulum, the centrifugal governor, or the fly-ball governor, as it is variously called, was invented by Huyghens about 1650, and applied by him to the regulation of horological mechanism. It was subsequently (1789) applied by Hooper to control the motion of windmills, and Watt about the same time (1784) applied it to the regulation of the steam-engine.

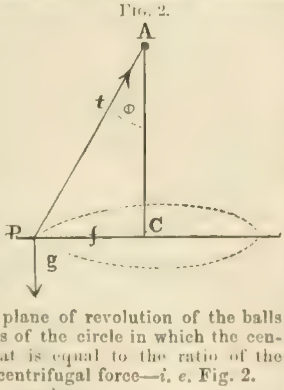
7. The pendulum governor consists of two heavy balls (A B, Fig. 1), suspended by short links from the spindle C D. Other links, E F and G H, connect with a sleeve H F in such a manner that any movement of the balls will produce a vertical movement of this sleeve, which is attached to an arm M N, forming part of the train of mechanism, M N R S, through which the adjustment of power is effected. In the case of the steam-engine the rod R S is attached to the "throttle-valve" or to the expansion gear; in the water wheel it connects with the mechanism operating the "gate" by means of which the supply of water is adjusted; in the windmill this train of mechanism changes the pressure existing between the millstones, or it changes the position or the area of the "sails."

Fig. 1.



Pendulum Governor.

Fig. 2.



8. In this governor there exists at every position, with uniform motion, an exact equilibrium of the vertical component of the force acting along the suspending arm B C, the force of gravity, and centrifugal force. The height of the point at which the line of the arm crosses the spindle—the virtual point of suspension—above the plane of revolution of the balls bears a ratio to the radius of the circle in which the centres of the balls move that is equal to the ratio of the weight of the balls to the centrifugal force—*i. e.* Fig. 2.

$$t \sin\theta - \frac{m v^2}{r} = 0,$$

$$t \cos\theta - m g = 0,$$

$$v^2 = \frac{g r \sin\theta}{\cos\theta} = g . A P \frac{\sin^2\theta}{\cos\theta},$$

$$\text{and } t = \frac{2\pi r}{v} = 2\pi\sqrt{\frac{A P \cos\theta}{g}} = 2\pi\sqrt{\frac{A . C.}{g}}$$

The number of revolutions per second $N = \sqrt{\frac{0.815}{H}}$, and the height of the point of vertical suspension above the plane of revolution of the balls $A C = H = \frac{0.815}{N^2}$ foot $= \frac{9.78}{N^2}$ inches $= \frac{0.248}{N^2}$ mètres. Also $H = \frac{35186}{R^2}$, where H = height in inches and R = number of revolutions per minute, and $\frac{187.5}{\sqrt{H}} = R$.

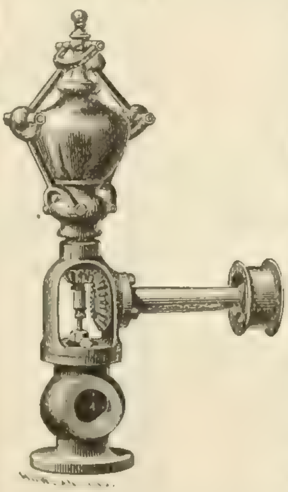
9. The speed of the governor should be carefully determined, either by experiment or by calculation, when first designed, in order that the transmitting mechanism which determines the velocity ratio of governor and driving-shaft may be precisely proportioned to its work.

10. The weight of balls is determined by the character of the resistance to be overcome. It is proportional to the resistance to be overcome, but can seldom be calculated, and is usually determined by experiment.

The simple pendulum governor has comparatively little power, and does not give truly isochronous motion. Being rigidly connected with the regulating valve, the speed can only be precisely maintained under one set of conditions. Any variation of load or of steam-pressure will produce a limited but unavoidable change of speed. The limits of variation are determinable by the arrangement of the connecting mechanism, and are usually but slightly removed from the proper speed.

11. To secure greater sensitiveness and strength in action a weight is sometimes mounted upon, or suspended from, the collar I L (Fig. 1), which enables the speed of the governor to be greatly increased with the same height of suspension and with a smaller size of balls, giving, at the same time, quickness and much greater strength of action. This form was introduced by Charles T. Porter of New York, and has been extensively adopted both in the U. S. and Europe. It is shown in Fig. 3. In this case the effect of gravity is increased, while the effect of centrifugal force, at the same speed of revolution, remains unchanged, and the height $A C$ is increased in the ratio $A + \frac{A W}{W'}$ to 1; A representing the ratio of increase of the action of gravity, W the weight of balls, and W' the total weight of balls and the increased action of gravity produced by the added load. Then, $H = \frac{9.78}{N^2} \cdot \frac{W + W'}{W'}$. A change of speed in the engine causes a greater change of position of balls than in the unloaded governor, in the proportion of W' to $W' + A W$. The governor is thus rendered more sensitive in this proportion. The suspending arms of this governor are forked, and the pins are thus made double. This construction is no less an essential feature than the preceding. It enables sudden variations of speed to produce change of altitude without serious retardation due to friction on the joints. Another important advantage possessed by this instrument is the comparatively slight resistance to change of speed, which is a consequence of the comparatively small weight of balls and of their small orbit. Strain upon the connecting gearing, or slipping of the governor-belt, is thus avoided, and the governor is enabled to act promptly and effectively where the ordinary form would be slow in action, or where it might break its belt and cease to act.

Fig. 3.



12. Approximate isochronism is secured in the governor of Farcot of Paris by crossing the arms, thus carrying the points of suspension of each ball to the opposite side of the vertical spindle from the ball, and thus causing the trajectory of the ball, as it rises and falls in its circular orbit, to coincide with the paraboloid of which the subnormal is equal to the altitude A C (Fig. 1). This form of governor is used to some extent in Europe. In the Farcot governor minor adjustments are secured, to eliminate faults in its action due to the arrangement of the mechanism transmitting movement of the controlling valves. The links connecting the ball-rods to the collar on the main spindle are crossed, and a helical spring on the spindle resists slightly the tendency of the balls to rise, its tension increasing as the balls separate.

Precise isochronism is obtained by the parabolic governors, in which the height H remains constant in all positions. In these governors the path of the balls in the vertical plane is such that they describe the arc of a parabola. The height A C (Fig. 1) is then the subnormal of this parabola. The subnormal is of constant magnitude, and only at that speed which gives a height H equal to this quantity is a position of equilibrium held. It consequently follows that any change of speed from that due the height A C will destroy equilibrium, and it can only be restored by a return to the proper speed. These governors therefore continue their action upon the connecting mechanism until normal speed is obtained or until the extreme of their range is reached. An altitude of the points of suspension above the plane of motion of the balls equal to twice the focal distance of the par-

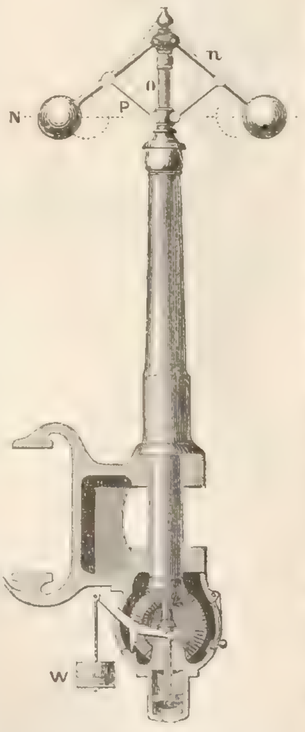
abola is the only one in which the balls can remain steady. The force with which the balls tend to move is proportional approximately to $\frac{W\delta}{N}$, in which W is the aggregate weight of balls, δ is the amount of deviation of speed, and N the proper speed of revolution.

The balls are given their parabolic path in Davey's governor by suspending them from a spindle by steel springs, which, as they diverge, unwrap from the edge of a guide-cheek having the form of the evolute of the parabola. The balls may also be carried on a guide-curve, as in Madden's governor.

The parabolic governor may be loaded, like Porter's governor, to obtain higher speed of rotation, and increased strength and sensitiveness. This will produce an increase of altitude in the proportion of the aggregate new weight to the original weight, and the speeds of revolution will be increased as the square root of those quantities. The added load gives a means of adjustment of speed by varying the amount of that load. A common method of applying it is by means of a sliding weight upon a lever, thus making the load upon the governor easily and accurately adjustable. By causing the balls to move in a high portion of the parabolic arc, also, increased strength of action and sensitiveness may be secured. Since the centrifugal force varies inversely as the square of the periodic times, the greater the speed of revolution thus secured, the greater the power of the governor. Smaller balls can thus be used with higher speed, as in the loaded pendulum governor, and their less weight gives greater sensitiveness, in consequence of their slight inertia, as well as because of their greater speed of revolution.

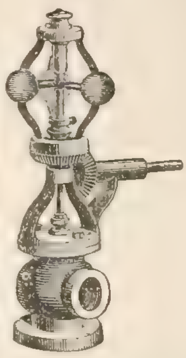
In the Babcock & Wilcox governor the balls always move in a horizontal plane, as shown in Fig. 4; the ball rods, n n, being jointed to a spindle, o, which slides vertically within a hollow driving-spindle, and which is counterbalanced by weights at w, carried in a scale-pan on the end of a lever, through which they act upon the lower ends of the sliding spindle. The ball-rods are jointed at the middle to links P, which are secured at their opposite ends to the main driving-spindle, which takes its motion, through bevel gearing and intermediate shafting, from the main shaft of the engine. A dash-pot, seen at the foot of the sliding spindle, prevents sudden fluctuations of speed from throwing the governor beyond the proper position for adjusting speed, and prevents the oscillation of speed which attends the use of very sensitive governors not thus controlled. When the engine is precisely at speed the action of centrifugal force is equilibriated in every position by the action of the weight. At any other speed this equilibrium is destroyed, and the action of the governor is similar to those just described. It continues acting until the proper speed is resumed, or until it reaches the extremity of its range. Adjustment of speed is obtained by varying the weight upon the scale-pan.

Fig. 4.



Pickering's governor (Fig. 5) is the invention of Mr. T. R. Pickering of New York. In this governor the balls are carried upon flat springs which are curved in the form of a double cyma, and are attached at one extremity to the vertical driving-spindle, and at the upper end to a sliding collar which supports the stem of a balanced throttle-valve. The peculiar form of spring employed keeps the parts in proper relative position, and permits the use of steel so thin that it is not liable to "set" or break. Where an increase of centrifugal force is required, it is obtained by increasing the number of springs, using two or more together for each ball. Three balls are generally used. This governor has the sensitiveness and strength of the loaded pendulum governor, and is cheap in construction. It has come into extensive use in the U. S.

Fig. 5.



Silver's marine governor in its earlier form consisted of two crossed arms carrying balls at each extremity, and balancing about the pin by which they were carried on the spindle. The action of centrifugal force was balanced by a helical spring coiled upon the spindle. It was designed to regulate the engines of steam vessels, and was one of the earliest introduced.

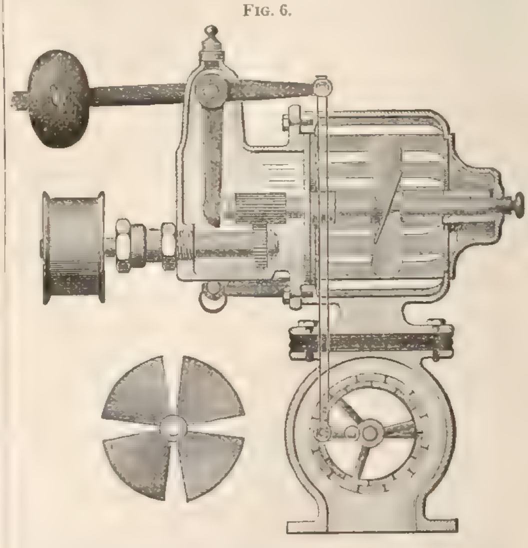
In the chronometric governor a train of gearing is driven by a clock or other uniformly moving apparatus. Another train is driven by the engine or machine to be regulated. The two trains are connected by intermediate mechanism in such a manner that, so long as both move at the same speed, no motion of the intermediate gearing occurs. A difference of velocity in the two trains being produced by a change of speed of the engine, a motion of the intermediate gear takes place, adjusting the regulating apparatus to restore the proper speed. This arrangement evidently gives isochronism.

In Siemens' differential pendulum governor the balls of a pendulum governor are suspended within a cylinder, and their friction against its interior surface produces a resistance which, acting through a "dynamometer train," moves the valve. In the governor of Prof. Sir Wm. Thomson the principles illustrated in Siemens' governor are applied to a governor attached to physical apparatus.

Hydraulic governors are of several forms. They usually consist of a pump or bellows which forces water or oil into a reservoir, from which it issues at a uniform rate by an orifice the size of which is adjustable. At the proper speed the liquid is pumped into the reservoir at precisely the speed at which it issues from it. An increase of speed produces an excessive supply, and a decrease of speed causes a deficiency of fluid to be forced into the reservoir. Connected with the reservoir is a pump-barrel containing a weighted piston or plunger. As the reservoir fills this piston is forced up and shuts off the supply of steam or water. As the reservoir empties itself the loaded piston descends, opening the supply-valve. The "Pitcher hydraulic regulator" is of this form. These governors are isochronous.

A hydraulic governor of quite a different form has come into considerably extensive use in the U. S. This is the Huntoon governor, shown in Fig. 6. A screw, resembling the ordinary screw-propeller in form, revolves in a horizontal cylinder filled with oil. The shaft on which it is mounted is arranged to slide longitudinally, and thrusts against a vertical arm which is connected with a horizontal lever carrying a weight. Motion is communicated to the screw through a pulley-shaft which gears into a pinion on the screw-shaft. As the screw revolves it tends to traverse

Fig. 6.



the cylinder in the axial line, and this tendency becomes greater or less as the resistance of the liquid increases or diminishes with changes of speed. At the proper speed this resistance is just sufficient to counterbalance the weight. A greater speed raises the weight, and a slower speed allows it to fall. These movements are transmitted by a vertical link to the arm of a register throttle-valve, by means of which the supply of steam is adjusted to the requirements of the engine. Fig. 6 exhibits a sectional view of this governor, accompanied by a separate sketch of the screw. This governor is theoretically perfectly isochronous. So long as the engine does not run at speed, the valve will be kept moving, and it will either bring the engine to speed or will reach the extremity of its range. Practically, isochronism is somewhat interfered with by the friction of the parts. In another form of this governor a paddle wheel takes the place of the screw; both forms are in use.

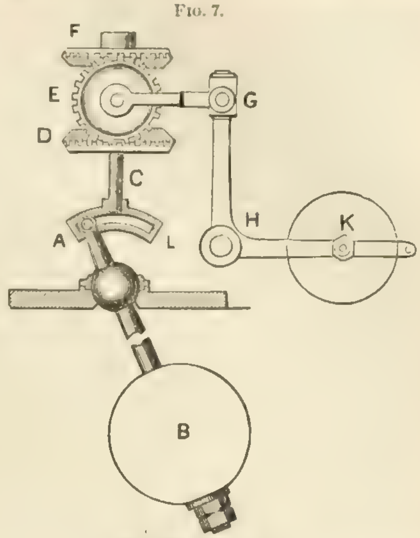
Pneumatic governors, in which the resistance of air is made useful in producing an equilibrium with the force exerted by a weight or spring, are of several forms. The best known form consists of several hemispherical cups carried at the outer ends of radial arms revolving about a central spindle, as in the anemometer. At the proper speed the resistance of the air is just sufficient to counterpoise a weight attached to the apparatus, while at higher or lower speed the rise or fall of the weight moves the mechanism connecting the governor with the supply-valve.

The marine steam-engine requires a governor of somewhat different qualities from those demanded in the regulation of the stationary engine. The motion of the marine engine when the vessel is in smooth water is uniform so long as the pressure of steam remains constant, as there is then a perfect uniformity in impelling power and of resistance, and no governor is required. At sea, however, in rough weather, the vessel is tossed about by the waves, and meets with a varying resistance. Frequently, all resistance to the motion of the engine is removed by the pitching of the ship and consequent lifting of the propeller out of the water. At such times the engine, if uncontrolled, starts off with great velocity, causing danger of accident and a wasteful expenditure of steam. While revolving at this high velocity the engine is next suddenly checked by the return of the vessel to a position in which the propeller is again immersed, and the resulting shock is even more dangerous than that due to the effect of inertia at the higher speed. This is the kind of fluctuation of speed which the marine governor is intended to prevent. No governor in which gravity acts can be used at sea, on account of the motion of the vessel. The ordinary forms of balanced governors are not usually satisfactory, because the inertia of the heavy parts, which must be suddenly made to move at higher velocity when a "jump" of the engine occurs, is liable either to prevent their prompt action or to strain and break the connecting mechanism.

Momentum governors have been usually found most satisfactory. Silver's momentum-wheel governor is an illustration of this class. This consists of a fly-wheel fitted loosely upon a shaft driven by the engine. The wheel carries flat vanes, so set that the resistance of the air when they are turning at the proper speed shall just equilibriate the effort of a helical spring by which the wheel is connected to the shaft, and through which it is driven. Any sudden increase of speed taking place, the inertia of the wheel prevents a proportional increase of its velocity. The shaft "running ahead" of the wheel, the spring is coiled up; and this change is made, by suitable mechanism, to change the position of the throttle-valve. A sudden decrease of the speed of the engine occurring, the inertia of the fly-wheel causes it to overrun the shaft, and the spring is uncoiled and the throttle-valve opened. This governor has been very considerably used. It is sensitive and quick in action.

In Siemens' pendulum governor (Fig. 7) the arrangement of the epicyclic train DEF, through which the suspended ball B is moved, is such that E may move around the vertical spindle C between limits which are determined by stops fixed on either side. In this movement the arms G and K participate, and the throttle-valve is controlled by the movement of the rock-shaft E, which may be made a continuation of the valve spindle. The motion of the vertical spindle C produces rotation of the pendulum A B by means of the slotted curved link on crosshead A L. When the speed of the system is uniform, the resistance of the revolving pendulum produces a tendency in the intermediate wheel E to move in the direction G E, raising the weight K, and holding it counterpoised in a position which is determined for every case. When so running in equilibrium the slightest change of speed in the engine and the driving mechanism produces a change of relative position of C and D, in consequence of the inertia of the pendulum, which cannot change its rate without exerting a

FIG. 7.



Siemens' Governor.

resistance which moves the weight K from the ordinary position of equilibrum, opening or closing the valve promptly and effectively regulating the engine. This regulator is used in the Greenwich Observatory, England, for regulating a chronograph. It is extremely sensitive, and very powerful under sudden changes of velocity incurred by sudden, even although moderate, changes of speed.

The governor is used in steam-engines of the best class to determine the point of "cut-off," instead of moving the throttle-valve, which latter method produces loss of efficiency by "throttling" the steam and diminishing the gain due to higher pressure and greater expansion. In some cases the governor changes the position of the "eccentric" which moves the valve-gear. In other cases it adjusts the "link-motion," producing a similar change of action in the valve, and consequently in the distribution of steam. The attachment of a governor to a "detachable cut-off valve-gear"—with which arrangement the grade of expansion of steam is determined without necessarily demanding from the governor the employment of any considerable moving force—is the most generally satisfactory method of regulation of steam-engines. It has been suggested by Bourne that in condensing steam-engines it would be advantageous to so arrange the governor connections as to automatically adjust the supply of condensing water.

The force required in the regulation of water-wheels is so great that water-wheel governors are arranged to simply throw trains of mechanism connected with the motor into gear with the water-wheel gate, opening or closing it as required. R. H. THURSTON.

Gov'ernor's Isl'and, an island of Suffolk co., Mass., in Boston harbor, directly N. of Castle Island and of the main ship-channel or President Roads. It is occupied by fortifications (of which Fort Winthrop is the *keep* or réduit), forming part of the system of defence of Boston harbor and its maritime approaches.

Governor's Island, a small island in New York harbor, three-fourths of a mile S. of the southern extremity (now occupied by the esplanade known as the Battery) of the site of New York City (Manhattan Island), separated from Southern Brooklyn (Long Island) by a narrow (the Buttermilk) channel. A mile and a half westward are the small islands Ellis' and Bedloe's on the eastern margin of the extensive shoals known as the Jersey Flats, which constitute the western margin of the ship channel to New York City, which passes between it and Governor's Island. The prominent position of Governor's Island marked it out in early days as the key to the maritime defence, and it was occupied for such purposes by the Dutch. In 1614 they built their first rude fort on Manhattan Island, probably where the Battery now is, and doubtless, as their settlement increased, occupied Governor's Island. The English took possession in 1674, and under them the first regular fort, on the site of what is now Fort Columbus, was built, and the island (probably through the residence of the early governors, who were also military commanders) became known as Governor's Island. The present Fort Columbus (which has, however, since undergone extensive repairs and modifications), occupying the centre of the island, and Castle Williams, on the western point, were built in 1807-10

(as also Fort Clinton (Castle Garden) and Fort Gansevoort, 3 miles higher up) by Col. Jon. Williams, the first chief engineer of the U. S. army—an officer whose services have since been in a measure lost sight of, but who has many claims to the title, since given to the late Gen. Thayer, "father of the U. S. Military Academy." Castle Williams was the first "casemated" battery erected in this country, and was planned after the system of Montalembert, with which Col. Williams had made himself acquainted in France. This and other works of Col. Williams, though they have been superficially and ignorantly criticised, were really meritorious, and do not suffer by comparison with European structures of the same or even much more recent dates. Besides the fortifications and small garrison, the ordnance department has one of its dépôts here, and the island is also a rendezvous of the general recruiting service of the U. S. army. J. G. BARNARD.

Gow'an (Col. OGLE R.), b. about 1800 at Wexford, Ireland, was well educated, and became editor of the *Antidote*, a newspaper of Dublin; removed in 1829 to Canada; resided for a time in Escott, Leeds co., Ont., and afterwards in Toronto; was the founder of the Orange lodges of North America, and for twenty years their grand-master; sat 1834–41 in the Canadian Parliament; served against the insurrectionists of 1837–38; was for a time a post-office inspector, and afterwards a license-officer at Toronto.

Gowan'da, post-v. of Cattaraugus and Erie cos., N. Y., separated by the Cattaraugus Creek, 30 miles S. of Buffalo, on the Buffalo and Jamestown R. R. It contains a bank, a newspaper, a large agricultural implement and machine works, 2 tanneries, 3 hotels, 2 flouring mills, 3 churches, 4 carriage-factories, a cheesebox-factory, 3 saw-mills, a planing mill, a sash and blind factory, 27 stores, and many other smaller branches of business. It has splendid water-privileges. Principal business, farming and dairying. Pop. 934. JOHN S. FIDLER, ED. AND PROP. "GAZETTE."

Gow'deysville, post-tp. of Union co., S. C. Pop. 2647.

Gow'er, tp. of Cedar co., Ia. Pop. 957.

Gower (JOHN), an English poet, b. about 1327. The place of his birth is variously given as having been in Wales, Kent, and Yorkshire. He was probably a man of property, and it is said that he became chief-justice of the common pleas, and some state that he was knighted. He was a friend of Chaucer, who calls him "the moral Gower." His poetry was written in English, French, and Latin, the latter versified according to quantity. His principal work, undertaken by command of Richard II., who directed him to "book some new thing," was in 3 parts: the *Speculum Meditantis*, now lost; the *Vox Clamantis* (Latin), never printed entire, but existing in MS.; and the *Confessio Amantis*, completed 1394, first printed by Caxton (1483), best edition by Pauli, 1857. The Roxburghe Club in 1818 published his *Cinquante Balades*. He became blind in 1400, d. in Oct., 1408, and was buried in St. Saviour's Church, London, where his old monument still stands.

Gow'rie Conspir'acy, an attempt made (Aug. 5, 1600) by John Ruthven, earl of Gowrie, and others, either to assassinate the king, James VI. of Scotland (afterwards James I. of Great Britain), or much more probably to make him prisoner, for the purpose of permitting the government to be administered in a manner more thoroughly in the interest of Presbyterianism. The affair took place at Gowrie House, Perth, and the earl and his brother Alexander were both killed in the affray. It is possible that Gowrie's motive in this affair was revenge for the death of his father, who was executed as a traitor in 1584, but this is not generally believed to have been the cause.

Go'ya, town of Corrientes, a province of the Argentine Republic, on the river Goya, 100 miles S. of Corrientes, and near the Paraná. Its site is flat and low. The cattle-trade and the accessory industries are important. Pop. 10,907.

Goyan'na, town of Brazil, in the province of Pernambuco, on a river of the same name. Pop. 12,000.

Goy'az, an inland province of Brazil, extending between the Tocantins and the Araguay, two affluents of the Amazon, comprises an area of 275,000 square miles, but has only 151,000 inhabitants, most of whom are Indians. The gold-mines were formerly the principal source of wealth in this province, but they seem to have become exhausted. Rearing of cattle and agriculture are the principal occupations, but as the means of exportation are very poor, nothing more is produced than necessary for home consumption; and even this poor industry is carried on in so backward and slovenly a manner that famines occur, though the land is one of the most fertile regions on our globe.

Goyaz, town of Brazil, the capital of the province of Goyaz, on the Vermelho, has 8000 inhabitants.

Go'zo, or **Gozzo,** one of the Maltese Islands, in the Mediterranean, belonging to Great Britain. Area, 20 square miles. Pop. 16,000. It is beautiful and fertile, and has two good harbors. The remains of the cyclopean wall called the "Giant's Tower" are interesting. Principal town, Rabato.

Go'zzi (CARLO), COUNT, Italian dramatist and competitor of Goldoni, was b. in Venice in 1722. His *Useless Memoirs of his Own Life*, in connection with Goldoni's memoirs, give a very interesting and instructive picture of the state of the Italian theatre at that time. It was his idea that improvisation is a natural talent with the Italians, and for this reason he left open certain parts of his dramas, especially the comical parts, to be filled out by the momentary inspiration of the actors. But, although it is very true that the Italians often display a brilliant talent for improvisation, still there is in all improvisation something contradictory to the idea of modern art. Gozzi did not succeed in his opposition to Goldoni. His dramas have disappeared from the stage, though they bear evidence of a talent of a higher and finer order than that of Goldoni. There is a tenderness and romance in his imagination which would attract attention in any literature, and which are very seldom met with in the Italian art, cast as it is in the old classical forms. The two best of his dramas are *The Three Oranges*, and *The Princess Turandot*. D. Apr. 4, 1806. CLEMENS PETERSEN.

Go'zzoli (BENOZZO), (BENOZZO DI LESE DI SANDRO was his real name), an Italian artist who lived between 1424 and 1496, a pupil of Fra Angelico, remarkable for his love of nature and the introduction of landscape, natural objects, animals, and picturesque beauty into his paintings. His most famous and best-preserved work is in the Campo Santo at Pisa. His own tomb, directly under these frescoes, was presented to him by the Pisans. O. B. FROTHINGHAM.

Graaf'ian Ves'icles, or **O'visacs,** are numerous small globular transparent follicles found in the ovaries of mammals, probably representing the inner part of the calyx of oviparous animals. They are named from Regnier de Graaf, their discoverer (1641–73). They are filled with a transparent albuminous liquid. Very small at first and deeply bedded in the ovary, they gradually approach the surface, and finally burst and discharge the OVUM (which see).

Graal, or **Grail.** See SANGREAL.

Graccha'nus (M. JUNIUS) lived in the time of C. Gracchus (B. C. 123), enjoyed his friendship, and from this circumstance, according to Pliny, derived his cognomen. He was the author of a treatise *De Potestatibus*, addressed to Pomponius, the father of Pomponius Atticus, in which he gave a history of the constitution and the great offices of state from the time of the kings, which is highly commended by Niebuhr (*Hist. Rome*, vol. ii. p. 10–11). The original work is lost, but it is often referred to by Cicero, Varro, and others, and a portion of it is preserved in the Greek treatise of Joannes Lydus (*De Magistratibus*). (See GERLACH, *Geschichtschreiber der Römer*, p. 84 *seq.*: L. MERCKLIN, *De Junio Gracchano*, Dorpat, 1840–41.) H. DRISLER.

Grac'chus, the name of a family of illustrious Romans, plebeians of the gens Sempronia. The most noteworthy members were TIBERIUS SEMPRONIUS GRACCHUS, consul 238 B. C., and a victorious general; another TIBERIUS, who in 216 B. C. was curule ædile and magister equitum to M. Junius Pera, the dictator; consul 215 and 213; served against Hannibal and defeated Hanno at Beneventum 214; was betrayed to the Carthaginians and slain by Mago 212 B. C. He was a man of noble magnanimity.—A third TIBERIUS was early distinguished for valor; became tribune of the people 187 B. C.; married the noble Cornelia, daughter of Scipio Africanus; was prætor in Hither Spain 181–178; conquered all the Celtiberians and took hundreds of towns, and by his justice and magnanimity won the veneration of the subjected people; triumphed 178; consul 177; triumphed over the Sardinians 175; censor 169, when he brought about important political reforms; consul again 163 B. C. The time of his death is not known. He was the father of twelve children, among whom were Tiberius and Caius, the "Gracchi" *par excellence*.—TIBERIUS SEMPRONIUS GRACCHUS, eldest son of the foregoing, b. (according to Plutarch) 164 B. C.; went with the younger Scipio Africanus in 146 to the destruction of Carthage, and, according to Fannius, was the first Roman to mount the wall of that town; as quæstor (137) concluded an unpopular but highly advantageous treaty with the Numantines; became tribune of the people 134 B. C. At that time the Roman people were enduring most grievous hardships, kept out of their lands and many lawful rights by the senatorial party, headed by the Scipios; and Gracchus, with the advice of his mother Cornelia, his father-in-law Appius Clau-

dius, and the wisest leaders of the patricians, decided to bring forward anew, with slight modifications, the Licinian law, which had never been repealed. The party which opposed him was small but influential, and he felt compelled to resort to measures which, though perfectly just, were impolitic; and some additional measures, by which he sought to improve the condition of the poor, were so artfully misrepresented that the ignorant rabble began to clamor against him, and a mob led by Scipio Nasica set upon him and his followers with sticks and stones, and murdered him 133 B. C. He was a man of most amiable and noble character, and his worst fault was a certain lack of prudence in the conduct of his praiseworthy undertaking.—CAIUS SEMPRONIUS GRACCHUS, his brother, nine years younger, was serving in Spain at the time of his brother's murder; was quæstor in Sardinia 126 B. C., where his valor, wisdom, and justice made him very popular, but caused him to be regarded with suspicion at Rome. In 124 he went without leave to Rome, but so defended himself before the censors that his conduct was declared justifiable. Filled with a noble but almost hopeless enthusiasm for Roman liberty, now nearly extinct, he entered upon the tribuneship in 124 B. C., and was twice re-elected; renewed the Agrarian law in 123 B. C.; but, deserted by the ungrateful equites and by the misguided people, and a price having been put upon his head by Opimius, thousands of his friends were killed in an insurrection 121 B. C., and Gracchus himself was killed by his own slave, who thereupon killed himself. His greatest offence was the proposal to enfranchise the Italian allies. His eloquence was remarkable, and, viewed in the light of modern ideas, his character seems one of the noblest in all antiquity. Nearly all the Roman writers vilify the reputation of the Gracchi, but their virtue was too conspicuous to be thus obscured.

Grace [Gr. χάρις; Lat. *gratia*]. I. *In General*, is used (1) of *external form*, as elegance or gracefulness; thus Homer (*Od.* 2, 12), "She poured upon him an unspeakable grace;" and of *discourse* (Luke iv. 22), "They wondered at his words of grace." But mainly (2) it involves an *inward feeling* or *disposition*. It may refer (*a*) to favor *obtained* from another. From *man* (Gen. xxxix. 21, Sept.): Joseph obtained favor with the keeper of the prison; from *God*: "Thou hast found grace in my sight;" "Thou hast found favor with God" (Gen. xxxiii. 17, and Luke i. 30). For the most part, however, (*b*) its reference is to favor *cherished* or *bestowed*; in Scripture, the *Divine favor towards men.*

II. *Evangelical Import.*—This, its most important signification, denoting *God's favor manifest in Jesus Christ*, is to be derived from the New Testament, which warrants the following positions:

1. *Grace is a Peculiar Expression of the Divine Glory.*—The work of redemption is referred to God's own good pleasure, and is to be to the praise of the glory of His grace (Eph. i. 5, 6). The abundant grace is to redound to the glory of God (2 Cor. iv. 15). To the same import are the words of our Lord himself: "I have glorified Thee on the earth" (John xvii. 4).

2. *Grace, though manifest in Christ, is attributed to the One God and to each of the Persons.*—To the *One* without distinction: "To testify the gospel of the grace of *God*;" "This is the true grace of *God* wherein ye stand" (Acts xx. 24; 1 Pet. v. 12). To the *First* Person, as in the common introduction to Paul's Epistles: "Grace from God the *Father*;" less frequently to the *Third*: "Despite to the *Spirit* of grace" (Heb. x. 29). Grace is the Father's, as He is the *source* of redemption; the Spirit's, as He *applies* it; but, since *provided in the Son*, the doctrine of grace connects itself with the *Second* Person in a special manner. The grace of God is *given* in Christ Jesus (1 Cor. i. 4); "We believe that through the grace of our *Lord Jesus Christ* we shall be saved" (Acts xv. 11).

3. *Men are Saved by Grace.*—The condensed argument of Paul is this: All having sinned and being under a just condemnation, are, on the one hand, unable to save themselves. Hence, on the other, if saved, it must be by the free—*i. e.* undeserved—grace of God. It is this which *brings* salvation (Tit. ii. 11): "The grace of God and the *gift by grace*, which is by one man, Jesus Christ, hath abounded unto many" as their salvation (Rom. v. 15). (*a*) *By grace, not by the law.* An attempt to be justified by the law is a falling from grace (Gal. v. 4). The assurance of being delivered from sin lies in this, that we are *not* under the law, but are under grace (Rom. vi. 14). (*b*) *By grace rather than works.* Men by the deeds of the law cannot be justified before God, but, justified freely by His grace, are made heirs according to the hope of eternal life (see Rom. iii. 20; Eph. ii. 9; Tit. iii. 7). (*c*) *By grace through faith.* This, the receptive faculty of the soul, *takes* the offered gift by which believers are made heirs of the *grace of Christ* (comp. Rom. v. 1, 2, and Gal. ii. 16).

4. *Grace is to the Church the Source of Peculiar Gifts (charisms), and to Believers of Success in Life and Labor.*—There are diversities of gifts (χαρισμάτων), but they are all by the one Spirit, and are due to that *grace* which is according to the measure of the gift of Christ (comp. 1 Cor. xii. 4, and Eph. iv. 7). Paul's mission to the Gentiles he counts one of grace (Eph. iii. 8). He and his works are nothing: "By the grace of God I am what I am. I labored more abundantly. . . . Yet not I, but the grace of God which was with me" (1 Cor. xv. 10). This is the common source of satisfaction and success: "God is able to make all grace abound towards you, that ye always, having all sufficiency in all things, may abound in every good work" (2 Cor. ix. 8).

5. *The Gospel Dispensation is one of Grace, and to be carefully distinguished from the Reign of Mere Law.*—The thought is contained in John i. 17: "The law was given by Moses, but grace and truth came by Jesus Christ." It is the underlying argument of the Pauline Epistles, the antithesis being strongly stated in Galatians; but the *new* dispensation is most fully *contrasted* with the *old* in the Epistle to the Hebrews, according to which the law—even God's revealed will—proving inadequate to save, He caused the former to give place to the latter, bringing in a better hope through the one offering of His Son. And this method of grace, *being adequate, is not to pass away.* (See Heb. *passim*, especially ch. ix.)

III. *Theological Terms.*—1. *Special or efficacious grace* (*gratia efficax*), that divine influence which, in the soul, changes it from sin to holiness—held by Augustinians and Calvinists, who refer the *initial* of man's salvation *to God*; rejected by Pelagians, who make *individual choice the initial.* Arminians, though affirming grace to be initial or "prevenient" (enabling), admit no special grace—only one common to all. (See ARMINIANISM and CALVINISM.) 2. *Irresistible grace*, used to denote that grace, spite all opposition, realizes its purpose. The conception being too mechanical, most would prefer *is not resisted* (*irresistita*), as indicating the work wrought *within* the sphere of moral freedom and in harmony with it. 3. *Gratia antecedens*, the divine work prior to regeneration; *gratia operans*, the same *in* the soul's renewal; *gratia co-operans*, the Spirit's work subsequently, in which the creature-will, renewed, concurs. 4. *Sovereign grace*, grace provided when not deserved, and applied as God wills. 5. *Covenant of grace*, that the Father accepts the mission and work of the Son, for satisfaction to Himself and His law, on the one hand, and on the other, as pledge of salvation, through and in Him, of all believers, or the elect.

J. R. HERRICK.

Gra'ces, or **Grace Notes,** certain short notes in music, generally written in small characters, and introduced occasionally by way of ornament before some of the principal notes of a melody. The name is a very general one, referring to appogiaturas, trills, turns, beats, half-beats, springing notes, and similar embellishments, which are inserted for the purpose of developing or intensifying the effect of some particular notes in an air.

Gra'ces, The (*Charites, Gratiæ*), in Greek and Roman mythology, the female personifications of beauty and grace. Their names and number and their whole mythus are variously given. Hesiod makes them daughters of Zeus and Eurynome, and names them Euphrosyne, Aglaia, and Thalia. In art, they were once represented as draped, but afterwards as nude figures, in the bloom of early youth.

Gracio'sa, one of the AZORES (which see), received its name from its beautiful aspect. Pop. 11,000. Principal town, Santa Cruz.

Gradien'tia [plu., from the Lat. *gradior*, to "walk"], a name given by Laurenti in 1768 to the tailed amphibians (Urodela), as well as the lizard-like reptiles, but first limited as an ordinal designation to the group now to be defined by Merrem in 1821. It combines in one order all living forms of ambulatory amphibians—*i. e.* salamanders and kindred types—or those which are adapted for progression by running on the ground; and thus contrast with the Salientia or Anura (frogs, toads, etc.) and the Pseudophidia (*Cæcilia*, etc.). The forms associated under this head (1) are more or less elongated, and always provided with a long tail; (2) the vertebræ are ossified; (3) the frontal bones are distinct; (4) ethmoids are two lateral pieces; (5) the hyoid apparatus has a narrow or small distinct basihyal, and the ceratohyals or cornua, in part at least, retain their original form or are little modified, and remain connected with the suspensorium of the lower jaw; (6) the gills of the tadpole are external; (7) the pelvic elements are not confluent; (8) the sacral vertebræ (when differentiated) are normal; (9) when limbs are developed, the fore ones precede the hind ones in order of appearance; and (10) the bones of the fore arm remain separated through life, and the hind feet have the tarsal bones abbreviated; the

astragalus and calcaneum not being elongated). In other respects they exhibit great differences among themselves. The degree to which these various characters are carried, and the combinations in which they occur, are exhibited in the following table, in which groups assumed are analyzed with reference to various features in their economy:

1*a*. Branchiæ retained through life: Trachystomata, Proteida (and *Siredon?*).
1*b*. Branchiæ absorbed before maturity: Amphiumoidea, Protonopsoidea, and Salamandroidea.
2*a*. Epibranchials three: Proteida.
2*b*. Epibranchials four: Trachystomata, Amphiumoidea, Protonopsoidea.
2*c*. Epibranchials one (the last three pairs being atrophied): Salamandroidea (adults).
3*a*. Ceratobranchials in contact with basi-branchials, one: Proteida, Amphiumoidea.
3*b*. Ceratobranchials in contact with basi-branchials, two: Trachystomata, Protonopsoidea (*Sieboldia*), Salamandroidea.
4*a*. Branchial clefts retained through life: Trachystomata, Proteida, Protonopsoidea (*Protonopsis*), (and *Siredon?*).
4*b*. Branchial clefts closed at maturity: Protonopsoidea (*Sieboldia*), Salamandroidea.
5*a*. Skull narrowed: Trachystomata, Proteida, Amphiumoidea.
5*b*. Skull broad: Protonopsoidea, Salamandroidea.
6*a*. Pterygoids absent: Trachystomata and Salamandroidea, Plethodontidæ. Desmognathidæ.
6*b*. Pterygoids present: Proteida, Amphiumoidea, Protonopsoidea, and Salamandroidea (fam. sup. excl.).
7*a*. Palatine bones developed: Trachystomata, Proteida.
7*b*. Palatine bones undeveloped: Amphiumoidea, Protonopsoidea?
7*c*. Palatine bones metamorphosed: Salamandroidea.
8*a*. Prefrontals absent: Trachystomata, Proteida, Salamandroidea (Desmognathidæ).
8*b*. Prefrontals present: Amphiumoidea (Protonopsoidea), Salamandroidea (Desmognathidæ excluded).
9*a*. Nasal bones not developed; nasal sacs elongated and uncovered by bones or cartilages: Trachystomata, Proteida.
9*b*. Nasal bones developed; nasal sacs abbreviated and covered by bones or cartilages: Amphiumoidea, Protonopsoidea, Salamandroidea.
10*a*. Premaxillaries and dentaries with horny plates: Trachystomata.
10*b*. Premaxillaries and dentaries without horny plates: Proteida, Amphiumoidea, Protonopsoidea, Salamandroidea.
11*a*. Vertebræ differentiated into four regions or kinds—viz. cervical (one), dorsal, sacral, and caudal, a sacrum being developed, with which are connected posterior limbs: Proteida, Amphiumoidea, Protonopsoidea, Salamandroidea.
11*b*. Vertebræ differentiated into two regions or kinds only—viz. cervical and post-cervical, no sacrum or posterior limbs being developed: Trachystomata.
12*a*. Sternum developed: Amphiumoidea, Protonopsoidea, Salamandroidea.
12*b*. Sternum not developed: Trachystomata, Protonopsoidea.
13*a*. Hind members developed: Proteida, Amphiumoidea, Protonopsoidea, Salamandroidea.
13*b*. Hind members not developed: Trachystomata.

Divisions.—Weighing these several characters, and checking our observations by reference to their functional or developmental relations, we are led to the combinations embodied in the following arrangement:

The TRACHYSTOMATA have no pterygoid nor palatine bones; the ethmoid is represented by two bones which extend forward and form a part of the palate; no prefrontal or maxillary bones are distinguishable; but nasals are present, and embraced by spines of the premaxillaries; the mandible is destitute of teeth, but is covered with a horny plate; the hind members are wanting; apparently no sternum is developed: the gills are retained through life. To this group belongs a single family (the Sirenidæ), whose species are confined chiefly to ponds and ditches of the Southern U. S.

The PROTEIDA have pterygoid and palatine bones approximated to each other; the ethmoid is represented by two vertical plates (one on each side of the cerebral lobes), which are elongated, and do not enter into the palate; no pre-frontal, maxillary, or nasal bones are developed; the mandible has no horny plate, but carries teeth; the sternum is wanting; the gills are persistent; a sacrum and hind limbs exist. To this group belong the Proteidæ, the celebrated slender, salamander-like animal of the caves of Carniola, in Austria; and the Necturidæ, represented by a single genus (*Necturus* or *Menobranchus*), found in American lakes and rivers.

The Salamandroidea, Amphiumoidea, and Protonopsoidea agree together in many characters and form one group, combined under the name CADUCIBRANCHIATA by Cope: they are provided with palatine and in many with independent pterygoid bones; with ethmoids (two in number) of large size, but not extending to the palatal surface; with prefrontal bones (except in Desmognathidæ, etc.); and with maxillary and nasal bones; the mandible is without a horny plate, and always carries teeth; a sternum is always developed; the gills are deciduous, and disappear generally before maturity is attained, but, exceptionally, are retained through life. To this group belong the vast majority of the species of the order; these are popularly known under the names newts, tritons, mud-eels, etc. They are naturally segregated into the three primary groups above designated as Amphiumoidea, Protonopsoidea, and Salamandroidea.

The Amphiumoidea are very elongated animals with very weak limbs; the cranium is broad, and has anterior axial bones; the anterior dorsal vertebræ only are rib-bearing, and in the skin are imbedded minute scales, and the branchial fissures remain through life.

The Protonopsoidea have moderately elongated bodies; well-developed limbs; the cranium broad, and with no anterior axial-cranial bones; the branchial fissures are in one form (*Protonopsis*) retained through life, and in another (*Sieboldia*) become closed.

The Salamandroidea also have moderately elongated bodies and well-developed limbs; a broad skull with no anterior axial-cranial bones, and, except in *Siredon*, the branchial fissures disappear with the gills before maturity. The Salamandroidea offer peculiarities in the relations of the dentigerous bones, which differentiate the members into two groups: in one (to which the name Lechriodonta has been applied) the vomero-palatine bones are truncated or produced backward towards the medial line, and on their posterior margins the teeth are developed, in two more or less converging series; in the other (which has been named Mecodonta) the corresponding bones are extended backward, diverge from each other, and bear teeth on the inner margins, which therefore form two diverging series. To the Lechriodonta belong the families Amblystomidæ, Plethodontidæ, Desmognathidæ, Thoriidæ, and Hynobiidæ: the Mecodonta include the typical salamanders, constituting the families Salamandridæ and Pleurodelidæ.

Development.—The characters distinguishing the several groups above defined, as well as those distinctive of the families of Caducibranchiata, are remarkably correspondent to those exhibited in the successive stages of development of the higher types; and so strongly are these characteristics marked that they have furnished the best basis for the hypothesis of the evolution of animal types, and their assumption of characters by acceleration or retardation in the development of parts. The older naturalists associated in one group all those forms of the sub-order which possessed branchiæ throughout life, and these were contrasted with all the other members of the class—*i. e.* salamanders, frogs, toads, etc.—or at least with all of the European types. Inasmuch as with these modifications of the branchiæ were associated other characters not found in the adult—at least of the European salamanders—such as the fish-like or amphicœlian vertebral column, imperfectly developed skull, etc., there seemed to be some good reason, independent of the retention of the branchiæ, in favor of at least the later of the views alluded to.

All the members of this sub-order come from the egg with slits upon each side behind the head, and through these the branchial apparatus sends forth shoots provided with filaments. The skeleton is then imperfectly developed, and contrasts remarkably with that of the adult animal. Among the commonest North American salamanders are certain black or blue species with grayish or yellowish spots, which belong to a peculiar genus known as *Amblystoma.* In Mexico, likewise, a common form of this great group is found, and is known to the natives under the name of *Axolotl.* It attains a size about equal to the largest of the North American Amblystomas, and resembles them in external appearance, except that on each side of the neck are slits through which project branchiæ. No form without branchiæ having been found in its native country, it was quite naturally assumed that this form was mature, and never underwent further development, although suspicions had been entertained by several naturalists that it was merely a larval condition of some unknown species. This opinion, however, seemed again to be falsified by the fact that it matured eggs in this condition. M. Duméril of Paris having finally obtained specimens, found that although in many of the individuals the young underwent no further development, but brought forth young in the condition noted, a few in one season lost their branchiæ and assumed all the

characteristics of the genus *Amblystoma*. And still more remarkable was the fact that although he repeated his experiment often and under all conditions, he was unable to breed any young from these amblystomoid forms, although he had no difficulty in obtaining progeny from the branchiferous individuals. It is quite possible, therefore, that the typical *Axolotl* of Mexico may be arrested permanently in its development, and not pass beyond the larval stage in its native country. The species of the genus *Amblystoma* are numerous, and exhibit much variation in the loss of their branchiæ, some shedding them when very small, others retaining them till they have attained their full size. The families of the order also exhibit characteristics which are expressive of different stages of development, some, *e. g.*, retaining their fish-like or amphicœlous vertebræ, while others towards maturity becoming opisthocœlous. This has been regarded as a very important character, but is merely dependent on the ossification and union of the intervertebral capsules with the vertebræ which they precede; and whatever may be the adult condition, are amphicœlous in the larval stage. It may be finally remarked that *Necturus* is very similar to the larval stage of *Spelerpes*, a plethodont salamander, but as it appears never to assume the characters of the adults of that genus, it is retained by all naturalists in an independent group next to *Proteus*.

Geographical Distribution.—The range of this order is exceptional. It is nearly confined to the temperate regions. In the entire temperate zone species are found, but the genera are mostly limited in their distribution: only two genera (*Triton* and *Spelerpes*) are common to the North American and European faunas. About 100 species (according to Strauch in 1870, 84) are known; of these America has the greatest proportion. The Sirenidæ, Necturidæ, Amphiumidæ, and Desmognathidæ are peculiar to it; and, with the exception of one or two species, the Amblystomidæ and Plethodontidæ also. On the other hand, the Salamandridæ and Pleurodelidæ are chiefly confined to the Old World; the Hynobiidæ are represented by a single genus, confined to Japan. The Protonopsidæ have one genus in North America, and another in Japan and China, and the Proteidæ are confined to certain caves in Carniola and Carinthia. The Salamandroidea known to Strauch were apportioned by him in the following manner:

I. *Eastern Hemisphere, with 28 species.*
 A. Circummediterranean District, with 19 species.
  1. European Province, with 15 species.
  2. African Province, with 3 species.
  3. Asiatic Province, with 5 species.
 B. Asiatic District, with 9 species.
  1. Western Siberia, with 1 species.
  2. Eastern Siberia, with 2 species.
  3. Japan, China, Siam, with 6 species.
II. *Western Hemisphere, with 57 species.*
 A. Pacific District, with 25 species.
  1. Northern Province, with 15 species.
  2. Southern Province (from Mexico southward), with 10 species.
 B. Atlantic District, with 32 species.
  1. Province W. of Mississippi, with 13 species.
  2. Province E. of Mississippi, with 28 species.

Geological Range.—The first appearance of representatives of this order has been until recently ascribed to the Tertiary epoch, but Dr. Newberry has obtained remains of an amphibian in the coal-measures of Ohio which have been identified by Prof. Cope as representing a type of this order, and constituting a new genus (*Cocytinus*, and family Cocytinidæ), related to the Amphiumidæ and Protonopsidæ. In the schistose beds of Oeningen, Switzerland (which belong to the Miocene Tertiary), remains are found of a gigantic salamander (named *Andrias Scheuchzeri*) related to our hell bender (*Protonopsis*) and the great salamander of Japan (*Sieboldia*): these were supposed by some early naturalists (*e. g.* Scheuchzer) to have belonged to man. In the earliest geological ages the several forms of this order appear to have had analogous representatives in members of the order of Labyrinthodonts. THEODORE GILL.

Grad'ual [from *gradus*, a "step," because it is chanted from the steps of the pulpit], in the office of the mass that portion of Scripture which follows the Epistle and precedes the Gospel. It is generally a part of a psalm. The name is also given to the music, and to the book containing the music, for the Gradual.

Gradua'tion is the art of accurate division as applied to instruments of a mathematical character or those used in all kinds of measurement, as in astronomy, or of indication, as the surveyor's or mariner's compass. In its most extended sense graduation is the determination of equal distances as used in art or science. The distance of objects in every relation, and their size in measurement, depend entirely upon the accuracy of the graduation of the instrument employed. The importance of graduation is best illustrated by the fact that an error of $\frac{1}{100}$th of an inch in the divisions of a sextant or quadrant would cause a corresponding error of *four miles* as to the spot occupied by the observer. (*Chambers.*) Those who have attempted by means of the dividing compass alone to set off equal spaces, as in architectural drawings, have invariably realized the great difficulty of doing this with perfect accuracy; but it is not generally known that graduation is really the most delicate and difficult branch of mechanical art, and that the very few who have excelled in it are as well known by name to men of science as Bacon or Kepler. The difficulties are simply mechanical, as may be inferred from what was said by Troughton, a distinguished graduator (1809), who declared that with a steady hand and good eye he was much disappointed to find that after making two points, neat and small, he could not possibly bisect the distance between them without enlarging, displacing, or deforming them with the points of the compasses. Even with the beam-compass, vernier, and other hand instruments, accuracy can only be attained by a surprising talent for practical mechanism. Yet, notwithstanding the immense number of curious machines dividing surfaces with surprising accuracy, the processes of *original graduation* are still conducted in this manner. The other kinds are the so-called *common* and *engine graduation*. The difficulty with which graduation contends is "the accumulation of minute errors." (*Simms.*) Common graduation consists of copying from a scale already prepared by a higher process, and is only used where extreme correctness is not needed. It is effected by means of a *dividing-plate*, which is a disk of metal not more than 30 inches in diameter. Around its inner edge is a series of circles containing all the divisions and numbers requisite, with Gunter's and other logarithmic lines; also tangents in $\frac{1}{10}$th part of the radius, and the difference of the hypothenuse and base as applied to the theodolite; also the equation of time for dialling the points of the compass, etc. (*Tomlinson.*) In the centre is a hole, through which passes a pin or arbor. An index, a very straight, long, narrow plate of fine steel, passes to the centre, but so that the line of one of its sides shall be in a line with the centre of the pin. Its end in the centre is supplied with a brass plate which diverges to one side, and in it is a notch into which the pin or arbor fits exactly. This directs the straight edge to the centre. It will be understood from this that if a certain number of divisions are marked on the extreme edge of the disk, and one or more smaller circles be drawn within it, even to the minutest circle possible in the centre, the index, as moved from one of the outer graduated distances to another, must describe corresponding but smaller distances on the inner circles. If now a compass-plate, to be marked with the proper divisions, with a hole in its centre just fitted to receive the centre pin of the disk, be properly placed, we can easily mark the lines required, simply by moving the index from one to the other on the disk. As it moves it moves over the compass-plate also, and the lines are marked with a kind of knife made for the purpose. In doing this a draw-cut is used, instead of pushing the tool, as in engraving. In common dividing straight lines are ruled with a *dividing* square. It is like a carpenter's right-angle or square, and is simply pushed along over the pattern, while the distances thus given are marked off on the new plate. The beam-compass, the vernier, and spring dividers are essential in graduating, and with them alone much work is done.

Engine Graduation.—Henry Hindley of York was the first inventor of a *machine* for graduating, and in 1768 the duke de Chaulnes published two able works on the subject, which gave to Ramsden the basis for an engine which, though far from perfect, exceeded anything before known. This he subsequently improved. In 1778 the celebrated John Troughton completed a graduating engine which soon became popular. He was succeeded by his brother Edward, who invented an improved method of graduation, which was rewarded by a medal from the Royal Society. In 1788, John Stancliffe also made a dividing engine. Since their time the works of Andrew Ross and Simms in England, of Reichenbach in Germany, and of Gambey and Froment in France, have raised *engine graduation* to a high pitch of perfection. Ramsden's engine, as Tomlinson suggests, has supplied the principle on which later and far more elaborate graduating machines have been constructed; and this is, in effect, simple enough. "A horizontal circle 1 feet in diameter turns on a vertical axis, its outer edge being ratched by an endless screw, one revolution of which carries the circle round 10′, the screw being worked by pressure with the foot." The circle to be divided is fixed upon the dividing engine, and made concentric with it, and a division is cut with each pressure of the foot. The engine of Edward Troughton was one of the most complicated and ingenious machines ever made. A very com-

plete description of it, written by himself, may be found in the *Edinburgh Cyclopædia* (art. "Graduation"). With it the operator could cut twenty-four strokes in a minute, but it required a skilled operator, who was obliged to labor incessantly. Simms's engine (see *Memoirs of the Royal Astronomical Society*, vol. xv., 1846) was intended to make Troughton's self acting and self-regulating, "and having performed its work, to throw itself out of gear." This he effected in his self-acting circular dividing engine, which is one of the greatest triumphs of the century, and which has justly been classed with Babbage's analytical machine and those elaborate inventions which seem to spare man not merely manual, but also brain labor. In 1831, Andrew Ross received from the Society of Arts 50 guineas and the gold Isis medal for an improved method of dividing instruments and for a circular dividing engine. This machine, which is not less complicated and elaborate than those of Simms and Troughton, may be found fully described and illustrated by the author in the 48th vol. of the society's *Transactions*. Its main object was to correct the errors caused by the ratched cylinder and screw in Ramsden's and Troughton's engine, and ensure greater ease and delicacy in action. He effected this by substituting for the driving motion of the screw that of an independent apparatus. Ross's engine excelled its predecessors in an improved method of stopping the circle at its *precise* angular position by giving it a steadier motion, and so adjusting its details that much wear and tear is prevented.

Original graduation is, as the name indicates, the art of preparing the original standards by which common and engine graduation are determined. The engine simply multiplies copies, more or less correct, but the *original* must be as nearly as possible absolutely correct. The principal methods recorded are those of Hooke, Romer, Hindley, Graham, the duke de Chaulnes, Ramsden, and Troughton. That of Hooke consisted in racking the edge of his quadrant with an endless screw (*Tomlinson*), using its revolutions and parts as divisions. This was ingenious, but impracticable without *independent* divisions. Of the two general methods recognized in original graduation, one, *bisection*, is effected by dividing the space into halves, and these again into halves, until the unit of measurement is reached. The other process, *stepping*, consists of several successive steps, in any of which errors may occur, although in the whole they generally balance one another. Hindley's method (1748) consisted of taking a long plate, 1 inch broad by 8 feet in length. He then bent double a long flat plate of steel, so as to make its ends press flat together. In these ends he bored two small holes, the units' distance apart, one to receive a small pin, the other a drill. The plate was then put at right angles between the chaps of the steel press, and a hole was bored carefully through the plate, into which the pin was placed. The next hole covering the plate served as guide to bore a second hole, and the steel chaps were now moved one hole forward, the pin placed in the second hole, and a third hole was bored. The plate was then advanced a second time, the pin placed in the third hole, and a fourth was bored; and this operation was repeated as often as necessary. By making the plate again into a hoop the circle was obtained to measure the required disk. Graham's method was the extremely simple one of bisection, leaving intentionally a small space between two arcs drawn with a beam-compass. The space between these arcs can be accurately marked with the aid of a lens. The duke de Chaulnes invented a highly ingenious and simple method of actual dividing by means of two micrometer microscopes. Ramsden also employed the microscope, and Troughton successfully combined Graham's method of perpetual bisections with the duke de Chaulnes' method of reading off the divisions of astronomical instruments. Troughton's method was, in fact, exactly Graham's principle of perpetual bisection, only using an *optical* beam-compass instead of one with points, and registering the errors of the dots instead of cutting actual divisions. (*Tomlinson.*) A full description of his method may be found in the article on graduation in the *Penny Magazine*. The celebrated engineer Smeaton says that one Abram Sharp, assistant to Flamsteed in 1689, was the first who accurately cut divisions on astronomical instruments. (See *Observations on the Gradation of Astronomical Instruments, with an Explanation of the Method Invented by the late Mr. Henry Hindley of York, Clockmaker, to divide Circles into any given Number of Parts*, by Mr. JOHN SMEATON, F. R. S., communicated by Henry Cavendish, Esq., F. R. S., and S. A. Read, Nov. 17, 1783.) Rowley and the Sissons graduated large instruments with great accuracy; and about the same time Bird, who had as a country-boy manifested a strange natural talent for correcting clock-dials, distinguished himself by his ingenuity in graduation. He received from Parliament a handsome reward for making known certain methods which he had invented. Among recent modern inventions is the electro-dividing machine of Froment, by which spaces from one inch to the $\frac{1}{25000}$th part of an inch are marked off. This is, however, nothing, as regards minuteness, to the *standard bar-measurer* of Mr. Whitworth, on which, by means of a metallic frame provided with two micrometers, and a simple combination of a screw, tangent screw, wheel, and circle, a division is reached on the circle which corresponds to the threads and teeth of the screws, as to the tenth of the four hundredth of the two hundred and fiftieth part of an inch—*i. e.* to the $\frac{1}{1000000}$th of an inch. By this machine the distances are of course determined by *touch*, and not by sight.

CHARLES G. LELAND.

Gra'dyville, post-v. of Adair co., Ky. Pop. 1713.

Grä'fe, von (ALBRECHT), M. D., b. in Berlin in May, 1828; was skilled in natural science and mathematics; studied medicine at the leading schools of continental Europe, and became (1856) professor of ophthalmology at Berlin; acquired a world-wide fame as an operator upon the eye; author of many valuable papers upon his specialty, chiefly published in the *Archiv für Ophthalmologie*, conducted in his name. D. at Berlin July 18, 1870.

Gräfe, von (ALFRED KARL), nephew of Albrecht, b. Nov. 23, 1830; graduated at Halle 1858; became an assistant to his uncle; founded a very successful ophthalmological institute at Halle; and became to some extent heir to his uncle's fame as an operator in diseases of the eye. Author of professional works.

Gräfe, von (KARL FERDINAND), M. D., b. at Warsaw, Poland, Mar. 8, 1787; graduated at Leipsic 1807; became professor of surgery at Berlin 1811; a staff-surgeon of the army 1815; was one of the restorers of rhinoplasty and a famous eye-surgeon, in which branch of his profession his son Albrecht became even more famous. D. at Hanover July 4, 1840. Author of *Angiektasie* (1808); *Normen für die Ablösung grösser Gliedmassen* (1812); *Rhinoplastik* (1818); and was 1820–40 one of the editors of the *Journal für Chirurgie und Augenheilkunde.*

Grä'fenberg, a hamlet of Austrian Silesia, where in 1826 Priessnitz opened the first water-cure establishment. It is 37 miles N. of Hohenstadt. The water-cure is still carried on.

Graffi'ti [It., "scratches"], the rude inscriptions found upon ancient buildings and stones, chiefly in Italy. The fact that they are in the Latin, Greek, or old Italian languages proves their great antiquity. They are of rude and almost always intrinsically worthless character, and are evidently in many cases the work of idle scribblers. Except in the case of those found in the Catacombs their antiquity confers upon them the only interest they possess. Several collections have been published, from which a little archæological knowledge has been gained.

Gräf'rath, town of Rhenish Prussia, on the Itter, has breweries and manufactures of cotton and silk fabrics, chemicals, and ribbons. Pop. 5003.

Grafting. See ENGRAFTING.

Graf'ton, county of New Hampshire, bounded on the W. by Vermont. Its area is 1463 square miles. Its surface is hilly, and the N. E. portion contains a part of the White and Franconia mountains. Much of the soil is very fertile. Cattle, grain, wool, potatoes, and dairy products are the staples. Lumber, starch, harnesses, wagons, metallic wares, woollens, gloves, and leather are among the leading manufactures. The county is traversed by the Boston Concord and Montreal and the Northern R. Rs. Caps. Plymouth and Haverhill. Pop. 39,103.

Grafton, post-tp. of Yolo co., Cal. It contains the village of Knight's Landing, on the Sacramento River and the California Pacific R. R., 90 miles N. of San Francisco. Pop. 1861.

Grafton, tp. of McHenry co., Ill. Pop. 1361.

Grafton, post-tp. of Oxford co., Me., 22 miles N. W. of Bethel. Pop. 94.

Grafton, thriving manufacturing town of Worcester co., Mass., on the Boston and Albany R. R., 6 miles E. of Worcester, near junction of Millbury branch. A railroad 2 miles long connects Grafton Centre with B. & A. R. R. The township contains several flourishing villages, 7 cotton-mills, important manufactures of boots, shoes, leather, and other goods; 2 national and 1 savings bank, a public library, 8 churches, a weekly newspaper, and a beautiful soldiers' monument. The cotton-mills run, in all, 34,422 spindles. The Blackstone and Quinsigamond rivers furnish power. P. 4594.

Grafton, post-tp. of Grafton co., N. H., on the Northern R. R., 40 miles N. W. of Concord. Pop. 907.

Grafton, tp. of Rensselaer co., N. Y. Pop. 1599.

Grafton, tp. and post-v. of Lorain co., O., at the cross-

ing of the Lake Shore and Tuscarawas Valley and the Cleveland Columbus and Cincinnati R. Rs. Pop. 960.

Grafton, post tp. of Windham co., Vt., 12 miles N. W. of Bellows Falls. It has manufactures of lumber, cassimeres, etc. Pop. 1008.

Grafton, post-tp. of York co., Va. Pop. 1431.

Grafton, post v. and tp. of Taylor co., W. Va., on the Valley River, at the junction of the Baltimore and Ohio and North western Virginia R. Rs., 100 miles from Wheeling and the same distance from Cumberland, Md. It has a bank, 1 newspaper, large railroad shops, 2 foundries, 7 wholesale and 23 retail stores, 7 churches, 6 hotels, 2 building associations, 3 planing mills, several flouring and saw mills, and a large number of small shops of various kinds. Principal business, lumber, coal, etc. Pop. of tp. 1987.

HOLT & GARNER, EDS. "GRAFTON SENTINEL."

Grafton, post-tp. of Ozaukee co., Wis. Pop. 1864.

Gragna'no, town of Italy, near Castellamare di Stabia, in the province of Naples, celebrated for its superior wines. Is a bishop's see. Pop. 12,278.

Gra'ham, county of N. W. Kansas. Area, 900 square miles. It is mostly drained by S. fork of Solomon River.

Graham, county in the S. W. of North Carolina, formed since the census of 1870. Its surface is mountainous, and abounds in unexploited mineral wealth. Cap. Robbinsville.

Graham, post-tp. of Jefferson co., Ind. Pop. 1408.

Graham, tp. of Johnson co., Ia. Pop. 1019.

Graham, post v., county-seat of Alamance co., N. C., on the North Carolina R. R., 67 miles W. N. W. of Raleigh. Pop. 502; of Graham tp. 2332.

Graham, tp. of Clearfield co., Pa. Pop. 638.

Graham, post-v., cap. of Young co., Tex.

Graham, tp. of Mason co., W. Va. Pop. 2325.

Graham (CHARLES K.), b. in New York City in 1824; received a liberal education, and entered the U. S. navy as midshipman. Soon after his enrolment the Mexican war broke out, and the vessel to which he was attached was ordered to the Gulf of Mexico to take part in the war. During this contest young Graham had abundant opportunities to witness the engineering operations, and to the study of engineering science he devoted himself. At the close of the war he returned to New York, and after continuing his studies for several years under the most competent engineers, commenced private practice. About 1857 he was appointed constructing engineer of the Brooklyn navy-yard, the dry dock and landing-ways being constructed under his supervision. On the outbreak of the civil war (1861) he announced his intention of volunteering his services to defend the government, upon which upwards of 400 men in his employ at the navy-yard followed his example, and the Excelsior Guard was organized, of which Graham was elected major subsequently. Throughout the early part of the war Col. Graham was actively engaged with his command in the various contests of the Army of the Potomac. At Gettysburg (July, 1863) Graham (now brigadier general) was seriously wounded; recovering from his wounds, he again proffered his services, and was ordered by the secretary of war to report to Gen. Butler, who assigned Graham to the command of a gunboat flotilla, with orders to proceed to Bermuda Hundred, James River, and hold the place till the navy came up; which he did. During the remainder of the war he was actively engaged in the field, having attained the rank of brigadier-general and brevet major-general of volunteers. Soon after the close of the war he returned to New York and resumed the practice of his profession. Among other important duties, he has been engineer of the Broadway Pavement Co., of the Beach Pneumatic Transit Co., besides being connected with various surveys for the boards of public works and of public parks. In 1873, he was appointed chief engineer of the department of docks.

G. C. SIMMONS.

Graham (ISABELLA), b. in Lanarkshire, Scotland, July 29, 1742. Her maiden name was MARSHALL. In 1789 she came to New York and established a seminary for young ladies. Before leaving Scotland she founded the Penny Society, now known as the Society for the Relief of the Destitute Sick. After reaching New York she was instrumental in starting several benevolent societies. D. in New York July 27, 1814.

Graham (JAMES D.), b. in Prince William co., Virginia, in 1799; graduated at the U. S. Military Academy, and entered the U. S. army as third lieutenant of artillery July, 1817; promoted to be second lieutenant Oct., 1817, first lieutenant Sept., 1819; adjutant at the Military Academy till Feb., 1819; accompanied Major Long on his Western exploration 1819–21; on topographical duty 1822–29, when transferred as assistant topographical engineer, and continued on railroad and military surveys 1829–38, when promoted to be major Topographical Engineers; from 1838 to 1850 engaged as astronomer to determine the boundary between the U. S. and the republic of Texas; commissioner in survey of the north-eastern boundary of the U. S.; head of the scientific corps and principal astronomer to determine the boundary between the U. S. and the British provinces; on survey of "Mason's and Dixon's line," and of the boundary between the U. S. and Mexico. Promoted to be lieutenant-colonel 1861, and colonel of engineers 1863, and engaged in the survey of the lakes, lighthouse duty, and in charge of harbors on the North Atlantic coast. D. at Boston, Mass., Dec. 28, 1865. G. C. SIMMONS.

Graham (JOHN ANDREW), LL.D., b. at Southbury, Conn., June 10, 1764; was admitted to the Connecticut bar in 1785, and removed immediately to Rutland, Vt.; was sent to England as agent of the diocese to make application to the English bishops for the consecration of the Rev. Samuel Peters; was unsuccessful. In 1797 he published his *Descriptive Sketch of the Present State of Vermont.* A small volume of his ablest speeches was published in 1812. D. in New York Aug. 29, 1841.

Graham (LAWRENCE P.), b. in Virginia; entered the U. S. army in 1837 as lieutenant of dragoons, serving against the Seminole Indians in Florida, and in Louisiana and Texas till 1846. During the war with Mexico he was engaged in the battles of Palo Alto, Resaca de la Palma, and Monterey, being brevetted major for gallantry. From 1848 to 1852 he was on duty in California, New Mexico, and on expeditions against the Navajo Indians; promoted to be major in 1858, and on recruiting service, the Utah expedition, and superintendent of cavalry recruiting till 1861. Appointed brigadier-general of volunteers Aug., 1861, he organized and commanded the cavalry brigade till Apr., 1862; served on various courts-martial and examining boards, and was promoted to be colonel 4th U. S. Cavalry 1864; retired from active service May, 1864.

G. C. SIMMONS.

Graham (SYLVESTER), an advocate of the vegetarian dietetic theory, b. in Suffield, Conn., in 1794; entered Amherst College in 1823, to prepare for the ministry, but did not graduate. He began to preach in 1826, but soon left this for the work of temperance and dietetic reform. In 1832 he published his *Essay on Cholera*, and later, in 1839, delivered a course of lectures entitled *Graham Lectures of the Science of Human Life.* He wrote *Bread and Bread-making*, etc. D. in Northampton, Mass., Sept. 11, 1851.

Graham (THOMAS), D. C. L., F. R. S., b. at Glasgow, Scotland, Dec. 21, 1805; was educated at Glasgow High School and the universities of Glasgow and Edinburgh; passed M. A. in 1826; professor of chemistry in the Andersonian University 1830–37; announced the discovery of the law of the diffusion of gases 1834; became F. R. S. 1836; professor of chemistry in the London University 1837–55; master of the mint 1855; was the first president of the Chemical Society 1840; president of the Cavendish Society 1846; was the recipient of many honors and distinctions. D. at London Sept. 16, 1869. He first fully developed the theory of liquid diffusion; made numerous and important discoveries in theoretical and applied chemistry, and became widely known by his excellent *Elements of Chemistry* (1842).

Graham (WILLIAM ALEXANDER), b. in Lincoln co., N. C., Sept. 5, 1804; studied law, and entered in 1833 public life as a member of the lower branch of the State legislature, of which he was several times chosen Speaker; was a member of the U. S. Senate 1841–43, and governor of the State 1845–49; was secretary of the navy under Pres. Fillmore until 1852; in 1852 candidate for the Vice-Presidency on the ticket with Gen. Scott; was a member of the Confederate Senate. D. at Saratoga Aug. 11, 1875.

Graham (WILLIAM M.), brother of James D., b. in Prince William co., Va., 1798; graduated at West Point July, 1817, and entered the army as third lieutenant of artillery; second lieutenant Sept., 1817; first lieutenant 1819; captain 4th Infantry 1832; major 2d Infantry Feb., 1847; lieutenant-colonel 11th Infantry Apr., 1847; served on recruiting service, constructing military roads in Mississippi and Florida, and in garrison till 1835; engaged against Seminole Indians in Florida 1835–38 and 1841–42, being severely wounded at the battle of Withlacoochee, Dec., 1835. In the Mexican war he was engaged in the battles of Palo Alto, Resaca de la Palma, Monterey, siege of Vera Cruz, Contreras, Churubusco, and Molino del Rey, where he was killed while gallantly engaged in assaulting the enemy's works, Sept. 8, 1847.

Gra'hame (JAMES), LL.D., b. in Glasgow, Scotland, Dec. 21, 1790; was admitted as advocate to the Scottish bar in 1812. Published in 1827 a history of the U. S., 2 vols., but

its American spirit prevented a large circulation. He subsequently (1812) brought out *Who is to Blame? or, Cursory Review of the American Apology for American Accession to Negro Slavery*. D. in London July 3, 1842. He was a graduate of St. John's College, Cambridge.

Gra'hame's Isl'and, an island in the Mediterranean, 30 miles off the coast of Sicily. It appeared in July, 1831, and disappeared in August. It was built of material thrown up by a submarine volcano, and it was washed away by the waves. It reappeared for a short time in 1863.

Gra'ham's Land, an island in the Antarctic Ocean, discovered in 1832 by Biscac, and situated in lat. 64° 45' S. and lon. 63° 51 W.

Gra'ham's Town, town in the eastern part of Cape Colony, South Africa, cap. of Albany district. Bishops of the Church of Rome and the Church of England reside here. Pop. about 5000.

Grain, the unit of the system of weights prevailing in the U. S. and Great Britain. A statute of Henry III. (1266) enacted that 32 grains of wheat from the middle of the ear, well dried, should weigh a pennyweight, of which 20 should go to the ounce; but finally (as noted in the art. GALLON) the pennyweight came to be divided into 24 grains. At present in the U. S. the troy and apothecaries' pound each contain 5760 grains, or 12 ounces of 480 grains each; while the avoirdupois pound has 16 ounces of 437½ grains each, or 7000 grains to the pound. There are 15.43234874 grains in the gramme of the French or metric system of weights, according to Miller's determination made in 1844.

Grain. See CEREALIA, and the names of particular kinds of grain.

Grain Coast, the former name of the coast of what is now Liberia, in Africa, so named from the grains of paradise, formerly an important article of trade in that region.

Grain Elevator, an American invention by which grain is loaded in railroad cars, ships, etc. at a very great saving of labor and cost. The principle is very simple—an endless belt carrying up tin buckets or scoops, each containing a small quantity of grain, which is deposited in an elevated receptacle, whence it is discharged by spouts or chutes into the holds of vessels or into railroad cars, which are thus loaded in a very rapid manner and at small expense. Similar elevators are employed in Northern Michigan in loading vessels with iron ore, but the force of the falling ore must be broken by suitable appliances; for if allowed to fall directly into a ship, there would be danger of breaking holes in her bottom. *Elevators* for goods or persons are employed in the hoistways of warehouses, hotels, and manufactories, and are worked by power in various ways. They are entirely different in principle and construction from the elevators of the class above noticed. (See HYDRAULIC ELEVATOR, by F. A. P. BARNARD.)

Grain'ger, county of the N. E. of Tennessee. Area, 330 square miles. The county is hilly and mountainous. The low lands are fertile, the hills rich in mineral wealth. Iron ores abound. Cattle, grain, tobacco, and wool are leading products. Cap. Rutledge. Pop. 12,421.

Grain'ing, the *Leuciscus Lancastriensis* of England and continental Europe, a fresh-water fish of the dace family. It is prized for the table, and makes good sport for the angler, rising well at a fly. In habits it resembles the trout.

Grains of Par'adise, the seeds of the Malaguetta pepper (*Amomum Meleguetta*), a scitaminaceous plant of West Africa, cultivated to some extent in Guiana and Trinidad. The name is also given to other similar seeds. They are of a hot, fiery quality, and are used in giving apparent strength to watered spirits, beer, and wine. They are used in farriery, and their alcoholic tincture makes a good stimulant in some cases of neuralgia.

Gra'kle, or **Grack'le** (*Gracula*), a genus of birds of the starling family. The paradise grakle (*Gracula gryllivora*) is celebrated as a devourer of insects. The *Gracula religiosa* of the Eastern Archipelago is often trained to talk. Several blackbirds of the genus *Quiscalus* are called grakles in the U. S. They are allied to the true grakles in habits and structure.

Grallato'res [Lat. *grallæ*, "stilts"], the wading birds, an order of birds having very long necks, legs, and bills, and short tails. They are mostly found about marshes and shores, occasionally in dry regions. Cranes, storks, herons, the ibis, plovers, rails, and snipes afford examples.

Graminaceæ. See GRASSES, by W. W. BAILEY, A. M.

Gram'mar [Gr. ἡ γραμματική, from γράμμα, a "letter"], the science of language, or the art of using words correctly for the expression of thought. As a science, grammar investigates the relations between words and ideas, examines the structure of speech in general, and treats of the essential principles common to all tongues; in this broad signification, it is distinguished as philosophical, general, or universal grammar. As a science, also, it places side by side the words of different tongues, with their inflections, and, allowing for the changes of form due to phonetic corruption, seeks by the coincidences it detects to discover the genealogical relationship of languages; such is the province of comparative grammar. As an art, grammar has to do with the words and structure of some particular tongue; analyzes its sentences into their elements in order to show how those elements may properly be put together; and, furnishing the principles which regulate its use, teaches how to speak and write it correctly. The grammar of a language is generally considered under four heads: orthography, which considers letters, syllables, and spelling; etymology, which treats of the "parts of speech," and the changes of form that words undergo to express different relations; syntax, which deals with the relation, agreement, government, and arrangement of words in sentences; and prosody, which has for its province the accent and quantity of syllables and the laws of versification. To these is sometimes added a fifth division, orthoepy, which treats of pronunciation.

Thought is communicated by words, and words are the signs of ideas. Now, our first ideas are those of sensation; therefore names for the objects that make an impression on the senses must, from the very necessities of man, have been elements of the first language, and must constitute a fundamental part of every language whatsoever. Whether such names were at first arbitrary inventions, or had logical connection with the things named, it is clear that they are indispensable to speech, and as "substantives" they enter into the grammar of every language. Now, every substance thus named is endowed with some attribute of quality, quantity, action, or passion; and to express these attributes is needed a second class of words, which may be called "attributives." Again, the object of speaking is to assert something respecting the subject of discourse. Unless the attributive itself affirms the attribute, which in some cases it does (as "birds *sing*," "grass *grows*"), a third word, whose function it is to affirm, is required ("birds *are* singing," "grass *is* green"); such words may be distinguished as "affirmatives." Here, then, we have all that is absolutely essential to speech—the substantive, attributive, and affirmative, or *noun*, *adjective*, and *verb*—round which, as the chief parts of the sentence, cluster less important elements introduced for the sake of convenience or ornament. With these three alone may be formed the PROPOSITION, or affirmation of a thought in words—consisting of a SUBJECT, or that of which something is affirmed, and a PREDICATE, or that which is affirmed of the subject.

It is obvious that for the purpose of extended communication, as well as for improving and beautifying discourse, other classes of words besides the three enumerated above would soon be found necessary. The substantive would require "definitives," to limit its signification; "substitutes," to prevent its too frequent repetition; and "relationals," either used separately or coalescing with it, to express various relations of cause and effect, position, duration, and the like; hence what are called in English *articles*, *pronouns*, and *prepositions*. The attributive and affirmative must have "modifiers," which we distinguish as *adverbs*. As the graces of style are cultivated, and the brief modes of expression give way to elaborate periods, "connectives," or *conjunctions*, become necessary to combine propositions into sentences. Finally, *interjections*, or exclamations expressing strong and sudden emotions, find a place in every tongue. Constituting the chief element of that natural language which belongs to man in common with other animals, they have been regarded by some as the earliest part of speech, and are still used when the suddenness or violence of some mental emotion, surprising men into a forgetfulness of their more cultivated forms of discourse, brings them back to their natural state.

Such are the different classes of words, or "parts of speech," current in language, and which it is the province of grammar to consider. The most polished tongue requires no more for the expression of every conceivable shade of thought with perspicuity and strength; and the rudest can ill dispense with any of these classes if it is to be the vehicle of connected discourse.

A natural distinction of objects endowed with life is sex; and to this corresponds a modification of the substantive to denote what is technically called GENDER (which see).

The use of a distinct class of words (*prepositions*) to indicate the relations in which one object may stand to another, has been alluded to above. In some languages such relations are also indicated by terminations appended to the noun, which is then said to be *inflected*. Hence, the modification known as *case*. (See DECLENSION.) The terminations which mark the different cases of nouns are not accidental outgrowths or conventional contrivances for the

expression of certain relations, but they were originally independent words, capable of separate use, and each having a signification which gives to the word in that special case its peculiar force. In proof of this we are pointed to Chinese, in which the relational term is not disguised at all, but is added to the root unchanged, forming a compound whose elements are recognized at once, and are seen to retain their original meaning. In the agglutinative languages, the root, as in Chinese, remains unchanged, and stands out in bold relief from the relational appendage, which, however, having lost its primitive form and etymological meaning, has come to be regarded as a mere termination. But in the Aryan or Indo-European languages (including ancient Sanscrit, Greek, and Latin, and our own English), the elements, put together as before, coalesced into a word in which neither root nor relational retained its original form, or could be at a glance detected, the appended term dwindling in many cases to a syllable, or even a single letter.

To facilitate the expression of thought, modifications are as necessary in the case of the verb as of the noun. It may be desired to affirm the action or state expressed by the verb positively, or as a condition or supposition, or as a thing possible, necessary, wished for, or commanded; also, to affirm it as present, past, or future, either absolutely, or relatively to some other specified time, present, past, or future. Here again, as in the case of the noun, recourse is had either to terminations or auxiliary words, and these may in their turn be varied to denote that the action or state is affirmed of one or more than one,—of a person or persons speaking, spoken to, or spoken of. In some languages a termination is also appended to certain adjectives and adverbs, to make them denote the higher of two degrees compared, or the highest of more than two. Whenever such a termination, or indeed any other, is used, comparative grammar teaches that it is not a mere meaningless form, but the relic of a root whose original force still adheres to the insignificant appendage to which it has become reduced.

Comparative grammar as a science had no existence till the commencement of the present century. At that time Sanscrit began to be critically studied, and its remarkable affinities with the other Indo-European languages were soon perceived and thoroughly investigated. The study of philology received a new impulse; and the researches of several distinguished English scholars, but particularly of the Germans Bopp, Schlegel, Grimm, Pott, Bunsen, and Müller, have within the last three-quarters of a century thrown a flood of light on this whole subject. The various languages of which there is sufficient knowledge have been grouped according to their grammatical analogies into families, and made to reveal the relationship, and measurably the social condition, of nations during ages respecting which history is silent. These discoveries Humboldt pronounces "one of the most brilliant results of modern study."

Though the science of comparative grammar is of so recent an origin, the art of grammar may lay claim to great antiquity. As far as is known, the first attempts at systematic technical grammar were made in Sanscrit. The early language of the Vêdas had already given place to later dialects, but its purity was jealously guarded by the Brahmans, who from time to time accompanied the sacred text with critical observations on its pronunciation and constructions. These Bráhmanas, or commentaries, supposed to have been written from 700 to 800 B. C., formed the foundation of that great Sanscrit Grammar of Pânini which Max Müller pronounces "the perfection of a merely empirical analysis of language, unsurpassed nay, even unapproached—by anything in the grammatical literature of other nations." The records of his countrymen assign Pânini to a remote antiquity; we may safely assume that this masterpiece of grammar was composed at least a century before Plato taught.

Among the Greeks, technical grammar was of later origin. With them what was not Greek was barbarian; and, if we except itinerant traders, and philosophers who sought foreign lands in quest of knowledge, they had little desire to become acquainted with other languages than their own, and little need of a formal grammar. Plato and Aristotle, indeed, both used the term ἡ γραμματική, and distinguished certain of the parts of speech. The latter, also, recognized number and case as modifications of the noun, and wrote a treatise, embraced in his *Organon*, on the expression of thought by means of speech. But the philosophers just named viewed these things as logicians rather than grammarians; they dealt with the thought rather than the word, and were deficient in grammatical terminology. Not till fifty years after Aristotle's time, when Alexandria became a great seat of learning, do we find much progress made in grammar. At that time the revision and explanation of the texts of Homer and the early dramatists and philosophers led to the cultivation of this art among the Greeks, just as the study of the Vêdas had done among the Brahmans. A rich crop of critics and scholiasts was the result. Zenodotus, the first superintendent of the Alexandrian library (280 B. C.); Aristophanes of Byzantium, who introduced accents into the Greek language; and Aristarchus, author of 800 commentaries,—are deserving of special mention as having prepared the way for a practical grammar of the language. Their labors, however, had chiefly in view the restoration and exposition of the text of Homer and other ancient Greek authors; it was reserved for Dionysius the Thracian, who established himself as a teacher at Rome about B. C. 80, to construct, out of the materials which had been accumulating for generations in the works of philosophers and commentators, and were specially valuable in those of his master Aristarchus, the first systematic grammar of the Greek language. The study of Greek had for years been regarded at Rome as a necessary part of a liberal education; indeed, the young patricians were often taught the Greek language before their own. How thoroughly their teachers, who were for the most part slaves or freedmen, may have drilled them orally in the details of declension and conjugation and the niceties of syntax, we cannot tell; but there is no evidence that any of these *grammatici* attempted to reduce their lessons to a systematic form and embody them in a manual of instruction. The first attempt of this kind of which we have any knowledge was made by Dionysius in his Τέχνη γραμματική, which has come down to us, and which was a standard school-book for centuries.

But even before the appearance of Dionysius at Rome, a taste for the study of grammar had prevailed in that metropolis. It originated with the lectures of the distinguished grammarian, Crates of Pergamus, who, sent as an ambassador to Rome about 157 B. C., and detained there by an accident, delivered a series of discourses on his favorite art. The study of grammar at once became fashionable, and it was not long before the scholars of Rome sought to apply its principles practically to the teaching of their own language. We read of Stilo writing on etymology and lecturing on his native tongue. His pupil Varro, "the most learned of the Romans," composed a comprehensive treatise, *De lingua Latina*, the first part of which was devoted to etymological investigations, the second to the inflections of words, and the third to syntax. Nor must we forget Julius Cæsar, who, amid the labors of the Gallic war, found time to prepare an essay on the analogies of the Latin language. Many grammarians followed; we may name Quintilian, who flourished near the close of the first century after Christ, and Priscian, one of the bright ornaments of Justinian's reign, whose treatise on the *Eight Parts of Speech* maintained its authority as a text-book for many centuries.

The labors of later grammarians have consisted chiefly in simplifying, illustrating, adapting, and carrying out the work of their predecessors; as regards the great principles of the art, they have added little that was really new. What is to-day taught in our schools as grammar, whether English, Latin, or Greek, has substantially the same framework that Priscian used, and Dionysius and Pânini constructed, centuries ago. There has been little change; from the very nature of things little could be expected. Much as our present systems of grammar have been decried, much as has been said in favor of banishing them from the schools, and letting the young learn to speak and write by imitation or by so-called natural processes, there yet remains to be found a royal road to the learning of language, which can dispense with the classification of words, the formal array of declensions and conjugations, verbal and sentential analysis, and syntactical rules based on the usage of standard writers. G. P. QUACKENBOS.

Gramme, commonly in English written *Gram* [Gr. γράμμα, a letter] the unit of weight in the Metric System of Weights and Measures. Theoretically it is the weight in vacuo of a cubic centimètre of distilled water at the temperature of maximum density, assumed to be 4° C. or 39°.1 F. Practically it is the one thousandth part of the weight of the standard kilogramme in platinum, deposited on the 22d June, 1799, in the Palace of the Archives in Paris, by the international commission appointed to fix the standards, who on that day completed their work. (See METRIC SYSTEM.) The original determination of this standard was made in 1795 with great care, by Mr. Lefèvre Gineau, a member of the commission. It was adopted as representing exactly the weight in vacuo of one cubic decimètre of water under the conditions above named. Its weight in British grains has since been carefully ascertained on three occasions, viz.; by Hassler, Chief of the U. S. Coast Survey, in 1832; by Kupffer of St. Petersburgh, in 1841; and by Miller of London, in 1844. These determinations are severally as follows: Hassler, 15,433.1669; Kupffer, 15,432.36186; Miller, 15,432.34874. Miller's determination has been officially adopted by the British Standards Bureau, and is hence generally accepted. But

as the officially adopted length of the mètre in England is 39.37079 inches, and the officially adopted weight of the cubic inch of distilled water in vacuo, at 62° F. (252.724 grains) reduced by Miller's coefficient to 39.°1 F. is 253.00452 grains, it results from the combination of these numbers that the standard kilogramme of the Archives is 7.77118 grains too light. Kupffer on the other hand found the weight of the cubic inch of water in vacuo at 13°$\frac{1}{3}$ R. = 16.°67 C = 62° F., to be only 252.598 grains; and taking this with his determination of the weight of the standard kilogramme (which exceeds that of Miller only by the minute fraction 0.01312 gr.), a cubic centimètre of water at maximum density weighs in vacuo 1000.0115 grammes, or only about one sixth part of a grain more than the standard kilogramme. On this Mr. Chisholm, Warden of the Standards to the British Government, remarks (Second Report of the British Standards Commission, 1869) that "if Capt. Clarke's more recent valuation of the mètre = 39.370432 English inches, be taken as the base, a cubic decimètre of water at its maximum density weighs 0.015 gramme or 0.23145 grains *less* than a kilogramme," and that "If the mean of these two computations be taken, the weight of a cubic decimètre of water at its maximum density will be only 0.00175 grammes, or 0.027 grains less than a kilogramme." Capt. Clarke, the authority above referred to, is the eminent geodesist connected with the Royal Ordnance Survey of the British Islands.

It is still unsettled what is the true weight in British grains of a cubic inch or of any other given volume of water; and hence it is for the present equally uncertain what is the amount of discrepancy, if any, between the actual or legal and the theoretic weight of the standard kilogramme. A pretty full summary of the results of investigation up to 1832 on the weight of the cubic inch of water, may be found in Hassler's first and large Report on Weights and Measures made in that year to the Secretary of the Treasury of the United States. This document will probably at present be found only in libraries, public or private. The substance of Kupffer's results is given in the Sixth Appendix to the Second Report of the British Standards Commission, made in 1869 and published as a blue book. A pretty full discussion of the whole subject may be found in the essay on the Metric System, Appendix B, by the writer of this article, published in 1872.

The gramme = 15.43 grains though the unit base of the system of metric weights, is the practical unit only where small quantities are concerned, as in medicine, chemistry, coinage, &c. The usual commercial unit is the kilogramme = 2.20462 pounds avoirdupois. It should be observed that this equivalent of the kilogramme, which is commonly received, is a weight in vacuo, and involves consequently for ordinary uses a trivial error, which is however of no practical importance. F. A. P. BARNARD.

Grammont, town of Belgium, in the province of East Flanders, on the Dender. It has manufactures of damasks, linen, cotton, and black laces. Pop. 9362.

Grammont, Order of, called also **Grandmontains,** an order of monastics established at Muret, near Limoges, in France, in 1076, by Stephen of Thiers, who wore a shirt of steel rings and slept in a coffin. He took the title of corrector. Gregory VII. imposed the rule of St. Benedict. In 1124, after Stephen's death, the order was removed to Grandmont, whence it took its name. It had a verbal or traditional rule, derived from its founder and afterwards reduced to writing. The Grandmontains were afterwards very numerous and much respected. They were at first allowed to hold no lands or churches. This was one of the orders whose members were known as Bons Hommes. The order perished at the Revolution, having at last become degenerated.

Gramont, de (PHILIBERT), COUNT, b. in 1621; served in the French armies in Germany, Burgundy, and Spain, but is chiefly famous for his scandalous intrigues at the French and English courts; but having seduced Eliza Hamilton, a Scottish lady, he was compelled by her brother, afterwards Count Anthony Hamilton, to marry her (1664). He re-entered the French service in the Low Countries, and d. Jan. 10, 1707. Count Anthony Hamilton published in French his *Mémoires* (1713), a brilliant narrative of Gramont's exploits in love and at the gaming-table, well known in the English translation.

Gram'pians is the name of a range of mountains in the western part of Victoria, Australia, stretching from N. to S. in a curve around the basin of Glenelg and its affluents. Mount William, the highest peak, is 4500 feet above the sea.

Grampians is the name of a range, or rather system, of mountains which traverse Scotland from N. E. to S. W., from the Atlantic to the North Sea, and form the highlands of Aberdeenshire, Kincardineshire, Forfarshire, and Perthshire. The highest point is Ben Nevis, 4408 feet; the general height is from 2000 to 3000 feet. Towards the N. the Grampians send forth ranges of wild mountains, forming extensive highlands; towards the S. they slope more gently.

Gram'pus [from the Fr. *grand poisson,* "great fish"], a name applied to various cetaceans of the family Delphinidæ and of the genera *Grampus, Globicephalus, Orca,* etc. It has been also appropriated as a scientific name for a genus of Globicephalinæ, distinguished by the complete want of teeth in the upper jaw and the few of the lower jaw.

Gran, town of Hungary, on the right bank of the Danube. It is one of the oldest towns of Hungary, being the birthplace and residence of St. Stephen, the first king, and it is still a handsome and lively place. It is the see of the primate of all Hungary, an archbishop of the Latin rite, and has a most beautiful though yet unfinished cathedral. Its trade in wine is considerable. Pop. 8780. It is called Esztergom by the Magyars.

Grana'da was the name of one of the largest and richest kingdoms which the Moors established in Spain. It comprised the three modern provinces of Malaga, Granada, and Almeria, and had an area of 11,063 square miles of the most diversified and fertile land, bordering S. on the Mediterranean, and traversed by the Sierra Nevada, from whose lofty snow-clad peaks the ground gradually sinks, through beautiful terraces, into the low and hot plain of Andalusia. In the time of the Romans this territory belonged to the province of Bætica. After the invasion of the Moors it formed part of the kingdom of Cordova until 1235, when it rose into an independent kingdom, with Granada as its capital. Here the genius of the Moorish people seems to have had its finest and happiest inspirations. The land was densely peopled, the soil most excellently cultivated, and the kingdom covered with works of the most wonderful architecture and engineering. The most delicate products of art and industry passed from here to all the markets of the world, and a considerable influence was exercised on the civilization of Europe—on its science, its morals, and its customs. But in 1492 the kingdom of Granada was conquered by Ferdinand and Isabella, and in 1510 the Moors were expelled from Spain. The works of irrigation stopped operation, the plantations withered away, the gloom of the Inquisition fell like a frost on the sciences and arts, and the splendor of Granada was gone. The present province of Granada has an area of 4937 square miles. Pop. 485,346.

Granada, town of Nicaragua, in Central America, on the north-western shore of Lake Nicaragua. It is an old Spanish settlement founded 1522, and once a very thriving town, but in 1854 and 1855 it suffered very much during the civil wars, and is still mostly in ruins. It is said to have about 8000 inhabitants.

Granada, city of Spain, the capital of the province of Granada. It is built on two spurs of the northern range of the Sierra Nevada, at an elevation of 2445 feet above the level of the sea, and has a most delightful climate, the atmosphere being refreshed by the breezes from the snowy peaks behind it. Below it stretches the Vega, the plain of Granada, watered by the Jenil and the Darro, and once a wonder of cultivation and the scene of the most romantic valor and gayety. Granada is the see of an archbishop, and has a university founded in 1531, and yearly attended by several hundred students, and a large cathedral, most gorgeously decorated with variegated marble and containing the monuments of Ferdinand and Isabella. But its chief interest it derives from its historical remains. It was founded by the Moors in the eighth century, and became in 1248 the capital of the kingdom of Granada. As such it was one of the most splendid cities the world ever saw. It had 400,000 inhabitants, and was surrounded by a strong wall crowned by 1030 towers; and in spite of centuries of decay, not only the ALHAMBRA (which see), but many other buildings, fascinate the traveller. Pop. 61,993.

Granada, post-tp. of Nemaha co., Kan. Pop. 893.

Granadil'la [Sp., dim. of *granada,* a "pomegranate"], the fruit of several tropical species of passion-flower. The great granadilla is the fragrant, gratefully sub-acid fruit of *Passiflora quadrangularis,* whose root is emetic and narcotic. *P. laurifolia* (water-lemon), *P. maliformis, filamentosa, edulis,* and many other species bear edible fruits. They are all natives of America. (See PASSION-FLOWER.)

Gran'bury, post-v., cap. of Hood co., Tex., on the river Brazos. It has one weekly newspaper.

Gran'by, tp. and post-v. of Shefford co., Quebec, Canada, on the Stanstead Shefford and Chambly Railway, has an academy and 2 weekly papers. Pop. of v. 876; of tp., exclusive of v., 2225.

Granby, post-v. and tp. of Hartford co., Conn., on the New Haven and Northampton R. R., 17 miles N. of New Haven; has considerable manufacturing interests. The township contains the villages of West and North Granby. Pop. 1517.

Granby, post-tp. of Hampshire co., Mass., 5 miles E. of Holyoke. It has one insurance company, and is an excellent agricultural town. Pop. 863.

Granby, post-tp. of Nicollet co., Minn. Pop. 566.

Granby, post-tp. of Newton co., Mo., on the Atlantic and Pacific R. R., 8 miles N. E. of Neosho. It has lead-mines and one weekly newspaper. Pop. 1889.

Granby, tp. of Oswego co., N. Y., contains the village of Oswego Falls (which see). It has extensive manufactures of lumber, cheese, leather, and wooden-ware. P. 3972.

Granby, post-tp. of Essex co., Vt., 58 miles N. E. of Montpelier. It has manufactures of boots, shoes, and lumber. Pop. 171.

Gran'by (John **Manners**), Marquis of, b. Jan. 2, 1721, was the son of the duke of Rutland; was educated at Eton and Cambridge; raised a foot regiment in 1745; was chosen to Parliament 1754, 1761, and 1768; became colonel of the horse-guards in 1758; lieutenant-general in 1759, and at the battle of Minden was greatly distinguished; commanded the British troops in the Seven Years' war 1760–63; was distinguished at Warburg 1760, at Kirchdenken 1761, at Gräbenstein and Homburg 1762; became master-general of ordnance 1763; had chief command of the British army 1766–70. D. at Scarborough Oct. 19, 1770. Granby had during life an immense popularity and a brilliant fame as a general, but the sentence of military critics has found nothing to commend in his generalship. He was, however, a brave, honest, and humane officer.

Gran Chaco. See Chaco, El Gran.

Grand, the north-westernmost county of Colorado, formed since the census of 1870.

Grand, tp. of Marion co., O. Pop. 403.

Grand Bank, the subaqueous plateau in the Northern Atlantic which extends eastward from Newfoundland towards Europe. Its limits are not at present accurately known. It is believed that its existence is largely due to the melting of icebergs by means of the warm waters of the Gulf Stream. The icebergs bring great amounts of gravel, earth, and stone from the parent-glaciers of Greenland, and as they melt this matter is deposited upon the sea-bottom. The Grand Bank is the most extensive and important of the known resorts of the codfish, and French, British, American, and colonial fishing vessels visit it in great numbers.

Grand Bank, port of entry and fishing-town on the S. side of Fortune Bay, Burin district, N. F. It has a good trade with St. Pierre. Pop. 740.

Grand Bay, or **Ha-Ha Bay,** a beautiful inlet from the river Saguenay in Chicoutimi co., Quebec, Canada, averaging 1 mile in breadth, with water 600 feet deep. At its head the largest ships load with lumber. Pop. of v. about 300; of sub district, 1301.

Grand Blanc, post-tp. of Genesee co., Mich. P. 1367.

Grand Chute, tp. of Outagamie co., Wis., contains Appleton (which see). Pop. exclusive of Appleton, 1390.

Grand Combe, La, town of France, department of Gard, has important coal, zinc, and lead mines. Pop. 8706.

Grand Coteau, post-v. of St. Landry parish, La. It is the seat of St. Charles College, a Jesuit institution, and has a convent of ladies of the Sacred Heart. Pop. 470.

Grand Coutumier, a name applied to each of two collections of ancient French laws. One, known also as the *Coutumier de France*, is a collection of the customs, usages, and forms of practice which had been in use from time immemorial in the kingdom of France. The work was first planned by Charles VII. in 1453, but was not finished until 1609. The other collection, which is more specifically designated as the *Coutumier de Normandie*, embodies the laws and customs of Normandy, and is much more ancient, having been made about the year 1229, in the reign of Henry III. of England. The great similarity between this latter collection and the ancient laws of England has been regarded as indicating that the Norman laws were in great measure derived from the English.

George Chase. Revised by T. W. Dwight.

Grand Days, the days of social festivity appointed by the English Benchers for the entertainment of judges, barristers, and students of the Inns. These were formerly great occasions, and were celebrated four times a year with much revelry.

Grand Détour, post-tp. of Ogle co., Ill., at the Great Bend of Rock River, 166 miles N. N. E. of Springfield. Pop. 605.

Grandee' [Sp. *grande*, "great"], in the kingdom of Castile, and afterwards in Spain, a nobleman of the most highly privileged class. The privileges of the grandees, always greater than those of the merely titled nobility, have been subject to great variations. Originally feudal magnates, their privileges latterly have degenerated to childish matters of punctilio.

Grande Ligne, post-v. of St. John's co., Quebec, Canada, near the Richelieu River, and on the Montreal St. John's and Rouse's Point R. R., 17 miles N. of Rouse's Point, N. Y., has an academy, and is the seat of the celebrated Baptist mission established by the late Mme. Feller among the Canadian French. Pop. about 400.

Grande Ronde, The, a beautiful valley of Union co., Or., near the N. E. corner of the State. It is drained by the Grande Ronde River. It lies E. of the Blue Mountains and W. of Snake River. It has 275,000 acres of fertile arable land, and timber abounds on the mountains around it. La Grand is the principal town.

Grand Forks, county of Dakota, separated from Minnesota on the E. by the Red River of the North. Area, about 4200 square miles.

Grand Glaize, tp. of Jackson co., Ark., on the Cairo and Fulton R. R. Pop. 447.

Grand Gulf, post-v. of Claiborne co., Miss., on the Mississippi River, 2 miles below the mouth of the Big Black. It is on a high bluff, and has a hospital, a theatre, and trade in cotton and lumber. Pop. 190.

Grand Ha'ven, city and tp., cap. of Ottawa co., Mich., on Lake Michigan, opposite Milwaukee, Wis. It is connected with Milwaukee, Chicago, and ports N. and S. by 5 daily lines of large steamers. It is the terminus of the Detroit and Milwaukee R. R., and is the transfer-station of the Lake Shore R. R. It has a national bank, 2 newspapers, a high school, 8 churches, a public library, magnetic mineral springs, a fine hotel, 2 shipyards, and several manufactories. It is a summer resort. Pop. of city, 3147; of tp., exclusive of city, 558.

John H. Mitchell, Sr. Ed. and Prop. "News."

Grand Isl'and, post-tp. of Colusa co., Cal. Pop. 702.

Grand Island, city, cap. of Hall co., Neb., situated in the Great Platte Valley, 153 miles W. of the Missouri River, on the Union Pacific R. R. It is the end of the eastern division of the road, and also the initial point of the Grand Island Hastings and St. Joseph and the Central Nebraska and Montana R. Rs., running S. from the city, and the eastern terminus of the Grand Island and Nebraska R. R., on all of which work has already been commenced. It has a large flouring-mill, 3 public halls, 2 churches, 1 public-school building, 2 newspapers, 4 hotels, and 16 stores, and is growing rapidly. Principal business, handling and shipping grain. Pop. about 1600.

S. P. Mobley, Ed. "Independent."

Grand Island, tp. of Erie co., N. Y., consisting of Grand, Beaver, and Buckhorn islands in Niagara River, above the Falls. Here (1810–25) Maj. M. M. Noah vainly attempted to found a Jewish city of refuge. Pop. 1126.

Grand Isle, the north-westernmost county of Vermont, consisting of North and South Hero, and other islands in Lake Champlain, and of a part of a peninsula extending S. from Canada into the lake. The soil is fertile. Cattle, grain, fruit, and wool are leading products. It is crossed by the Central Vermont R. R. Cap. North Hero. P. 4082.

Grand Isle, post-tp. of Grand Isle co., Vt., consisting principally of the N. part of South Hero Island, in Lake Champlain. It is 46 miles N. W. of Montpelier. P. 682.

Grand Junc'tion, post-v. of Greene co., Ia., at the junction of the Keokuk and Des Moines and the Chicago and North-western R. Rs., 50 miles N. of Des Moines and 80 miles E. of the Missouri River. It has a bank, a newspaper, a graded school, a large steam flouring-mill, 2 large hotels, and the usual number of stores and shops. Principal business, farming and stock-raising. Pop. 444.

S. C. Maynard, Ed. "Head Light."

Grand Junction, post-v. of Van Buren co., Mich., at the crossing of the Chicago and Michigan Lake Shore R. R. and the S. Haven division of the Michigan Central.

Grand Junction, post-v., cap. of Bell co., Tenn., at the crossing of the Mississippi Central and the Memphis and Charleston R. Rs., 52 miles E. by S. of Memphis.

Grand Ju'ry, a jury whose province it is to determine whether indictments shall be brought against alleged criminal offenders. The origin of the custom making the trial of any person for a crime entirely dependent upon the decision of his fellow citizens must be referred to a very ancient period of English history; and its importance as a safeguard for the due protection of civil liberty, by prevent-

ing vexatious and vindictive prosecutions has caused its scrupulous maintenance down to the present day as a cardinal principle in English jurisprudence. In the U. S. the continuance of the practice has been deemed so essential to public welfare that provisions have been inserted in the national Constitution, and, for the most part, in the State constitutions as well, prohibiting criminal prosecutions for all but an inferior class of offences, or such as occur among the military or naval forces, except upon the presentment or indictment of a grand jury. The power of the government to prosecute on account of political or partisan reasons receives by this institution a salutary restriction.

As constituted under the common law, a grand jury must consist of not more than twenty-four members nor less than twelve, but in practice not more than twenty-three are ever sworn, in order that twelve may form a majority, for the concurrence of at least this number is always required that a bill of indictment may be found. The grand jury receives its name from its size, to distinguish it from the petit (*i. e.* "little") jury, which consists of only twelve men. There is also a diversity between them in another important respect, since it is a rule in regard to a petit jury that unanimity is required, instead of the agreement of a mere majority. In a few of the American States the number of members composing a grand jury has been altered by statute. In New York, for example, it varies from sixteen to twenty-three, in Massachusetts from thirteen to twenty-three, but the rule that twelve only need concur seems to have been uniformly retained. The proper number of jurors is returned by the sheriff or marshal at every session of a court for the trial of criminal causes, in pursuance of a writ termed a "venire," which directs him to summon a jury to be present at the appointed time. The names of those to be summoned are determined by lot from among the whole number of citizens liable to jury duty. After the appearance of those selected a foreman is either chosen by themselves or appointed by the court, and they are severally required to take an oath to perform their duties faithfully and impartially. This organization of the jury is termed an "impanelling." In performing their duties of investigation they sit in secret, and may either consider and pass upon bills of indictment presented by the attorney-general or other officer representing the government, or they may make presentments by themselves independently. By a "presentment" is meant an accusation made by the grand jury upon their own observation and knowledge or upon evidence laid before them, and without any introduction of a bill at the instance of the governmental officer. Much the larger proportion of business transacted, however, is regularly brought forward by the prosecuting attorney, and even when there is a jury presentment the proper officer of the court must frame an indictment upon which the party accused may be brought to trial. The proceedings before a grand jury are entirely *ex parte.* Only witnesses in support of the prosecution are examined, and no evidence is admitted in favor of the accused. The effect of a conclusion that an indictment shall be brought is not to determine the guilt of the alleged offender conclusively, but only presumptively. The decision of the jury merely indicates that in their opinion the evidence against him is of sufficient weight to justify his being brought to trial; the introduction of his defence may establish his perfect innocence. The sound rule is, that the evidence before the grand jury should be sufficient to convict him, unless he offer evidence in his defence, at the trial. The rule requiring the preservation of secresy in the conduct of the deliberations of a grand jury is very stringent. No spectators are allowed to be present, but only the officers presenting the accusation and the necessary witnesses. The jurors, moreover, are not permitted, on grounds of public policy, to disclose in a court of justice what occurs in the jury-room. The enforcement of this rule is necessary in order that the consultation may be free and unbiassed, that no fear of animosity or hostile acts on the part of those against whom accusations are brought may deter the jurors from agreeing upon an indictment if they deem it proper and requisite, and that those indicted may not receive intelligence of the fact, and be thus enabled to make their escape. But in some instances a grand juror may by statute be compelled to serve as a witness upon the actual trial of the cause, to establish, as a part of the requisite testimony, what occurred before him. A case of this kind might arise when the evidence of a witness upon the trial was directly contrary to that given before the grand jury, and it became necessary to prove the variance, that his testimony might be impeached or a prosecution for perjury brought against him. If the requisite number of members of a grand jury are satisfied, from the evidence presented to them, of the truth of the accusation, they write upon the back of the indictment the words, "A true bill;" but if they are convinced of the groundlessness of the charge, the indorsement is "Not a true bill" or "Not found." Formerly they used in this latter case the word *Ignoramus*, "we are ignorant." This is the origin of the common expression, "that the bill of indictment has been *ignored.*" After all the accusations laid before the jury are considered, and indictments found or denied, their labors are ended, and the causes are ready for trial before a petit jury. (See JURY.) GEORGE CHASE. REV. BY T. W. DWIGHT.

Grand Lake, in Maine. This name sometimes designates the great SCHOODIC LAKE, between Maine and New Brunswick, but it is more properly restricted to a large lake lying some 30 miles S. of the former. It is mostly in Washington co. Its waters are discharged into the St. Croix. Both these lakes are famous for trout and land-locked salmon.

Grand Lake, a large sheet of water in Iberia, St. Martin's, and St. Mary's parishes, La. It is often called Lake Chetimaches. It is connected with Atchafalaya Bayou, is very shallow, and scarcely navigable.

Grand Ledge, post-v. of Eaton co., Mich., 12½ miles from Lansing. It has 4 hotels, 1 newspaper, a good improved water-power, and 4 mineral wells. It is a resort for invalids. Pop. about 1200.

SAUNDERS & WESTLAND, PUBS. "INDEPENDENT."

Grand Manan′ [*manan* signifies "island" in the Passamaquoddy language], an island in the Bay of Fundy, belonging to Charlotte co., N. B. Lat. of N. E. head, 44° 45′ N., lon. 66° 45′ W.; lat. of S. W. head, 44° 34′ N., lon. 66° 53′ W. It is 22 miles long, and from 3 to 6 miles in breadth. It is fertile and well timbered, and its coast abounds in good harbors. Its shores are bold and high, but the general surface is not greatly elevated. The herring, haddock, and cod fisheries are important. Grand Harbor is the principal settlement. The island is a favorite summer resort. Total pop. 1867.

Grand Mead′ow, tp. of Clayton co., Ia. Pop. 945.

Grand Meadow, post-tp. of Mower co., Minn. P. 444.

Grand Monad′nock, or **Monadnock,** an isolated mountain-peak in Jaffrey tp., Cheshire co., N. H. It is 3718 feet high, and is visible for many miles in every direction. The view from its top is very fine. It is regarded as an outlying member of the White Mountain group.

Grand Pass, tp. of Saline co., Mo. Pop. 1956.

Grand Pen′sionary, in the former Dutch republic, the state secretary for the province of Holland. He was originally also advocate-general for the same province. In later times he was, by virtue of his position, an official of the states-general, a kind of premier in that body, and a virtual minister of foreign affairs. His term of office was five years. The syndic, or paid consellor, of any important Dutch town was called a pensionary.

Grand-Pierre (JEAN HENRI), D. D., was b. at Neuchâtel, Switzerland, in 1799. He was educated in his native city and at the University of Tübingen in Germany. He was licensed to preach by the consistory of Neuchâtel, and was called to be an assistant pastor at Bâle, Switzerland, in 1823. Here he was associated with the eloquent and pious Vinet, and his success was so remarkable that his reputation extended beyond his own country to France. In 1827 he was called to Paris to take charge of the House of Missions, which is a theological seminary for training young men for the work of foreign missions. He was not only president of this institution, but also professor of theology, of languages, etc., and became known as one of the most eloquent and successful preachers in the city of Paris. The place in which he preached was repeatedly changed in consequence of the numbers that flocked to hear him. It was at the time of the revolution of July, 1830, that a remarkable revival of religion occurred among the Protestants of Paris, and M. Grand-Pierre was one of the most eminent ministers engaged in it. He did not join in the movement for an independent Church, which was one of the results of this revival, but remained in connection with the national Church. For some years he was at Batignolles, a suburb of Paris, but during nearly the last twenty years of his life he was pastor of l'Oratoire, the most important Protestant church in Paris, and for a number of years was president of the consistory of Paris. After the death of his colleague, M. Adolphe Monod, he was the acknowledged leader of the orthodox party in the Reformed Church, and possessed great influence not only in the Church, but upon the public at large. Under Louis Philippe the government gave him "grand letters of naturalization for his distinguished services to France." This was an unusual honor to be conferred upon a Protestant minister, and for services essentially religious. Under Napoleon III. he was made a member of the Legion of Honor. In 1838 the College of New Jersey conferred upon him the degree of doctor of

divinity. He twice visited America, publishing an account of his first visit in his *Glance at America* in 1850. He was in this country in 1870, when the Franco-German war broke out, but hastened home, and reached Paris just as the empire fell and the republic was proclaimed. With his wife he passed through the privations of the siege and the horrors of the Commune. In consequence of feeble health he resigned his position in 1872, and retired to Lausanne in Switzerland. D. at Arlesheim, near Bâle, when visiting friends, July 10, 1874. As a preacher he was styled "the Bourdaloue of the French revival." For many years he was editor of *L'Espérance*, the principal religious paper of the orthodox Protestants in France. An easy, graceful, and learned writer, he published a number of works, almost entirely of a religious character. The principal of these are a series of sermons entitled *Doctrine Chrétienne, Vie Chrétienne, Unité et Variété, Tristesse et Consolation;* also *Séjour aux États-Unis d'Amérique, Le Guide du Fidèle, Essai sur le Pentateuque,* and *Souvenirs d'un Ancien Pasteur,* besides numerous reports, pamphlets, and occasional sermons.

Grand Prai'rie, tp. of Marion co., O. Pop. 370.

Grand Pré (post-o. LOWER HORTON), a beautiful village on the Basin of Minas, Horton tp., Kings co., N. S., on the Windsor and Annapolis Railway, 15 miles from Windsor, is the scene of Longfellow's *Evangeline*. It was settled by the French under De Monts in 1604, but they were expelled by the Virginia colonists in 1613. The Pré is a fertile tract of dyked land. Area, 10 square miles. Grand Pré is the seat of a seminary. Pop. about 600.

Grand Rap'ids, tp. of La Salle co., Ill. Pop. 1118.

Grand Rapids, city and tp., cap. of Kent co., Mich., at the head of navigation on Grand River, 30 miles E. of Lake Michigan. Six railroads enter the city, connecting it with all important points. It is in the midst of an excellent agricultural and fruit-growing region, and is a place of great manufacturing and commercial importance. It is an important distributing point for pine and hard-wood lumber. Its manufactures of furniture, wooden-ware, agricultural implements, brushes, and machinery are extensive, upwards of $2,000,000 being invested in the manufacture of furniture alone. Extensive quarries of gypsum are operated near the city, from which the product amounts to 100,000 barrels of stucco and 100,000 tons of land-plaster annually. The city has 2 public parks, 2 street railways, a paid fire department, and a reservoir system of waterworks. It is the place for holding the U. S. circuit and district courts for the Western district of Michigan. It has 3 daily and 6 weekly newspapers, one of the latter printed in the Dutch language; 2 national, 3 private, and 1 savings bank, and a public library of 7000 volumes. Grand River at this point has a fall of 17 feet in a distance of 2 miles, affording an excellent water-power, which is used for manufacturing and milling purposes. Pop. of city, 16,507; of tp., exclusive of city, 1650. ED. "DAILY EAGLE."

Grand Rapids, post-v. of Wood co., O.

Grand Rapids, city and tp., cap. of Wood co., Wis., on the Wisconsin River and the Wisconsin Valley and Green Bay and Minnesota R. Rs., 200 miles N. W. of Milwaukee. It has a national bank, 2 newspapers, a large machine-shop and foundry, several lumber-mills, 3 churches, 5 hotels, and a number of stores. Large beds of pure kaolin are found in close proximity. Principal business, lumbering and agriculture. Pop. of city, 1115; of tp. 1661.

H. B. PHILLEO, ED. "WOOD CO. REPORTER."

Grand Riv'er, in Michigan, is formed by the union of various streams in the southern peninsula, and flows in a devious course to Lake Michigan. At its mouth is Grand Haven. The river is navigable 40 miles to Grand Rapids, and boats ply upon it 50 miles above that point.

Grand River, in Missouri, an affluent of the Missouri River. Its head-streams rise in Iowa. With its numerous forks it drains a large part of Northern Missouri. Its mouth is at Brunswick in Chariton co.—Another GRAND RIVER is a north-western fork of the Osage.

Grand River, in Ohio, flows into Lake Erie at Fairport, Lake co. Its course is generally westward, through a pleasant region.

Grand River, in Utah, becomes, after its union with Green River, the Rio Colorado of the West. It is formed in Colorado by the union of the Blue and Gunnison rivers.

Grand River, tp. of Adair co., Ia. Pop. 235.

Grand River, tp. of Decatur co., Ia. Pop. 345.

Grand River, tp. of Madison co., Ia. Pop. 598.

Grand River, tp. of Wayne co., Ia. Pop. 833.

Grand River, tp. of Bates co., Mo. Pop. 1024.

Grand River, tp. of Carroll co., Mo. Pop. 3802.

Grand River, tp. of Cass co., Mo. It includes Harrisonville, the county-seat. Pop. 3978.

Grand River, tp. of Daviess co., Mo. Pop. 1093.

Grand River, tp. of De Kalb co., Mo. Pop. 959.

Grand River, tp. of Henry co., Mo. It includes Clinton, the county-seat. Pop. 5450.

Grand River, tp. of Livingston co., Mo. Pop. 1160.

Grand Sergeanty. See FEUDAL SYSTEM, by PRES. T. D. WOOLSEY, S. T. D., LL.D.

Grand Tactics. See TACTICS.

Grand Tower, post-v. and tp. of Jackson co., Ill., on the Mississippi, 120 miles below St. Louis, is the W. terminus of the Grand Tower and Carbondale R. R. It ships coal by the river, and has 1 weekly newspaper, large iron-works and an active trade. It takes its name from a huge rock in the river. Pop. of tp. 2181.

Grand Trav'erse, county of the N. part of the southern peninsula of Michigan, having Grand Traverse Bay to the N. Area, 500 square miles. It has numerous lakes and hard-wood forests, and its climate is far less severe than might be supposed from its latitude, 45° N. Grain is raised considerably. Cap. Traverse City. Pop. 4443.

Grand Traverse Bay, in Michigan, extends S. from Lake Michigan. Its southern part is divided by Preogenise Point into the E. and W. arms. Leelenaw co. lies on the W., Antrim co. on the E., Grand Traverse co. on the S.

Grandview', post-tp. of Edgar co., Ill. Pop. 1899.

Grand View, post-v. of Hammond tp., Spencer co., Ind., on the Ohio River, 5 miles N. E. of Rockport. It has 1 weekly newspaper.

Grandview, post-v. of Louisa co., Ia. Pop. 422; of Grandview tp. 1635.

Grand View, post-v. of Washington co., O., on the Ohio River, 15 miles above Marietta. Pop. 193; of Grand View tp. 2273.

Grane, or **Quade,** town of Arabia, on the Persian Gulf, in lat. 29° 23′ N. It has a very extensive trade on the Red Sea and with India. Pop. 8000.

Grange, an old English word derived from the Latin *granum*, through the Spanish, Portuguese, and Provençal *granja*, and the French *grange*. We find the word used by most of the poets from Spenser, Shakspeare, and Milton down to our own time, and occasionally by eminent prose-writers, but in slightly different significations. Primarily, it seems to have signified a granary or storehouse for grain; from this it passed to comprise the outhouses of the farm generally, as the stables, poultry-house, etc., and at an early period it was also used to designate an isolated farmhouse of the better class, a sort of semi-castle with its moat, drawbridge, portcullis, etc. Both in England and the U. S. the word has been frequently used as a proper name to designate an estate, with or without a prefix; as, The Grange, Suffolk, or Belair Grange.

Since 1867 the word has been extensively used with a still different meaning. The order of PATRONS OF HUSBANDRY (see PATRONS OF HUSBANDRY) in that year selected it as the name of their national, State, and subordinate organizations. The National Grange, which holds an annual session, is composed of the masters or presiding officers, past-masters of the State granges, and the wives of each; the founders of the order; and the present and past officers of the National Grange. The State granges are composed of the masters and past masters of the subordinate granges, with their wives, who are members of the order, and the deputies or organizing officers, as well as the previous and current officers of the State grange. The subordinate granges are composed of the officers and lay members, male and female, within a given territory, or in a city those who from acquaintance or other causes most naturally affiliate with each other. All the members of the granges must be "interested in husbandry," and not connected with any interest which is in conflict with it. Every fully organized grange, whether subordinate, State, or national, should have thirteen officers, having the following titles: master, overseer, lecturer, steward, assistant steward, chaplain, treasurer, secretary, gate-keeper, Ceres, Pomona, Flora, and lady assistant steward. The last four are women. The room or hall in which the meetings of the grange are held is designated as the grange-room. The exercises of the grange at its meetings are, aside from those connected with its ritual, social, intellectual, politico-economical, and moral. The effect of these frequent gatherings (the granges usually meeting weekly or fortnightly), with their music, their libraries and periodicals, their discussions, and their financial aid and co-operation, has been very salutary upon the farmers of the North-west, West, and South, where they are most numerous. They have become more intelligent,

thoughtful, and successful farmers, and better citizens. There were in Aug., 1874, over 25,000 subordinate granges in the U. S., having a membership of about 2,000,000. (For the origin, history, and purposes of the order, see PATRONS OF HUSBANDRY.) L. P. BROCKETT.

Grang'er, post-tp. of Allegany co., N. Y. Pop. 1050.

Granger, post-tp. of Medina co., O. Pop. 987.

Granger (FRANCIS), b. at Suffield, Conn., Dec. 1, 1792; from 1826–31 was a member of the general assembly of New York; member of Congress 1835–37, 1839–40 from New York; appointed in Mar., 1841, U. S. postmaster-general; delegate to the peace convention in Feb., 1861. D. in Canandaigua, N. Y., Aug. 28, 1868. He was a son of Gideon Granger.

Granger (GIDEON), b. in Suffield, Conn., July 19, 1767; graduated at Yale College in 1787, and, being admitted to the bar, rapidly rose to distinction; was a member of the legislature of Connecticut; one of the originators of the Connecticut school fund; postmaster-general 1801–14; in the State senate in 1819. Author of several essays on the school fund, etc. D. in Canandaigua, N. Y., Dec. 31, 1822.

Granger (GORDON), b. in New York in 1821; graduated at the U. S. Military Academy; entered the army as brevet second lieutenant of infantry July, 1845; transferred to the mounted rifles in July, 1846, and in May, 1847, attained a full second lieutenancy. In the war with Mexico he was actively engaged at the siege of Vera Cruz, in the battles of Cerro Gordo, Contreras, Churubusco, Chapultepec, and the final attack and capture of the capital; promoted to be first lieutenant in 1852, captain May, 1861; transferred to 3d Cavalry Aug., 1861. From 1848 to 1861 he was almost constantly on active duty on the frontier against hostile Indians. When the civil war commenced he was in June assigned to duty on the staff of Gen. Sturgis, and participated in the battles of Dug Spring and Wilson's Creek. In September he was appointed colonel 2d Michigan Cavalry, and in Mar., 1862, brigadier-general U. S. volunteers. In the movement on New Madrid he commanded a brigade, and at the capture of Island No. 10; in command of cavalry in the advance on Corinth and subsequent pursuit of Beauregard's army. Promoted to be major-general of volunteers Sept., 1862, he commanded various districts in Kentucky and Tennessee, and at the defence of Franklin successfully repulsed the attack of Gen. Van Dorn; at the battle of Chickamauga he arrived in time to drive back the columns of Longstreet. At the battle of Missionary Ridge he commanded the 4th army corps; in the South-west the 13th corps, being engaged in the siege of Fort Morgan and Spanish Fort, the storming and capture of Blakely, and final occupation of Mobile; subsequently commanded the district of Texas and department of Kentucky. For gallant conduct in the Mexican war he was brevetted first lieutenant and captain, and for similar services in the civil war he received the successive brevets from major to that of major-general U. S. A. In July, 1866, he was appointed colonel 25th Infantry; transferred to 15th Infantry in 1870, which command he held until his death, Jan. 10, 1876. G. C. SIMMONS.

Granger (MILES TOBEY), b. at New Marlboro', Mass., Aug. 12, 1817; graduated at the Wesleyan University, Conn., in 1842; taught in Louisiana; was admitted to the bar in Wilkinson co., Miss., in 1845; removed in 1847 to Canaan, Conn., where he was seventeen years a judge of probate; judge of the Connecticut superior court 1867–75, residing at North Canaan, Conn.

Granger (ROBERT S.), b. in Ohio in 1816; graduated at the U. S. Military Academy; entered the army as second lieutenant of infantry July, 1838; promoted to be first lieutenant 1839, captain 1847, and major 1861. His first service was in Florida, where he was engaged in the war against the Seminole Indians till 1841, when he was transferred to the northern frontier. With the exception of a year at the Military Academy as instructor of infantry tactics, he remained on frontier duty up to 1861, at which date he was captain 1st Infantry, stationed in Texas, where he was captured Apr. 27. He was subsequently paroled, and not exchanged till Aug., 1862. In Sept., 1862, he was appointed brigadier-general Kentucky vols., and acting brigadier-general U. S. vols. Assuming command of State troops Sept. 1, he was engaged in a skirmish at Lebanon and at the battle of Lawrenceburg, Ky.; subsequently commanded a division of the army of the Cumberland and various districts in Tennessee and Alabama; captured Gen. Roddy's camp near Courtland, and was engaged in driving the command of Gen. Wheeler from Middle Tennessee; defence against raids of Gen. Forrest; defence of Decatur, Ala., and assault upon the Confederate siege-works at that place. Brevetted colonel, brigadier-general, and major-general for gallant conduct; mustered out of volunteer service Jan., 1866. In June, 1865, he was promoted to be lieutenant-colonel 11th Infantry, and colonel 21st Infantry Aug., 1871. Retired from active service Dec., 1873. G. C. SIMMONS.

Grani'cus, the ancient name of the Kodshasu, a small river of Asia Minor, which rises in Mount Ida and runs into the Sea of Marmora. Here Alexander the Great won his first great victory over the Persians, in 334 B. C.

Granier de Cassagnac (ADOLPHE), b. at Bergelles in 1808. As early as 1832 he was one of the editors of the *Journal des Débats* and the *Revue de Paris*. After a voyage to the French West Indies, where he was married, he advocated the maintenance of slavery in the French colonies, and started many papers in Paris. In 1852 he was elected deputy to the Corps Législatif, of which he remained a member until the fall of the empire. He was chief editor of *Le Pays*, an imperialist paper. He wrote a *History of the Laboring and Bourgeois Classes*, *History of the Causes of the Revolution*, *Voyage to the French West Indies*, etc.

Granier de Cassagnac (PAUL), son of Adolphe, b. about 1841; became assistant to his father on *Le Pays* 1866, and afterwards chief editor, a position he still retains (1875). He has become widely notorious as the champion of imperialism, less by his pen than by his sword, employed in numerous "affairs of honor," of which the most celebrated were those with Gustave de Flourens, Lockroy, and Ranc. He served as a volunteer in the Franco-German war, and was taken prisoner at Sedan. During 1875 he was brought prominently into notice by his philippics against Gen. Wimpffen and Henri Rochefort.

Gran'ite, a crystalline granular rock essentially composed of quartz, feldspar, and mica, but often containing other minerals, such as hornblende, talc, etc., in such quantities as to modify its structure and produce varieties which have received distinct names, as syenite, in which the mica is chiefly replaced by hornblende, and protogine, in which the mica is largely replaced by talc. Granite is the most widely diffused of all known rocks, and as it is usually strong and durable, and may be quarried in blocks of any desired size or form, it has always been largely employed for architectural purposes. From its density and granular structure it works with difficulty under the chisel, and is rarely employed for ornamental work where elaborate carving is required, but it receives a high polish, and is therefore well adapted to the construction of columns, obelisks, etc. From the qualities mentioned, granite is more especially suited to heavy work, such as the construction of docks, bridges, foundations, and the more massive kinds of buildings. The prevailing colors of granite are gray and red, a difference occasioned by the presence or absence of iron in the feldspar. This feldspar is usually orthoclase, in which the alkali is potash, but it is frequently albite or soda-feldspar. In strength granite exceeds all other building-stones in common use. Its resistance to a crushing force varies, according to trials reported, from 2300 to 13,400 pounds to the square inch. Its weight is about 166 pounds to the cubic foot; hence, a cubic yard weighs about two tons. The specific gravity of ordinary granite is 2.66. It usually contains nearly 1 per cent. of water. Granite has been largely employed for architectural purposes from the most ancient times. Many of the monuments of Egypt are constructed from syenitic granite quarried at Syene in Upper Egypt, and where not marred by violence some blocks of this stone which have been exposed to the action of the weather for more than 4000 years show little deterioration. Granite has, however, this peculiarity, that, owing to the unequal expansion of its parts, it cracks, and sometimes explodes, when exposed to the action of fire, and it is therefore more easily destroyed by this agent than sandstone, brick, or even marble.

The granites used in the U. S. are obtained from many sources, the larger part being derived from quarries on the coast of New England, where granite forms a conspicuous feature among the crystalline rocks by which this region is generally underlaid. The islands off the coast of Maine are chiefly composed of granite, and on Dix Island and Mt. Desert gray granites of excellent quality are found, which are extensively quarried to supply the demand in the cities on the Atlantic slope of the U. S. The granite used in the construction of several public buildings at Washington comes from Maine. The gray granite quarried at Quincy, Mass., is one of the best known and highly esteemed varieties used in this country. A granite of similar quality, but of lighter color, and on that account sometimes preferred, is brought from Concord, N. H. The red granite now so much used for monumental purposes in this country is brought from Peterhead, near Aberdeen, Scotland. This is composed of red orthoclase, albite, black mica, and quartz, and is justly esteemed for its beauty, closeness of texture, and homogeneousness. A gray granite is imported from Aberdeen. This also takes a high

polish, and is much used for monuments and columns. A red granite resembling that brought from Scotland is found at St. George, New Brunswick, on the Bay of Fundy. In beauty and durability it is scarcely inferior to its foreign rival. In all the mountain-chains of our country granitic rocks abound, and excellent stone of red or gray color may be obtained from a great number of localities. In the Laurentian area back of Marquette, Lake Superior, a red syenite occurs which is fully equal in beauty and durability to the Aberdeen granite. This will hereafter undoubtedly be used in the great cities which are growing up on the lakes, but at present the wants of their inhabitants are so well supplied with handsome and excellent freestones that granite is very little used. In the Rocky Mountains both red and gray granites abound, and in the southern portion of this chain the granite which forms the core or centre of many of the ranges is red, and resembles the Scotch granite. In the Sierra Nevada the granites are generally gray, and sometimes nearly white, from the albite of which they are chiefly composed.

The origin of granite has been much discussed among lithologists. It is popularly regarded as the oldest of rocks, but is in fact of all ages, some of it being, geologically speaking, very modern. Granite is generally classed as a plutonic igneous rock—*i. e.* one that has been completely fused, but has solidified at great depths, and hence under great pressure. That it has formed slowly is shown by its coarse crystallization. Most granites are, however, probably metamorphic — *i. e.* are sedimentary deposits changed and made crystalline by long-continued but not necessarily very high heat, and especially through the influence of steam. Sorby and Zirkel have found cavities partially filled with water in the crystals of some granites. These they consider as evidence of the presence of steam during their formation. By measuring the relative quantity of water in the crystal cavities of different granites, Sorby has attempted to determine the relative pressure under which they consolidated. By observations of this kind he has been led to the conclusion that some granites have solidified at a depth of 28,700 feet greater than others. That some granites have been completely fused is shown by the fact that they have been injected into fissures which ramify through other rock, such as slate, and even limestone. When granite is distinctly stratified—like most of that of New England and the Alleghany belt—it is called gneiss. Granite is often found decomposed to a considerable depth by atmospheric action; this is specially marked in the granites of the tropics, and is also well shown in the southern portion of the Alleghanies. This disintegration was called by Dolomieux *la maladie du granite*, and he attributes it to the action of carbonic acid on the feldspar. Granite veins are often found decomposed in this way. In such cases the feldspar is changed to kaolin, and a large part of the kaolin of commerce is derived from these decomposed veins. J. S. Newberry.

Granite, tp. of Sacramento co., Cal. Pop. 1579.

Granite, post-v., cap. of Lake co., Col., on the Arkansas, 50 miles S. W. of Fairplay. It has important gold-mines.

Gran'ite Falls, post-v., cap. of Yellow Medicine co., Minn. Pop. of Granite Falls tp. 373.

Gran'iteville, post-v. of Westford tp., Middlesex co., Mass., on the Stony Brook R. R., has extensive granite quarries.

Graniteville, post-v. of Aiken co., S. C., at the junction of the Charlotte Columbia and Augusta and the South Carolina R. Rs., 12 miles N. E. of Augusta, Ga. It has prosperous manufactures, running 600 cotton-looms.

Gran Miche'le, or **Grammiche'le,** town of Sicily, in the province of Catania, near which are found interesting remains of the Græco-Sicilian period. Pop. 10,192.

Grant. In its most comprehensive sense the term *grant* denotes a transfer of any kind of property from one person to another, but it acquired at common law a specific technical signification, being confined in its application to a conveyance of such intangible interests in real property as reversions, rents, franchises, and other kinds of incorporeal hereditaments. In the early history of the English law feoffment and grant constituted the only modes of conveyance unconnected with judicial proceedings, the former being employed in the transfer of freehold estates of a tangible nature, of which an actual delivery of possession, termed in law, "livery of seizin," could be made (see Feoffment); while the latter was adopted when, from the necessity of the case, an actual transfer of possession would have been impossible, either on account of the unsubstantial nature of the interest conveyed or because the estate to be created was future and reversionary in its nature. Therefore, corporeal hereditaments were said to "lie in livery" —those incorporeal to "lie in grant." The grant was evidenced by a deed containing appropriate words of transfer, as *dedi et concessi* ("I have given and granted"), and corresponding terms have been retained in conveyances by deed until the present day. But the old system of feoffment has gone out of use, and it has been declared by statute in England that the distinction between corporeal and incorporeal forms of real property shall be abolished, and that transfer by grant shall be sufficient for both these classes of estates. In the U. S. also the ancient and distinctive meaning of the word has received important modifications. Still, in a majority of the States it would be generally employed, if used at all, with particular reference to the conveyance of incorporeal interests, as formerly. But in New York a special statutory provision has been enacted by which every mode of transfer of a freehold has been declared a grant, so that though deeds of bargain and sale and of lease and release may continue to be used, they are to be deemed grants. In Maine, New Hampshire, and Massachusetts nearly every form of conveyance is in actual practice denominated a grant, so that the old peculiar meaning of the word seems effectually abolished.

Besides "private grant," which is a transfer by a private person, there is a mode of conveyance known in law as "office grant," which consists in a transfer of land made by some officer of the law where the owner is either unwilling or unable to execute the necessary deeds to pass the title. An example would be the conveyance of lands sold by a government official for the payment of taxes, or by an administrator under license of the court for the payment of the debts of the deceased. The phrase "public grant" is employed to designate the mode of creating a title in an individual to lands which had previously belonged to the government. Conveyances of this kind are also termed "letters patent."

George Chase. Revised by T. W. Dwight.

Grant, county of S. Central Arkansas. Area, about 615 square miles. Its surface is rolling and somewhat broken; the valleys fertile, the mineral wealth great, but unexploited. Corn and cotton are leading products. Cap. Sheridan. Pop. 3943.

Grant, county of Dakota, bounded E. and N. E. by Minnesota, and having Big Stone Lake on the N. E. border. It is not included in the returns of the census of 1870. Area, about 700 square miles.

Grant, county of N. E. Central Indiana. Area, 420 square miles. It is level and fertile, producing wool, grain, and cattle in abundance. Lumber is sawed and carriages and wagons manufactured. The county is traversed by the Pittsburg Cincinnati and St. Louis R. R. Cap. Marion. Pop. 18,487.

Grant, county in the S. W. of Kansas. Area, 720 square miles. It is traversed by the Arkansas River. It is open prairie for the most part.

Grant, county in the N. of Kentucky, occupying a part of the watershed between the Kentucky and the Licking rivers. Much of the soil is very fertile. Cattle, grain, tobacco, and wool are leading products. Area, 200 square miles. Cap. Williamstown. Pop. 9529.

Grant, parish of Central Louisiana, bounded on the W. by the Rigolet de Bon Dieu, and on the E. by Bayou Saline. Area, about 500 square miles. It is well watered and fertile. Cotton is the leading product. Cap. Colfax. Pop. 4517.

Grant, county of W. Central Minnesota. Area, 576 square miles. It is traversed by the St. Paul and Pacific R. R., and is fertile, and diversified with hills and small lakes. Cap. Herman. Pop. 340.

Grant, county of Nebraska. Pop. 484. Since the U. S. census this county has been broken up and parceled out to other counties.

Grant, the south-westernmost county of New Mexico, bordering on Mexico and Arizona. Area, about 8430 square miles. It contains great mineral wealth. Copper, gold, silver, iron, and lead are abundant. The surface is in many parts elevated, broken, and dry. Cap. Silver City. Pop. 1143.

Grant, large county of Eastern Oregon, containing 20,020 square miles. Towards the N. it is mountainous. The southern part is a basin containing numerous lakes with no outlets. The climate is dry and healthful. The soil is finely adapted to grazing, and the mineral wealth is probably great. Some grain is produced. Cap. Cañon City. Pop. 2251.

Grant, county of the N. E. of West Virginia. Area, about 375 square miles. It is bounded on the N. W. by Maryland. The surface is mountainous, with smooth plateaus and valleys. Wool is a leading product. Coal and iron are found. Cap. Grant. Pop. 4467.

Grant, the south-westernmost county of Wisconsin. Area, about 1100 square miles. The surface is diversified, the soil fertile. Lead and zinc are abundant, and the former is extensively mined. Cattle, grain, and wool are staple products. Flour and wagons are leading manufactures. Cap. Lancaster. Pop. 37,979.

Grant, tp. of Johnson co., Ark. Pop. 960.

Grant, tp. of Lake co., Ill. Pop. 572.

Grant, tp. of Vermilion co., Ill. Pop. 1204.

Grant, tp. of Benton co., Ind. Pop. 835.

Grant, tp. of Greene co., Ind. Pop. 532.

Grant, tp. of Newton co., Ind. Pop. 699.

Grant, tp. of Cerro Gordo co., Ia. Pop. 95.

Grant, tp. of Dallas co., Ia. Pop. 382.

Grant, tp. of Franklin co., Ia. Pop. 156.

Grant, tp. of Grundy co., Ia. Pop. 436.

Grant, tp. of Guthrie co., Ia. Pop. 104.

Grant, tp. of Hardin co., Ia. Pop. 148.

Grant, tp. of Monona co., Ia. Pop. 252.

Grant, post-tp. of Montgomery co., Ia. Pop. 351.

Grant, tp. of Page co., Ia. Pop. 201.

Grant, tp. of Ringgold co., Ia. Pop. 290.

Grant, tp. of Story co., Ia. Pop. 406.

Grant, tp. of Tama co., Ia. Pop. 211.

Grant, tp. of Taylor co., Ia. Pop. 173.

Grant, tp. of Crawford co., Kan. Pop. 421.

Grant, tp. of Dickinson co., Kan. Pop. 849.

Grant, tp. of Douglas co., Kan. Pop. 583.

Grant, tp. of Republic co., Kan. Pop. 292.

Grant, tp. of Riley co., Kan. Pop. 616.

Grant, tp. of Clare co., Mich. Pop. 147.

Grant, tp. of Grand Traverse co., Mich. Pop. 293.

Grant, tp. of Huron co., Mich. Pop. 309.

Grant, tp. of Iosco co., Mich. Pop. 107.

Grant, tp. of Keweenaw co., Mich. Pop. 152.

Grant, tp. of Mason co., Mich. Pop. 125.

Grant, tp. of Mecosta co., Mich. Pop. 144.

Grant, tp. of Newaygo co., Mich. Pop. 77.

Grant, tp. of Oceana co., Mich. Pop. 208.

Grant, tp. of St. Clair co., Mich. Pop. 1143.

Grant, tp. of Goodhue co., Minn. Pop. 338.

Grant, tp. of Washington co., Minn. Pop. 309.

Grant, tp. of Caldwell co., Mo. Pop. 909.

Grant, tp. of Clarke co., Mo. Pop. 756.

Grant, tp. of Dade co., Mo. Pop. 279.

Grant, tp. of Dallas co., Mo. Pop. 1002.

Grant, tp. of Daviess co., Mo. Pop. 784.

Grant, tp. of De Kalb co., Mo. Pop. 956.

Grant, tp. of Nodaway co., Mo. Pop. 1105.

Grant, tp. of Putnam co., Mo. Pop. 638.

Grant, tp. of Richardson co., Neb. Pop. 515.

Grant, tp. of Washington co., Neb. Pop. 479.

Grant (or **Booth**), post-v. of Russia tp., Herkimer co., N. Y. Pop. 71.

Grant, tp. of New Hanover co., N. C. Pop. 1119.

Grant, tp. of Randolph co., N. C. Pop. 949.

Grant, post-tp. of Indiana co., Pa. Pop. 999.

Grant, tp. of Darlington co., S. C. Pop. 2172.

Grant, tp. of Edgefield co., S. C. Pop. 1116.

Grant, tp. of Cabell co., West Va. Pop. 980.

Grant, tp. of Doddridge co., West Va. Pop. 1128.

Grant, post-v., the county-seat of Grant co., West Va., 30 miles S. W. of New Creek Station. Pop. of Grant tp. 1598.

Grant, tp. of Hancock co., West Va. Pop. 1005.

Grant, tp. of Harrison co., West Va. Pop. 1547.

Grant, tp. of Jackson co., West Va. Pop. 2031.

Grant, tp. of Jefferson co., West Va. It contains the village of Charlestown. Pop. 4571.

Grant, tp. of Marion co., West Va. Pop. 530.

Grant, tp. of Monongalia co., West Va. Pop. 2216.

Grant, tp. of Nicholas co., West Va. Pop. 729.

Grant, tp. of Pleasants co., West Va. Pop. 601.

Grant, tp. of Pocahontas co., West Va. Pop. 837.

Grant, tp. of Preston co., West Va. Pop. 1733.

Grant, tp. of Putnam co., West Va. Pop. 1146.

Grant, tp. of Ritchie co., West Va. Pop. 2552.

Grant, tp. of Wayne co., West Va. Pop. 1314.

Grant, tp. of Wetzel co., West Va. Pop. 1021.

Grant, tp. of Clark co., Wis. Pop. 386.

Grant, tp. of Dunn co., Wis. Pop. 588.

Grant, post-tp. of Portage co., Wis. Pop. 240.

Grant, tp. of Shawanaw co., Wis. Pop. 226.

Grant (Sir Alexander), Bart., LL.D., eighth baronet of his line, b. in 1826; was educated at Harrow and Balliol College, Oxford; became a fellow of Oriel 1849; an examiner for the Indian civil service 1855; came to the baronetcy 1856; was a public examiner at Oxford; appointed inspector of schools in the Madras presidency 1858; professor of history and political economy in Elphinstone College, Madras, 1860, and its principal 1862; vice-chancellor of the University of Bombay 1863; director of public instruction, Bombay presidency, 1865; vice-chancellor and principal of the University of Edinburgh 1868. Has published an edition, with notes, of Aristotle's *Ethics* and a summary of the works of Xenophon; is a son-in-law of the late Prof. Ferrier of St. Andrew's.

Grant (Anne), b. at Glasgow, Scotland, Feb. 21, 1755, the daughter of a British army-officer named McVicar, whose estate in Vermont (where she for some years lived) was confiscated during the American Revolution. She married in 1779 the Rev. Mr. Grant of Laggan, and became the mother of a large family. He d. in 1801, and the stress of poverty forced her into literary work. *The Highlanders*, a successful volume of verses (1803), *Letters from the Mountains* (1806–07), *Memoirs of an American Lady* (Mrs. Schuyler of Albany, 1808), *On the Superstitions of the Highlanders* (1811), *Eighteen Hundred and Thirteen* (a poem, 1814), are her principal works. D. at Edinburgh Nov. 7, 1838. Her *Life*, by J. P. Grant, her son, but partly autobiographical, was published in 1844.

Grant (James), b. at Edinburgh, Scotland, Aug. 1, 1822; at the age of ten he accompanied his father, who was a British officer, to Newfoundland, and his education was principally acquired in barracks in British North America. In 1839 he returned to England, and was appointed ensign in the 62d; retiring from the army, however, the following year, he turned his attention to literature, his first work, *The Romance of War, or Highlanders in Spain*, appearing in 1846, since when he has published many romances, principally of a military character, all of which have been well received, and many of them republished in America and translated into French and German. He is also a frequent contributor to periodicals. G. C. Simmons.

Grant (James Augustus), C. B., C. S. I., b. at Nairn in 1827; educated at the grammar school and at the Marischal College, Aberdeen. In 1845 he was appointed to the Indian army, and served at both sieges of Mooltan; was present at the battle of Goojerat, for which he received a medal, and did duty with the 78th Highlanders at the relief of Lucknow, where he was wounded. In 1863 he accompanied the late Capt. Speke on his exploration of the source of the Nile, a joint account of their travels being published in 1864, and was made a C. B. in 1866; accompanied the Abyssinian expedition under Lord Napier in 1868, and for his services was nominated a companion of the order of the Star of India, and afterwards went upon the retired list.

Grant (Gen. Sir James Hope), G. C. B., b. in 1808; entered the army in 1826 as cornet in the 9th Lancers; served with distinction in China as brigade major; served with his regiment at Sobraon, commanding it in the battles of Chillianwallah and Goojerat; in 1854 he became brevet colonel, and in 1858 was made a major-general and nominated a K. C. B. for his eminent services in command of the cavalry division at the siege of Delhi, at the relief of Lucknow, and in subsequent operations at Cawnpore. In the campaign in China terminating with the capture of Pekin he commanded the British forces throughout, for which he received the thanks of Parliament and was nominated a G. C. B.; appointed commander-in-chief at Madras in 1861, with the rank of lieutenant-general; appointed colonel 4th Hussars in 1861, and transferred to the 9th Lancers (his old regiment) in 1865. In 1872 he was promoted to be general. Author of *Incidents of the Sepoy War* (1874). D. Mar. 7, 1875.

Grant (Gen. Sir Patrick), G. C. B., G. C. M. G., b. at Duthill, Elginshire, Scotland, in 1804, and entered the military service of the East India Company in 1819; served for many years with distinction in India, and took part in the battles of Maharajpore, Moodkee, and Sobraon. In 1856 he was appointed commander-in-chief of the Madras army, and in 1857 of the army in India at the period of the mutiny; for his services during this period he was made a

G. C. B. and aide-de-camp to the queen; was made governor of Malta 1867–72, general in 1870, and colonel of the 78th Highlanders.

Grant (ULYSSES S.) was b. Apr. 27, 1822, at Point Pleasant, Clermont co., O. His father was of Scotch descent, and a dealer in leather. At the age of seventeen he entered the Military Academy at West Point, and four years later graduated twenty-first in a class of thirty-nine, receiving the commission of brevet second lieutenant. He was assigned to the 4th Infantry, and remained in the army eleven years; was engaged in every battle of the Mexican war except that of Buena Vista, and received two brevets for gallantry. In 1848 he married Julia, daughter of Frederick Dent, a prominent merchant of St. Louis, and in 1854, having reached the grade of captain, he resigned his commission in the army. For several years he was engaged in farming near St. Louis, but met with small success, and in 1860 he entered the leather-trade with his father at Galena, Ill.

When the civil war broke out in 1861, Grant was thirty-nine years of age, but entirely unknown to public men, and without any personal acquaintance with great affairs. Pres. Lincoln's first call for troops was made on the 15th of April, and on the 19th Grant was drilling a company of volunteers at Galena. He also offered his services to the adjutant-general of the army, but received no reply. The governor of Illinois, however, employed him in the organization of volunteer troops, and at the end of five weeks he was appointed colonel of the 21st Illinois Infantry. He took command of his regiment in June, and reported first to Gen. Pope, in Missouri. On Aug. 7 he was commissioned a brigadier-general of volunteers, the appointment having been made without his knowledge. He had been unanimously recommended by the Congressmen from Illinois, not one of whom had been his personal acquaintance. For a few weeks he was occupied in watching the movements of partisan forces in Missouri.

On Sept. 1 he was placed in command of the district of South-east Missouri, with head-quarters at Cairo, and on the 6th, without orders, he seized Paducah, at the mouth of the Tennessee River, and commanding the navigation both of that stream and of the Ohio. This stroke secured Kentucky to the Union, for the State legislature, which had until then affected to be neutral, at once declared in favor of the government. Early in November he was ordered to make a demonstration in the direction of Belmont, a point on the W. bank of the Mississippi about 18 miles below Cairo; it was not only in possession of the Confederates, but commanded by the guns of Columbus on the opposite shore. The object of the demonstration was to prevent the crossing of hostile troops into Missouri. Grant got his orders on the 5th, and moved on the 6th, with 3100 men on transports. On the 7th he landed at Belmont, broke up and destroyed the camp under a heavy fire from Columbus, and was returning to his transports when large reinforcements arrived from the eastern bank to intercept him. His troops were raw, and even the officers were greatly disturbed at the idea of being surrounded. But Grant soon rallied the force, and charging the enemy cut his way out, reached the steamers, and returned to Cairo, having fully obeyed his orders and accomplished the object of the expedition. If any reinforcements had been intended for Missouri, they were by this operation detained. In the affair of Belmont the Confederates had 7000 men engaged against Grant's 3000. Their loss was 642, and his 485. Grant carried off two pieces of artillery and 200 prisoners.

Early in Feb., 1862, after repeated applications to Gen. Halleck, his immediate superior, he was finally allowed to move up the Tennessee River against Fort Henry, in conjunction with a naval force. The gunboats silenced the fort, which surrendered on the 4th, before the troops arrived. Grant immediately made preparations to attack Fort Donelson, about 12 miles off, on the Cumberland River. Without waiting for orders, he moved his troops to the latter point, and on the 12th with 15,000 men began the siege. This position was extremely strong, and the garrison numbered 21,000. There was hard fighting on three successive days, and on the 15th Grant carried by assault the works which were the key to the place. On the 16th the Confederates surrendered unconditionally 65 cannon, 17,600 small arms, and 14,623 soldiers. About 4000 more had escaped in the night, and 2500 were killed or wounded. Grant's entire loss was less than 2000. On the last day of fighting his numbers amounted to 21,000. This was the first important success won by the national troops during the war. Its strategic results were marked; the entire States of Kentucky and Tennessee at once fell into the national hands, and the navigation of the Mississippi, the Tennessee, and the Cumberland rivers was opened for hundreds of miles. Grant was made a major-general of volunteers, and placed in command of the district of West Tennessee. In March he was ordered to move up the Tennessee River towards Corinth, where the Confederates were concentrating a large army; he was directed, however, not to attack. His forces, numbering 38,000, were accordingly encamped near Shiloh, or Pittsburg Landing, on the W. bank of the Tennessee, waiting the arrival of Gen. Buell with 40,000 more; but on Apr. 6 the Confederates came out from Corinth, 50,000 strong, and attacked Grant violently, hoping to overwhelm him before Buell could arrive; 5000 of his troops were beyond supporting distance, so that he was largely outnumbered. Both sides fought fiercely, but the national forces were pushed back to the river. There, however, Grant held out till dark, when the head of Buell's column came upon the field. There was no more heavy fighting that night, but on the 7th the combined national armies attacked and drove the hostile force, who retreated as far as Corinth, 19 miles. Grant was senior in rank to Buell, and commanded on both days. His entire loss was 12,217; that of Beauregard, the Confederate commander, was 10,617; but the ground remained in the hands of Grant, and the object of the attack was unattained. Two days afterwards Halleck arrived at the front and assumed command of the army, Grant remaining at the head of the right wing and the reserve. On May 30, Corinth was evacuated by the Confederates, although no fighting had occurred since Shiloh. In July, Halleck was made general-in-chief, and Grant succeeded him in command of the department of the Tennessee. On Sept. 19 he fought the battle of Iuka, where, owing to the failure of Gen. Rosecrans to carry out his orders, only an incomplete victory was obtained. The national loss was 736, that of the Confederates 1438. The strategy of this battle was Grant's, the tactics were those of Rosecrans and Ord. Subsequently, Grant fortified Corinth, and directed the operations which resulted in the repulse of the Confederates from that place on the 3d and 4th of October, and in the battle of the Hatchie on the 5th, the commanders under him being again Rosecrans and Ord. At the battle of Corinth the entire national loss was 2359, that of the Confederates more than twice as large.

Immediately after the victory of Corinth, Grant proposed to the general-in-chief the capture of Vicksburg, and, receiving no answer, on Nov. 2 he began a movement into the interior of Mississippi. While he threatened Vicksburg from the rear with 30,000 men, Sherman was sent by way of the Mississippi River with 40,000, to attack it in front. Grant advanced without opposition as far as Oxford, 50 miles, when Holly Springs, his principal base of supplies, was surrendered by Col. Murphy, who was dismissed from the army in consequence. This compelled the abandonment of the campaign, and Grant returned to the neighborhood of Corinth. Sherman's assault on Vicksburg failed at about the same time. In Jan., 1863, Grant took command in person of all the troops in the Mississippi Valley, and moved by the river to a point opposite Vicksburg. There he spent several months in fruitless efforts to turn the place; one plan was to build a canal in sight of Vicksburg, but out of reach of its guns, through which the army could pass to a point below; another, to divert the Mississippi River from its course; a third, to find or make a circuitous passage to the rear of the town through the tortuous streams on the N. and E. But all these failed, and in April Grant marched his army through the swamps on the western bank to a place below Vicksburg, while the gunboats and the transport fleet ran the batteries under a terrific fire. On Apr. 30 he crossed the river, and landed at Bruinsburg, 30 miles S. of Vicksburg. There were now two armies opposed to him. Pemberton, with 52,000 men, defended Vicksburg, and Johnston, with a smaller but rapidly increasing force, was at Jackson, 50 miles farther E. Grant's column was 43,000 strong. He at once abandoned all communication with the river, and pushed into the interior between the two hostile armies. On the 1st of May he met and defeated a portion of Pemberton's command at Port Gibson; then advancing eastward, on the 12th he fell upon and destroyed a force coming out from Jackson to resist him; and on the 14th he captured Jackson and scattered Johnston's army. Turning the same day to the Mississippi, on the 16th he utterly routed Pemberton's entire force at Champion's Hill; on the 17th, pursuing hotly, he came up with the enemy and beat him again at Black River Bridge; and on the 18th drove him into Vicksburg, encamping in its rear, with his own base once more on the Mississippi. On the 19th and 22d he made unsuccessful assaults, and on the 23d began a regular siege. On the 4th of July the place surrendered with 31,600 men and 172 cannon, at that time the largest capture of men and material ever made in war. During the entire campaign the Confederates had lost 40,000 prisoners, besides 12,000 in killed and wounded and about 8000 by disease and straggling; altogether, an army of

60,000 men. Grant's entire loss was 8873. The great river was thus opened to the sea, and no more important fighting occurred in the Mississippi Valley. Grant was made a major-general in the regular army. On Oct. 16 he was placed in command of the military division of the Mississippi, which included the armies of the Ohio and the Cumberland, as well as that of the Tennessee, with which he had been so long associated. Chattanooga was at this time beleaguered and almost surrounded by hostile forces, and the army of the Cumberland, which defended it, was in imminent danger of starvation or capture. On Oct. 23, Grant reached this place, and on the 27th the battle of Lookout Valley, fought under his direction, relieved the army of the Cumberland. On Nov. 23, 24, and 25 he fought the battle of Chattanooga, utterly defeating Bragg, driving him from positions that seemed impregnable, and capturing in the open field over 5000 prisoners and 40 pieces of artillery. His own losses were 6616; the Confederates reported 2500 killed and wounded, besides prisoners. Grant's force in this battle was 60,000; that of Bragg, 45,000; but the enemy enjoyed advantages of position which more than counterbalanced the disparity. The victory of Chattanooga overthrew the last important hostile force W. of the Alleghanies, and opened the way for the national armies into Georgia.

The remarkable series of successes which Grant had now achieved pointed him out as the appropriate leader of the national armies. In Feb., 1864, the rank of lieutenant-general was created for him by Congress, and on Mar. 17 he assumed command of the armies of the U. S. Having beaten all the other important hostile commanders, and broken in pieces every other great opposing force, he now prepared to encounter in person the army of Northern Virginia, under Lee, and at the same time, by his subordinates, to occupy all the remaining forces of the enemy, so that no Confederate army could in any emergency or by any possibility support another. Accordingly, while he sent Sherman into Georgia, and directed Sigel to penetrate the Valley of Virginia, and Butler to capture Richmond, he fought his own way from the Rapidan to the James. On May 4 he could put into battle 110,000 soldiers; Lee confronted him with 75,000; while 30,000 under Butler were opposed by the same number at Richmond, and Sigel with 7000 fought Breckenridge with 5000 or 6000. Before Grant reached the James he had lost 6000 men killed, 26,000 wounded, and nearly 7000 missing. The losses of Lee's troops can never be known, as their records were destroyed by their own hands; but Grant captured in this period 10,000 men (4000 more than Lee), and it is probable that the entire loss of the enemy was little if any less than his, although Lee fought constantly on the defensive, and therefore with immense advantage and security. The battles of the Wilderness, Spottsylvania, North Anna, and Cold Harbor were the hardest Grant ever fought, but after each he advanced and Lee withdrew. They cost the national commander dear, but they inflicted losses on Lee from which he never recovered, and thus accomplished the object at which Grant was aiming. He was more anxious to annihilate Lee's army than to effect any purely strategic result, or even to capture Richmond, for he believed that only by the annihilation of Lee could the Confederacy be overthrown. With this view and for this purpose the campaign of the Wilderness was planned and fought. When Grant arrived in front of Richmond he crossed the James, in pursuance of the design formed months before. Butler had failed to take the city, and his army was now joined to that which had fought its way from the Rapidan; and in June the siege of Richmond was begun. Sherman, meanwhile, was marching and fighting daily in Georgia, and steadily advancing towards Atlanta; but Sigel had been defeated in the Valley of Virginia, and was superseded by Hunter, who made his way as far as Lynchburg, and was then in his turn repelled. Hunter's retreat left open a road to Washington, and Lee sent Early to threaten the national capital; whereupon Grant gathered up a force which he placed under Sheridan, and that commander rapidly drove Early, in a succession of battles, through the Valley of Virginia, and destroyed his army as an organized force. But the siege of Richmond still went on. The Confederates were gallant and stubborn, and though Grant made numerous attacks, he was only partially successful. His army reached out on the right and left on both sides of the James, but for many months he was unable to get possession of the railroads by which Richmond was supplied. The government advised him to abandon the attempt, and the country was sometimes impatient and distrustful, but Grant never wavered.

By September, Sherman had made his way to Atlanta, and Grant then sent him on his famous march to the sea, a route which the chief had designed for himself six months before. He made Sherman's success possible, not only by holding Lee in front of Richmond, but by sending reinforcements to Thomas, who then drew off and defeated the only army which could have confronted Sherman. Sherman by this strategy was left unopposed. Thus Thomas, Sheridan, and Sherman were all used in furtherance of Grant's plans; each executing his part in the great design, and contributing his share to the result at which Grant was aiming. Sherman finally reached Savannah, Schofield beat the enemy at Franklin, Thomas at Nashville, and Sheridan wherever he met him; and all the while Lee was held near Richmond, unable to send to any part of the theatre of war to reinforce any army, no matter how threatened or assailed. Schofield was now brought from the West, and Fort Fisher and Wilmington on the sea-coast were captured, so as to afford him a foothold; from here he was sent into the interior of North Carolina, and Sherman was ordered to move northward to join him. When all this was effected, and Sheridan could find no one else to fight in the Valley, Grant brought the great cavalry leader to the army in front of Richmond, and, making a last effort, drove Lee from his intrenchments and captured Richmond.

When the final campaign began, Lee had collected 73,000 fighting men in the lines at Richmond, besides the local militia and the gunboat crews, amounting to 5000 more. Including Sheridan's force, Grant had 110,000 men in the works before Petersburg and Richmond. Petersburg fell on the 2d of April, and Richmond on the 3d, and Lee fled in the direction of Lynchburg. Grant pursued with remorseless energy, only stopping to strike fresh blows, and Lee at last found himself not only out-fought, but out-marched and out-generalled. He was completely surrounded, and on Apr. 9, 1865, he surrendered at Appomattox Court-house, in the open field, 27,000 men, all that remained of his army. In ten days Grant had captured Petersburg and Richmond, fought, by his subordinates, the battles of Five Forks and Sailor's Creek, besides numerous smaller ones, captured 20,000 men in actual battle, received the surrender of 27,000 more at Appomattox, absolutely annihilating an army of 70,000 soldiers. During the year Grant's entire loss among the troops immediately under his command, including those in Butler's army, amounted to 12,663 killed, 49,559 wounded, and 20,498 missing; total, 82,720. He captured in the same time 66,512 soldiers; of the Confederate killed and wounded no return was ever made. He had destroyed every army opposed to him—those of Lee, Early, and Beauregard, besides the reinforcements sent to Lee from all quarters of the South, leaving at the last not a living man of all those armies who was not a prisoner. His forces had never been more than one-third greater than those of his antagonist, and he had constantly fought on the offensive. The terms granted to Lee at Appomattox were so magnanimous that the whole population of the South at once sought to share their benefits. All the other Confederate armies offered to surrender, and the greatest civil war in history was at an end.

Grant returned at once to Washington to superintend the disbandment of his armies. This work was scarcely begun when Pres. Lincoln was assassinated. It had doubtless been intended to inflict the same fate on Grant, but he, fortunately, on account of leaving Washington early in the evening, declined an invitation to accompany the President to the theatre where the murder was committed. This event made Andrew Johnson President, but left Grant by far the most conspicuous figure in the public life of the country. He became the object of an enthusiasm greater than had ever been known in America. Every possible honor was heaped upon him; the grade of general was created for him by Congress; houses were presented to him by citizens; towns were illuminated because he entered them. Pres. Johnson soon took such a position in politics as threw most of those who had supported the war into open hostility to him. At first he had been so bitter towards the defeated South that Gen. Lee asked Grant's interposition in his behalf, and it was given. Grant saved Lee from prosecution for treason when Andrew Johnson was eager for it. But Mr. Johnson soon became the ardent friend of the former Confederates, and was believed by many to be plotting their return to power. In this conjunction all parties turned to Grant. Congress passed laws to restrain the President and giving Grant an amount of power unknown before to any subordinate. His position was extremely delicate. He was a soldier, and it was his duty to be subordinate to the President. Yet the President was in direct opposition to Congress, the law-making power. Grant, however, for a long time was able to comply with the directions of Congress without offending the President. Johnson, indeed, sought to obtain the sanction of Grant's name for his policy. He suspended the secretary of war, and placed Grant in his stead, and the soldier for some months was a member of Mr. Johnson's cabinet. Finally, however, it became necessary for him either to

break with the President, or by compliance, as he thought, to disobey the law; and he refused to do the latter. From this time Pres. Johnson was his political and personal enemy. Grant's popularity, however, remained unshaken with those who had supported the war, and in 1868 he was elected President by large majorities. He was inaugurated on Mar. 4, 1869. His first administration was distinguished by a cessation of the strifes which sprang from the war, by a large reduction of the national debt, and by a settlement of the difficulties with England which had grown out of the depredations committed by privateers fitted out in England during the war. These difficulties threatened at one time to embroil the two nations, but they were referred to arbitration, and the result was a large award of damages, which were paid by England to the U. S., on account of the injuries she had occasioned or allowed. During the latter half of his administration a violent opposition arose to Grant, led by men in his own party, who were dissatisfied with his course. He was, however, re-elected to the Presidency in 1872 by a larger vote and a larger majority than any candidate had received since the U. S. became a nation. (The figures in this article are, without exception, taken from the official returns now on file at Washington.) ADAM BADEAU.

Grant City, cap. of Worth co., Mo. It has 1 bank, 2 real estate offices, 2 newspapers, 2 schools, lumber and wagon yard, 2 churches, 2 hotels, 9 stores, etc. Pop. about 800. PUB. "WORTH CO. TIMES."

Gran'tham, town of England, in the county of Lincoln, on the left bank of the Witham. Its church is an interesting building of the thirteenth century, with a fine spire 273 feet high. In its grammar school Newton received his first education. Pop. of town, 5028; of parliamentary borough, 13,248.

Grantham, post-tp. of Sullivan co., N. H., 40 miles N. W. of Concord. It has manufactures of lumber, etc. Pop. 608.

Grantham, tp. of Wayne co., N. C. Pop. 1823.

Grant Isle, post tp. of Aroostook co., Me., 90 miles N. of Houlton, on the St. John's River. Pop. 688.

Gran'ton, post-v. of Biddulph tp., Middlesex co., Ont., Canada, on the Grand Trunk Railway, 18 miles from London. It has 1 weekly newspaper. Pop. about 350.

Grants'burg, post-v., cap. of Burnett co., Wis. Pop. of Grantsburg tp. 706.

Grants'ville, post-tp. of Alleghany co., Md. P. 1786.

Grantsville, post-v., cap. of Calhoun co., West Va.

Grant'ville, tp. and v. of Baker co., Ala. Pop. of v. 1761; of tp. 1859.

Grantville, post-v. of Needham tp., Norfolk co., Mass., on the Boston and Albany R. R., 13 miles W. of Boston. It is one of the most attractive villages in the vicinity of Boston.

Granvelle (or **Granvella**), **de** (ANTOINE **de Perrenot**), CARDINAL, b. at Besançon Aug. 20, 1517, was the son of the Sieur de Granvelle, prime minister to Charles V.; studied at Dôle, Paris, Louvain, and Padua; became bishop of Arras 1540; attended the Diets of Worms and Ratisbon 1540, and in 1545 was sent to the Council of Trent; became a prominent state councillor under Charles V., and in 1550 took the chancellorship of the empire after his father's death; negotiated the treaty of Passau 1552; arranged the marriage between Philip II. and Mary of England 1553; concluded the treaty of Cateau Cambrésis 1559; was minister to the duchess of Parma in the Low Countries 1559–64; became archbishop of Mechlin 1560, cardinal 1561, and in 1564 retired to Besançon, compelled to leave his office by the clamors of nobles and people, led by Horn, Egmont, and the prince of Orange, for Granvelle's tyranny was of the most odious type; Spanish envoy at Rome 1570; viceroy of Naples 1570–75; became president of the supreme council of Italy and Castile 1575; was translated to the archbishopric of Besançon 1584. D. at Madrid Sept. 21, 1586. He was a man of learning and ability. Of his vast correspondence a large part has been printed, and forms a valuable mass of material for the historian.

Granville, town of France, in the department of La Manche, on the English Channel. It is fortified, and has manufactures of laces and considerable oyster and cod fisheries. Pop. 17,180.

Gran'ville, county of North Carolina, bordering on Virginia. Area, 750 square miles. Its surface is undulating, the soil productive, yielding large crops of tobacco and grain. The former product is manufactured for market. The county contains slate and sandstone. Cap. Oxford. Pop. 24,831.

Granville, tp. of Jasper co., Ill. Pop. 1260.

Granville, post-tp. of Putnam co., Ill. Pop. 1668.

Granville, post-tp. of Hampden co., Mass. It has 4 churches, and manufactures of cheese, kegs, drums, etc. Pop. 1293.

Granville, a v. of Monroe co., Mo. Pop. 71.

Granville, post-v. and tp. of Washington co., N. Y., on the Rutland and Washington division of the Delaware and Hudson Canal Co. R. R., 65 miles N. of Albany. Within the limits of the township are 6 villages, 5 post-offices, 12 churches, 3 hotels, 15 stores, 1 bank, and several cheese-factories. Granville Female Seminary is located in the village of North Granville. Principal business of the town, agriculture and the quarrying and manufacturing of roofing slate, mantels, and all articles of marbleized slate. Pop. 4003. WM. HASWELL, ED. "GRANVILLE REPORTER."

Granville, a post-v. and tp. of Licking co., O., 6 miles W. of Newark and 3 miles N. of the Central Ohio R. R. It has a national bank, a newspaper, 2 hotels, 12 stores, 2 female colleges, is the seat of Dennison University, and has several mills and shops. Pop. of v. 1109; of tp. 2127. GEO. W. EVANS, ED. "LICKING MONITOR."

Granville, tp. of Mercer co., O. Pop. 1234.

Granville, tp. of Bradford co., Pa. Pop. 1375.

Granville, post-tp. of Mifflin co., Pa. Pop. 1297.

Granville, post-tp. of Addison co., Vt., 23 miles S. W. of Montpelier. It has manufactures of lumber, woodenware, charcoal, and pyroligneous acid. Pop. 726.

Granville, post-tp. of Milwaukee co., Wis., on the Milwaukee and St. Paul R. R., 15 miles N. W. of Milwaukee. Pop. 2401.

Granville (GRANVILLE GEORGE **Leveson-Gower**), EARL, K. G., D. C. L., F. R. S., the second earl of the present line, b. in London May 11, 1815; was educated at Eton and Christ Church, Oxford; entered Parliament 1836; was under-secretary for foreign affairs 1840–41; master of the buckhounds 1846–48; vice-president of the board of trade 1848–51; foreign secretary 1851–52; chancellor of the duchy of Lancaster 1855; ambassador extraordinary to Moscow 1856; lord president of the council 1855–58 and 1859–66; colonial secretary 1868–70; secretary for foreign affairs 1870–74; also chancellor of London University, constable of Dover Castle, and lord warden of the Cinque Ports; is an able and distinguished Liberal politician; succeeded to the peerage in 1846, and in the same year was sworn of the privy council.

Grape, the fruit of the vine; the berry (one to four seeded) of the climbing shrubs of the genus *Vitis* (order Vitaceæ), of which species are found in the warm and temperate regions of both hemispheres. The Old-World cultivated grapes are the fruit of *Vitis vinifera*, which is believed by Regel to be the hybrid offspring of *V. Labrusca* and *V. vulpina*, both natives of the U. S. and of Eastern Asia. *V. vinifera* does not thrive in the U. S. east of the Rocky Mountains, except under glass, but in California its varieties yield a very large proportion of the vineyard products of that State; but numerous varieties have been produced by Rogers and others which are considered hybrids of *V. vinifera* and *Labrusca*. There are in the U. S., east of the Mississippi, nine recognized species, besides innumerable varieties, of many of which the proper species is hard to determine. Of these species we need notice only (1) *V. Labrusca*, which ranges from Canada southward to North Carolina, and indefinitely westward, the parent of a very great number of cultivated sorts, of which the Isabella, Catawba, Concord, and most other kinds raised in the Northern U. S. in open air are examples. (2) *V. vulpina*, the Southern fox, muscadine, or bullace grape, not found N. of Maryland; of this the scuppernong is a variety, and perhaps also the mustang grape (*V. mustangensis*) of Texas. The Mish, Thomas, and other Southern varieties are of this species. (3) *V. æstivalis*, or summer grape, the parent of the Delaware, Herbemont, Rulander, and other favorite kinds. (4) *V. cordifolia*, the frost grape, which has fragrant flowers. From this stock have sprung the Clinton, the Taylor, the Franklin, and a few other cultivated sorts, not generally of high excellence.—The vine is important, not only as affording a copious supply of excellent fruit, but it is the source from which are derived all genuine wines, brandies, and the cream of tartar; all of which are of such commercial value that they are everywhere subject to large adulterations. Raisins, vinegar, and currants are also products of the vine. The grapes of the *vinifera* class are readily distinguished by the fact that (as a rule) the skins do not readily slip from the pulp within, and that the pulp itself is not so tough as in most native kinds. They are with us reared only in cold graperies or in forcing-houses. The rules for grape-culture must vary with peculiarities of soil, climate, variety, exposure of land,

etc. (The reader is referred to the treatises of Strong, Fuller, Hussmann, Haraszthy, Chorlton, and other specialists.)

The culture of the vine is very ancient, as is shown by the narrative of Noah and by abundant references in all the ancient literatures. In the U. S. grape-culture is of very recent origin, the foreign grape not succeeding well except on the Pacific slope; but the readiness with which our native species can be made to afford valuable varieties for cultivation has caused a wonderful development of this industry. California, Ohio, New York, Missouri, Illinois, and Pennsylvania are, in the order named, the principal grape-growing States, but grape-culture is fast developing in other States, especially southward. Cryptogamous vegetable parasites (*Peronospora*, *Oidium*, etc., called mildew) and many insect enemies (notably the *Phylloxera vastatrix*) attack the grapevine, and of late have completely paralyzed the vine-growing industry over large areas; but their effect has not been very seriously felt as yet in the U. S.

Grape Grove, tp. of Ray co., Mo. Pop. 2660.

Grapeshot [Fr. *mitraille*], a name applied to several kinds of artillery missiles, but especially to a cluster of iron balls grouped together about a spindle and held in place by iron disks, through which the spindle passes. Grapeshot is very effective against infantry in masses at short range.

Grape-Sugar. See GLUCOSE.

Graph'ite [Gr. γράφω, "I write," from its property of leaving a distinct trace on paper], a form of carbon, usually classed as a mineral, but supposed to be of organic origin and the ultimate product of the destructive distillation of vegetable or animal tissue. When pure it crystallizes in flat hexagonal tables. Its specific gravity is 1.81, and its hardness from 0.5 to 2. As it occurs in nature, graphite is usually mixed with more or less foreign matter, consisting of silica, alumina, lime, magnesia, etc. The purest known variety of natural graphite, found at Ticonderoga, N. Y., consists of 99.9 carbon. The best Ceylon graphite contains 99 per cent., and that from the famous Borrowdale mine in Cumberland, England, 87 per cent. of carbon. The inferior varieties of graphite frequently contain 50 to 60 per cent. of foreign matter. Graphite usually occurs in metamorphic rocks, such as gneiss, granite, slate, crystalline limestone, etc., but it also is sometimes found in trap. It is often produced in iron furnaces, crystallizing in flat, specular flakes in cavities in the cast iron. In many instances it is seen to be the direct product of metamorphism on coal, as at Craigman, Ayrshire, Scotland, where coal is altered by trap, and at Newport, R. I., where the coal, highly metamorphosed in mass, varies from anthracite to graphite, and may be classed as graphitic anthracite. Still more direct evidence of the conversion of vegetable tissue into graphite is seen in the coating of graphite which sometimes covers the impressions of fossil plants in metamorphosed carboniferous strata. Here it is plain that the graphite is the residual product of the distillation to which the vegetable tissue has been subjected. Graphite occurs most abundantly in somewhat irregular sheets or in detached masses, occupying nearly the same plane in gneiss, slate, and other metamorphic rocks. In these instances it apparently represents collections of vegetable matter, like those which in more recent deposits form beds of coal. Graphite also occurs as a more or less abundant constituent of graphitic schist, which is probably but the metamorphic condition of bituminous shale. Usually, these stratified deposits of graphite contain much earthy matter. Graphite also frequently occurs in detached grains, crystals, lumps, or masses, sometimes of remarkable purity. In this category should be included the specks and grains found in crystalline limestone at Amity, Orange co., N. Y., the flattened crystals of Ticonderoga, N. Y., the larger masses found in trap at the Borrowdale mine, England, and perhaps those of the no less famous Alibert mine, Siberia. In some of these cases the graphite is almost chemically pure, and it seems to have crystallized out of its associations, as it does in cast iron. The detached masses or particles of graphite which occur in limestone probably represent the carbon of the soft parts of the animals of which the shells and bones have supplied the calcareous matter. Many unchanged limestones contain asphalt and petroleum, and these, in the process of metamorphism, may, by the loss of their hydrogen, be left as masses or specks of nearly pure carbon. The graphite which is sometimes found filling fissures in crystalline rocks is perhaps the product of the metamorphism of asphaltic veins or asphaltic coals like albertite, grahamite, chapapote, etc.

The uses of graphite in the arts are very varied. It is a good conductor of electricity, and is frequently employed for coating moulds in electrotyping. It is also an excellent lubricant, and is frequently added to the compositions applied to the bearings of machinery to reduce friction. The great consumption of graphite, however, is for the manufacture of crucibles and pencils. Although in certain circumstances graphite will burn, producing carbonic acid, yet it is practicably infusible. When mixed with clay and moulded into crucibles, it forms one of the most refractory substances known, and supplies the material from which the best crucibles used in chemistry and metallurgy are made. For the manufacture of pencils only the finer varieties of graphite are used. Where it occurs in blocks of considerable size and great purity, it is sawed in sheets, and these are again cut into rods which are inserted in wooden holders. The graphite obtained from the Borrowdale mine was largely used in this way, and the pencils made from it were in such repute that the material was sometimes sold at $40 the pound. The Siberian graphite from the Alibert mine is also used in the same way for the manufacture of pencils, the monopoly of which has been enjoyed by A. W. Faber of Stein, Germany. This house has consumed nearly 100 tons of Siberian graphite, brought by a long and expensive overland route from the frontier of China. Although the pencils made from the purest natural graphite are most highly esteemed, nearly all those used at the present day are manufactured from graphite which is washed free from its impurities, ground to an impalpable powder, and then consolidated by pressure, with or without cement. For the harder pencils a considerable quantity of fine clay is mixed with the powdered graphite.

The great source of supply of graphite to commerce and the arts at the present time is Ceylon. Most of the product of this island is carried to England for distribution or manufacture. It varies much in purity, some being almost entirely free from foreign matter—being second only to the Ticonderoga graphite in purity—while other varieties contain large quantities of earthy matter. These different grades are applied to different uses, the finer qualities serving for the manufacture of pencils, the coarser for crucibles, etc. Graphite is also produced in considerable abundance from Harnon, Sweden; from Passau, Bavaria; Schwarzbach, Bohemia; Stiermark, etc. It has also been recently discovered in the province of Nelson, New Zealand. In the U. S. graphite occurs at innumerable localities, but is mined only at Sturbridge, Mass., Ticonderoga and Fishkill, N. Y., Brandon, Vt., Wake, N. C., and at the Eureka mine, Sonora, Cal.; the latter, it is said, can yield 1000 tons per month. Important deposits of graphite are also known to exist in Canada, the most considerable of which is perhaps that of Buckingham on the Ottawa River, 16 miles above Ottawa City. This, like most of the New England and New York graphite, occurs in gneiss and crystalline limestone, and is mixed with much foreign matter, from which it needs to be freed by crushing and washing. The impurities contained in or associated with graphite are of two kinds—(1) the foreign matter of the rock which contains it; and (2) earthy material intimately blended with it. From the former it may often be easily separated by washing. The latter is an inherent impurity, like the ash in coal, and its character and quantity determine the value and uses of the material. Sometimes it exists as a mere trace, as in the Ticonderoga graphite, or it may amount to more than 50 per cent. of the mass. The market-value of graphite is, however, not directly proportioned to the earthy matter or ash it contains, as even when this is in large amount, if very fine and equally diffused, it may not forbid the employment of the material for the manufacture of pencils and other uses for which a kind is demanded that commands a high price. For the manufacture of crucibles, graphite may contain much ash, provided the quantity of lime, magnesia, etc. is small. Much of the alkalies or alkaline earths renders the substance fusible. The market-price of graphite has varied much within a few years, but the average commercial quality applicable chiefly to the manufacture of crucibles is worth, at wholesale, from $150 to $300 per ton. J. S. NEWBERRY.

Graph'otype, a process by which prints are made without engraving. A tablet of prepared and compressed chalk is used, and upon it the draughtsman makes his drawing with a peculiar ink. The tablet is gone over with a brush in such a way as to leave the inked parts in relief. The chalk is now hardened by an appropriate process, and from it electrotypes may be taken. Well-made graphotype plates sometimes afford prints of much merit.

Grap'tolite, a name given to fossil acalephs of the genus *Graptolithus* and its allied genera; named "written stone" from the slender black tracings left by the fossils upon the slates where they occur. They first appear in very early Lower Silurian rocks, and finally disappear in the Clinton group of the Upper Silurian. They were somewhat closely allied to the living sertularians, and some have found in them bryozoan affinities.

Gras'litz, town of Bohemia, near the frontier of Sax-

ony. It has manufactures of musical and mathematical instruments and of looking-glasses. Pop. 5786.

Grass, tp. of Spencer co., Ind. Pop. 1871.

Grass-Cloth, a popular name for fabrics made of the fibre of the RAMIE (which see), the *Bœhmeria nivea*, manufactured chiefly in Asia, but of late to some extent in Europe. The grass-cloths are extremely durable, and often very beautiful.

Grasse, town of France, in the department of Alpes-Maritimes. Its main industry is the manufacture of essences and perfumes from odoriferous flowers, for which it is very celebrated. Pop. 12,015.

Gräs'se (JOHANN GEORG THEODOR), b. at Grimma, Germany, Jan. 13, 1814; studied philology and literary history at Leipsic and Halle; became collaborator in the Kreuzschule at Dresden, and in 1843 private librarian to the king of Saxony; in 1848 inspector of the cabinet of coins and medals, in 1852 director of the collection of porcelain, in 1853 Hofrath, and in 1864 director of the Green Vaults at Dresden. Author of *Lehrbuch der Allgemeinen Literaturgeschichte* (4 vols., 1851 59); a *Handbuch* of the same (4 vols., 1844 50); *Die Sage vom Ewigen Juden* (1844); *Bibliotheca Psychologica* (1845); *Die Sage vom Ritter Tannhäuser* (1846); *Beiträge zur Literatur und Sage des Mittelalters* (1850); *Handbuch der Altenumismatik* (1852); *Beiträge zur Geschichte der Gefässbildnerei* (1853); *Orbis Pictus* (1861); a translation of *Gesta Romanorum* (1842); *Sagenbuch des Preussischen Staates; Trésor de livres rares et précieux* (7 vols., 1858–67, with subsequent supplementary volumes).

Grasse, de (FRANÇOIS JOSEPH PAUL), COUNT, and Marquis de Grasse-Tilly, b. at Valette, Provence, in 1723; entered a galley of the Knights of Malta in 1734, and served against the Moors and Turks; was transferred in 1749 to the French navy; became a lieutenant in 1754, captain in 1762, rear-admiral in 1778, *chef d'escadre* in 1779. Having long been one of the most renowned of French captains, and having an equal reputation for skill and valor, he sailed for America in 1781; contributed essentially to the reduction of Yorktown, and afterwards served with great distinction in the West Indies; but was surprised by the superior force of the British admiral Rodney, and utterly defeated Apr. 12, 1782. D. at Paris Jan. 11, 1788, while holding the rank of lieutenant-general of the naval forces.

Gras'ses. 1. The grasses or Gramineæ form one of the largest natural orders in the vegetable kingdom, and are distributed over the whole earth. The albumen of the seeds and the nutritious herbage form the chief part of the food of man and the herbivorous animals. None of the family are known to be deleterious, although the darnel (*Lolium temulentum*) has until recently been so regarded. The stems of grasses often contain large quantities of sugar, as in the maize, sorghum, and sugar cane. The latter is the well-known source of supply for the greater part of the sugar known in commerce. Besides these uses, certain members of the order are applied in the regions where they grow to a multiplicity of purposes. It is doubtful whether the natives of the East could survive without the bamboo, which they use in constructing their dwellings, in making mats, cordage, rafts, boats, sails, masts, musical instruments, and weapons. Man, by observing the processes of nature, has in some cases usefully applied certain species of grasses to prevent the encroachments of the sea, the fibrous and interlacing roots serving admirably to bind the shifting sands. Our own *Calamagrostis arenaria* is used in this way on the coasts both by individuals and by the government. Much land is thus reclaimed which would else be given over to the ocean. The grasses are eminently social plants, in cool climates usually growing together and forming a green sward. Often, however, they are tufted and scattered in little groups, as in the case of the *Aira flexuosa*, or hair grass. There is no kind of soil apparently that is not adapted for some grass. They flourish in meadows and alluvial bottoms, on the banks of rivers and streams, by the seaside, and often in the water. Again, other species live in the clefts of rocks, on dry lands, or even in deserts. They range through all climates. The extreme alpine and arctic regions see them thriving, and in the tropics they are everywhere abundant. It is a waste indeed where there is no form of grass. Some of them are annual in habit and some perennial. They have fibrous roots, and often runners, as in the case of the quick-grass (*Triticum repens*), which, spreading by its vigorous root stocks, takes entire possession of a field, and is a great pest to the agriculturist. The stem of grasses is called a *culm*. It is often hollow and jointed, with a siliceous coating, closed and swollen at the joints. The leaves are two-ranked, having many fine veins running parallel to the midrib; this and the stem structure of course shows them to be endogenous in character. The leaves, which are sheathing, often have the sheaths prolonged into an appendage called the *ligule*. The flowers are arranged in spikes, as in the timothy (*Phleum pratense*), or in panicles, as in the bent-grass (*Agrostis*). These spikes and panicles differ greatly as to their degree of concentration or diffusion, and the flowers themselves as to their appendages. Some are armed with long awns or bristles, as in the barley. The stamens are usually three, with anthers attached only by one point, or what is called *versatile*. The styles are two, with feathery stigmas. The flowers are enclosed by two-ranked, imbricated bracts. The outer ones are called *glumes*, and the inner ones, or *palets*, are known as *paleæ*. The perianth if present consists of very small membranous hypogynous scales, one to three in number, distinct or united. They are termed *squamulæ*. The fruit is a *caryopsis*, or fruit in which the seed completely fills the cell and adheres to the pericarp. Embryo small, on the outside and at the base of the floury albumen. These humble plants, which form our out-door carpet, are, in their way, as beautiful as any of their prouder associates. They are often used for dry bouquets and in-door ornamentation, when their grace of form and varying shades of color make them highly valued. The prairie and herd grasses are especially lovely, both in the fields, which some of them tinge with their ruddy smoke, and in parlor vases. W. W. BAILEY.

Phleum pratense: a detached spikelet, magnified, showing the flower with its palets raised above the glumes.

Grass'hopper, a term popularly and very loosely applied in America to all sorts of saltatorial Orthoptera. It is particularly used to designate the Rocky Mountain locust (*Caloptenus spretus*), which in certain years proves such a scourge in much of the country lying W. of the Mississippi. (See LOCUST.) Popular misapplication of terms is often extremely confusing, and should not be encouraged. The above insect, which is so generally miscalled "grasshopper," is in reality a locust, belonging to the very same family as the locust of Scripture, the well-known migratory locust of Asia. In order to properly restrict the term "grasshopper" as it is restricted entomologically, it will be best to follow Harris, the father of popular entomology in America, and briefly characterize the three principal divisions of the saltatorial Orthoptera, as follows: CRICKETS (Achetidæ of Westwood) are distinguishable from the others by invariably having the wing-covers placed horizontally on the back. They have, with few exceptions, but three joints to the tarsi or feet, and as they usually live in holes away from the light, their organs of hearing and feeling, the antennæ, are very long, while those of sight are generally small. GRASSHOPPERS (Gryllidæ of Westwood) may be distinguished by having four joints to the feet. The wing-covers are roofed, and slope downward at the sides of the body; they are long and wide, and those of the male are furnished at the base with a talc-like plate, which produces the usual chirrup as the wings are rubbed sharply over one another. The female is distinguished by having an exserted or sabre-shaped ovipositor. Most grasshoppers are green, and their legs, though longer, are not so muscular as those of locusts. They are mostly nocturnal insects, and their antennæ are consequently long and tapering. They are also more solitary, never migrating in multitudes, like locusts. A few of the larger, tree-inhabiting species are called katydids, well known insects peculiar to America. LOCUSTS (Locustidæ of Westwood) are distinguished from the above insects by having much shorter, thread-shaped antennæ, which terminate abruptly, or are sometimes even club-shaped. The feet appear on the under side five jointed, but are in reality only three-jointed, the basal joint being long, with two impressions underneath. They nearly all agree in having straight, narrow wing-covers, lapping over and forming a ridge on the back. The female has, instead of the projecting piercer of the grasshopper, four short horny, cuneiform projections, placed in pairs, and opening and shutting opposite to each other. Their stridulation is produced by rubbing the posterior femora or thighs against the prominent nerves of the wings while resting on the fore legs. They are more robust, more muscular, than grasshoppers, are essentially social and diurnal insects, and their wing covers, being so much narrower, do not so impede their passage through the air. C. V. RILEY.

Grasshopper, tp. of Atchison co., Kan. Pop. 1115.

Grass'hopper Falls, post v. and tp. of Jefferson co., Kan., is centrally located in a fine agricultural region, 25 to 30 miles distant from Leavenworth, Lawrence, Topeka,

and Atchison, the four principal cities of the State, at the crossing of the Kansas Central and the Atchison Topeka and Santa Fé R. R. It has 2 newspapers, 2 banks, a graded school of five departments, 2 fine mills, a large woollen-factory, 3 hotels, 5 churches, and the usual number of stores and shops. It is situated on the Grasshopper River, and has an excellent water power. Pop. of v. 603; of tp. 1943.

S. WEAVER, ED. "NEW ERA."

Grass Lake, post-tp. of Jackson co., Mich., on the Central R. R., 66 miles W. of Detroit. Pop. 2042.

Grass'mann (HERMANN GÜNTHER), b. at Stettin, Prussia, Apr. 15, 1809; was an instructor in Stettin 1834–52; took his father's professorship of mathematics in the gymnasium of Stettin 1852. He published philological works of importance, but was chiefly noted for his profound treatises upon the theory of mathematics. D. Sept. 26, 1877.

Grass-Moth, a name applied to the lepidopterous insects of the genus *Crambus* and family Pyralidæ. They are extremely abundant in this country in the summer in pastures and hay-fields. *C. mutabilis* is a common species.

Grass of Parnas'sus, the popular title of the genus *Parnassia* of smooth herbs, now generally referred to the order Saxifragaceæ, growing mostly in cold regions of both continents. The U. S. has five or six species, of which one, *P. palustris,* rare in this country, is the common grass of Parnassus of Europe.

Grass Oil, a volatile oil extensively distilled in the East Indies from *Andropogon Schœnanthus, A. muricatus, A. nardus, A. Iwarancusa,* and other grasses. It is used in scenting honey soap and in adulterating oils of geranium and roses; in perfumery it is called oil of citronella. Ceylon exports tons of this oil annually.

Grass Tree [so called from the long grass-like leaves], a genus (*Xanthorrhœa*) of long-lived, tree-like, liliaceous plants, somewhat resembling the *Yucca* in habit. They grow in Tasmania and Australia. Their leaves are not stiff and sharp like the leaves of *Yucca,* but are gathered as food for cattle. The tender base of the leaves is edible and agreeable. The tree abounds in a balsamic gum which has been used in medicine. There are several species, of which *X. hastilis* and *humilis* are best known. The "grass tree gum" is obtainable in inexhaustible quantities, and has been recommended as a source of illuminating gas and of picric acid.

Grass Valley, in Humboldt co., Nev., 10 miles S. E. of Winnemucca, contains 50,000 acres of fertile land, but is deficient in surface-water. Elevation, 4300 feet.—GRASS VALLEY, a v. of Austin tp., Humboldt co., Nev. Pop. 27.

Grass Valley, post-v. and tp. of Nevada co., Cal., is the centre of the chief gold quartz-mining district of the State, from which source it derives the principal part of its business. It has 6 churches, 2 orphan asylums, high, intermediate, and preparatory public schools, 3 banks, a number of hotels, 1 daily and 1 weekly newspaper, 2 foundries, 1 planing-mill, quartz-mills, etc. It is 12 miles distant from the Central Pacific R. R. at Colfax, with which it will be shortly connected by rail. Grass Valley is the seat of a Roman Catholic bishop. Pop. 7063.

CHAS. H. MITCHELL, PROP. "DAILY UNION."

Grass Valley, tp. of Lander co., Nev. Pop. 26.

Grass-wrack, called **Eel-grass** in the U. S., the *Zostera marina,* a salt-water plant of the order Naiadaceæ, growing in coves and sea-ditches, always under water. It grows upon both continents, and is used to weave into the coverings of flasks, as a material for stuffing paillaisses and cushions, and as packing for glass and queensware. In the U. S. it is gathered like sea-weed, chiefly as a manure. Several other species of the genus are described.

Gras'sy Creek, tp. of Mitchell co., N. C. Pop. 514.

Gras'sy Fork, tp. of Jackson co., Ind. Pop. 1188.

Gras'sy Moun'tain, tp. of Greenville co., S. C. P. 1335.

Gra'tian, or **Gratia'nus,** the founder of the science of canon law, was b. in the latter part of the eleventh century, and entered the convent of Classe, near Ravenna, whence he removed to that of St. Felix de Bologna. Here he wrote his *Decretum,* and sent it to the pope, Alexander III., who in reward appointed him bishop of Chiusi. The *Decretum* is a complete and systematized collection of all the canons issued by the popes and councils. It is divided into three parts: (1) *De Ministeriis,* subdivided into 101 *distinctiones;* (2) *De Negotiis,* subdivided into 36 *causæ;* (3) *De Sacramentis,* subdivided into five *distinctiones.* There existed earlier collections of this kind, but they were vastly inferior to that made by Gratian, and the science of canon law was not taught in the theological schools until after the publication of the *Decretum.* As Gratian never doubted the authority of the False Decretals, and as his collection was used and referred to for more than three centuries without comment or reservation, it contributed very much to the establishment of the doctrine of the pope's authority as above the canon law, absolute and unrestrained: of the exemption of the clergy from the secular jurisdiction, etc. In 1580, under Pope Gregory XIII., a critically revised and corrected edition of the *Decretum* was published in Rome, forming the first part of the whole *Corpus Juris Canonici.*

Gra'tian (GRATIANUS AUGUSTUS), Roman emperor, son of Valentinian I. and grandson of Gratianus Funarius, a soldier of humble origin, chiefly distinguished for his strength. The grandson was b. at Sirmium, in Pannonia, Apr. 19, 359 A. D.; was declared consul 366, and Augustus in 367; was educated by Ausonius the poet; succeeded his father in 375, jointly with Valentinian II., his half-brother, his uncle Valens also reigning in the East until 378, when Gratian succeeded him, but in 379 gave the dominion of the East to Theodosius I. He was a Christian, and, though he persecuted heathenism, was a man of justice and virtue, but of somewhat feeble and luxurious character. His wars against the barbarians were measurably successful. He lived chiefly at Treves, and was murdered Aug. 23, 383 A. D., by Andragathius, a follower of Maximus, who succeeded him as emperor.

Grati'ola [once called *Gratia Dei,* "God's grace," from its supposed medicinal virtues], a genus of herbs of the order Scrophulariaceæ. The U. S. have numerous species, none of them important. The hedge hyssop (*G. officinalis*) of Europe and some South American species have been used in medicine.

Gra'tiot, county of Michigan, near the centre of the southern peninsula. Area, 576 square miles. The soil is productive, and is well timbered with pine. Wool, grain, and lumber are the chief products. Cap. Ithaca. Pop. 11,810.

Gratiot, post-v. of Licking and Muskingum cos., O. Pop. 228.

Gratiot, post-tp. of La Fayette co., Wis., on the Mineral Point R. R., and on the Illinois State line. Pop. 1718.

Gratiot (CHARLES), b. in Missouri in 1788; graduated at the U. S. Military Academy in 1806, and entered the army as second lieutenant of engineers; promoted to be captain in 1808, major 1815, lieutenant-colonel 1819, and colonel and chief engineer U. S. A. (brevet brigadier-general) 1828. In the war with Great Britain (1812–15) he served with distinction as chief engineer of the N. W. army; subsequently in the construction of fortifications to 1838, when placed in command of the corps of engineers, which position he held till Dec., 1838, when he was dismissed by the President for having failed to pay into the treasury certain balances of money placed in his hands for public purposes, etc. Gen. Gratiot memorialized the U. S. Senate in 1852 for an expression of opinion as to the legality of his dismissal, which petition was referred to the committee on the judiciary, who, deeming such expression inconsistent with their duty, asked to be, and were, discharged from the further consideration of the subject; but in their report they say, "The career of the petitioner during a long period of nearly forty years is a matter of history that may justly excite the pride and admiration of every American citizen. Brave in battle, he presided for a long time, with distinguished honor and ability, at the head of one of the most difficult and arduous bureaus of the military department, and has left to the country lasting monuments of his skill and science in the construction of various magnificent fortifications." . . . "While thus honorably and usefully employed he was constantly confided in by his country, and never abused her confidence in the disbursement of immense sums of money, and lived honored and respected by all classes of men, with no taint of suspicion attaching to his name." In support of his plea that the power exercised by the President in summarily dismissing him was arbitrary and illegal, Gen. Gratiot exhibited a mass of testimony which the committee said was entitled to be "calmly weighed and measured;" and in support of his second plea, he denied totally the truth of the charge of defalcation, and contended "that a just and legal adjustment of his accounts will bring the U. S. in debt to him—that he was then, and is now, prepared for an equitable settlement." In conclusion, the committee reported, "It seems to the committee that both the pleas are reasonable, and should receive attention, urged as they are with the earnestness of conscious rectitude by a gallant soldier, who has acquired a right to be heard from the blood he has spilled in battle." The case of Gen. Gratiot was never afterwards reopened, and after holding a clerkship in the land office at Washington from 1840 to 1855, he died in destitute circumstances at St. Louis, Mo., May 18, 1855.

G. C. SIMMONS.

Grat'is, post-tp. of Preble co., O. Pop. 2023.

Gra'tius Falis'cus, a Roman poet of whom nothing is known but the three following circumstances: he was a contemporary of Virgil (see Ovid, *Epistles from Pontus IV.*, 16, 33); he wrote a poem upon the chase entitled *Cynegeticon Liber;* and this poem was so entirely forgotten at the time of Numerianus (283 A. D.) that Nemesianus, writing on the same subject, could assert that he entered on a hitherto untrodden path. The poem, consisting of 540 hexameters, has come down to us through one single MS., discovered in France in the beginning of the sixteenth century, printed in Venice in 1534, translated into English verse by Christopher Wase in 1654, and into German verse by Perlet in 1826.

Gratry (AUGUSTE JOSEPH ALPHONSE), b. at Lille, France, Mar. 30, 1805; studied at the École Polytechnique; became in 1841 director of the College Ste. Barbe, Paris; almoner of the higher normal school 1846–51; was one of the reorganizers of the Oratory of the Immaculate Conception, and became an instructor of youth; vicar general of the diocese of Orleans 1861; professor of moral theology in the Sorbonne 1863; was chosen to the French Academy 1867; left the Oratory 1869. D. at Montreaux, Switzerland, Feb. 6, 1872. Author of *La Connaissance de Dieu* (1853); *Cours de philosophie* (1855–57); *Logique* (1856); *Pâix: méditations historiques et religieuses* (1862); *Les Sources, conseils pour la conduite de l'esprit* (1861–62); *Philosophie du Credo* (1861); *Commentaries* on St. Matthew (1863); *Jésus Christ* (addressed to Renan, 1864); *Les sophistes et la critique* (1864); *La morale et la loi de l'histoire* (1868), and other works. Shortly before his death he accepted the definitions of the Vatican Council, which he had hitherto opposed.

Grat'tan, post-tp. of Kent co., Mich. Pop. 1297.

Grattan (HENRY), b. at Dublin, Ireland, July 3, 1746; graduated at Trinity College in 1767; studied at the Middle Temple, London, and was admitted to the Irish bar in 1772; was a member of the Irish Parliament in 1775 from Charlton; brought forward in 1780 and 1782 the famous Bill of Rights, asserting the right of Ireland to self government, and for his earnestness was presented with a valuable estate by the Parliament; was in 1790 returned from Dublin; opposed alike the rebellious schemes of the United Irishmen and the union with Great Britain; entered the imperial Parliament in 1805; advocated Catholic emancipation with great zeal, and wore himself out with labors in behalf of Ireland. D. in London May 14, 1820. Personally, Grattan was small and of unprepossessing appearance; his private character was pure and noble.

Grätz, city of Austria, the capital of Styria, situated on both sides of the Mur at an elevation of 1047 feet above the level of the sea, and forming the principal station on the route from Vienna to Trieste. It is an old town, with narrow and crooked streets, but its surroundings are very picturesque, and it contains many interesting buildings. The cathedral of St. Ägidi was built in 1462; the church of St. Leonhard in 1283; the mausoleum of Ferdinand II. in 1615. Besides these buildings is the old ducal palace, a structure of great interest. Grätz has a university and many good educational institutions. Its manufactures of steel and iron wares and saltpetre are large, and its trade very extensive. Pop. 80,732.

Gratz, post-b. of Dauphin co., Pa. Pop. 386.

Grau'denz, town of Prussia, in the province of West Prussia, on the right bank of the Vistula. It has manufactures of cotton and wool, and close by lies the fortress of Graudenz, constructed by Frederick II., and commanding the course of the Vistula. Pop. 15,559.

Grau'wacke [Ger., "gray flint"], often half Anglicised as **Graywacke,** a sort of conglomerate found in various strata, chiefly Cambrian and Silurian. The term is not often used in this country.

Grave Creek, W. Va. See MOUNDSVILLE.

Grav'el, a collection of small pieces of stone, of which the constituents are larger than those of sand and smaller than those of shingle. Gravel is a deposit usually made by currents of water. In all but the more recent formations it is frequently found cemented into a mass called conglomerate, lime, iron, or siliceous matter constituting the cement.

Gravel, a disease manifested by the formation of small concretions either in the kidneys or bladder, and their expulsion with the urine. They are generally composed of some of the salts of urine, and are deposited either on account of being in abnormal abundance, or in consequence of the urine not being of the proper reaction to hold them in solution. When they form in the kidneys, they sometimes cause the most excruciating pain when passing along the ureter to the bladder, giving rise to what is commonly known as renal colic. Gravel may be divided into three varieties, according to its composition—viz. (1) uric acid or red gravel (see LITHIC-ACID DIATHESIS); (2) oxalate of lime (see OXALURIA); (3) phosphatic deposits (see PHOSPHATIC-ACID DIATHESIS). Other rare varieties are mentioned in the art. CALCULUS (which see).

EDWARD J. BERMINGHAM.

Gravelines, town of France, in the department of Nord, on the Aa, where it falls into the English Channel. It is fortified, but most famous from the battle in which the count Egmont defeated the French in 1558. Pop. 6428.

Grav'elly Springs, post-tp. of Lauderdale co., Ala. Pop. 862.

Gravelotte, Battle of, Aug. 18, 1870, also called the BATTLE OF REZONVILLE, or, by the French, the BATTLE OF ST. PRIVAT, was the greatest and bloodiest battle of the Franco-German war of 1870–71. By the battle of Vionville (Aug. 16) the French army was prevented from marching to Verdun, and Bazaine concentrated his forces nearer Metz, and occupied, with his front facing W., a favorable defensive position, marked by the points of St. Privat, Amanvillers, Verneville, and Rozerieulles. On the morning of the 18th the Germans were still in doubt whether the enemy would march towards the N. or whether he would keep his ground. An attack was expected on the day before, but none took place. King William then ordered that the whole army should make a great circuitous movement to the right, so that the left wing would fall in with the enemy if he tried to march off, while the right wing and the centre kept him where he was. Soon reports came from the outposts that the French had not marched off, but were before Metz; and at 10 o'clock orders were given that the army corps as they came in should wheel round to the right, against the front of the enemy. The centre of the French army was first attacked, the 9th corps planting its batteries at noon on the hill of Verneville, and opening a violent fire on the French batteries at Ste. Marie, St. Privat, and Amanvillers. But it was 7 o'clock P. M. when St. Privat was taken, and it was completely dark when the battle was finally decided by the failure of the attempt at breaking through the German lines at Gravelotte; the French army was now shut up in Metz, and could not escape. The Germans, numbering 211,000, lost 904 officers and 19,658 men; the French, numbering 140,000, lost 609 officers and 11,605 men.

AUGUST NIEMANN.

Gravel Walls, so called, are composed of a mortar of cement or lime filled in with gravel, stones of considerable size, pieces of slag, and the like. The mass is laid up in a casing of boards, kept from spreading by means of slips of wood passing from the inside to the outside tier of boards. These slips may be left in. The material should be well rammed, and kept covered from rain until dry. Door and window frames can be set in as the wall goes up. An octagonal ground-plan is a favorite one for this material, which is, however, not as much employed as formerly.

Graves, county in the W. of Kentucky, bordering on Tennessee. Area, 515 square miles. It is level and fertile. Cattle, tobacco, grain, and wool are leading products. It is traversed by the New Orleans and Ohio R. R. Cap. Mayfield. Pop. 19,398.

Gravesand. See 'S GRAVESANDE.

Gravesend, town of England, in the county of Kent, on the right bank of the Thames, 20 miles below London, to whose inhabitants it affords a pleasant holiday resort, on account of its fresh air and beautiful scenery. Pop. of town, 21,183; of b. 27,451.

Gravesend, post-v. and tp. of Kings co., N. Y., on the lower bay of New York. The tp. includes Coney Island, and is on the Brooklyn Bath and Coney Island R. R. Pop. 2131.

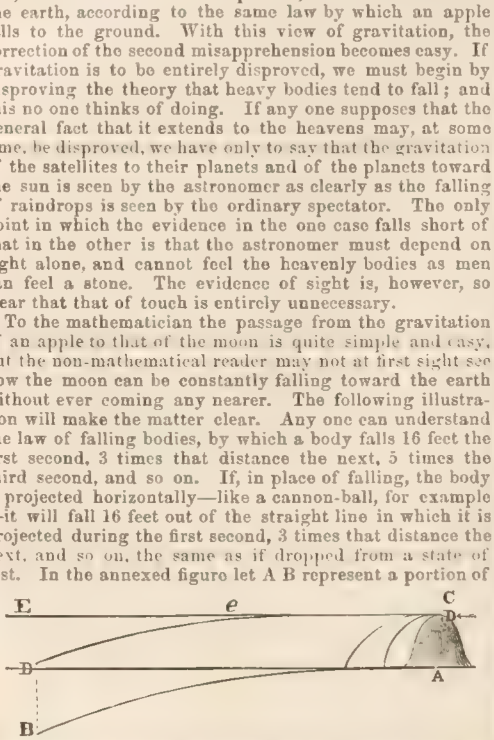
Gravesville, post-v. of Herkimer co., N. Y., in Russia tp. Pop. 67.

Gravi'na, town of Italy, in the province of Bari delle Puglia, situated in a very fertile district, with considerable commerce and industry. It is a bishop's see. Pop. 14,443.

Gravita'tion is, in its widest sense, the tendency which all bodies exhibit to approach each other with a force directly as their masses, and inversely proportional to the square of the distance between them. Two misapprehensions respecting this force are so widely prevalent, even among men of intelligence, that it is worth while to present such a view of the subject as shall remove them. They are (1) that gravitation was first discovered by Sir Isaac Newton; and (2) that it is simply a theory to account for the celestial motions, which may be hereafter disproved and superseded by some other theory. Neither of these views is strictly correct. The word "gravitation," derived from the Latin *gravitas*, literally means heaviness or weightiness, or, more exactly, the act or quality of being

heavy. That bodies in general tend to fall toward the earth is known to all even from earliest infancy; and as this tendency is gravitation, gravitation has been known to all men in all times. What Newton did was to show that the same force which causes a stone to fall extends to the moon and holds her in her orbit, and is only a special case of a force which extends through the entire solar system. He showed that the planets tend to fall toward the sun, the satellites toward the planets, and the moon toward the earth, according to the same law by which an apple falls to the ground. With this view of gravitation, the correction of the second misapprehension becomes easy. If gravitation is to be entirely disproved, we must begin by disproving the theory that heavy bodies tend to fall; and this no one thinks of doing. If any one supposes that the general fact that it extends to the heavens may, at some time, be disproved, we have only to say that the gravitation of the satellites to their planets and of the planets toward the sun is seen by the astronomer as clearly as the falling of raindrops is seen by the ordinary spectator. The only point in which the evidence in the one case falls short of that in the other is that the astronomer must depend on sight alone, and cannot feel the heavenly bodies as men can feel a stone. The evidence of sight is, however, so clear that that of touch is entirely unnecessary.

To the mathematician the passage from the gravitation of an apple to that of the moon is quite simple and easy, but the non-mathematical reader may not at first sight see how the moon can be constantly falling toward the earth without ever coming any nearer. The following illustration will make the matter clear. Any one can understand the law of falling bodies, by which a body falls 16 feet the first second, 3 times that distance the next, 5 times the third second, and so on. If, in place of falling, the body is projected horizontally—like a cannon-ball, for example—it will fall 16 feet out of the straight line in which it is projected during the first second, 3 times that distance the next, and so on, the same as if dropped from a state of rest. In the annexed figure let A B represent a portion of



the curved surface of the earth, and A D a straight line, horizontal at A, or the line along which an observer at A would sight if he set a small telescope in a horizontal position. Then, owing to the curvature of the earth, the surface will fall away from this line of sight at the rate of about 8 inches in the first mile, 24 inches more in the second mile, and so on. In 5 miles the fall will amount to 16 feet, in 10 miles, in addition to this sixteen feet, three times that distance will be added, and so on, the law being the same with that of a falling body. Now, let A C be a high steep mountain from the summit of which a cannon-ball is fired in the horizontal direction C E. The greater the velocity with which the shot is fired, the farther it will go before it reaches the ground. Suppose, at length, that we should fire it with a velocity of 5 miles a second, and that it should meet with no resistance from the air. Suppose *e* to be the point on the line 5 miles from C. Since it would reach this point in one second, it follows from the law of falling bodies just cited that it will have dropped 16 feet below *e*. But we have just seen that the earth itself curves away 16 feet at this distance. Hence, the shot is no nearer the earth than when it was fired. During the next second, while the ball would go to E, it would fall 48 feet more, or 64 feet in all. But here, again, the earth has still been rounding off, so the distance D B is 64 feet. Hence, the ball is still no nearer the earth than when it was fired, although it has been dropping away from the line in which it was fired exactly like a falling body. Moreover, meeting with no resistance, it is going on with undiminished velocity. And just as it has been falling for two seconds without getting any nearer the earth, so it can get no nearer in the third second, nor the fourth, nor any subsequent second; but the earth will constantly curve away as fast as the ball can drop. Thus, the latter will pass clear round the earth, and come back to the point C from which it started, in the direction of the arrow, without any loss of velocity. The time of revolution will be about an hour and twenty-four minutes, and the ball will thus keep on revolving round the earth in this space of time. In other words, the ball will be a satellite of the earth, just like the moon, only much nearer and revolving much faster.

The ball we have just described is deflected from a straight line 16 feet in a second. The way in which Newton proceeded to find whether the moon was held in its orbit by the gravitation of the earth, was to calculate the amount by which the moon was deflected from a straight line every second, and compare this with the gravitation of the earth. It was already known from observations of the moon's parallax that her mean distance was 30 diameters of the earth. But the diameter of the earth itself was not known with any accuracy, and the value first used by him was one-half too small. The consequence was, that the distance of the moon he used in his calculations was also too small, and the result did not agree with the theory of gravitation. But a few years later a new determination of the magnitude of the earth was made by the French geodesists, which enabled Newton to repeat his calculation with exact data. He now found that the moon actually dropped $\frac{1}{15}$th of an inch in a second, or $\frac{1}{3600}$th as far as a stone at the earth's surface. The number 3600 being the square of 60, the distance of the moon in radii of the earth, he was enabled to announce that the force which held the moon in her orbit was the same which made the stone fall, only diminished in the ratio of the square of the moon's distance.

The next step in the demonstration was to show that the planets were held in their orbits by a force directed toward the sun, and inversely as the square of the distance from it. This demonstration was the great object of the *Principia*, and the data from which Newton set out were the laws of Kepler. From the law that equal areas were described around the sun in equal times it was easy to show that the force in question must be directed toward the sun; and from the relation between the distances of the planets and their times of revolution, the law of a force proportioned to the inverse square of the distance followed by a very simple demonstration. It remained to prove that the same law held true for the different distances of one and the same planet from the sun; in other words, that a planet revolving around the sun under the influence of gravitation would describe an ellipse having the sun in its focus. This demonstration occupied the attention of other mathematicians, as well as of Newton, but the latter first succeeded in it, and in doing so completed the theory of the gravitation of the planets toward the sun.

The next step was to apply to the moon the combined gravitation of the sun and earth. It was known that this body in its movement showed deviations from Kepler's laws, and Newton succeeded in showing that most of these deviations could be traced to the attractive force of the sun. But his mathematics were insufficient to enable him to calculate all the inequalities, or to give the exact values of those which he did calculate. Nevertheless, his success was sufficient to justify the enunciation of the greatest law of nature ever discovered: *Every body in nature attracts every other body with a force directly as its mass, and inversely as the square of its distance.* If this law is true in all its generality, then each planet must be attracted by every other planet, as well as by the sun, and its motion must be slightly altered by these attractions. To compute the effect of these attractions is a problem which has occupied the attention of most of the great mathematicians since Newton, and the result has been that the most complicated motions of the heavenly bodies can thus be predicted years in advance with a degree of accuracy limited only by the mathematician's power of calculating and the practical astronomer's power of observing.

Nor has the demonstration of gravitation been limited to the sun, moon, and planets. Nearly a century ago Maskelyne determined the attraction of a mountain, and this attraction is now shown whenever accurate observations for latitude and longitude are made in the neighborhood of great mountain-chains. Not only so, but Cavendish and Bailly succeeded in measuring the attraction of balls of lead upon very delicately balanced weights, and thus found the mean density of the earth to be about six times that of water. Passing from the smallest things to the greatest, Herschel found that many double stars revolve around each other, and by carefully observing those motions his successors have found that these also attract each other according to the law of gravitation. The gravitation of widely distant stars has not yet been seen, but the distances of these bodies from us and from each other are so immense that thousands and perhaps millions of years would be required before any motion due to gravitation could be perceived. From all the evidence we are justified in considering the mutual gravitation of bodies to be a universal law of nature, connecting the smallest masses as well as the largest. S. NEWCOMB.

Gravity, Specific—relative weight. Absolute weight is the weight of a body as measured by the units of ordinary metrology. Relative weight is the weight of a body as measured by the absolute weight of some other body equal to it in bulk taken as unity. Specific gravity is such relative weight when the measure is one which has been

adopted by common consent to be a *standard of comparison.* Water is the universally accepted standard for all solids and liquids; air, for all gases and vapors. But as the dimensions of bodies change with temperature, and in some cases with pressure also, and as the buoyant power of the air depends on the same conditions, it is necessary that comparisons for determining specific gravities should be made at certain determinate temperatures and states of barometric pressure, or that the results should be reduced to such. In regard to the standard temperature there has been no general agreement. In England, 62° F. has been used by many experimenters. Others both in England and the U. S. have used 60° F. Of recent years there has been a tendency to adopt the freezing point of water = 32° F. = 0° C. or the temperature of the maximum density of water, which is 4° C. = 39.1° F. Every table of specific gravities should state the temperature to which the determinations have been referred. As to the standard pressure, no such difference of usage has prevailed. This is always taken at 30 inches of mercury, or 760 millimètres.

To ascertain the specific gravity of a liquid, the expedient which naturally suggests itself is to fill with water any convenient vessel up to a certain point and weigh it; and afterwards to weigh the same vessel filled to the same point with the liquid. The weight of the vessel having been deducted in both cases, the specific gravity is equal to the second weight divided by the first; and it will be greater or less than unity according as the liquid is more or less dense than water. For convenience in actual practice, a light vessel is constructed for these determinations, in the form of a bottle with a narrow neck (Fig. 1) capa-

FIG. 1.

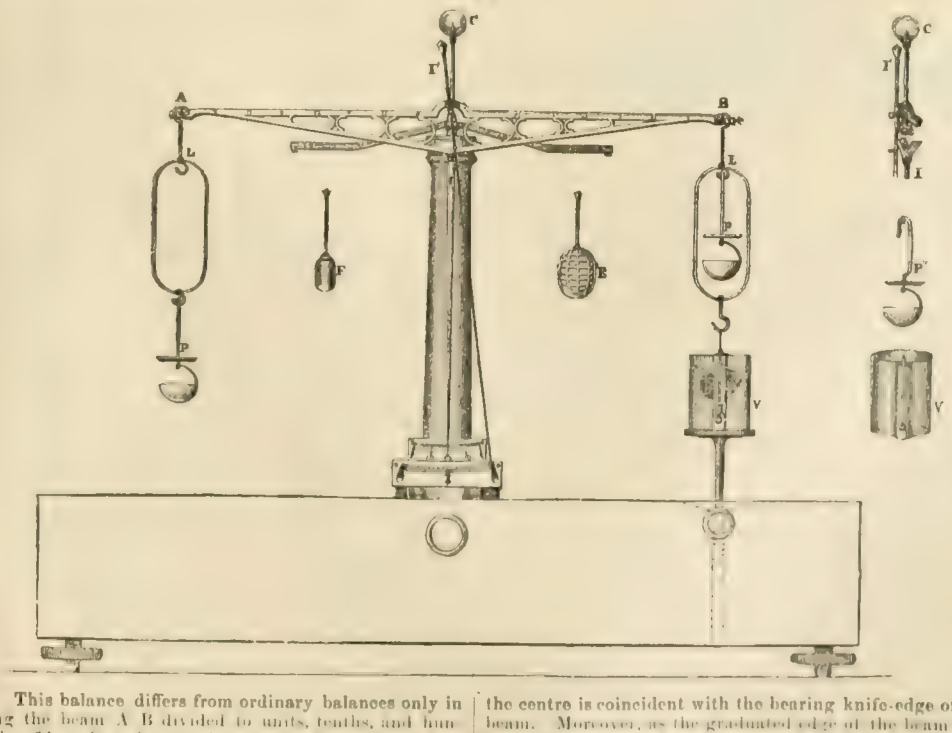
FIG. 2.

ble of containing 1000 grains or 100 grammes of water at the standard temperature. The weight of the liquid in grains or grammes then directly expresses the specific gravity, the decimal point being suitably placed. A mark on the neck shows exactly to what point the bottle is to be filled. Two marks are sometimes made to indicate the ends and the middle point of the curve in the surface of the fluid, produced by capillarity. In some instances also the bottle is made with a perforated stopper (Fig. 2), and after being entirely filled to the lip, is closed by putting in the stopper, the excess of fluid overflowing. The exterior must then be carefully dried before weighing. With every specific-gravity bottle a counterpoise weight is furnished by the maker, which exactly balances the weight of the bottle when empty. Placing this in the opposite scale, the additional weights necessary will be only the weight of the contents. The specific gravities of liquids may also be determined expeditiously by instruments constructed expressly for the purpose, called generally hydrometers, but variously named according to the nature of the liquid for which they are specially intended. (See HYDROMETER.)

The specific gravity of a solid could be ascertained by giving to a portion of the solid such regular shape as to allow an accurate determination of its dimensions, and then dividing its weight by the weight of an equal bulk of water. But this would be in general practically impossible; and it is not necessary. Advantage is taken of the Archimedean principle, that a solid body immersed in a liquid is buoyed up, or made apparently lighter, by an amount equal to the weight of the liquid it displaces. Hence, to ascertain the specific gravity of a solid, it is first carefully weighed in the air, and then, being suspended by a slender thread, is immersed in water and weighed again. The difference between these two weights is made the divisor, and the total weight of the solid, the dividend; the quotient being the specific gravity sought. If the temperature and pressure at the time of making the determination are not those adopted as standard, the result must be corrected, or reduced to standard; a process for which rules will be found in systematic treatises on physics. Should the solid be too light to sink, a sinker is attached to it, and the water-weight [weight of equal bulk of water] of the two together is ascertained as above. From this is afterwards deducted the water weight of the sinker alone, and the remainder is the water-weight of the solid itself, which is to be used as the divisor.

The arithmetical operations necessary in computing and reducing specific gravities, involving generally divisors and factors of several places of figures, are troublesome. They may be avoided by the use of a balance constructed on a plan devised by the writer of this article, and represented in Fig. 3, which gives specific gravities by simple inspec-

FIG. 3.



tion. This balance differs from ordinary balances only in having the beam A B divided to units, tenths, and hundredths of length, and two index-needles, I and I', the first for determining the position of horizontality, as in the common balance, and the other movable about a pivot of which the centre is coincident with the bearing knife-edge of the beam. Moreover, as the graduated edge of the beam is in a line with the bearing points, the ball C is placed above the middle point to prevent the centre of gravity from falling too low. These modifications do not in any manner

interfere with the usefulness of the balance for the ordinary purposes of weighing. When employed for determining specific gravities, the scale pans commonly used are removed, and two open loops of wire L. L. about two and a half or three inches long, are suspended from the ends of the beam, which still maintains its equilibrium after their attachment. The body under examination is fastened by a slender thread to the right-hand loop, and beneath it; while to the left-hand loop is suspended a pendant P designed to receive the weights which are to serve as a counterpoise. This pendant is itself a part of the counterpoise, and is so constructed as separately to weigh one gramme. It consists of a stem curved into a hook at top as shown at P′ on the right, provided below with a disk, through the centre of which it passes (designed to hold the weights), and carrying at bottom a small cup, into which may be introduced fine sand instead of small weights, to complete the counterpoise. The weights are disks, notched to the centre, in order that they may be placed on the disk of the pendant without being interfered with by the suspending wire. They are of different values, from twenty grammes to one centigramme. For smaller fractions, fine sand is used, the object being not to find out how much the body weighs, but to obtain a weight which is its exact equipoise. After a true equilibrium has been established, the beam is lifted, and the water vase V which stands beneath the suspended body is raised till the body is completely immersed. This vase is furnished with a thermometer, T, to show the temperature of the contained water. A pendant, exactly similar to that used in the first weighing, is now placed within the right-hand loop, over the immersed body, and weights are added to this until the equilibrium destroyed by the immersion is once more established. The total weight is the weight of the water displaced. The beam is now lifted again, the vase depressed, and the body removed. From a little table of numbers, with temperatures from 10° to 25° C., at the top, and cubic centimètres (represented for this purpose by gramme weights) at the side, is taken a correction for the reduction from the temperature of observation to 4° C. (the temperature of the maximum density of water), and this amount is added to the pendant in the loop. The left-hand pendant is then removed from the extremity of its arm, and placed at the unit division on the same arm; and the right-hand pendant is suspended on the right arm at such a distance from the point of support as to produce as nearly as possible an equipoise. The divisions of the arm being only to hundredths, perfect equipoise will not, in general, be in this manner secured. The nearest division short of equipoise will give the specific gravity to the second place of decimals. For the third and fourth places, the movable index needle above referred to must be used. This needle, which is made as light as possible, has its centre of gravity exactly coincident with its centre of motion; so that the equilibrium of the balance is not at all affected by its change of position when without a load. But at a distance from the centre equal to one-tenth of its entire length, it has a pin standing at right angles to itself, upon which may be placed weights which are made disk-shaped, with a hole through them at the centre. The construction is better seen in the perspective view on the right. A set of weights for the needle is provided, each being one-tenth part of the corresponding weight used with the pendants; and the load placed on the needle is one-tenth of that of the right-hand pendant, including the pendant itself. The needle, thus loaded, is then moved on its pivot toward the right, far enough to make the equilibrium, which had been previously almost attained, quite perfect; and when in this position the reading of its scale will give the third and fourth places of decimals in the specific gravity sought. It will be observed that, as no weights are used smaller than a centigramme in weighing the body immersed, the completion of the equipoise being effected by the use of fine sand, the load of the needle, which is in theory one-tenth of the weight of the pendant, must be a trifle deficient, no account being taken of the sand. The extreme deficiency, however, would not be so much as a milligramme; and this would usually affect only the sixth decimal, and would never affect the fifth by more than a single unit.

The beam A B is forty centimètres long, each arm being twenty centimètres. There are four unit divisions on each arm. For specific gravities exceeding *four*, the right-hand pendant is placed, when sinking the immersed body, at half-arm's length. The specific gravity found in this case, by proceeding as before, must be doubled to give the true result. If the pendant be in like manner placed at the quarter-arm's length, the observed specific gravity must be quadrupled. This carries the determinations up to *sixteen;* and by placing the *left*-hand pendant at *one-half* the unit distance from the middle, instead of the entire unit distance, they may be advanced to thirty-two, which is far beyond the actual specific gravity of any known substance.

For bodies lighter than water, a loaded cage E is provided, which confines and sinks them by its superior weight. When this is used, a counterpoise F is suspended within the left-hand loop, to balance it during the weighing in the air; and there is a second one to be used for the same purpose in weighing during immersion. For the specific gravity of liquids, a plunger is employed having an ascertained displacement in standard water of ten or one hundred cubic centimètres; and this is counterpoised by an exactly equal weight upon the left-hand arm. Accordingly when this plunger, thus counterpoised, is immersed in a liquid presented for examination, the figures expressing the metric weight required to re-establish equilibrium are themselves a direct expression of the specific gravity.

For determining the specific gravities of aëriform bodies, the principle of buoyancy is practically unavailable, though not so theoretically. Suppose the weight of a bulky solid weighed in vacuo to be P, and the apparent weight of the same solid weighed in air at standard density, to be W. Then if p be the weight of the air displaced by the solid, and w that of the air displaced by the counterpoising weights, we shall have for the actual weight of the air displaced by the solid,

$$p = P - W + w.$$

And if the same solid be weighed in a different aëriform medium, we shall have (using the same letters accented for the corresponding quantities)

$$p' = P - W' + w'.$$

Hence, putting S for specific gravity,

$$S = \frac{P - W' + w'}{P - W + w}.$$

If the weighings are made with platinum weights, the terms w and w' may be neglected, since they could in no case affect the value of S more than a unit in the fifth decimal place. This method is however inapplicable, on account of the difficulty of conducting weighings in different atmospheres. There are moreover many gases to which the apparatus could not be exposed without injury. The method actually employed in making these determinations, is to fill a large and light glass globe (previously exhausted of its air) with the gas which is the subject of experiment, and to weigh it thus filled. The difference between this weight and that of the exhausted globe is the weight of the contained gas; and this divided by the weight of the equal bulk of air similarly ascertained, gives the specific gravity.

Table of Specific Gravities.

	Specific gravity.	Weight per cubic inch in pounds.
Metals.		
Platinum	21.150	.775
Gold	19.258	.697
Mercury, solid	14.391	.566
" liquid	13.588	.489
Lead	11.330	.408
Silver	10.472	.377
Bismuth	9.822	.353
Copper	8.878	.316
Iron	7.778	.280
Tin	7.291	.262
Zinc	6.862	.252
Antimony	6.712	.242
Arsenic	5.763	.208
Aluminum	2.670	.096
Rocks and Minerals.		
Topaz, Oriental	4.011	.145
Emery	4.000	.144
Diamond	3.520	.127
Limestone, white	3.156	.114
Glass, flint	3.078	.111
" crown	2.520	.091
" com. green	2.520	.091
" plate	2.760	.099
Alabaster	2.730	.098
Marble, statuary	2.718	.098
Coral	2.700	.097
Slate	2.672	.096
Chalk	2.620	.094
Granite, Ab. red	2.620	.095
Gypsum	2.286	.082
Salt	2.130	.077
Clay	1.900	.068
Sand, river	1.880	.067
" quartz	2.750	.099
Coal, anthracite	1.530	.055
" bituminous	1.270	.046
Woods		
Lignumvitæ	1.333	.048
Box	1.280	.046
Ebony	1.187	.043
Mahogany, Span.	0.852	.031
Oak, Am. white	0.779	.028
" English	0.777	.028
Beech	0.696	.025
Ash	0.690	.025
Maple	0.675	.025
Pine, red	0.657	.024
" white	0.553	.020
Chestnut	0.606	.022
Cedar, American	0.554	.020
Elm, English	0.553	.020
Fir, spruce	0.512	.018
Cork	0.240	.008
Miscellaneous.		
Acid, phosphoric	1.880	.056
" sulphuric	1.842	.066
" nitric	1.552	.044
" hydrochlor.	1.270	.043
" acetic	1.062	.038
Asphalt	2.500	.090
Ivory	1.822	.065
Sugar	1.605	.058
Blood	1.054	.038
Beer, lager	1.034	.037
Milk	1.032	.037
Cider	1.018	.036
Water	1.000	.036
Camphor	0.988	.035
Beeswax	0.965	.034
Lard	0.947	.034
Butter	0.942	.034
Oil, linseed	0.940	.034
" whale	0.923	.033
Tallow	0.934	.034
India-rubber	0.933	.033
Alcohol, absolute	0.792	.028
" proof	0.916	.033
Ether	0.716	.026
Gases and Vapors.		
Steam	0.00880	.000317
Carb. acid	0.00197	.000071
Oxygen	0.00143	.000051
Atmos. air	0.00129	.000046
Olefiant gas	0.00127	.000046
Nitrogen	0.00125	.000045
Hydrogen	0.0000895	.0000032

F. A. P. Barnard.

Gray, town of France, in the department of Haute-Saône, on the Saône. It has a brisk trade in corn, wine, and fruits. Pop. 7051.

Gray, tp. of White co., Ark. Pop. 2252.

Gray, post tp. of Cumberland co., Me., 16 m. N. of Portland, has 3 churches and some manufactures. Pop. 1758.

Gray, tp. of Edgefield co., S. C. Pop. 2523.

Gray (ALONZO), LL.D., b. at Townshend, Windham co., Vt., in 1808; graduated from Amherst College in 1834; was professor of chemistry and natural philosophy at Andover Academy 1837–43; professor of chemistry in Maryland College; principal of Brooklyn Seminary. Author of *Elements of Chemistry* (1853), *Elements of Natural Philosophy* (1851), etc. D. in Brooklyn, N. Y., Mar. 10, 1860.

Gray (ASA), M. D., LL.D., b. at Paris, Oneida co., N. Y., Nov. 18, 1810; received in 1831 his medical degree at the Fairfield College of Physicians and Surgeons, Herkimer co., N. Y.; studied botany with the late Prof. Torrey of New York; was appointed in 1834 botanist to the Wilkes expedition, but declined the post; became in 1842 Fisher professor of natural history in Harvard University, from the more active duties of which position he retired in 1873; became in 1874 a regent of the Smithsonian Institution. Dr. Gray has long been recognized throughout the scientific world as one of the ablest and most philosophic of botanists. Among his numerous writings are *Elements of Botany* (1836); *Manual of Botany* (1848); the unfinished *Flora of North America*, by himself and Dr. Torrey, the publication of which was commenced in 1838; *Genera Boreali-Americana*, also incomplete (1848); *Botany of the U. S. Pacific Exploring Expedition* (1854); numerous important and elaborate papers on the botany of the West and South-west, published in the *Smithsonian Contributions*, *Memoirs*, etc. of the American Academy of Arts and Sciences, of which he was for ten years president, and in various government reports; also *How Plants Grow*, *Lessons in Botany*, and other works, forming a series of admirable textbooks upon this subject. In 1861 appeared his *Free Examination of Darwin's Treatise*. He is editorially connected with the *American Journal of Science and Arts*, and is a frequent contributor to that and other scientific journals in Europe and the U. S. Elected member of Institute of France, Academy of Sciences, July 29, 1878.

Gray (DAVID) was b. in Edinburgh, Scotland, Nov. 9, 1836; emigrated with his family to the U. S. in May, 1849, and settled in Marquette co., Wis., as backwoodsman and farmer. In 1856 he went to Buffalo, N. Y., and three years later became connected with the *Buffalo Courier* as reporter. In 1868 he became managing and general editor of the same paper, a position which he now holds. J. B. BISHOP.

Gray (FRANCIS CALLEY), LL.D., son of Lieut.-Gov. William Gray, b. at Salem, Essex co., Mass., Sept. 19, 1790; graduated from Harvard University in 1809; was bred a lawyer; was private secretary to J. Q. Adams while U. S. minister to Russia; was often in the legislature; was corresponding secretary of the Academy of Arts and Sciences. He was an early contributor to the *North American Review*; was the author of *Prison Discipline* in 1848. He bequeathed $50,000 for the establishment and maintenance of a museum of comparative zoology in connection with Harvard University; and also a collection of engravings made during his life, probably the largest and most valuable of any in the U. S. He left, in addition, a sum of money the interest of which is to be expended for the increase and care of the collection, and provided for the publication of a catalogue of the engravings. This catalogue has since been prepared by Mr. Louis Thies, the first curator of the collection. It is a work of great thoroughness and accuracy. D. at Boston, Mass., Dec. 29, 1856.

Gray (GEORGE ROBERT), F. R. S., a brother of J. E. Gray, was b. at Little Chelsea, England, July 8, 1808. From 1821 till his death was connected with the British Museum as a zoologist, but gave especial attention to entomology and ornithology. Author of the entomological part of the English edition of Cuvier's *Animal Kingdom*, of *Genera of Birds* (1837–49), *Hand List of the Species of Birds* (1870), and other valuable treatises. D. May 6, 1872.

Gray (HENRY PETERS), b. in New York City June 23, 1819; began his art studies with Daniel Huntington in 1838, but after a year's practice he went to Europe to study the masterpieces of foreign art. In 1843 he returned to New York, but for a short time. In 1846 he went abroad again for a few months, after which he lived in New York till the winter of 1872, when he went to Italy and stayed two years. Gray has been an industrious painter; his portraits number some 300. But his reputation rests mainly on his composition pictures, the subjects of which are biblical, classical, and romantic. As a draughtsman and a colorist he stands high. Mr. Gray was for several years president of the National Academy of Design. D. in New York City Nov. 12, 1877. O. B. FROTHINGHAM.

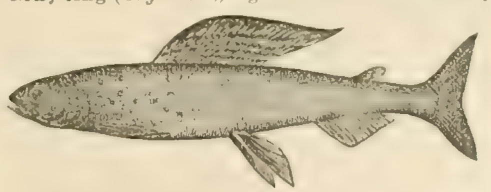
Gray (JOHN EDWARD), PH. D., F. R. S., the son of S. F. Gray, a savant and author), was b. in 1800 at Walsall, England, and educated as a physician. His father's *Arrangement of British Plants* (1821), a valuable treatise, was mainly the work of J. E. Gray. From 1824 to 1875 he was prominently connected with the British Museum; was one of the most laborious of naturalists, a member of many learned societies, and the author of hundreds of scientific papers and of many valuable catalogues. He published zoological reports of the expeditions of the Erebus, Terror, Sulphur, and other historic British exploring ships; edited Turton's *Manual of Land and Fresh-Water Shells*; wrote *Illustrations of Indian Zoology*, etc.; and took a prominent part in favor of sanitary and social reforms. D. Mar. 7, 1875.

Gray (ROBERT), b. at Tiverton, R. I., in 1755. On Sept. 30, 1787, the sloop Washington, Capt. Gray, sailed from Boston to trade with the natives of the north-west coast. Returning in 1790, viâ Canton (China), Capt. Gray was the first man to carry the stars and stripes around the globe. He made a second voyage, and May 11, 1791, discovered the river which is now called Columbia. D. at Charleston, S. C., in 1806.

Gray (THOMAS), LL.B., b. in Cornhill, London, Dec. 26, 1716, the son of a scrivener of brutal temper and habits; was educated at Eton and the Peterhouse, Cambridge; travelled in Italy and France (1739–41) with Horace Walpole; took his legal degree at Cambridge 1742, and afterwards lived at the university, in which he was appointed professor of modern history in 1768, but never actively engaged in the duties of that position. D. at Cambridge July 24, 1771. Gray's fame rests almost entirely upon his *Elegy written in a Country Churchyard* (1749), which has given him a high position in English literature. He was a man of delicate and refined tastes, retiring and sensitive, fond of learning, art, and philosophic studies, almost effeminate in manners, and of constitutionally infirm health. His published *Letters* are admirable in style and matter, and his Latin verse is good. The *Ode on a Distant Prospect of Eton College* (1747), *Progress of Poesy*, and the *Hymn to Adversity* (1742) are noteworthy among his other poems. Mitford's edition of his works (1814, often reprinted), with a memoir and notes, is one of the best.

Gray (WILLIAM), b. at Lynn, Mass., June 27, 1750; became engaged in shipping, in which pursuit he amassed great wealth, having at one time 60 square-rigged vessels on the ocean; was lieutenant-governor of Massachusetts in 1810, having before this been a State senator. D. at Boston Nov. 4, 1825.

Gray'ling (*Thymallus*), a genus of fishes of the family



Michigan Grayling.

Salmonidæ, resembling the trout in habits and character. It is one of the best of the game fishes, an order of aquatic nobility to which some authorities admit only the trout, salmon, and grayling. The *T. vulgaris* is the common grayling of Europe. It is in great request for the table. The *T. tricolor* is found in some streams of Michigan and in the head-waters of the Yellowstone. Its discovery has been hailed as a great acquisition to the anglers of the U. S. It is perhaps identical with *T. signifer*, a splendid inhabitant of the far northern waters of British America. There are other species, chiefly European and Asiatic.

Gray Powders. See MERCURY, MEDICINAL USES OF.

Gray'son, county of W. Central Kentucky. Area, 700 square miles. Its surface is undulating. Coal, iron, limestone, and mineral springs abound. Cattle, tobacco, grain, and wool are leading products. Cap. Litchfield. P. 11,580.

Grayson, county of Texas, bounded on the N. by the Red River. Area, 950 square miles. Cattle, grain, pork, and cotton are staple products. The soil is fertile and well timbered. It is intersected by the Missouri Kansas and Texas R. R. Cap. Sherman. Pop. 14,387.

Grayson, county of Virginia, bordering on North Carolina, and included between the two easternmost ranges of the Appalachian Mountains. It abounds in iron and other mineral wealth, and is a good grazing region. Grain and wool are leading products. Area, 340 square miles. Cap. Independence. Pop. 9587.

Grayson, post-v., county-seat of Carter co., Kentucky. Pop. 152.

Grayson (JOHN BRECKENRIDGE), b. in Kentucky in 1806; graduated from the U. S. Military Academy, and was appointed second lieutenant of artillery July, 1826, first lieutenant 1834; transferred to the subsistence department in 1838, with the rank of captain, and promoted to be major 1852; as an artillery officer he served in garrison and on special duty until 1836, with the exception of a period (1835) when on active duty in the field in Florida against the Seminole Indians; he served throughout the Mexican war as Gen. Scott's chief commissary, and for gallant conduct at Contreras, Churubusco, and Chapultepec was brevetted major and lieutenant-colonel. On the outbreak of the civil war he resigned his commission, and was appointed a brigadier-general in the Confederate service. D. in Florida in 1861. G. C. SIMMONS.

Grayson (WILLIAM), b. in Prince William co., Va., graduated at the University of Oxford; studied law, and settled at Dumfries. He was chosen as aide-de-camp to Washington in 1776; also as colonel of a Virginia regiment in 1777. He was eminent throughout the Revolution as an officer of intrinsic worth and undaunted courage. He was one of the first U. S. Senators from Virginia in 1789. D. at Dumfries Mar. 12, 1790.

Grayson (WILLIAM), b. in Maryland 1786; served with distinction in both houses of the Maryland Assembly; also took an eminent part in the struggle to acquire a new and more liberal constitution for the State in 1838; was governor 1838–41. D. July 9, 1868.

Grayson (WILLIAM J.), b. at Beaufort, S. C., in Nov., 1788; graduated at South Carolina College in 1809; was educated for the law; occupied the office of commissioner in equity of South Carolina; became a member of the State legislature (1813); a State Senator (1831); held the position of M. C. 1833–37, and in 1841 was appointed collector of customs at Charleston, S. C., by Pres. Taylor. He contributed many articles to the *Southern Review*; was the author of *The Hireling and the Slave* (1856), *Chicora*, and other works. D. at Newbern Oct. 4, 1863.

Gray's Peak, on the Rocky Mountains, is in Summit and Clear Creek cos., Col., 12 miles W. of Georgetown. It is 14,466 feet in height. Named in honor of Dr. Asa Gray, and is the twin of Torrey's Peak, of the same height.

Grays'ville, post-v. of Monroe co., O. Pop. 199.

Gray'ville, post-v. and tp. of White co., Ill., on the Wabash River at the mouth of the Bonpas River, on the Cairo and Vincennes R. R. A portion of the town lies in Edwards co. It has 2 weekly newspapers, 1 bi-monthly religious paper, a literary society, good schools, 2 flouring and 3 saw mills, 1 stave and 2 furniture factories, 2 planing mills, and 3 hotels. Pork is packed and grain shipped at this point. It is surrounded by a fertile region. Pop. of tp. 1925. JONATHAN STUART, ED. "REPUBLICAN."

Grazale'ma, town of Spain, in the province of Cadiz. It is very peculiarly situated behind Sierra de Ronda and Cerro de St. Christoval, approachable only through a very narrow pass. Smuggling is largely carried on. Pop. 6600.

Grease [akin to the Lat. *crassus*, "thick"], the popular name of many inferior fats, or oils which are solid or semi-solid. They are used as lubricants for wagon-wheels (in which case a little tar or soda increases their durability) and in dressing some sorts of leather. "Mare's grease" is the oil of horses, imported from South America and used as a lubricant. Many kinds of grease are employed in making soap, candles, and glycerine.

Grease-Wood, the *Sarcobatus vermiculatus*, a plant of the order Chenopodiaceæ, very abundant in the Far West in barren places which are charged with alkaline salts. It is one of the characteristic plants of that region.

Great Barrington, post-v. and tp. of Berkshire co., Mass., on the Housatonic River and R. R. It is a prominent and pleasantly situated town, surrounded by beautiful hills. It contains manufactures of woollens, cotton goods, paper, flocks, pig iron, brick, and saw-mill products. It has a national and a savings bank, a weekly newspaper, 18 public schools (including a high school), and 7 churches. The post-villages of Van Deusenville and Housatonic are within the town limits. It is a popular resort in summer, has several first-class hotels, is supplied with gas and pure spring water, and the main street is lined with grand old elms. The town was settled in 1730, incorporated in 1761, and until 1787 was the county-seat. The territory was purchased from the Indians, and originally bore the name of the Housatonic Propriety. Pop. of tp. 4320. MARCUS H. ROGERS, ED. "COURIER."

Great Basin, or **Fremont's Basin,** the great area extending westward from the Wahsatch Mountains to the Sierra Nevada, measuring some 300 miles N. and S., and 350 E. and W., and including nearly all of Nevada, a great part of Utah, a large area in California, and small parts of Wyoming, Idaho, and Oregon. Its waters do not reach the sea, hence it is called a basin. It is, however, in reality, a series of basins, mostly long, broken N.-and-S. valleys lying between rugged mountain-ranges. Across these ridges and valleys the valley of the Humboldt River strikes diagonally, affording the only practicable railroad route from E. to W.—the route of the Central Pacific R. R. The climate is very dry, and agriculture is not practicable without irrigation. The streams are small, and important only for irrigation and mining purposes. The Humboldt, Carson, Bear, Jordan, Provo, Beaver, Sevier, and Weber rivers are the largest. Great Salt Lake is the largest body of water, and Utah Lake is the principal fresh water lake. The other lakes, some of them mere "sinks" or marshy places, are partly salt and partly fresh, while some are composed of highly complex chemical solutions, like Mono Lake in California. The climate is generally healthful. "White-pine" timber is cut on some of the mountains. There is a considerable grazing industry. Gold, silver, lead, borax, salt, sulphur, and soda-salts are abundant, and the mining interest is important. The basin is peculiarly exposed to the ravages of the "hateful grasshopper" (*Caloptenus spretus*).

Great Bear Lake, in British America, under the Arctic Circle, between lon. 117° and 123° W. It has an irregular outline, is very deep and clear, abounds in fish, and is frozen over for half the year. Area, 11,000 square miles.

Great Bend, post-v., cap. of Barton co., Kan., on the Arkansas River and the Atchison Topeka and Santa Fé R. R., near the centre of the State. It has a bank, a newspaper, a large brick court-house, a graded school building, 2 churches, 2 hotels, 15 stores, and a large trade. A. J. HOISINGTON, ED. "REGISTER."

Great Bend, post-b. and tp. of Susquehanna co., Pa., 14 miles S. E. of Binghamton, N. Y., on the Susquehanna, at the junction of the Erie and the Delaware Lackawanna and Western R. Rs. Pop. of b. 855; of tp. 1431.

Great Britain [Gr. Ἀλουίων νῆσος, Βρεττανικὴ νῆσος; Lat. *Albion*, *Anglia*, *Britannia*]. Under this head we propose to notice the United Kingdom of Great Britain generally, and refer to the articles on England, Wales, Scotland, Ireland, the Isle of Man, and the Channel Islands for further particulars. Great Britain, thus called to distinguish it from Lesser Britain or the Bretagne, is the largest island in Europe, and, next to Greenland, New Guinea, Borneo, Madagascar, and Sumatra, the largest in the world. It is separated from the continent of Europe by the British Channel (La Manche of the French), the narrowest portion of which is called the Strait of Dover (Pas de Calais), and by the German Ocean or North Sea, and from Ireland by the Irish Channel or Sea, which communicates with the open Atlantic through the North and St. George's channels. The island of Great Britain comprises England, Wales, and Scotland, and lies between lat. 49° 57′ 30″ and 58° 40′ 24″ N., and between lon. 1° 46′ E. and 6° 13′ W. of Greenwich. Its most southerly point is Lizard Point in Cornwall; its most northerly, Dunnet Head in Caithness; its most easterly, Lowestoft Ness in Norfolk, and its most westerly, Ardnamurchan Point in Argyleshire. Its greatest length is 608 miles; its greatest breadth, between the Land's End and the North Foreland in Kent, 325. Farther N. the island is narrow. Near the frontier of Scotland it is only 64 miles across, and the distance between the Friths of the Forth and Clyde hardly exceeds 30 miles. The area of Great Britain is 84,392 square miles, and that of the 931 smaller islands along its coasts 4614 square miles. Of these smaller islands, 224 are inhabited. The more important among them are the Orkneys (320 square miles), the Shetlands (615 square miles), the Hebrides or Western Islands (3141 square miles), Anglesey (192 square miles), the Scilly Islands (6 square miles), and the Isle of Wight (156 square miles).

Great Britain, Ireland, the Isle of Man in the Irish Sea, and the smaller islands in the British seas are spoken of generally as the *British islands*. Their area is as follows:

Great Britain, mainland	84,392	square miles.
" " lesser islands	4,614	"
Ireland, mainland	32,285	"
" lesser islands	246	"
Man, Isle of	227	"
Total British islands	121,764	"

The "United Kingdom" includes Great Britain and Ireland, but neither the Isle of Man nor the Channel Islands near the French coast, which are not represented in Parliament, in spite of their vicinity to the seat of the central government. These islands are in the enjoyment of ancient institutions; and although, in statistical documents,

they figure occasionally as if they formed integral parts of the United Kingdom, they are in reality merely British dependencies.

The area of the whole British empire, including colonies, dependencies, etc., is as follows:

	Area.	Population.
Europe:		
United Kingdom	121,537	32,412,000
Isle of Man	227	54,042
Channel Islands	76	90,596
Heligoland	$\frac{1}{5}$	1,913
Gibraltar	2	25,216
Malta	143	149,084
Asia:		
British India	943,406	193,223,418
Native states (feudatory)	202,531	11,270,315
Ceylon	24,454	2,405,287
Straits settlements	1,206	308,097
Keeling Islands	8	400
Aden and Perim	12	29,750
Labuan	45	4,898
Hongkong	32	124,198
Africa:		
Cape Colony	200,616	566,158
Basuto Land	8,000	75,000
Griqualand, West	16,632	25,477
Griqualand, East	3,400	35,000
Natal	17,801	293,832
West African settlements	17,000	633,400
St. Helena	47	6,241
Ascension	34	27
Tristan da Cunha	15	53
Mauritius	739	317,069
Dependencies of do	350	13,391
Australia:		
New South Wales	308,560	581,273
Queensland	668,259	146,690
Victoria	88,451	790,492
South Australia	380,602	198,257
Northern Territory	523,531	55,000
West Australia	975,824	25,209
Tasmania	26,215	101,217
New Zealand	106,259	378,000
Chathani Islands	520	152
Norfolk Island	17	481
Fiji Islands	8,034	100,000
America:		
Dominion of Canada	3,513,325	3,718,745
Newfoundland	40,200	145,536
Bermuda	41	15,509
West India Islands	13,754	1,063,886
Honduras	13,500	24,710
British Guiana	85,425	210,200
Falkland Islands	4,741	803
Summary:		
Europe	121,985	32,732,851
Asia	1,171,694	210,600,343
Africa	264,658	1,866,648
Australia	3,086,274	2,383,761
America	3,670,986	5,185,189
Total	8,315,597	252,533,752

In addition to the territories enumerated above, Great Britain has taken possession at various times of a number of islands, not at present under British administration. Amongst these may be mentioned the Kuria Muria Islands on the coast of Arabia, Kamaran in the Red Sea, New Amsterdam and St. Paul in the Indian Ocean, the Auckland Islands, Lord Howe's Island, Fanning, Malden, Starbuck, and Caroline in the Pacific.

Physical Geography.—The British islands rise on a submarine plateau joined to Denmark, Germany, the Netherlands, and France, but separated from Norway by a deep channel exceeding 200 fathoms in depth. A fall of the sea to the extent of only 102 feet would cause the appearance of an isthmus joining the Netherlands to Norfolk and Lincoln, and the Dogger Bank, at present one of the most productive fishing-grounds, would rise to the surface, a huge flat island, in the middle of the German Ocean. A further fall of 18 feet would cut off the communication between the British Channel and the German Ocean and render superfluous any scheme for bridging or tunnelling the Strait of Dover. A total fall of the level of the sea of 180 feet would convert nearly the whole of the southern half of the German Ocean and a considerable portion of the British Channel into dry land. A fall of 240 feet would join Ireland to Great Britain. The depth of the sea increases rapidly at a distance of from 20 to 50 miles to the W. and N. W. of Ireland, the Hebrides, and Shetland Islands. The wide channel between the latter and the Faroe Islands attains a depth of 640 fathoms (3840 feet), and that of the Atlantic between Ireland and Rockall (a rock 70 feet high in lat. 57° 32′ N., lon. 13° 42′ W., and the centre of a productive fishing bank) exceeds 1600 fathoms.

Coast-line.—The coast-line of Great Britain has a development of 2900 miles; that of Ireland of 1400 miles, minor indentations excluded. On the former island no point is at a greater distance from the sea than 75 miles; on the latter, this distance is only 50 miles. The eastern coast of Great Britain is unbroken, and there are only a few bays and natural harbors affording shelter to shipping, a deficiency compensated for to some extent by the existence of several estuaries of rivers, such as the Thames and Humber in England and the Forth and Tay in Scotland. The safest harbor along the whole of this coast is that formed by the Cromarty Frith, one of the two arms of the Moray Frith, though it is of small importance commercially. A considerable portion of this coast is flat, especially that of Norfolk and adjoining the sand-choked bay called the "Wash," where the Fens form an extensive marshland. In many parts the sea has encroached upon the land, but elsewhere considerable tracts of country have been conquered from the sea, and are defended against its ravages by dikes and embankments. The northern coast of Scotland, between Duncansby Head and Cape Wrath, is steep throughout, and the W. coast, as far S. as the mouth of the Clyde, is intersected by numerous narrow sea-lochs bounded by steep hills and of considerable depth. Narrow "sounds" separate the mainland from Skye, Mull, and others of the Hebrides, and a broad strait, the Minch, separates it from the Outer Hebrides. Amongst the numerous peninsulas of that part of Scotland, that of Cantire is the most considerable. It is nearly 60 miles in length, and terminates in the Mull of Cantire. The eastern coast of the Frith of Clyde is generally level, whilst that of the peninsula of Galloway, further S., is generally steep, and juts out in the bold Mull of Galloway, the most southerly point of Scotland, in lat. 54° 38′ N. The eastern portion of the Irish Sea forms a vast bay, bounded on the N. by Galloway, on the E. by the English counties of Cumberland and Lancashire, and on the S. by Wales. Its centre is occupied by the Isle of Man. Three subsidiary bays open into it—viz. those of the Solway Frith, Morecambe Bay, and Liverpool Bay (with the estuaries of Mersey and Dee). They all abound in sandbanks, which render navigation exceedingly intricate. The peninsula of Wales has generally bold and rugged coasts. Menai Strait, hardly 600 feet in width, separates it from the island of Anglesey. The wide sweep of Cardigan Bay opens here towards the W., and Milford Haven penetrates far inland towards the S. W. This is one of the most secure harbors of the British islands, though, owing to its geographical position, it is but little used. Bristol Channel and the estuary of the Severn separate South Wales from the counties of Somerset and Devon. The most important bays along it are those of Caernarvon and Swansea on the coast of Wales, and of Barnstaple on the coast of Devonshire. The navigation of its upper portion is obstructed by sandbanks. Devon and Cornwall form a peninsula, terminating in the Land's End (50° 4′ N., 5° 42′ W.), the most westerly point of England. The Scilly Islands lie off this cape, and have proved fatal to many a homeward-bound merchantman. The coasts of this peninsula are generally steep and celebrated for their picturesqueness. There are several excellent harbors, amongst which we may mention Mount's Bay, the harbor of Falmouth, and that of Plymouth; the latter is protected by a magnificent breakwater, and the celebrated Eddystone lighthouse points out the way to it. The remainder of the S. coast of England is generally level. The Bill of Portland, a rocky promontory joined to the mainland by the Chesil Bank, bounds the roadstead of that name to the W. The only other secure harbors on the S. coast are those of Southampton and of Portsmouth, opposite the Isle of Wight, the latter the most important naval station of Great Britain. Spithead is a secure roadstead between it and the Isle of Wight. Farther to the E. the South Downs gradually approach the coast and form the bold Beachy Head (532 feet). The coast then again becomes level and, at Dungeness, marshy, but from Sandgate to the North Foreland it is formed of white chalk cliffs. These "white cliffs of Old England" have become proverbial, though their extent is very limited. They owe their prominence in the popular estimation principally to the fact of their first meeting the eye of a traveller coming from the Continent.* There are no natural harbors along this coast (that of Dover has been created artificially), but the roadstead called the "Downs," lying between the land and the Goodwin Sands, offers some shelter to shipping. The estuary of the Thames is bounded by low coasts, and sandbanks render its navigation exceedingly intricate. The estuary of the Medway, which opens into it, forms one of the most secure harbors, and has been strongly fortified (Chatham).

Relief.—The British islands cannot vie with other European countries in the height of their mountains, but they nevertheless possess a variety of relief which removes them

* The name Albion which is bestowed sometimes upon Great Britain is derived frequently from *albus*, "white," with reference to the chalk cliffs. A more correct derivation, however, appears to be that from the Gaelic words *alb* and *ain*, which mean "high land."

far from the monotonous low plains of Northern Europe. England, speaking generally, is a level country, especially towards the E., where the marshy district of the Fens offers an analogue to that we meet with on the opposite coast of the Continent, but it is traversed by table-lands and ridges of varying elevations, and which in the N. assume the height of veritable mountains. Wales, and also Scotland, may fitly be described as mountainous countries, whilst Ireland presents itself as a vast lowland dotted over by isolated mountain-groups. The culminating point of the whole country, Ben Nevis, attains an elevation of 4406 feet, and its mean height does not probably exceed 700 feet. The Highlands of Scotland are intersected by a long and narrow valley, the Great Glen (Glenmore), extending from Loch Eil to the Beauly Loch. This valley is occupied by a chain of lakes connected by the Caledonian Canal, and its highest point is only 94 feet above the level of the sea. The mountain-region to the N. of it consists of irregular groups, for the most part sterile and inhospitable and very thinly populated. There are extensive moors, and the mountain-summits rise above them to a height of about 4000 feet (Ben Derag 3235 feet, Ben Wyvis 3422 feet, Ben Attow 4000 feet). Towards the N. E. it merges into the undulating sandstone plains of Caithness, which form bold and striking headlands on the coast. The mountain-region to the S. of the Glenmore is known as the Grampians. In its arrangement it is much more linear than the northern Highlands. A central chain may be traced from Ben Nevis (4406 feet) in the S. W. to the coast of Aberdeen. The Pass of Drumouchter, on the confines of Perthshire and Inverness, crosses this chain at an elevation of 1488 feet. The northern Grampians branch off from this central chain near the head-waters of the Dee, and attain an elevation of 4295 feet in Mac Dhui. The southern Grampians culminate in Ben Lawers, 3984 feet. The Grampians are hardly inferior to the northern Highlands in sterility, and moors abound, but there are likewise excellent pastures in the valleys; and where these open out towards the N. E. and S. E. they offer every facility for a successful pursuit of agriculture. The western coast of the Highlands is generally steep and rugged, and sea-lochs penetrate far into the land: their interior abounds in picturesque lakes. Strathmore (the great vale) extends along the foot of the Highlands from Loch Lomond, in the S. W., to Stonehaven, in the N. E. It is separated from the sea and the great central plain extending between the Forth and the Clyde by a range of hills broken through by the Forth and Tay, and known as the Campsie Fells, the Sidlaw (1700 feet), and Ochill Hills (2352 feet). Southern Scotland consists of an extensive hilly region stretching from St. Abb's Head in the German Ocean to the Stranraer on the Irish Sea, and culminating in the Broad-Law (2754 feet). The valleys of the Tweed and Clyde almost cut off from the main mass the outlying ranges of the Lammermoor and Pentland towards the N. The range forming the boundary towards England is known as the Cheviots (2669 feet). The hills of Southern Scotland are generally broad and flattened; they are intersected by deep pastoral glens, which open out into fertile valleys and plains. Amongst the latter that called the Merse, at the mouth of the Tweed, is the most considerable.

Northern England, from the foot of the Cheviots to the middle of Stafford and Derbyshire, is intersected by a range of mountains forming the water-parting between the German Ocean and the Irish Sea. To geographers these mountains are known as the Pennine chain; locally they are known by a great variety of designations. The depression which separates this hilly region from the Cheviots is marked by the line of the old Roman wall which extended from Carlisle to Newcastle, and only rises 445 feet above the level of the sea. They naturally divide themselves into two groups, separated by a depression at the heads of the rivers Ribble and Aire, where the Liverpool and Leeds Canal crosses them at an elevation of 500 feet. The northernmost of these groups culminates in the Cross Fell (2928 feet), and is but loosely connected with the picturesque Cumbrian Mountains towards the W., which abound in lakes, shady woods, and rich pastures. Scafell (3230 feet), the highest summit of the Cumbrian Mountains, is at the same time the culminating point of all England. The southern group of the Pennine chain is far less elevated than the northern, and the Peak of Derbyshire, its culminating point, only rises to a height of 1981 feet. It terminates with the Weaver Hill, in lat. 53° N. (1154 feet). The region of the Pennine Mountains is one of the most sterile of England, and the moorlands are of great extent. In the rest of England there are no hill-ranges equal in importance with the Pennine chain, and the general level of the central portions of the country even but rarely exceeds 500 feet in height. The bands of Lias and Oolite which extend from Yorkshire to Dorset form a series of hills, interrupted by table-lands or plains, and having generally a steep escarpment to the W., and sloping down gently towards the E. Amongst these may be mentioned the North York moors (1864 feet), to the N. of the Ouse; the Lincoln Heights, to the S. of it; the Cotswold Hills (1134 feet), to the E. of the Severn; and the Dorset Heights. The valley of the Thames is bounded on the N. and S. by chalk hills, affording generally excellent pasturage. Those on the N. extend from Wiltshire into Suffolk, and attain an elevation of 905 feet in Wendower Hill. The southern chalk hills are known as the Downs, and attain nowhere an elevation of 1000 feet; Inkpen Beacon, on the boundary of Hants and Berks, is their culminating point. The northern Downs (Leith Hill, 967 feet) extend from it to the coast of Kent, at Dover, where they form white cliffs; the southern Downs terminate in the Beachy Head (532 feet), on the coast of Sussex. These two ranges bound a fertile district called the Weald, formerly a forest of oak, at present one of the most productive agricultural districts of the country. Geologists describe the Weald as a valley of denudation, and frequently refer to it in illustration of that kind of geological action. The Mendip Hills (979 feet), near the mouth of the Severn, are already beyond the chalk region of Southern England, for they consist of mountain limestone, and the Exmoor (1706 feet), a range on the southern shore of the Bristol Channel, consists of Devonian rocks, which, with members of the Carboniferous series, occupy the greater portion of Devonshire and Cornwall, and are intruded by granite and other igneous rocks. To this intrusion is due the origin of the so-called "Dartmoor Forest," a desolate moor region rising in Yes Tor to a height of 2050 feet. The fertile plain of Cheshire and the valley of the Severn form the natural boundary between England and the mountain-region of Wales, next to Scotland the most considerable in the British islands. It is frequently distinguished as the "Cambrian Mountains," though "Welsh Hills" is the more popular designation. The highest summit is the Snowdon (3590 feet), close to Menai Strait. A natural depression at the head of the Severn divides North from South Wales, and the hills of the latter are particularly distinguished by their barrenness, their highest range being known as Black Mountains (Brecknock Beacon, 2863 feet), from the color of the heather which covers them. The Welsh Hills, towards the E., merge into the table-lands of Salop, Hereford, and Gloucester, where several outlying hill-ranges rise, amongst which may be mentioned the Malvern Hills (1444 feet), the Clee Hills (1805 feet), and the isolated Wrekin (1320 feet) in the centre of Shropshire. Several of the valleys of this Cambrian region are distinguished for their loveliness, and amongst these that of the Wye in the S. and of the upper Dee in the N. carry off the palm for beauty. The Isle of Man, in the Irish Sea, rises to a height of 2024 feet. The western islands of Scotland are generally of considerable height (Ben More, on Mull, 3185 feet); the Orkneys and Shetlands, though they present bold cliffs towards the sea and are much broken up by intricate channels, only rise to a height of 1556 and 1476 feet respectively.

Hydrography.—The rivers of the British islands are small if we compare them with those of the Continent; but as they all carry an abundant supply of water throughout the year, and many of them are navigable for considerable distances, they are nevertheless of considerable importance to commerce and industry. The following drain a basin of more than 1500 square miles:

Great Britain.	Length in miles.	Basin, sq. m.	Ireland.	Length in miles.	Basin, sq. m.
Thames	204	5255	Suir	114	3555
Ouse	143	2765	Shannon	160	6060
Humber	185	9293	Corrib	64	1689
Tweed	96	1870	Erne	64	1689
Tay	103	2250	Bann	85	2242
Clyde	48	1580			
Mersey	85	1722			
Severn	186	8119			

The Thames rises at Thameshead, 376 feet above the level of the sea, and enters the German Ocean at the Nore Light, between Shoeburyness and Sheerness. At its mouth it is 5 miles, at London bridge, 46 miles above it, 692 feet, and as far as the latter it is navigable for vessels of 500 tons. Its most important tributary is the Medway, which forms an excellent harbor. The Ouse rises in Northamptonshire, and is navigable from Retford, 46 miles above its mouth. It enters the Wash at King's Lynn. The Humber, properly speaking, is an arm of the sea, into which the Trent and Yorkshire Ouse pour their waters, and extends 37 miles inland. Kingston-upon Hull, an important commercial town, is situated on its N. coast at the mouth of the small river Hull. The Trent rises in the moorlands of Staffordshire, intersects an exceedingly fertile district, and becomes navigable at Burton-upon-Trent. Small sea-

going vessels can ascend it as high up as Gainsborough. The Ouse rises in Yorkshire, is navigable for small sea-going craft as far as York, and for barges to Linton. The Tweed is a rapid stream, forming, in its lower course, the boundary between England and Scotland, and entering the German Ocean at Berwick. The Forth, though an inconsiderable stream, deserves to be mentioned because Edinburgh Leith lies near its firth. It is navigable to Stirling. The Tay is the most important river of Scotland. It rises to the N. of Loch Lomond, flows through Loch Tay, leaves the mountains at Dunkeld, intersects the Strathmore, and finally enters the Frith of Tay. It is navigable as far as Perth. The remaining rivers of Scotland, with the exception of the Clyde, are of little use to navigation, for their fall is generally very rapid, but they abound in fish. The Clyde rises in a small lake on the southern confines of Lanarkshire, and enters the Frith of Clyde below Glasgow. Like other Scotch rivers, its current is very rapid, and it forms several waterfalls, but at a vast expense for dredging it has been made navigable for large vessels as far as Glasgow. The Mersey rises on the confines of Cheshire and Derbyshire, and forms a wide estuary at its mouth, on which is situated Liverpool, the first shipping-port of the world. Its tributary, the Irwell, is navigable for barges as far as Manchester, and canals connect it with the principal rivers of the rest of England. The Severn rises on the slope of Plinlimmon in Wales, and becomes navigable at Welshpool, 170 miles above its mouth. It traverses the fertile plain of Shrewsbury and the vale of Gloucester, and enters the Bristol Channel below the town of that name. The tides at its mouth are of tremendous height (60–70 feet), and the country is protected against them by embankments. Its most important tributaries are the Wye and the Avon. Bristol is situated on the latter.

Scotland abounds in lakes, in most of which productive fisheries are carried on. They are, almost without exception, in the Highlands. The more considerable amongst them are Loch Lomond (45 square miles), Lochs Awe and Ness (30 square miles each), Loch Shin (25 square miles), Loch Maree (24 square miles), and Loch Tay (20 square miles). England may boast of numerous lakes in the Cumbrian Mountains, the so-called "Lake District," but, though they are distinguished for picturesque beauty, the largest amongst them, the Windermere, covers an area of only 4 square miles. Wales is even poorer in lakes.

Climate. The climate of Great Britain is mainly determined by the insular position of the country, to which it owes its mildness and equability, and that absence of extremes which distinguishes it from the climate of continental countries under the same latitude. The Gulf Stream, above all, by sending its warm waters towards the British islands, most potently influences their temperature, which it raises above that of the sea-board countries on the western shores of the Atlantic having the same latitude. The difference between the annual temperature of Penzance (52.17° F.) and Unst (44.99°), the former in lat. 50° 11′ N., the latter in lat. 60° 42′ N., only amounts to 7.18°. In spring it is only 5.76°; in autumn it rises to 10.38° F. The potent influence of the Gulf Stream is exhibited, moreover, by the fact of the temperature of places on the W. coast of Great Britain being about 1° in excess of that of places on the E. coast having the same latitude. The mean annual temperature of England has been estimated at 49.5°, that of Scotland at 47.5°, and that of Ireland at 50°, these figures being the means observed at a large number of meteorological stations. S. W. winds are the most prevalent throughout the year, and are generally attended with rain. The rainfall varies exceedingly according to locality. In the greater portion of England and Scotland it does not exceed 30 inches a year, but towards the W. and in Ireland this amount is much exceeded, and in some of the hill districts which catch the clouds as they drift eastward the amount of rain is only equalled in tropical countries. (At the Style Pass in Cumberland 189 inches fell in a single year.) The maximum rainfall in South western Ireland and England takes place in winter, but the greater portion of the country lies within the region of winter rains. Snow falls but rarely, except in the hills, where it remains on the ground frequently for three or more months.

Geology.—The geological features of Great Britain are distinguished by the presence of the whole series of recognized stratified rocks, which were first studied here systematically, and in most instances have become typical of similar series met with in other parts of the world. As a rule, the oldest stratified rocks occupy the W. and N. of Ireland, and in going to the E. or S. E. we pass in succession over the more recent formations until we reach the most recent of all, which form the marshland along some parts of the E. coast. The Palæozoic strata occupy about one-third of the entire superficies. Their comparative sterility is compensated for, in part, by the existence of mineral treasures, constituting one of the principal sources of Great Britain's eminence as a manufacturing country. The oldest rocks of this series are met with in the Outer Hebrides and on the coast of Ross and Sutherland. They consist principally of crystalline gneiss, and have been recognized as being equivalent to Sir W. Logan's Laurentian rocks of North America. The *Cambrian rocks* of Northern Scotland, Cumberland, and North Wales are superimposed upon them. In Scotland they consist of red sandstone and conglomerate, in England and Wales of sandstone, gritstone, and slates. To these succeed the *Silurian rocks*, most fully developed in South Wales, in the Cumbrian Mountains, and, above all, in Scotland, where they constitute nearly the whole of the southern hills and of the region of the Grampians, the broad belt separating them, and including Strathmore and the central plain, being occupied by members of the Devonian and Carboniferous series. The *Devonian* is most fully developed in Devonshire, but also occurs in Central Scotland. The *Carboniferous series* occupies a broad tract extending from the Bristol Channel to the foot of the Cheviots, and extends thence into Scotland. Within these limits there are no less than fourteen detached coal fields. Scotland is equally well provided with coal, and five distinct fields occur between the foot of the Grampians and the southern hills. The Permian strata, consisting of magnesian limestone and red sandstone, occupy a considerable area in Durham; and though traceable thence as far as Devon and Cornwall, they are nowhere of great extent. Fine marbles, and in the two latter counties tin and lead, are found in it. The *Triassic measures* are represented by sandstones and variegated marls. They may be traced as a ribbon from Hartlepool in the N. to the mouth of the Exe in the S., but are most fully developed in the counties of Leicester, Staffordshire, Warwickshire, Shropshire, and Cheshire. Beds of rock-salt occur in them in the latter. The *Lias* extends from Yorkshire to the Dorset coast, and detached tracts of it are met to the W. of this line and in Scotland. Jet and alum are found in the rocks near Whitby, on the coast of Yorkshire. The *Oolites* constitute one of the most important amongst the geological formations, for they yield the best of all building materials. They occupy a belt of country in places thirty miles wide, and extending from Yorkshire to Dorsetshire. In Scotland the Oolites of Brora contain coal. The *Cretaceous rocks*, principally chalk with intercalated sands and clays, exceedingly rich in fossils, occupy a considerable portion of South-eastern England, and altogether surround the *Wealden* clays and sands of Kent and Sussex. The chalk hills can be traced from Flamborough Head in Yorkshire to Hants, and extend thence on the one hand into Wilts, Dorset, and Devon, and on the other, through the counties to the N. and S. of the Thames, to the shores of the German Ocean and of the British Channel, where they form chalk cliffs. The *Tertiary formations* are limited to a portion of the S. coast, of which Hants forms the centre, to the valley of the Thames and the coast of Essex and Suffolk, to the low lands surrounding the Wash and the basin of the Humber. On the E. coast of England they occur on the Solway Frith, on the coast of Lancashire, and on the Bristol Channel. They consist of Eocene clays, sands, and marls, of Pliocene ferruginous sands and marl, and of Pleistocene deposits. The Miocene is apparently not represented. *Eruptive rocks*, such as granites, porphyries, syenite, and basalt, are met with principally in the hills of Devon and Cornwall, in Wales, in the Cumbrian Mountains, in the Cheviots, and throughout Northern Scotland. There are several hot springs in England (Bath, Bristol, Buxton, and others), but none in Scotland or Ireland. Cold mineral waters, however, occur in all these countries.

The *Natural History* of Great Britain corresponds generally with that of continental Europe, and there are only a few species which are peculiar to it. The flora is represented by 1600 species of phenogamous and 1800 of cryptogamous plants. The flora of by far the greatest portion of the island resembles that of Germany: that of the mountains in Western Ireland corresponds more or less to that of the Pyrenees; that of Devon and Cornwall agrees in many respects with the flora of North western France, the flora of Northern France is more fully represented in South west England, particularly in the chalk hills, whilst the vegetation of the mountains of Wales, North England, and Scotland has many affinities with that of the Alps or of Scandinavia. Perhaps the most remarkable example of a plant of one of the continental countries named not being likewise indigenous to Great Britain is that of the Norway spruce. The lemming offers a similar instance amongst animals. Only one species of the *Pinus sylvestris* is indigenous to the British Islands, and together with the yew and juniper it is the only representative of the coniferous family. Of other trees there are the oak, elm, beech, birch,

poplar, willow, ash, alder, hornbeam, and hazelnut, but numerous others have been acclimated, such as the cedar, maple, sycamore, and chestnut. The indigenous fruit trees yield plums, cherries, apples, sloes, pears, medlars, and nuts, and several others have been introduced, but generally require the protection of a wall to arrive at maturity. There is likewise a great variety of edible berries. Wheat, oats, barley, and rye are the cereals which are cultivated. The summers are not hot enough for maize. In the S. of England and Ireland many sub-tropical plants thrive in the open air.

With respect to the animal world, it may be stated that the bones of elephants, tigers, rhinoceroses, hippopotamuses, and alligators have been discovered in the rocks of Great Britain. But this is the only record that they once existed. The hyæna disappeared more recently, and there is documentary evidence to prove that wild oxen (the urus), wild boars, bears, beavers, and wolves were numerous in early times. All these have now disappeared, the wolf as recently as 1710. Irrespective of domesticated animals, there are 52 species of mammals—viz. 7 bats, the hedgehog, 2 shrews, the badger, the mole, the weasel, the polecat, the stoat, the beech and pine marten, the otter, the fox, the wild-cat, the common and the bearded seal, 8 species of mice and rats, the squirrel, the hare, the alpine hare, the rabbit, the stag, the fallow deer, and the roe, besides 16 species of whale. There are 274 species of birds—viz. 22 birds of prey, 101 perching birds, 14 gallinaceous birds, 59 wading birds, and 78 swimming birds. There are about 170 salt and fresh water fish, including the pilchard, the herring, the salmon, and trout. Much has lately been done for the promotion of fisheries by establishing a close time and purifying the rivers, and the results are already showing themselves in a more plentiful supply of salmon. The number of reptiles is exceedingly small. These are—a lizard (very rare), 3 species of eft, and 4 of snake, including the poisonous viper. The Amphibia are represented by the frog, toad, and natterjack, all harmless. There are perhaps 500 species of Testacea, amongst which are the oyster and the muscle. Scotland in former times was celebrated for its pearl fishery.

Population.—The following table conveys information on the population of the United Kingdom, inclusive of the Channel Islands and the soldiers and seamen abroad, for the years 1811, 1831, 1851, and 1871:

	1811.	1831.	1851.	1871.
England and Wales	10,164,256	13,896,797	17,927,609	22,712,266
Scotland	1,805,864	2,364,386	2,888,742	3,360,018
Ireland	5,956,460	7,767,401	6,574,278	5,412,377
Islands in the British seas	80,000	103,710	143,126	144,638
Army and seamen abroad	502,536	260,191	212,194	216,080
Total	18,500,116	24,392,485	27,745,949	31,845,379

For the middle of 1874 the population is estimated as follows: England and Wales, 23,648,609; Scotland, 3,462,619; Ireland, 5,300,485; total, 32,412,010. At the time of the census (in 1871) there resided in foreign countries no less than 3,181,199 natives of the United Kingdom, and in British colonies about 1,730,000. Taken as a whole, the population of the United Kingdom has not retrograded during any period for which we possess trustworthy census returns. Its increase between 1801 and 1871 amounted to 96.12 per cent., or 0.97 per cent. annually. This increase, however, has varied considerably during different periods. It was most rapid in 1811–21, immediately after the termination of the great wars, and least in 1841–51, when the potato disease, combined with cholera, took away many lives, and gave an immense impulse to emigration. During the former period the annual increase amounted to 1.40 per cent., during the latter to 0.26 per cent. only. But whilst the population of the kingdom increased as a whole, that of particular districts has exhibited a decrease, and the increase in the remainder has been very unequal, having been most considerable in the manufacturing districts, the large towns of which absorb an increasing proportion of the rural population, very much to the detriment of the *physique* of the people. During 1861–71 the population of England and Wales increased 1.31 per cent. annually, that of Scotland 1.01 per cent., but that of Ireland decreased at the rate of 0.47. In Ireland the decrease has been almost universal, extending even to the large towns, Belfast alone excepted. In Scotland a considerable decrease took place in the northern and southern counties, but was more than compensated for by an increase in the population of the central manufacturing districts. Emigration has at all times, and particularly since 1840, considerably interfered with the increase of the population. If we assume that the emigrants had remained in the country, without themselves contributing towards the number of births, the decennial increase between the years 1860–71 would have amounted to 14.32 per cent., instead of 8.6 per cent. Some idea of the extent of this emigration may be gathered from the fact that from the beginning of 1825 to the close of 1873 no less than 7,505,781 persons left the United Kingdom in order to seek a home elsewhere. The details of this emigration are as follows:

Years.	No. of emigrants
1825-30	72,485
1831-41	717,913
1841-51	1,692,063
1851-61	2,249,355
1861-71 (3 months)	1,978,800
1871 (9 months)	189,335
1872	295,213
1873	310,617

This vast emigration has been compensated for only to a small extent, for it is estimated that the number of immigrants between 1863–72 did not exceed 242,000 persons. Amongst the emigrants who left the country 1851–73 there were, according to nationality, about 1,613,000 English, 397,700 Scotch, 2,321,000 Irish, and 692,000 foreigners. Within the last few years the Irish emigration is on the decrease, and out of 310,613 emigrants who departed in 1873 they numbered only 83,693.

Taken as a whole, the United Kingdom is one of the most densely populated countries of the world, though there are extensive mountain-tracts and waste lands which support only a small population. The density in 1871 was as follows:

	Area, sq. m.	Population, 1871	Density
England	50,9[illegible]3	21,495,131	422
Wales	7,378	1,217,135	165
Scotland	30,685	3,360,018	109
Ireland	32,531	5,412,377	166
Man	227	54,042	238
Channel Islands	76	90,596	1192
Total	121,840	31,629,299	260

A remarkable feature in the distribution of the population consists in the large number of populous towns. The town-population is more numerous, proportionately, than in any other country of which we have trustworthy returns. The number of towns of 2000 inhabitants and their population in 1871 were as follows:

	No. of towns.	Inhabitants.	Percentage of total population.
England and Wales	938	14,041,404	62
Scotland	161	1,919,528	57
Ireland	127	1,197,344	22
Total	1226	17,157,276	54

The following are the towns having more than 100,000 inhabitants, arranged according to magnitude: London, 3,254,260; Glasgow, 547,538; Liverpool, 493,405; Manchester, 351,189; Birmingham, 343,787; Leeds, 259,212; Dublin, 246,326; Sheffield, 239,946; Edinburgh, 197,587; Bristol, 182,552; Belfast, 174,412; Bradford (Yorkshire), 145,830; Newcastle-upon-Tyne, 128,443; Salford, 124,801; Hull, 121,892; Dundee, 119,141; Portsmouth, 113,569; Oldham (Lancashire), 113,100. There are thus 18 towns of over 100,000 inhabitants, or 4,156,989 inhabitants in all, which is 24.2 per cent. of the total town-population of the United Kingdom. In most of the towns the population increases rapidly, but there are several, such as Bath, Coventry, and Canterbury, which have either no manufactures at all or where they are in a state of decay, and these have decreased in population during the last ten years.

The annual number of births and deaths to 1000 living has been as follows during 1861–71:

	Birth rate.	Death-rate.
England and Wales	35.06	22.41
Scotland	34.90	21.59
Ireland	25.99	16.38
United Kingdom	33.36	21.25

It should, however, be stated that the registration in Ireland is exceedingly defective, and that no dependence can therefore be placed upon the above figures. To every 1000 males there were, in 1871, 1058 females in the United Kingdom, 1056 in England, 1013 in Wales, 1096 in Scotland, 1050 in Ireland. This disparity between the sexes is due to the larger proportion of men who emigrate or who are abroad as soldiers or mariners. The following table furnishes information with respect to the ages of the population. It gives the percentage of persons under 20 years of age for the three portions of the United Kingdom:

	1821.	1841.	1871.
England and Wales	49.00	46.02	45.90
Scotland	48.30	47.07	46.67
Ireland	53.20	49.04	43.56

Nationalities.—According to place of birth the population of the United Kingdom is distributed as follows (1871):

	English.	Scotch.	Irish.	Natives of British Colonies.	For'ners and born at sea.
England and Wales	21,692,165	213,254	566,540	96,467	143,840
Scotland	70,482	3,061,531	207,770	10,469	9,766
Ireland	67,881	20,318	5,306,757	8,367	9,054
	21,830,528	3,295,103	6,081,067	115,303	162,660

This table does not exhibit the composition of the population according to nationality, but merely illustrates the changes which are going on at the present time.

English is spoken by the educated classes throughout the British islands. Cymric has maintained itself in Wales, Gaelic in the Highlands of Scotland, on the Isle of Man, and in Ireland, particularly in Connaught and Munster. These Celtic dialects, however, are gradually dying out, in spite of the efforts made to keep them alive. It is supposed that about 77,000 persons in Wales do not understand English, and that about 300,000 in Scotland still speak Gaelic. In Ireland the number of persons able to speak Irish only was 103,562 in 1871, and there were 714,313 who spoke English in addition to Irish. In 1861 these numbers were 163,275 and 942,261 respectively.

Occupations of the People.—The census returns for the year 1871 contain most elaborate statements with respect to the occupations of the inhabitants of the British islands. Unfortunately, the facts obtained have not been published on identical principles for each of the three kingdoms, and the classification of occupation is open, moreover, to serious objections. We have carefully gone through these voluminous returns, and the following is the result obtained:

Occupations.	England and Wales.	Scotland.	Ireland.	Percentage. Eng. & Wales.	Scotland.	Ireland.
1. General and local government	106,286	11,407	25,728	0.4	0.3	0.5
2. Army and navy	135,191	8,198	36,686	0.6	0.3	0.7
3. Learned professions, literature, art, science	299,595	33,508	44,971	1.3	1.0	0.8
4. Agriculture	1,559,657	236,745	1,047,347	6.8	7.0	19.4
5. Engaged about animals	98,101	35,458	18,152	0.4	1.1	0.3
6. Laborers and indefinite	802,593	98,239	386,504	3.5	2.9	7.1
7. Miners and working in minerals	1,156,621	168,168	44,746	5.1	5.0	0.8
8. Art and mechanical productions in which matters of various kinds are used in combination	1,144,571	158,500	77,738	5.0	4.7	1.4
9. Textile fabrics and dress	2,150,791	333,210	399,075	9.5	9.9	7.4
10. Working and dealing in food and drink	464,051	62,523	56,253	2.0	1.9	1.4
11. Working and dealing in animal substances	56,551	5,863	3,881	0.2	0.2	0.1
12. Working and dealing in vegetable substances	165,340	27,441	15,854	0.7	0.8	0.3
13. Commerce	287,164	42,858	55,283	1.3	1.3	1.0
14. Transportation	528,250	72,873	54,039	2.3	2.2	1.0
15. Persons of rank and property	168,895	37,197	15,715	0.8	1.1	0.3
16. Wives and women engaged generally in household duties	4,271,657	699,173	910,925	18.8	20.8	16.8
17. Entertaining and performing personal duties for man	1,633,514	161,460	386,983	7.2	4.8	7.2
18. Students, scholars, and children under 15, not engaged in productive occupations	7,683,137	1,167,208	1,832,227	33.9	34.7	33.9
Total	22,712,266	3,360,018	5,412,377	100	100	100

Agriculture.—The soil of Great Britain is almost exclusively devoted to the production of breadstuffs and of grasses, roots, etc. as food for cattle. The principal cereals cultivated are wheat, barley, and oats. Beans and peas are of some importance; turnips and swedes are the principal green crops. Potatoes are most extensively cultivated in Ireland, where they constitute the principal food of the laboring population. The cultivation of hops (64,000 acres) is confined to England, that of flax almost entirely to Ireland. Orchards are most extensive in the S. W. and S. of England. Amongst other objects of cultivation may be mentioned rape, saffron, coriander, caraway, teasel, madder and woad, mustard, liquorice, chamomile, peppermint, and other medicinal plants, but none of these occupies a considerable area. The beet, which is used on the Continent largely for the manufacture of sugar, is used in Great Britain almost entirely as food for cattle, as there are no protective duties which enable home-made sugar to compete with colonial produce. The land of the United Kingdom available for agricultural purposes is almost entirely in the hands of a small number of landed proprietors, from whom it is leased by the actual cultivators of the soil. Until quite recently the latter were almost entirely at the mercy of their landlords; their tenure was of a very uncertain nature, and they could claim nothing for permanent improvements. In this respect a change for the better has taken place, particularly in Ireland; and although Great Britain even now stands at the head of agricultural countries, there is no doubt that recent legislation will contribute to a more rational and exhaustive cultivation of the land.

The following are the leading agricultural statistics of the United Kingdom for 1874 (in thousands of acres):

	England and Wales. Acres.	Per cent.	Scotland. Acres.	Per cent.	Ireland. Acres.	Per cent.	Man. Acres.	British Islands. Acres.	Per cent.
Under crops and fallow	14,616	39	3,474	18	5,280	25	73	23,443	30
Permanent pasture	12,072	33	1,106	6	10,472	51	21	23,671	30
Orchards	149	0.4	2	...	...	..	...	151	
Woods	1,453	4	744	4	325	1.5	...	2,512	3
Waste and sheepwalks	8,029	21	13,729	69	4,249	9.5	49	26,056	34
Water	1,000	3	600	3	494	3	2	2,096	3
Total area	37,319	100	19,645	100	20,820	100	145	77,929	100
Horses	1,924,000		296,000		526,000		6,000	5,754,000	
Cattle	4,971,000		1,155,000		4,118,000		20,000	10,254,000	
Sheep	22,925,000		7,389,000		4,438,000		54,000	34,8[illegible]000	
Pigs	2,272,000		150,000		1,096,600		4,000	3,522,000	
Number of occupiers	480,178		81,007		600,000				
Average size of holdings, acres	56		57		26				

It would appear from this table that only 63 per cent. of the superficies of the British islands is cultivated or planted with woods. Making every allowance for buildings and roads, and for the barren moorlands of Wales, England, and Scotland, there ought still to be a considerable extent of land capable of cultivation. The waste given above actually includes the sheep-drifts in Great Britain as well as the "commons," the latter covering 2,632,772 acres, of which 883,989 are capable of cultivation. The bogs of Ireland, however, which are included above amongst waste lands, we are told are incapable of being utilized even for pasturing purposes. A thorough utilization of the agricultural resources of Great Britain is demanded all the more as great quantities of food are now imported annually. During the years 1866–74 the wheat crops of the United Kingdom averaged 12,105,000 quarters, and no less than 9,286,000 quarters had to be imported annually to meet the deficiency. The case is more favorable as respects cattle. It was estimated in 1870 that the live stock of the United Kingdom furnished 1,220,625 tons of meat, to which had to be added 111,693 tons of foreign meat to meet the demands for home consumption. It would appear from this that the annual consumption of meat amounts to 52 pounds per head—an amount by no means large if measured by an American standard, though very considerable if we compare it with the nations of continental Europe.

Fisheries.—The rivers and the seas surrounding the British islands abound in fish, and the fisheries give occupation to a large number of the population. In 1871 there were enumerated 58,967 fishermen, and the sea fisheries in 1873 employed 40,928 boats, having a tonnage of about 294,000 tons (Scotland 16,765, England and Wales, 15,[illegible], Ireland 8,[illegible]0, and the Isle of Man [illegible] vessels). Salmon are caught almost exclusively in the rivers of Scotland and Ireland; the herring fisheries are carried on principally from the Scotch ports; the pilchard is caught on the coasts of Cornwall and Devonshire, and England (Essex and Kent) rejoices in the possession of the best oysters. In former times, up to 1830, it was sought to encourage the fisheries by the payment of premiums. This system, however, proved fal-

lacious, and whilst in 1830 only 329,557 barrels of herrings were cured throughout Great Britain, the Scotch fisheries alone produced 681,193 barrels in 1860 and 938,000 in 1874.

Mining and Metallurgical Industries.—Amongst the valuable minerals which from immemorial times have been worked in Great Britain coal occupies at the present day the foremost rank. The position of the coal basins has already been indicated. They cover an area of about 12,000 square miles, and if worked to the depth of 4000 feet they will be exhausted in the course of 700 years if the present rate of consumption continues. The coal raised in 1873 amounted to 127,012,767 tons (in 1874 it was only 126,590,108 tons). Of this amount 28 per cent. is used in smelting iron and other metals, 21 per cent. for steam-power in factories, 16 per cent. for domestic purposes, 10 per cent. is exported, 8 per cent. is used in mines and collieries, 6 per cent. on railways and in steamers, 5 per cent. in potteries, chemical works, etc., and 5 per cent. for the manufacture of gas. The iron industry is the most important next to that of coal. It has assumed gigantic proportions since 1740, when coal was first used for smelting the ore. Then the produce of pig iron only amounted to 17,350 tons; in 1806 it was 250,000, in 1823 443,066, in 1860 3,826,752, and in 1873 6,566,451 tons. There is just now some depression in the trade, owing to over-production and to disputes with the workmen, but it will no doubt soon pass away. The iron ores of Great Britain are generally associated with the coal-beds, which enhances their value. In 1871 there were 851 blast and 6805 puddling furnaces in Great Britain (none in Ireland), employing 127,618 hands. Copper is raised principally in Cornwall and Devon, as well as in Scotland and Ireland. Lead has been worked in Derbyshire from the time of the Romans, but has since been discovered in other parts of the island, including Cornwall and Devon, the only counties furnishing tin, and celebrated on that account amongst the Phœnicians. All other ores are of subordinate importance. They include zinc, arsenic, manganese, antimony, nickel, silver, gold, etc. The quantity and value of metals produced from British ores in 1873 were as follows:

Pig iron	6,566,451 tons.	£18,057,739
Fine copper	5,240 "	502,822
Metallic lead	54,235 "	1,263,375
White tin	9,972 "	1,329,706
Zinc	4,471 "	120,099
Silver (from lead ore)	537,707 ounces.	131,077
Other metals		5,000
Total		£21,499,818

In addition to these, 1,442,218 tons of foreign ores were smelted in Great Britain. If we add to the above the value of 1,785,000 tons of rock-salt, of 1,785,000 tons of clay and shale, of the coals not used in smelting or in mines (say £30,000,000), of clays and slate and building-stones, it will be found that the value of the mineral produce of the United Kingdom amounted to about £57,580,000 in 1873.

Manufactures.—Amongst the great textile industries of the country, that of woollens is the oldest. It was carried on already under the dominion of the Romans, but in spite of protective duties and other well-meant laws enforcing the use of woollen stuffs, it was only after the immigration of Flemish weavers (1668) that really good cloth was produced. At the present time English broadcloth enjoys a deserved reputation. The cotton industry has been of some importance since the invention of the spinning-jenny in 1767, and has since assumed astounding proportions. In 1766 the value of all cotton goods was estimated at £600,000, in 1815 at £36,000,000, and in 1874 at £100,500,000. The progress of this industry (which depends for its raw material mainly upon the U. S.) is shown in the following table:

Years	Cotton consumed. Weight in millions of pounds.	Cotton consumed. Cost in millions of pounds.	Total value of goods produced in millions of pounds.	Weight of yarns and cloth in millions of pounds. Total.	Weight of yarns and cloth in millions of pounds. Exported.
1858	907	24.8	63.1	810	652
1860	1,079	28.9	80.6	913	740
1862	449	26.7	42.7	514	412
1864	561	52.5	76.4	513	403
1866	800	51.9	102.7	770	625
1868	936	41.0	91.7	883	723
1872	1,175	48.0	102.3	1055	910
1874	1,266	40.2	100.5	1120	946

The linen manufacture has only recently become of importance. Its principal seats are in Scotland and Protestant Ireland. The manufacture of silk was introduced in the fourteenth century, and was subsequently much improved by Huguenot French emigrants (1665). The following is a summary of the textile industries of the United Kingdom for 1871:

	Factories.	Spindles.	Power-looms.	Hands.
Cotton	2,483	37,719,759	450,676	449,087
Wool	1,829	2,692,771	45,140	125,130
Shoddy and worsted	750	2,265,245	67,346	113,463
Flax, hemp, and jute	598	1,861,906	39,727	144,466
Silk	696	1,130,441	12,376	48,124
	6,356	45,670,122	615,265	880,200

To these should be added 234 lace-factories (8370 workmen), besides 129 hosiery-factories (9692 hands), 61 elastic-factories (4623 hands), 37 horsehair-factories (2339 hands), 149 print-works (30,308 hands), 439 bleaching-works (31,427 hands), 150 calendering and finishing works (3902 hands), etc.

Next to the textile industries the most important are the metal manufactures, ranging from the production of rails to that of steam-engines, iron ships, and of the finest cutlery and silversmith's work. There were in 1871, 18,291 metal-factories, employing 634,035 hands. The English potteries supply goods appreciated throughout the civilized world. They number 541, and employ 45,029 hands. The breweries are of great importance, for beer is the national beverage of England, whilst spirits are more highly prized by the Scotch and Irish. The breweries (in 1873) consumed 59,194,089 bushels of malt, the distilleries produced 31,862,472 gallons of spirits, of which 29,322,087 were retained for home consumption.

We add to these notes a list of some of the leading industries, together with the number of persons employed in them. These figures are from the census of 1871, and do not in all cases agree with the factory returns given above:

Occupations.	England and Wales.	Scotland.	Ireland.
Wool and worsted manufacture	273,490	42,217	15,698
Silk manufacture	82,053	2,546	785
Cotton and flax manufacture	532,015	97,863	57,318
Manufacture of mixed materials	116,913	62,736	87,733
Lace (incl. above under cotton)	49,370	181	787
Tanners and curriers	23,334	2,127	1,327
Sugar-refiners	2,843	951	36
Brewers	25,831	1,330	646
Iron manufacture	180,207	30,393	1,720
Nailsmiths	23,231	941	3,532
Steelworkers	5,789	34	10
Cutlers	17,903	——	195
Engine and machine makers	105,680	15,555	3,379
Gunsmiths	11,576	237	222
Goldsmiths, etc	22,038	1,237	475
Watch and clockmakers	21,273	2,007	1,075
Philosophical instrument makers	3,242	247	54
Shipbuilders	40,627	14,298	2,139
Coachmakers and wheelwrights	53,408	2,037	2,973
Cabinetmakers	56,945	6,724	2,987
Musical instrument makers	7,339	392	142
Earthenware manufacture	45,119	3,305	279
Glass manufacture	20,081	2,020	356
Paper makers	16,772	6,274	627
Printers	44,814	5,589	3,420
Manufacturing chemists	11,328	2,978	159

The importance of these manufactures to the country can only be appreciated if we bear in mind that they not only supply the home market almost exclusively, but likewise furnish the bulk of the exports.

Transportation.—The roads of the United Kingdom have been constructed to a small extent only by government (in Wales, Scotland, and Ireland). The majority of them are maintained from local rates and managed by highway boards. The old turnpike roads, which were constructed by private speculators on condition of their being permitted to levy a toll, are gradually passing into the hands of the local authorities, their builders in many instances having suffered serious losses. We have already alluded to the importance of the rivers as navigable highways. They are connected with each other by an extensive system of canals, the whole of them being constructed since 1755, for the greater part by private companies. The railways have to a great extent superseded canals and roads. Tramways have been in use in some of the mining districts since 1797, but the first locomotive railway was opened in 1830, and since that time they have rapidly increased in extent. They are without exception the property of private companies. Their total length in 1862 was 10,870 miles; in 1873, 16,082. The following statistics refer to the latter year: Total capital, including loans, £588,320,380; number of passengers conveyed, 455,634,767, or 28,332 per mile; total traffic receipts, £55,674,421; miles run, 197,354,749; working expenses, £30,752,848; average dividend, 4.35 per cent.; railway servants, 274,535.

The shipping of the United Kingdom holds the first rank amongst the commercial marines of the world, for it has been calculated that no less than 57 per cent. of all steam-vessels and 37 per cent. of all sailing-vessels belong to it. In the foreign as well as home trade of the United Kingdom the British flag by far exceeds the flags of all other nations combined, and this result is achieved without differential duties, for even the coasting trade is open to for-

eigners on equal terms with the natives. The mercantile marine of the British islands included in 1800, 15,724 vessels of 1,698,515 tons; in 1845, 23,472 vessels of 3,004,398 tons; in 1860, 27,663 vessels of 5,758,687 tons; and in the beginning of 1874, 25,561 vessels of [illegible] tons. There has consequently been no appreciable increase in the tonnage since 1860, but the number of steamers has increased from 2000 to 3863, and their tonnage from 454,327 to 1,713,782. To this fleet must be added the colonial marines (about 11,000 vessels of 2,900,000 tons), and it will be seen that the British flag is now represented on the ocean by a total of about 36,000 vessels of 8,700,000 tons. The lighthouses and lightships encircling the British islands with a ring of light are managed by the Trinity board and two boards for Scotland and Ireland. There are now 360 shore lights and 50 lightships, besides 250 lifeboat stations supported by a private association. The tonnage of the vessels which entered the ports of the United Kingdom in the foreign and colonial trade in 1873 was 21,864,957 (including 14,541,928 British); that of the vessels which cleared was 22,575,029 (including 15,106,316 British). The tonnage of vessels which entered coastwise with cargoes was 21,494,297 (including 21,369,167 British).

The post-office in England, as in most other states, enjoys the monopoly of carrying letters, and since 1870 it has managed the telegraph-lines, which were purchased by government for about £9,000,000. It likewise manages numerous savings banks, and grants life annuities in behalf of the state. Some idea of the extent of its business may be conceived from the following figures, which refer to 1873: 907,000,000 of letters and postal-cards and 254,000,000 of newspapers and book parcels were delivered; 15,18[illegible],369 money orders for £2[illegible],820,124 were issued, and 17,291,[illegible] telegraphic messages forwarded; £8,135,[illegible]91 were received by the post-office savings banks, and £6,584,181 were paid by them. The number of depositors was 1,5[illegible]6,645, and the capital deposited at the end of the year, £21,167,749.

Commerce. There are neither export nor protective duties, for the customs duties levied upon articles which are likewise manufactured in the United Kingdom are balanced by corresponding excise or stamp duties. No tariff is probably as simple as that of the United Kingdom. It includes cocoa, coffee, chicory, tea, tobacco, wine, dried fruit, beer and ale, malt, vinegar, spirits, plate, and playing cards. Commercial activity has assumed now most gigantic proportions, for England not only exchanges her own products for those of foreign countries, but likewise acts as the agent for continental and other foreign markets. The extent of the commercial movement, for a number of years, will be appreciated from the following tabular statement:

Year.	Total imports.	Total exports.	Exports of British produce.	Bullion and specie Imports.	Bullion and specie Exports.
1854	£152,389,053	£115,821,092	£97,184,726	Not known.	£22,586,568
1860	210,530,873	164,521,351	135,891,227	£22,978,196	15,641,578
1866	295,290,274	238,905,682	188,917,536	34,287,139	12,742,059
1872	354,693,624	314,588,834	256,257,347	29,608,012	19,748,916
1873	371,287,372	310,994,765	255,164,603	33,599,231	19,071,220
1874	370,225,345	297,500,000	239,436,207	30,4[illegible],000	20,439,000

These figures do not include the value of the merchandise transhipped in British ports, which was £5,136,652 in 1860, and £13,764,100 in 1873. When we analyze the commercial returns we find that a vast proportion of the imports consists of articles of food, condiments, and stimulants (41 per cent.), and of raw materials to be used in manufactures (41 per cent.). Manufactured goods only constitute about 9 per cent. of the total imports. The exports of British produce, on the other hand, include 82 per cent. of manufactured goods. The value of some of the principal articles imported in 1874 was as follows: cotton, £50,9[illegible]7,000; wool, £22,610,000; silk, £15,713,000; ores of metals, £11,109,000; sugar and molasses, £16,083,000; grain and meal, £50,753,000; provisions, £25,868,000; tea, £11,573,000; coffee, £7,103,000; wines, £6,868,000; spirits, £2,612,000. The exports of British produce and manufactures included —cotton yarn and manufactures, £74,232,000; woollen do., £28,354,000; linen do., £8,845,000; silk do., £3,130,000; apparel, haberdashery, and millinery, £9,328,000; earthenware and glass, £3,152,000; iron, £31,225,000; coals and culm, £11,954,000; hardware, £4,413,000; machinery, £9,771,000; leather manufacture, £3,517,000; beer and ale, £2,451,000; soda, £2,602,000; books and stationery, £1,587,000, etc. In the foregoing table we give the imports and exports from and to the principal countries for 1860 and 1874, in pounds sterling.

	Total imports. 1860.	Total imports. 1874.	British exports. 1860.	British exports. 1874.
Russia	16,201,498	21,403,554	3,268,479	8,787,300
Scandinavia	6,930,257	11,8[illegible],527	1,775,879	7,915,258
Germany, Netherlands, & Belgium	27,780,504	49,344,791	21,216,519	45,049,057
France	17,774,031	46,545,585	5,249,980	16,376,690
Spain & Portugal	5,874,679	12,921,592	4,170,378	6,787,532
Italy	2,748,525	3,598,846	4,514,287	6,368,096
Turkey	3,253,246	3,552,804	5,064,233	4,634,164
Rest of Europe	5,580,548	3,942,791	4,462,147	6,089,535
Total Europe	86,143,288	156,143,490	49,721,902	102,017,432
Brit. India & Ceyl	18,435,284	37,477,836	19,306,674	27,927,783
Dutch E. Indies	361,866	1,308,860	1,432,657	1,282,329
China & Hongk	9,323,764	11,961,258	5,318,036	8,394,238
Japan	167,511	578,098	....	1,283,079
Rest of Asia	820,707	1,300,515	769,849	2,931,161
Total Asia	29,109,132	55,626,597	26,827,216	41,818,590
Egypt	10,352,574	10,467,598	2,479,737	3,559,791
Cape and Natal	1,713,502	4,291,646	2,065,523	4,302,622
Rest of Africa	4,143,724	5,892,465	2,336,403	3,810,198
Total Africa	16,209,800	20,651,709	6,881,663	11,672,611
Australia	6,025,001	14,971,506	9,138,195	14,662,645
New Zealand	445,244	3,547,564	569,066	1,408,886
Pacific	298	69,668	33,967	37,728
Total Australasia	6,470,543	18,588,738	9,741,228	19,109,259
United States	44,724,312	74,108,807	21,667,065	28,034,564
Brit. N. America	6,826,551	11,771,934	3,727,350	9,413,315
Mex. & Cen. Amer	1,024,321	1,856,449	787,450	1,529,748
West Indies	7,887,223	8,736,253	4,990,867	5,189,995
Brazil	2,269,130	7,019,831	4,446,776	7,689,137
Rest of S. Amer	9,721,283	15,600,737	7,099,623	12,931,561
Northern Whale Fisheries	145,284	120,807	105	
Total, America	72,598,101	119,114,809	42,719,216	64,818,315
Grand total	210,530,867	370,225,343	135,891,225	239,437,207

The details of the trade with the U. S. for a number of years are as follows:

Year.	Total imports from U. S.	Total exports to U. S.
1854	£29,795,302	£22,333,403
1856	36,047,773	22,616,877
1858	34,257,515	15,793,701
1861	49,389,584	11,025,683
1864	17,923,678	20,183,566
1866	46,854,218	31,84[illegible],836
1868	43,062,299	2[illegible],8[illegible],851
1870	49,8[illegible],181	31,306,089
1871	61,134,463	38,[illegible],8[illegible]7
1872	54,[illegible],948	45,907,998
1873	71,471,593	[illegible],424
1874	74,108,807	[illegible],000

Religion, and Provision for its Support. Great Britain is a Protestant country, but all other religions, as long as they do not offend against public or private morals, may be practised. In England and Scotland there are established churches, that of the former being Episcopal, that of the latter Presbyterian. Ireland has no longer an established Church. (See IRELAND.) The number of persons professing different religions may be estimated as follows (1871):

	Established Church and Episcopal Church: Number	Per cent.	Roman Catholics: Number	Per cent.	All others: Number	Per cent.
England and Wales	19,2[illegible],000	82.44	91[illegible],000	4.02	[illegible]	13.54
Scotland	1,505,000	44.76	298,000	8.89	1,556,418	[illegible]
Ireland	637,998	12.10	4,150,867	7[illegible]	[illegible],412	11.2
United Kingdom	21,395,998	67	[illegible]	17	[illegible]	16

Amongst "all others" are included about 51,000 Jews (48,000 in England, 3000 in Scotland, 285 in Ireland), but the bulk of them consists of Protestant dissenters. Those persons who in England dispensed with a religious marriage ceremony have been apportioned by [illegible] the churchmen and dissenters. They numbered [illegible] per

cent. of the English population. The number of Roman Catholics in England steadily increased until 1853, and in Scotland until 1865, owing almost exclusively to the Irish immigration. Since that time the number of Catholics, proportionately to the general population of the country, is on the decline, and we have endeavored to show elsewhere (*Geographical Mag.*, 1874) that many of these Catholic immigrants must have deserted the faith of their fathers. The established churches of England and Scotland, and particularly the former, are in possession of valuable endowments. All other denominations are dependent upon voluntary contributions, and several amongst them have succeeded in accumulating large funds. Some idea of the activity of religious life may be gathered from the fact that the income of 58 of the principal religious societies of England exceeded £2,000,000 in 1874–75, most of which was expended in the distribution of "good" books and in missions to the heathen. The number of ministers of religion, etc., according to the census of 1871, was as follows:

	England and Wales.	Scotland.	Ireland.
Protestant ministers	29,958	4,105	3,243
Roman priests and monks	1,620	224	3,505
Missionaries, Scripture readers, etc.	3,261	252	24
Nuns	2,474	243	3,719

Education.—Not many years ago Great Britain might fairly have been accused of not providing sufficiently for the elementary education of the growing population. Scotland already had a school law since 1696; in Ireland a system of national education was inaugurated in 1845; but in England government contented itself with making *pro rata* allowances to such among the schools as chose to submit to certain regulations. A further step in advance was taken in 1870, when the formation of school boards was sanctioned in all places not sufficiently provided with schools. The illiterateness of the population of the United Kingdom, however, has frequently been exaggerated, as is proved by the following statement, referring to the year 1871:

		England and Wales	Scotland.	Ireland
Teachers	male	32,991	6,368	8 995
	female	94 229	6,059	9,929
Medical students		4,528	1,138	1,292
Law students		1,543	204	248
Theological students		1,438	200	683
Scholars or students over 15	male	56,358	11,297	23,378
	female	77,762	9,462	21,523
Scholars under 15	males	1,821,046	283,420	318,776
	females	1 742 842	268,600	287 151
Total at school		3 705,517	574,321	653,054

It would appear thus that 15.7 per cent. of the total population attend school—viz. 16.3 in England, 17.1 in Scotland, 12.1 in Ireland. This proportion is satisfactory, for in Germany only 14.5 per cent. go to school. At the same time, it must be admitted that the British schools leave much to be desired, for in 1873 those amongst them (including Irish national schools) which admitted the government inspectors were attended by only 2,615,000 scholars, or not quite one-half the number of those put down above as being under fifteen years of age. There are undoubtedly many excellent private schools and educational establishments supported by private associations, who claim no government subsidy, and do not therefore admit government inspectors; but it is nevertheless satisfactory to know that the school boards are making rapid progress throughout the country. The salaries of certificated teachers average £103 in England, £110 in Scotland, and £57 in Ireland; those of schoolmistresses, £62, £59, and £46 respectively. About half of them receive a house in addition. Scotland is certainly the best educated amongst the three kingdoms, for in 1871 out of 100 men only 10.27 per cent., and out of 100 women, 19.54 per cent., could not sign the marriage register. In England this percentage was 19.4 and 26.8 per cent. respectively. In Ireland about 35 per cent. of the population 5 years of age and upwards were illiterate. Amongst Roman Catholics the proportion was 63 per cent. Indeed, the Roman Catholics throughout the kingdom are the least educated portion of the population, and they furnish the largest contingent of criminal prisoners. This is clearly exhibited by the following table:

	Catholics amongst general population. Per cent.	Catholics amongst prisoners. Per cent.
England and Wales	4.04	21.3
Scotland	8.9	31.4
Ireland	76 7	81.5
United Kingdom	17.0	34.2

Amongst the higher educational establishments, the universities of Oxford, Cambridge, Durham, and London, the Scotch universities of Edinburgh, Glasgow, Aberdeen, and St. Andrew's, and the Irish Trinity College and Queen's University, occupy the first rank. The latter, as well as the London University, are, strictly speaking, mere boards of examiners, and have a number of colleges throughout the country affiliated to them. There are numerous medical schools in connection with the leading hospitals throughout the kingdom; and the establishment of a law school by the inns of court has been advocated. Comparatively little has been done hitherto for systematic and technical education, considering the industrial character of the country, and neither the School of Mines nor the schools of design and "science" established by the authorities of the Industrial Museum can rival similar continental institutions. Owens's College at Manchester, a private institution, is perhaps the nearest approach to them. Art is promoted by a Royal Academy and by numerous art unions. A musical education may be obtained at the Royal Academy of Music and the recently established National School of Music. There are numerous musical societies, but no English opera company has succeeded hitherto in establishing itself permanently. Scientific societies cultivate every branch of science. Foremost amongst them is the Royal Society, founded in 1600.

The newspaper press occupies a prominent and respected position, and its influence upon public opinion is undoubted. In the present year (1875) there appear 1609 political journals and 643 magazines. Of the former, 308 are published in London, 939 in the rest of England, 58 in Wales, 149 in Scotland, 137 in Ireland, and 18 on the smaller islands; 133 are published daily. The publishing trade concentrates itself in London and Edinburgh; 3463 new works were published in 1873, and 3351 in 1874.

Social Condition and Provident Institutions.—There is perhaps no better standard for measuring the well-being of a population than the quantity of food consumed by it in the course of a year. Our data in this respect are unfortunately incomplete, but they nevertheless allow us to form some idea of the manner in which the bulk of the population live. The annual consumption per head is about as follows: wheat, 5.5 bushels; potatoes, 950 pounds; rice, 11.37 pounds; meat, 52 pounds; currants and raisins, 4.29 pounds; sugar, 51.59 pounds; tea, 4.11 pounds; coffee, 0.99 pound; cocoa, 0.26 pound; spirits, 1.23 gallons; wine, 0.56 gallon; malt, 1.98 bushels; tobacco, 1.41 pounds. The wages of the industrial classes are sufficiently high, as a rule, to enable them to live in comfort, but the agricultural class is barely able to exist, for in many parts of the country the wages do not exceed 12*s.* to 15*s.* ($3 to $3.75) a week. An "Agricultural Laborers' Union," in imitation of the trades-unions of the industrial classes, has lately been established, but its efforts have hitherto not proved very fruitful in results. The trades-unions exercise considerable power, and they have certainly succeeded in forcing up the rate of wages; 104 of these societies which had registered their rules numbered 264,357 members, and their funds amounted to £215,479. Of far greater importance are the "friendly societies:" 21,659 were on the register in 1873 for England and Wales, and 11,926 of these sent in returns. These latter numbered 1,787,291 members, and had funds amounting to £8,630,525. Most important amongst these societies are the Odd Fellows and the Foresters, which jointly number 860,000 members, have accumulated a capital of £5,100,000, and paid in one single year £771,000 to sick members and in cases of death. Their lodges and courts are scattered throughout the kingdom. 790 co-operative industrial societies had 340,930 members in 1873, and a capital of £3,334,104. They sold goods to the value of £13,651,127. In Ireland none of these societies have taken root. The money deposited in savings banks likewise furnishes a criterion of prosperity amongst the working classes. In 1863 there were 27,080,402 depositors, whose deposits amounted to £4,137,401; in 1873, the depositors had increased to 3,002,567, their deposits to £63,471,412.

But whilst the majority of the working classes are thus intent upon doing something to secure themselves against poverty in old age, there are many unable to sustain the struggle against adversity with success, or who from the prostration of trade become a burden to their fellow-citizens. The present poor law of England dates from the year 1834, and those of Scotland and Ireland are modelled upon it. Each poor union, consisting, as a rule, of several parishes, is bound to provide for its own poor by granting either outdoor or indoor relief. Schools and infirmaries are connected with each work or union house. The following is the number of paupers who were in receipt of relief on the 1st of January of each year named:

	England and Wales.	Scotland.	Ireland.
1849	934,419	82,357	620,747
1853	798,822	75,437	141 822
1858	908,186	79,199	50,782
1861	890,423	117,113	50 683
1865	1,142 624	121 284	65 230
1871	1,081 926	123 570	71 692
1874	829,281	111,996	79,633


MAP OF
GREAT BRITAIN
AND
IRELAND
Drawn and Engraved on Copper-Plate
EXPRESSLY
FOR
JOHNSON'S UNIVERSAL CYCLOPEDIA
Scale of Miles
Longitude West from Greenwich
SHETLAND ISLANDS
ORKNEY ISLANDS
SUTHERLAND
ATLANTIC OCEAN
NORTH SEA
IRISH SEA
ST. GEORGES CHANNEL
ENGLISH CHANNEL
HEBRIDES OR WESTERN ISLANDS
PERTH
FORFAR
EDINBURGH
BERWICK
Berwick on Tweed
Newcastle upon Tyne
Sunderland
DURHAM
NORTH RIDING
YORK
Hull or Kingston on Hull
IRISH SEA
CONNAUGHT
SLIGO
MAYO
GALWAY
CLARE
LEINSTER
MUNSTER
WATERFORD
CORK
NORFOLK
SOMERSET
DORSET
DEVON
LONDON
Cherbourg
Le Havre
Rouen
Dieppe
Boulogne
THE CHANNEL ISLANDS
Scilly Islands

In the year 1873 there were expended in the relief and management of the poor £7,692,169 in England, £[illegible] in Scotland, and £[illegible] in Ireland. The number of inmates living in charitable institutions, as far as ascertained by the census of 1871, was as follows:

	England and Wales. No.	England and Wales. Inmates.	Scotland. No.	Scotland. Inmates.	Ireland. No.	Ireland. Inmates.
Workhouses	730	[illegible]	66	8651	[illegible]	48,926
Hospitals	407	19,585	49	2682	91	2,894
Lunatic asylums	166	39,246	53	6027	26	7,116
Orphan, blind, etc. asylums	559	[illegible]	135	6587	100	[illegible]

The total number of blind is 30,956; of deaf and dumb, 18,072; of idiots, 40,815; and of lunatics, 81,701.

Political Institutions and Government.—The government of Great Britain is that of a so-called constitutional monarchy. The sovereign represents the executive, whilst the legislature is exercised by the imperial Parliament. The "act of settlement" settles the succession upon the descendants of Sophia of Brunswick, and no change in the act can be made except by consent of Parliament. The heir-apparent since Edward III. assumes the title of prince of Wales. The civil list granted to the queen amounts to £363,760 a year, in addition to which she enjoys the revenues of the duchy of Lancaster (£37,000 net). The members of the royal family enjoy annuities amounting to £132,000, and the prince of Wales, in addition, receives the revenues of the duchy of Cornwall (£63,000 net). The royal palaces are Buckingham, St. James's, and Kensington Palace in London, Windsor Castle, Balmoral (Scotland), and Osborne House (Isle of Wight). The royal arms are quartered, and exhibit three lions in red in the first and fourth quarters for England; a red lion in gold for Scotland, and a golden harp in blue for Ireland. The shield is supported by a lion and a unicorn. The motto is *Dieu et Mon Droit*. The king or queen is the fountain of honor. There are orders of chivalry—viz. that of the Garter (founded 1347), that of the Thistle (819?), that of St. Patrick (1782), that of the Star of India (1861), the order of the Bath (1399), and of St. Michael and George (the Maltese cross). The Victoria Cross is bestowed for deeds of valor performed in the field. Parliament consists of the sovereign, the House of Lords, and the House of Commons, and no act obtains the force of law until it has been passed by all three. The House of Lords is hereditary, and numbers 492 members, including the 2 archbishops and 24 bishops of the established Church of England. More than two-thirds of the peerages are of recent creation; only 14 go back to the fifteenth century. The lord chancellor presides over the sessions of the House of Lords. The House of Commons consists of 654 members (487 for England and Wales, 62 for Scotland, and 105 for Ireland). Of these, 360 are the representatives of 355 boroughs, 283 represent the counties, and 11 the universities. In boroughs the right of voting is restricted to householders and to lodgers paying a rent of £20 a year; in counties, to householders paying £10 rent. In 1874 there were 1,078,180 voters in counties, 1,647,596 in boroughs, and 23,209 in the universities. Members of Parliament are not paid for their services, nor are they able to compensate themselves by an exercise of patronage, as all government appointments in England are made for life. The king appoints the members of the privy council, the lord mayor of London being the only *ex-officio* member, but public business is in reality conducted by a cabinet council, whose members are likewise appointed by the king, but are responsible to Parliament. Their appointment is consequently virtually made by the party enjoying the majority. The members of the cabinet are the first lord of the treasury (generally prime minister), the lord high chancellor (the highest legal official and president of the House of Lords), the chancellor of the exchequer, secretaries of state for the home department, foreign affairs, the colonies, war, and India, a first lord of the admiralty, the postmaster-general, and two others. There are likewise a president of the board of trade, a chief secretary for Ireland, a president of the local government board, a vice-president of the council of education, and a chancellor of the duchy of Lancaster. The legal advisers of the Crown are an attorney-general and a solicitor-general, who both go out with the cabinet. In Ireland the Crown is represented by a lord lieutenant.

For purposes of local government the United Kingdom is divided into a great variety of divisions which are puzzling even to the inhabitants of the country. There are, *inter alias*, 117 counties, 1141 hundreds, wapentakes, wards, and similar divisions of counties, 316 municipal boroughs, 1451 petty sessional divisions of counties, 906 police districts, 404 highway districts, 18,258 civil parishes, 14 military districts, 2164 excise divisions and rides, [illegible] registration districts, etc.

The gross revenue and expenditure have been as follows:

Year ending March 31.	Revenue.	Expenditure.	[illegible]
[illegible]	£65,477,284	£64,663,882	[illegible]
1862	[illegible]	[illegible]	[illegible]
1866	67,812,292	[illegible]	[illegible]
[illegible]	72,591,991	[illegible]	[illegible]
1872	[illegible]	[illegible]	[illegible]
1874	77,335,657	76,466,510	[illegible]

The local receipts in 1871–72 amounted to £38,691,328, of which £26,444,136 was raised by taxation, or at the rate of 16*s*. 9*d*. per head of the population. If the amounts raised for imperial and local purposes be added together, the taxation in the United Kingdom would be about 64*s*. 4*d*. per head of the population. The sources of revenue in 1874 were—customs, £20,339,000; excise and licenses, £27,172,000; stamps, £10,550,000; land-tax and house-duty, £2,324,000; income-tax, £5,691,000; post-office revenue, £5,792,000; telegraph service, £1,210,000; crown-lands (net), £375,000; miscellaneous receipts, £3,882,657; total, £77,335,657. The expenditure included—interest and management of national debt, £26,706,726; civil list and civil charges of all kinds (including £3,196,875 for "Alabama claims"), £17,067,609; army and navy, £26,220,861; charges of collection, £6,471,311; total, £76,466,510. The charges for collection include £4,934,767 for the post-office and telegraph services, which yielded consequently a profit of over £2,000,000. The annual value of the property and profits upon which the income-tax was assessed during the last few years amounted to £485,000,000. The English national debt has rapidly increased after each war, and not very much has been done hitherto towards its redemption. It has now, however, been proposed to devote annually £28,000,000 a year to the payment of interest and reduction of the debt, as well as any surplus that may arise; and it is hoped by these means to reduce the debt in the course of thirty years to the extent of £232,000,000. The national debt and the charges for interest, etc. have been as follows:

	Debt.	Interest, etc.
[illegible]	£664,263	[illegible]
1702	[illegible]	[illegible]
1714	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
1793	[illegible]	[illegible]
1817	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
1874	779,283,245	26,706,726

Administration of Justice.—The judicial system of England very much resembles that of the U. S. The courts of justice may be classified into two grand divisions, those of common law and those of equity. The former include the courts of queen's bench, common pleas, and exchequer, and the courts of probate, divorce, and matrimonial causes; and the latter those of the lord chancellor, the lords justices of appeal, the master of the rolls, and the three vice-chancellors, and the court of appeal in chancery of the county palatine of Lancaster. The new Judicature Act (1874) combines these courts into a "high court of justice," from which an appeal lies to a newly constituted "court of appeal." The House of Lords and the judicial committee of the privy council retain their appellate jurisdiction as regards Scotch, Irish, colonial, ecclesiastical, and admiralty cases. In addition to the above there are courts of bankruptcy, three ecclesiastical courts, the lord mayor's court, the sheriffs' courts, and sixty county courts. The number of judges in the superior courts, including the lord chancellor and the lord chief-justice of England, is about 46, including "masters." The inferior jurisdiction is carried on by justices of the peace in petty and quarter sessions, and by stipendiary magistrates in the larger towns. In Scotland the court of sessions is the highest court for civil, the court of justiciary for criminal cases. The Irish courts resemble those of England, and there is in addition a landed estates court. The sessions of the justices of the peace are presided over by a salaried barrister. The number of salaried judges throughout the United Kingdom is about 450, and their joint salaries amount to about £550,000. They are appointed for life, in most instances by the lord chancellor.

The police (28,550 in England and Wales, 3200 in Scotland, and 12,000 in Ireland) are maintained by the local authorities, excepting that of the metropolis (exclusive of the city police), which depends upon the home secretary). The prison population of the United Kingdom numbers 35,526 persons, and there are in reformatories (for youthful criminals) 6709 inmates; in industrial schools (for young vagrants), 16,151. The number of criminal offenders convicted was in 1873—England and Wales, 11,089; Scotland, 2230; Ireland, 2542.

Army.—There is a law which renders service in the militia compulsory, but this law is at present in abeyance, and the whole of the military forces of the United Kingdom are at present recruited by voluntary enlistment. These forces include the following categories: (1) A regular standing army, consisting of men who enlist for at least three years. Desertions are numerous. The strength of the army has varied considerably during different periods. In 1792 it was 57,252 men; in 1815, 250,314; in 1834, 108,672; in 1862, 222,839; in 1870, 180,444; in 1874, 190,459 men, including the troops in India. (2) The militia, which is trained annually during four weeks, and is recruited by enlistment. (3) Enrolled pensioners and the army reserve force, consisting of old soldiers, who are trained annually for twelve to fourteen days. (4) Yeomanry cavalry and volunteer corps—the former an ancient institution, the latter formed since 1859. (5) The Irish police force (constabulary), which is organized and armed as a military body. (6) Local troops in India and colonial militia and volunteer corps. In 1874 these forces were approximately as follows:

Regular standing army at home and in colonies	128,995
Regular standing army in India	62,840
Militia United Kingdom	133,952
Enrolled pensioners and army reserve	33,000
Yeomanry	15,378
Volunteer corps	153,538
Irish constabulary	12,400
Native troops in India	132,542
Total	672,645

The available colonial militia and volunteer corps do not probably exceed 100,000.

Navy.—The navy has at all times been the pet of the nation, which looks upon it as the chief bulwark against foreign invasion. It is, comparatively speaking, a creation of modern times. Queen Elizabeth had the command of only 42 vessels of 17,000 tons; Cromwell left 150 vessels. In 1863 there were 567 steamers (including 29 iron-clads) and 267 sailing vessels. In 1874 there were 57 iron-clads, 300 steamers, and 170 sailing vessels, of which 25 iron-clads, 145 steamers, and 69 sailing vessels were in commission. Amongst the iron-clads there were 5 of over 10,000 tons, 10 of from 8000 to 10,000 tons, 20 of from 6000 to 8000 tons, 5 of from 4000 to 6000 tons, 10 of from 2000 to 3000, and 7 of from 1000 to 2000 tons. The ships in commission are manned by 33,500 seamen, 7000 boys, and 14,000 marines, but there are in addition 21,000 men of the naval reserve (merchant sailors, who are drilled annually on a man-of-war), 4300 coast-guardsmen, and 1200 men on Indian vessels.

History.—On the 1st of May, 1707, the union between England and Scotland was finally established, and though the Scotch, at first, were highly indignant at this event, they soon became reconciled to it, and now look upon it as a great blessing. For years after the union intrigues for the restoration of the Pretender (the representative of the exiled Stuarts) disturbed the peace of the country. Queen Anne was succeeded in 1713 by the elector of Hanover, who took the title of George I. The Whigs, led by Walpole, now regained the ascendency, and a rising in favor of the Pretender, led on by the earl of Mar in Scotland and the earl of Derwentwater in England, was speedily crushed (1715). Five years later a commercial crisis, brought about by the South Sea Bubble, wrought ruin in thousands of households. George II. succeeded in 1727, Walpole continuing in power as prime minister. He was forced into a war with Spain (1739), who had given offence to British merchants by checking the illicit trade carried on by them in South America. This war terminated ingloriously. Soon afterwards England became involved in the Austrian war of succession. The battle of Dettingen was won, but the victory of the French at Fontenoy paralyzed the efforts of England during the rest of the campaign, and the Peace of Aix-la-Chapelle (1748) left both nations, as far as territories were concerned, in the position they held before the war. Meanwhile, a second attempt had been made by Prince Charles Edward Stuart to win back the throne of his ancestors, but was crushed at Culloden (1746). During the Seven Years' war England sided with Prussia, and though 40,000 men, under the duke of Cumberland, surrendered in Hanover, Clive drove the French from India, while Wolfe conquered Canada. George III. reigned 1760–18—, a most eventful period. A war with France and Spain largely added to the extent of the colonial empire (1783). The government of the Tories caused much dissatisfaction throughout the country, but it was allayed by the appointment of Pitt, earl of Chatham, as prime minister. An attempt to tax the Americans drove them into rebellion, and led to the formation of the U. S. (1783). Fox, Burke, and Sheridan were the leading Whig statesmen during this epoch, but the foremost position must be assigned to the younger Pitt, who held office until his death in 1806. In 1793 he declared war against France without any real cause, but simply because his sympathies were anti-republican, and this war can be said to have terminated only with the battle of Waterloo (1815), where Wellington and Blücher shattered the forces of Napoleon. An Irish rebellion, assisted by a French force, was one of the incidents of these wars, but Great Britain, though suffering occasional defeats on land, finally proved victorious. Amongst the naval battles were those of Cape St. Vincent, Aboukir, Trafalgar (1805), whilst Vittoria and Waterloo proved great victories on land. These wars had increased the English national debt to an immense amount, and led to great distress amongst the working classes, whose discontent it was endeavored to suppress by severe measures. With George IV. an era of reform set in. Commercial reforms were introduced by Huskisson and Canning, and an act emancipating the Irish Catholics was passed in 1829. After the accession of William IV. (1830) the British reformers gained in strength, and a Whig ministry under Earl Grey again came into office, after an exclusion of more than fifty years. This ministry passed the first Parliamentary reform bill, decreed the abolition of slavery (1834), and reformed the poor law. William IV. died in 1837, and was succeeded by the present sovereign, Queen Victoria. Amongst the statesmen who have swayed the destinies of the country since her accession, the most prominent are Sir Robert Peel, Lord John Russell, the earl of Derby, Lord Palmerston, Gladstone, and Disraeli. The principles of free trade had their most able advocates in Cobden and Bright, who succeeded in abolishing the corn laws (1846) and in carrying other measures for the removal of restrictions on trade and commerce. Amongst the more recent acts of Parliament the Irish land act (1870), the act disestablishing the Protestant Episcopal Church in Ireland (1874), and that creating school boards are the most important. In 1854–55 Great Britain went to war with Russia (siege of Sevastopol) in order to stop Russian encroachments in the East; in 1857 an Indian mutiny was suppressed, and there have besides been minor wars in China, Abyssinia, and Ashantee.

E. G. RAVENSTEIN.

Great-Cir′cle Sail′ing. A great circle is one the plane of which, extended through the globe, passes through its centre, dividing it into equal sections or hemispheres. The equator and the meridian are such circles. To sail on an arc or part of a great circle which joins any two points on the earth's surface is to sail on the shortest possible line between them. This might be demonstrated on mathematical principles. It may be made apparent by measurement on a globe; for any one may satisfy himself of its truth by stretching a thread between two places in nearly the same latitude and considerably distant in longitude. Theoretically, then, this is the true line of sailing for ships. The foundation of their course must be the track which the spherical nature of the globe points out as the shortest distance between two given harbors. But a mere inspection of the globe shows at once that this rule, based on its spherical form, is modified by geographical considerations—by the natural projections of the continents and by islands and rocks which lie across or near the great-circle arcs. The experience of the navigator has further taught him the prevalence in different quarters of the world of constant and powerful winds and currents, by making use of which on one course, or avoiding them on another, he gains more than by following rigorously the great-circle arc. The navigator's rule, therefore, must be that he sail his vessel on a great circle wherever the land, rocks, or shoals do not intervene or where the prevalence of powerful currents or adverse winds will not lessen his speed more than the difference between the distance on a great circle and that of another route more favored in these respects. When compelled to deviate from a rigorous following of this shortest line, he may gain time by resorting to composite sailing; that is to say, to sailing on successive arcs of great circles between intermediate points selected to suit the winds, currents, and projections of land. His inquiry will be which course will be the shortest, taking into view all the impediments in his way.

The idea of sailing on the arc of a great circle must have occurred to many as soon as the earth was known to be a sphere. Sebastian Cabot planned his voyages on this true idea. The earliest English systems adopted it. Until the invention of Mercator's chart (in 1569) distant voyages were thus made in preference to sailing on what is known to mariners as the rhumb or spiral curve, which cuts all the meridians at the same angle. The progress of navigation up to Mercator's day may be thus briefly stated: When the invention of the compass first gave to ships their unfailing guide and covered the seas with commerce, the cross-staff and the astrolabe gave the latitude approximately by observations of the sun and stars. But the gross distortions

of the sea-charts in use, especially in voyages remote from the equator, misrepresented the sphere and misled the mariner. His next recourse was to globes, of which some famous pairs were made, having on them the tracks of distant voyages. Yet the plane chart, being more easy and convenient for daily use, kept its place until Gerard Mercator of East Flanders supplied his improvement. The directions of the compass or "compass courses" on his charts are straight lines; and, as the mariner works most easily on a plane surface, he could lay down his courses with a parallel rule on this chart, on which he found the meridians parallel, and yet proportional to the parallels of latitude. Mercator's method at once found favor, and brought great-circle sailing into comparative disuse. For, besides the advantages we have named for the eye which could see the whole track and determine how far it could be followed, there were other practical reasons against great-circle sailing. There was the very severe labor of calculations in an age before the invention of logarithms, and a yet greater difficulty in determining the ship's position in longitude, until the precise places of the heavenly bodies were given in nautical almanacs, and until the subsequent introduction of the lunar method. The usual mode of navigation was to steer on a line which would bring the ship to the latitude of her destination, when she would be about midway, and then to sail on that parallel until the port was reached—a method even now frequently practised.

For the reasons which have been given, and because the great circle projected on Mercator's chart appears not as a straight course, but as a curve, and *seemingly* a *longer* course than the rhumb, the latter idea until recently has continued to prevail, notwithstanding the greater distance which it is known the ship must go over. Within the last few years, however, intelligent navigators have begun to substitute the great-circle route wherever practicable. The improvements in the aids to navigation have removed the old difficulties. In addition to the use of logarithms, the tables furnished by the astronomer-royal for sweeping an arc of a circle on Mercator's chart approaching the projection of a great circle, and such methods as those found in the tables of Towson and others, have relieved the navigator of the old tedious processes. The accuracy of the star-places in our nautical almanacs, and the perfection of the chronometers of our day, aid in determining a ship's longitude as closely as her latitude, and our increasing knowledge of ocean meteorology lends a most valuable assistance in regard to the winds and currents. Beyond all this, the introduction of ocean steamers has changed the whole aspect of navigation. It is an age in which, as the late eminent hydrographer, Fitzroy, remarked, "to steer on the arc of a great circle is much required since steamers compete so keenly on the ocean," valuing even an hour's gain in voyages of great length. The routes recommended by Capt. Maury between a number of prominent ports are chiefly great-circle routes. The great steam-packets adopt this method. For the introduction of steam has enabled the mariner to shape his course and lay the ship's head whichever way he pleases, independently, in a great measure, of winds or of deflecting currents. In the case of distant voyages, as from England to Australia, the great circle route may abridge the distance more than 1000 miles, and in shorter distances, where the gain in distance is small, the gain in time may be important. Even for sailing vessels a knowledge of great-circle sailing will often greatly aid the navigator in shaping his course. A striking illustration is offered in the extreme case of a ship sailing from a point in high latitude to another on the same parallel, 180° distant in longitude. The great-circle route is across the Pole, while the rhumb-line is along the small circle, the parallel of latitude E. or W., the two courses differing 90°. Since any arc of a small circle drawn between the two points, and lying between the Pole and the parallel, is less than the arc of the parallel, a ship sailing on one of these small circles nearly W. would make a less distance than on the Mercator's rhumb or parallel due E.

What seems most needed for great circle sailing is an improvement in the construction of charts. The present sea-charts, constructed almost without exception on Mercator's projection, do not show great circles to the eye directly. The mariner wishing to sail on one has to lay down the arc on which he usually sails on short courses. His method is to compute the great-circle course at least once a day, making allowance in the intervals for the change of azimuth. But these constructions and computations constitute a task too tedious for the ordinary navigator. A partial remedy for this is supplied by Chauvenet's great circle protractor; the complete remedy would be the construction of charts on the gnomonic projection. On this projection the eye is supposed to be at the centre of the sphere. The arcs on the circumference are on planes which are tangents to that centre. Thus, the great circles are projected as straight lines. Charts on this projection are as conveniently used by the navigator as those on Mercator's projection. The government of the U. S. has very recently ordered the preparation of such sea-charts, under the direction of its hydrographic office. (For full information on great circle see MAURY's and COFFIN's *Navigation*; GODFRAY and FITZROY's pamphlets; AIRY in *Monthly Notices Roy. Astron. Soc.*, vol. xviii.; TOWSON's *Tables*; *Nautical Magazine* for 1847.) CHARLES H. DAVIS.

Great Cy'press, tp. of Barnwell co., S. C. Pop. 1620.

Great East'ern, the largest ship in the world, was built at Millwall on the Thames by Mr. Scott Russell for the Eastern Steam Navigation Co., from plans by Mr. I. K. Brunel, who had sole charge of the work. Her construction commenced May 1, 1854. She was launched with her broadside towards the stream. Owing to the flat pitch of her ways, the launching process lasted from Nov. 3, 1857, to Jan. 31, 1858, at a cost of £60,000, hydraulic pressure being employed. Her weight when launched was 12,000 tons. Her extreme length is 680 feet, breadth (exclusive of paddle-boxes), 82½ feet; inclusive, 118 feet; height, 58 feet, or 70 to top of bulwarks. She has no keel. Her frame is of iron ribs and cross-ribs covered inside and out with iron plates, 10,000 in total number. She has eight engines—four for her screws and four for her side wheels—capable in the actual work of 11,000 horse-power, and has besides 20 auxiliary engines. She has ten anchors, a mile of chain-cables, five iron masts and one of wood, with iron spars, shrouds, and standing rigging, and 7000 yards of sail. The electric telegraph conveyed her commander's orders. She carried two large steam-launches and twenty other large boats. On her trial-trip some of her steam-pipes exploded, killing seven men and wounding seven. Mr. Brunel died soon after hearing of this disaster. In 1860–61 she made several trips to New York, at a cost far exceeding the profits. In 1861 she was sent with troops to Canada after the Trent affair. She was sold in 1864 for £25,000, and was employed with good success in 1864–66 as a cable-laying vessel. In 1867 she made a trip to New York and Havre with passengers, running at a heavy pecuniary loss. It is stated that she can carry 20,000 tons of coal and merchandise, or 5000 troops, besides her crew of 400. Since 1867 she has been most of the time lying in the Mersey, a source of serious pecuniary loss to all who ever were concerned with her. She behaved admirably at sea, is remarkably comfortable for passengers, and possesses fair capabilities for speed.

Great Falls, post-v. of Strafford co., N. H., on the Salmon Falls River and Portsmouth, Great Falls and Conway, and the Boston and Maine R. Rs., 74 miles from Boston. It has 6 churches, 2 national banks, a savings bank, a newspaper, 7 large cotton mills, a woollen mill, a bleachery, a foundry, 3 hotels, and a village library. It is the centre of business for a large part of York co., Me. It derives its prosperity chiefly from the cotton-mills. Pop. about 1500. EDWIN FERNALD, ED. "JOURNAL."

Great Fish River, in British America, is a large stream, flowing some 500 miles in a N. E. course to Cockburn Bay, an arm of the Arctic Ocean. It is not navigable. Its mouth is in lat. 67° 8′ N., lon. 94° 10′ W.

Great Green Island, an island belonging to Knox co., Me., in the Atlantic, off the entrance to Penobscot Bay. Pop. 14.

Great Grim'sby, town of England, in the county of Lincoln, on the estuary of the Humber. It has a good harbor, which, with the exception of that of Hull, is the only good harbor on the E. side of England. It carries on an immense fishing-trade, sends one member to Parliament, and has 20,328 inhabitants.

Great Kanaw'ha Riv'er, in West Virginia, is formed by the junction of Gauley and New rivers. It is navigable from its mouth at Point Pleasant on the Ohio River to the Falls, 2 miles below its origin, but only for narrow vessels. The stream itself is swift and narrow, flowing through a rich and picturesque region abounding in coal, salt, and iron. The Great Kanawha Navigation Co. have rendered it navigable throughout most of its course for the entire year.

Great Mar'low, town of England, in Buckinghamshire, on the Thames. It is a municipal and parliamentary borough, returning two members to Parliament, and has manufactures of paper, silk, and lace. Pop. 6619.

Great Nem'aha A'gency, an Indian agency in Richardson co., Neb., for the Iowa and a part of the Sac and Fox tribes. Pop. [illegible].

Great Oak, tp. of Palo Alto co., Ia. Pop. 24[illegible].

Great Pedee' Riv'er is formed in North Carolina by the union of the Rocky and the Yadkin rivers. It flows S. S. E. into South Carolina, and reaches Winyaw Bay. In

its lower course it is often called the *Waccamaw*, which is properly the name of an affluent. The principal tributary is the Little Pedee, which rises by two main forks in North Carolina. It is navigable 150 miles to the falls at Cheraw.

Great St. Law′rence, a port of entry in Burin district, W. side of Placentia Bay, Newfoundland, has a good harbor. Pop. 270.

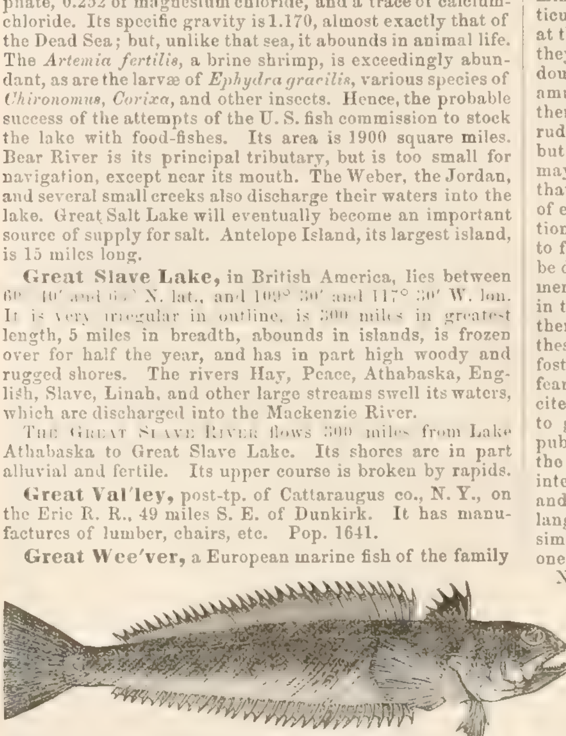
Great Salt Lake, in Northern Utah, the principal body of water in the Great Fremont Basin, and one of the most remarkable lakes on the globe. It is 70 miles long, 45 miles broad, and 4250 feet above the sea-level, and is slowly rising. It contains numerous rocky islands, some seven of which are of considerable size. Its maximum depth is 60 feet; mean depth, 12 feet. Some of the islands are used as sheep-pastures. The lake is doubtless much smaller than formerly. It is navigated by a line of steamers from Corinne to Black Rock, on the S. shore. Its water contains 20.196 per cent. of common salt, 1.834 of sodic sulphate, 0.252 of magnesium chloride, and a trace of calcium-chloride. Its specific gravity is 1.170, almost exactly that of the Dead Sea; but, unlike that sea, it abounds in animal life. The *Artemia fertilis*, a brine shrimp, is exceedingly abundant, as are the larvæ of *Ephydra gracilis*, various species of *Chironomus*, *Corixa*, and other insects. Hence, the probable success of the attempts of the U. S. fish commission to stock the lake with food-fishes. Its area is 1900 square miles. Bear River is its principal tributary, but is too small for navigation, except near its mouth. The Weber, the Jordan, and several small creeks also discharge their waters into the lake. Great Salt Lake will eventually become an important source of supply for salt. Antelope Island, its largest island, is 15 miles long.

Great Slave Lake, in British America, lies between 60° 40′ and 63° N. lat., and 109° 30′ and 117° 30′ W. lon. It is very irregular in outline, is 300 miles in greatest length, 5 miles in breadth, abounds in islands, is frozen over for half the year, and has in part high woody and rugged shores. The rivers Hay, Peace, Athabaska, English, Slave, Linah, and other large streams swell its waters, which are discharged into the Mackenzie River.

THE GREAT SLAVE RIVER flows 300 miles from Lake Athabaska to Great Slave Lake. Its shores are in part alluvial and fertile. Its upper course is broken by rapids.

Great Val′ley, post-tp. of Cattaraugus co., N. Y., on the Erie R. R., 49 miles S. E. of Dunkirk. It has manufactures of lumber, chairs, etc. Pop. 1641.

Great Wee′ver, a European marine fish of the family



Great Weever.

Trachinidæ, the *Trachinus draco*, a small fish, dreaded for the serious wounds its spines inflict. Its flesh is very good.

Greaves (JOHN), M. A. (*Gravius*), b. at Collmore, Hants, England, in 1602; became a fellow of Merton College, Oxford, 1624, M. A. 1628; was professor of geometry in Gresham College, London, 1630–43; travelled extensively in the East, making archæological and scientific collections, 1637–40; was Savilian professor of astronomy at Oxford 1643–48, but was ejected by the Puritans. D. in London Oct. 8, 1652. Among his works are *Pyramidologia* (1646); *Discourse on the Roman Foot and Denarius* (1647); *Elementa Linguæ Persicæ* (1649); *Epochæ celebriores* (1650); *Astronomica quædam* (1652), and miscellaneous papers.

Grebe, or **Dip′per,** a name applied to various aquatic birds of the genus *Podiceps*. The U. S. have nine species, frequenting lakes, rivers, and sea-coasts. The crested or satin grebe of both continents (*P. cristatus*) is much hunted for its coat of silvery feathers, which is used in trimming ladies' dresses and in making muffs. It is rare and costly. The *P. cornutus* (horned or Slavonian grebe) is common to both continents. The smaller species are called dabchicks. They are awkward on land, but are expert divers, having the power of remaining long under water and thrusting up the bill for a supply of air. It is asserted that the little grebe (*P. minor*) builds a floating nest, which she removes at the approach of danger, paddling it with one foot.

Gre′ble (JOHN TROUT), b. in Philadelphia Jan. 19, 1834; acquired his preliminary education at the grammar and high schools of his native city, receiving his bachelor's degree at the latter; entered West Point in 1850, graduated in 1854, and was promoted to be brevet second lieutenant 2d Artillery; served in Florida against the Seminole Indians 1854–56; was appointed acting assistant professor of ethics at the Military Academy Dec., 1856, performing his duties with great credit to himself; in Oct., 1860, he was assigned to active duty at Fortress Monroe at the artillery school, and in defence of the fortress 1861; in May, 1861, he was placed on ordnance duty at Newport News, and in June following was detailed to accompany the expedition to Big Bethel in charge of the artillery (two pieces). After the repulse of the U. S. forces at this place, he by skilful management protected their rear and saved them from complete destruction. He had given orders to withdraw from the field when he was struck by a cannon-ball and instantly killed, June 10, 1861.

Grecian Architecture. See ARCHITECTURE. By CLARENCE COOK.

Gre′cian Games. Public games were instituted in Greece at a very early period, but it is not easy to determine what they originated or what was their more particular design. It is evident that they arrived gradually at the state of complete organization and splendor in which they appear in historic times. Their beginnings go back, doubtless, to the days of Homer, who describes sundry amusements and athletic exercises in which the Greeks then already took delight. These probably constituted the rudiments of those great games which are so celebrated, but the development and systematic arrangement of which may be regarded as a natural outgrowth of the genius of that wonderful people, of their admiration of the beautiful, of ease and grace in motion and action, their early cultivation of skill in the use of arms, and of their constant desire to furnish models to painters and sculptors. But it cannot be doubted that their situation in the midst of hostile movements, which required them to be always ready and skilled in the use of arms, and the rivalries which existed among themselves, also contributed greatly to this result. Thus, these games were designed to cultivate personal courage, to foster a love of arms, to create a martial spirit, to promote fearlessness in danger and contempt of pain, but also to excite and cherish a love of that country which they tended to glorify. Thus, they were a school of patriotism and public spirit, besides affording frequent opportunities for the cultivation of kindly feelings and of a sense of common interests by so often bringing the different tribes together, and impressing upon them, through their use of the same language, and their possession of the same religion and of similar institutions, the conviction of their being essentially one and the same people.

National games have a general interest, because they are more or less indicative of national character. Thus, the Olympic and other games of the Greeks exhibit in a striking light the higher culture and the superior refinement of that people as compared with the ruder tastes, the less-refined culture, and the more vulgar—or rather the brutal—amusements of the Romans. Games were celebrated in Greece at different localities and under different names; but while they differ from each other in some particulars, and require to be separately noticed, they are very much alike in their general character. They present themselves under the four grand divisions of the Olympic, the Pythian, the Isthmian, and the Nemean, which will now be considered in order.

I. *The Olympic Games.*—These were, in several respects, the most important. Celebrated at Olympia in Elis, they preceded all others in the order of time, and served as a model for all those which were subsequently instituted. These circumstances invest them with paramount importance in Grecian affairs, which is still more increased by the greater solemnity which belonged to them, and especially by the fact that the Grecian method of reckoning time was based upon them and their regular occurrence. We shall therefore more particularly and fully consider the Olympic games; but ere we proceed to set forth their nature it will be necessary to describe the locality at which they were celebrated, and then to trace, as far as possible, their origin. Olympia in Elis was not a city or a town, but a small plain in the district of Pisatis, with beautiful environs, nearly surrounded by lofty hills, and bounded on the S. by the river Alpheus. On this plain was the sacred grove, called Altis, adorned with divers beautiful structures and works of art, with the Olympieum, the temple of Zeus Olympius, and with altars, statues, and monuments in great number. According to a legend greatly adorned by Pindar, this Altis was laid out by Hercules. Within it grew many wild olive trees, among which was that which furnished the wreaths or crowns for the victors in the various contests. The most important and beautiful edifice erected here was the temple of Zeus, which closely resembled the Parthenon at Athens. In it stood that most magnificent production of Hellenic plastic art, the chryselephantine statue of Zeus

Olympius by Phidias, around which were grouped a great many other beautiful statues, etc. In the western part of the plain, between the Altis, Mount Kronos, and the Cladeus, which empties into the Alpheus, lay the Hippodromus for hippic contests; in another part of it was the Gymnasium, with race-courses and palæstra for the preliminary practice of the athletes; and near it was the Stadium, in which the gymnic contests were held. At the passage from the Stadium into the Hippodromus the Hellanodicæ, or judges of the contests, had their seats. The history of the Olympic games must be divided into the pre-historic or mythical, which represents the Idæan Hercules as having founded them during the reign of Kronos, and into the historic or authentic, which begins with Iphitus and his associate Lycurgus, and which is alone entitled to consideration in an article like the present. Iphitus was a noble Elean, called king of Elis by some, and a reputed descendant of that Oxylus who led the Heraclidæ into the Peloponnesus. When Hellas was distracted by the dissensions of its tribes and states, Iphitus inquired of the Delphic Oracle how this unhappy condition of affairs could be remedied. The response was that he should, in conjunction with the Eleans, revive the Olympic games. He obeyed the oracle, reinstituted the games, establishing, at the very beginning, the Pentaëteris—*i. e.* their regular return after every four years. His most important enactment regarding these games was the ἐκεχειρία—*i. e.* the cessation of all hostilities throughout Greece during the continuance of these festivities. It was the duty of the Elean σπονδοφόροι, the peace-heralds, who published the ἐκεχειρία, or universal truce, to proclaim, first in Elis, and thereupon in the other states of Greece, the commencement of the sacred month (ἱερομηνία), from the first day of which those who proposed to take part in the contests and all spectators could travel to Olympia in perfect safety. Some instances occurred, however, in which this truce was violated. Although the Olympiads require a separate article, it may be mentioned here that the first of these, that with which Grecian chronology begins, is dated from the victory of Corœbus in the Stadium, which is placed in the 3938th year of the Julian era, or 776 B. C. It is probable that at first but few of the Peloponnesian states took part in the Olympic contests, and that it was only after the 15th Olympiad that participation in them became more general; but in the 30th the lists were thrown open to all Hellas, and in the 40th to the Greeks of Asia Minor, Sicily, Magna Græcia, and other Hellenic communities. With the 50th Olympiad began the most brilliant period of these great national games, but their classical period extends down nearly to the 85th Olympiad. This period is designated as the classical, because to this belong the most celebrated of the Hellenic athletes. Among these may be mentioned Milo of Crotona, Diagoras of Rhodes, Theagenes of Thasos, and the Locrian Euthymus. The privilege of taking part in these exercises was, until the Roman conquerors introduced innovations, confined to candidates of pure Hellenic descent; so that, when Alexander the Great proposed to enter the lists, it was required that he should first prove his descent from a Hellenic family of Argos. Even after the expiration of the classical period these great national assemblies maintained their importance; and, although the Romans were, during the republic, not favorable to numerous meetings of this kind in conquered countries, they did not materially alter, or impose any restrictions upon, these great Grecian festivities. Under the empire the victors in any of the four great Grecian games, and such combatants as had, by authority of the emperors, received the title of ἱερός, enjoyed sundry important privileges, and both Tiberius and Nero achieved victories at Olympia. These great national celebrations did not lose their importance until Christianity became the religion of the empire, and after the 293d Olympiad (A. D. 394), in the tenth year of the reign of Theodosius, the Olympic games were finally abolished.

We come now to consider the nature of these games, the gradual introduction and regular succession of the different contests, and the arrangement of the several festivities. For a long time after their reinstitution by Iphitus there was no other contest besides the single foot-race; but the recollection of the earlier varieties induced the Eleans gradually to reintroduce these, and, after a while, to add others. Thus, the double foot-race was introduced in the 14th Olympiad, the Dolichos (the long course) in the 15th, wrestling and the Pentathlum, which consisted of five exercises, in the 18th, and in the 25th the chariot-race with four full-grown horses, as practised in the early heroic age, was revived. In this the Theban Pagondas was the first to win the prize. In the 33d Olympiad followed the Pancratium, an athletic game which called into exercise all the powers of the combatant, as it combined all the arts of boxing and wrestling; also in this Olympiad, the horse-race (ἵππος κέλης). In the 37th, boys obtained permission to engage in wrestling and in the foot-race, and in the 38th they were admitted to the Pentathlum, which was, however, very soon again prohibited, because there was in this exercise no chance for any but Laconian boys to win the crown. In the 41st, boys were for the first time permitted to contend with the cestus—that is, to engage in boxing with fists armed with thongs which were loaded with lumps of lead to render their blows more powerful. In the 65th the foot-race in a full suit of armor was first introduced. This was probably at first a single foot-race once through the course (στάδιον), but became subsequently a δίαυλος, a foot-race in which the stadium was traversed twice—that is, to the goal and back again. In the 70th the chariot-race with mules, and in the 71st the horse-race with mares, were introduced, but discontinued in the 84th. The 94th brought the chariot-race with two full-grown horses, and the 96th the contests of heralds and trumpeters. In the 99th Olympiad the Eleans introduced the chariot-race with four foals, in the 128th that with two foals, and in the 131st single foals were first ridden in the race-course. In the 145th Olympiad the Pancratium for boys was instituted, and it appears from Pausanias that boys were also permitted to ride in the single horse-race. If, as Pausanias asserts, these games lasted at first only one day, this arrangement could not have remained in force after the number of exercises had been greatly increased; for, whenever new contests were introduced, a day was added to the festivities, and it is very probable that these were as early as the 80th Olympiad kept up for five days.

The whole panegyric festival was divided into two parts: (1) into the contests, designated as ἀγὼν Ὀλυμπικός, ἀέθλων ἅμιλλαι, κρίσις ἀέθλων, τεθμὸς ἀέθλων, νικηφορίαι; (2) into the sacrifices, the processions, and the banquets given to the victors in the games. The first day was devoted to initiatory sacrifices, and the classification and arrangement of all the competitors by the judges; the fifth to sacrifices, processions, and the banquets; and the intermediate days to the different contests. The sacrifices were either those instituted and offered in the name of entire states, or such as were brought by individual contestants, and they were of course offered to different divinities, and even to several heroes, such as Pelops and Hercules.

Among the visitors from other Grecian states, the θεωροί who represented them contributed greatly to the splendor of the festivities. Such θεωροί were sent by every Hellenic state interested in the great games, to attend the celebrations as its deputies, who were charged to take part in the sacrifices offered to Zeus Olympius, and in the processions, and to omit nothing that could reflect credit upon the state which they represented. It is likely that, for this reason, the richest citizens were appointed to this service, as the deputies were expected to make as splendid a display as possible.

Order of Exercises.—The gymnic contests began with the στάδιον, that is, the single foot-race, and then followed the δίαυλος and the δόλιχος, which have been explained already. According to Plutarch, the contests of the boys preceded those of the men, which was probably a later innovation. Before the 77th Olympiad the Pentathlon, or the contest of the five exercises, ἅλμα, δίσκος, δρόμος, πάλη, πυγμή—*i. e.* leaping, throwing the quoit, running, wrestling, boxing—preceded the Pancration, a union of the boxing and wrestling matches; an arrangement which was reversed during this Olympiad. After the Dolichos followed the wrestling, and next the boxing matches; but before the 112d Olympiad the Pancration was placed after the boxing contests. The contest of the ὁπλιτοδρόμοι, the runners in armor, completed the series of the gymnic contests. The order in which the contestants followed each other was determined by the drawing of lots, and, as this might decide the success or failure of different candidates, it was a matter of the utmost importance to all.

Qualifications.—From these games all ἄτιμοι, persons punished with civil degradation, all persons notoriously ἀσεβεῖς, impious, all ἐναγεῖς, persons polluted, especially blood-guilty, were strictly excluded. Hence, all applicants were subjected, before the commencement of the exercises, to a rigorous examination. Punctuality in appearing in the lists was peremptorily required of all who had their names entered as candidates, in default of which the delinquents were excluded from the exercises. There were other stringent regulations, always rigidly enforced, which cannot be mentioned here.

Ἑλλανοδίκαι, the Hellanodicæ—that is, the judges who awarded the prizes and fixed the time within which the combatants were required to give in their names. It was their duty to ascertain, by a rigid investigation, whether the candidates were Hellenes and free born, whether they had ever incurred ἀτιμία, the loss of civil rights, or been guilty of ἀσέβεια, impiety, and whether their age ranked them as παῖδες, boys, or as ἄνδρες, men. To those who proved to be in all respects duly qualified they now admin-

istered an oath which bound them to act honorably; they arranged all the details of the contests, investigated all charges which might be brought against any of the candidates, paired the combatants by lot, and took care that all the regulations of the games were strictly enforced. In the performance of these duties they were assisted by subordinates called ἀλυται, who were subject to an ἀλυτάρχης.

Rewards of the Victors, Processions, Feasts, etc.—At Olympia the prize bestowed upon the victors in the contests was not one that possessed any material value. As every contest was simply an ἀγὼν στεφανηφόρος or στεφανίτης, conferring honor or distinction, the prize consisted of a wreath or crown made of twigs taken from the wild olive tree which grew in the Altis. It may here be mentioned, incidentally, that at the Pythian games the chaplet was made of laurel; at the Isthmian, of twigs of the pine tree; at the Nemean, of ivy or parsley. At first the rewards were prizes which possessed intrinsic value, but after the 6th Olympiad the victors were, in obedience to an oracular response, simply crowned with wreaths or chaplets. The Hellenes regarded the Olympic crown as bestowing the very maximum of human felicity. In all the four great games the crowned victor received also a palm-branch, which he is always represented as carrying in his right hand. But in the ἀγὼν στεφανίτης no inferior prizes could be won; he who did not win the highest, the crown, won nothing, whereas in contests for prizes of material value there might be second and third grades. With the crowning of the victor was combined the loud proclamation, by a herald, of his name, of that of his father, and of his native city or state. He had, besides, the privilege of erecting a statue on the scene of his triumph at a particular place in the sacred Altis, and rich victors in the hippic contests had themselves, their charioteers, horses, and chariots represented there in bronze. The processions (πομπαί) were connected with the sacrifices, and probably marched at first around the altars while the offerings were ablaze; but doubtless they touched in later times at all the consecrated spots of the sacred Altis where the feasts were held. Ἐπινίκια, triumphal odes composed by celebrated poets, were sung at the feasts. Rich victors, like Alcibiades, sometimes invited to a feast all who were present at the games. The other distinctions and material advantages which were conferred upon the victor in the Olympic games in his native country or throughout Hellas were very great. He was honored with a solemn entry into his native city, or into any other as a citizen of which he had had himself inscribed in the list of contestants; and in order to make the triumphal procession more distinguished, it was customary to throw down a part of the city wall and gate. Statues were erected in honor of him in his native city, and sometimes in other cities where he had friends or to which he had rendered some important service. In later times he was, at Athens, maintained in the Prytaneum at the public expense, but long before this Solon had allotted to him a prize of 500 drachmæ, about $90. At Sparta the victors enjoyed the distinction of fighting in battle near the person of the king, and throughout all Greece they were invested with valuable privileges.

Discourses, Recitations (ἐπιδείξεις), etc.—From the 80th Olympiad it became customary at Olympia to engage in sundry intellectual exercises, to perform dramatic pieces, to deliver discourses, to make recitations and to read poetic productions in the presence of the vast assembly. Artists also exhibited their works here. Here Herodotus read his great historical work to a profoundly interested auditory; and this is said to have inspired Thucydides, who was present, with that enthusiasm for compositions of this kind which afterwards made of him also an eminent historian; but there is no satisfactory evidence of the truth of the tradition that he read his admirable narrative of the Peloponnesian war at Olympia. The spectators submitted to a great deal of inconvenience, and even suffering, for the sake of obtaining good seats from which to witness the contests, arriving at the stadium or the hippodromus generally before sunrise, often even at midnight, and remaining in their places till the hot hours of the afternoon, in order to be present when the minor contests were to be decided. As the celebration took place at the hottest season, and the spectators were required to have their heads uncovered, it cannot be a matter of surprise that the philosopher Thales, when he attended the games at a very advanced age, should have died from the effects of the sun's heat and the pressure of the crowd.

Minor Olympic games were celebrated, in imitation of the greater, in several Hellenic states and foreign cities, which cannot, however, be described here.

II. *Pythian Games.*—Of the other great Grecian games which have already been named, the Pythian are next in importance. Of these there were two kinds—the greater and the less. The great Pythian games were celebrated on the Crissæan Plain, which, lying N. of Crissa, was, in accordance with a response of the Delphic Oracle and a consequent decree of the Amphictyonic Council, to remain for ever uncultivated and uninhabited. There was here a hippodromus, a dromos for foot-races, and a theatre for musical contests. As regards their history, the mythical account represents Apollo as the founder and protector of this great festival. This will account for the contests having originally been exclusively musical, and also for the earliest performance of this kind having consisted in singing a hymn to the Pythian god. The historical period begins with the third year of the 48th Olympiad, when the Amphictyons, after the close of the Crissæan war, assumed the control of these contests; whence also the first celebration under their direction is counted as the first Pythiad. The celebration was originally an Ennaëteris, occurring regularly after every eight years; but after the third year of the 48th Olympiad it became a Pentaëteris, taking place every four years, regularly in the third year of each Olympiad. The musical contests comprised those of the performers who played on the cithara and sang to its accompaniment, of those who played on the flute, and of those who sang to the accompaniment of the flute. In the first Pythiad the gymnic and hippic contests, copied after the Olympic, were introduced. The nature and arrangement of the Pythian games, the prizes, the regulations, the sacrifices, the splendid processions, the display made by the official visitors (θεωροί) sent by different states, were all so very similar to those of the Olympic games, after which they were modelled, that they require no detailed description here. As they were sacred to Apollo, the god of divination, whose favor was coveted by all, the number of spectators was doubtless always very large, and the celebration exceedingly magnificent. The minor Pythian were, like the lesser Olympic games, simply imitations of the greater, celebrated at divers places where Apollo was worshipped.

III. *The Isthmian Games* are next in distinction and importance. It is rather surprising that they never attained to the highest rank, as the locality in which they were celebrated was far better adapted to the purpose than any other. The scene of the contests on the Corinthian isthmus was enclosed by a sacred grove of pine trees (Ποσειδάνιον τέμενος), and here was also the sanctuary of the Isthmian Poseidon. Here, as elsewhere, the principal parts of the arena were the hippodromus for the hippic and the stadium for the foot-races. The prescribed preparatory exercises of the athletes took place in the Kraneion, a spacious gymnasium in a grove of cypress trees which bore the same name. As regards the origin and organization of this great festival, we have, in this instance also, to distinguish between a mythical or pre-historic and an historical period. The legends are quite numerous and singularly attractive and interesting. The principal one represents the institution of this festival to have been commanded by Poseidon as a funeral celebration in honor of Melicertes, a son of Athamas (king of Orchomenus) and Ino, who threw herself into the sea with her son. The different beautiful myths relating to this Melicertes cannot be repeated here; they are all intimately interwoven with the worship of Poseidon, and one of the latest represents Theseus, the majestic descendant of the great sea-god, as having instituted these games to express his gratitude for the victory which he had gained over, and the destruction with which he visited, the wretch Sinis Pityocamptes. But as Sinis was himself a scion of Poseidon's, this institution of Theseus may perhaps be more correctly described as an expiatory celebration. As respects the historical period of these games, there is no reason to doubt that they commenced very early, and that a degree of rivalry between the Corinthians and the Eleans had considerable influence in promoting their celebration and their unquestionable splendor. There is positive evidence of their great antiquity in the fact that Solon awarded to each Attic victor in these contests a reward of 100 drachmæ, about $18. This great festival, at first an ennaëteris—*i. e.* occurring every eight years—became, it is not precisely known when, a trieteris, a biennial celebration, which it remained ever after, taking place in the first and the third year of each Olympiad. The Isthmian games consisted of the same gymnic and hippic contests as those of Olympia, to which musical contests were subsequently added. In all these the names of many distinguished victors occur. The customary truce in connection with these games was sometimes violated, and on one occasion so rudely by Agesilaus, king of Sparta, with a powerful army, as to prevent their celebration. Among the theoriæ which came, by sea and by land, from all parts of Greece to witness this great spectacle, those of Attica were doubtless the most splendid. The prize obtained at the Isthmian games was, for a long time, a wreath of parsley, until at last the Isthmionicæ were rewarded with crowns made of twigs of the pine tree.

Among the intellectual or literary performances which

formed a prominent part of this festival were recitations, discourses of various kinds, rhetorical and poetical productions, and, as many Sophists assembled here about the temple of Poseidon, loud declamations, and sometimes rude and boisterous demonstrations between rival Sophists, supported by their respective pupils. These celebrations were numerously attended by spectators from many parts of Europe and Asia, and among them Socrates, Æschylus, and Ion are named. As in the case of the other great games, imitations of the Isthmian were celebrated in several Hellenic states.

IV. *The Nemean Games.* –Nemea is a name which was applied to a valley in Argolis, between Cleonæ and Phlius, in which Argus is said to have kept watch over Io, and Hercules to have slain the famous Nemean lion. In the historical period there was here a splendid sanctuary of Zeus Nemeios, with a grove (ἄλσος) in which the games were celebrated. The pre-historic period of the Nemean games is connected with the legend of the war of the Seven Captains against Thebes; which seven heroes are said to have instituted them in honor of Archemorus. Some connect these games with Archemorus as the son of Nemea, the daughter of Asopus. The commencement of their historical period is uncertain. For a long time mere local contests, they did not become common to all the Hellenes until many Olympiads had passed. The first-reckoned Nemead began with the 51st Olympiad. They were, like the Isthmian, trieteric, recurring ordinarily after every two years, in the second and fourth years of each Olympiad. Besides the usual gymnic and hippic, they comprised also musical contests, especially vocal performances to the accompaniment of the cithara. In the customary contests, which correspond with those at Olympia, men and boys participated. As these constituted, like the others, an ἀγὼν στεφανίτης, it is a matter of course that the victors could win no other prizes than wreaths or crowns, which consisted, according to some authorities, of twigs of the olive tree, according to others of ivy or of parsley. In connection with these games, the Spartans sometimes violated the truce, but they were attended, like the others, by theoriæ from most Hellenic states. These games were, as well as the three great festivals already described, imitated, on a smaller scale, in other Grecian states; as, for example, at Ætna in Sicily.

(For further and very full particulars the reader is referred to the exceedingly elaborate articles by Prof. Dr. I. H. Krause of Halle in Pauly's *Real-Encyklopädie der classischen Alterthumswissenschaft*, etc., from which work the materials for this article have mainly been derived.)

H. I. Schmidt.

Gre'cian Mythol'ogy was so closely interwoven with Grecian civilization in general that there is hardly any Greek author from whose writings something may not be learned concerning the Greek gods. Poets and philosophers, historians and orators, mathematicians and astronomers,—they all have something to say about their gods, and thus the whole Greek literature may be mentioned as the first source for the study of Grecian mythology. Another source, as important and almost as rich, is the Greek art. It is hardly too much to say that without the aid of the Greek sculptors we should never have arrived at a true appreciation of the manner in which the Greeks conceived of their gods. The love stories of Zeus are of a character so light and frivolous that, in spite of their bright beauty and the brilliant symbolization to which they invite, they seem altogether incompatible with the idea of the Father and Ruler of the world. But after seeing the head of Zeus as modelled by Phidias we understand that although these stories kept the Greek and Latin poets pretty busy, they form, nevertheless, only a subordinate element of the Greek idea of the king of the gods. A more direct source of information are the writings of the old Greek and Latin mythographers, who collected, systematized, and interpreted the myths. The most important among the Greeks are Apollodorus, *Bibliotheca*; Conon, *Narrationes*, an epitome of which is preserved by Photius; Ptolemaeus, *Nova historia*; Parthenius, *Narrationes Amatoriæ*; Antoninus Liberalis, *Transformationes*; Joannes Pediasimus, *De Herculis laboribus*; and Nicetas, *Deorum cognomina*; among the Latins, Hyginus, *Fabulæ*; Fulgentius, *Mythologiarum Libri Tres*.

With Hesiod and Homer the formation of the myths is finished; the ideas are individualized into perfectly plastic figures and perfectly epic actions. With Euripides and Plato the dissolution of the myths has begun; the forms are broken asunder and considered only as symbols of the ideas. On being transferred from Athens to Rome the Greek myths hardly underwent any other changes than that of names: Cronos was called Saturnus; Zeus, Jupiter; Poseidon, Neptunus; Ares, Mars; Hephæstos, Vulcanus; Hermes, Mercurius; Hera, Juno; Athene, Minerva; Artemis, Diana; Aphrodite, Venus; Hestia, Vesta; Demeter, Ceres; Dionysus, Bacchus; Leto, Latona; Persephone, Proserpina; Selene, Luna; Eros, Amor, etc.

Two of the most interesting points of a mythology are its cosmogony and its eschatology, or its doctrines concerning that which goes before and that which follows after life on earth. The ideas which the Greek mythology contains of the origin of the world are very remarkable, and their symbolizations very suggestive. Uranos (heaven) and Gæa (earth) arose out of chaos, and their children were the wild and unruly powers of nature, the Titans. One of the Titans, Cronos (time), who eats his own children, slew his father and ruled the world for some time. But Uranos had cursed his sons, and the curse was fulfilled. Zeus, a son of Cronos, rose against his father, and, after a horrible contest which convulsed the whole world, he confined him and the other Titans in Tartaros, and raised his throne in Olympos, in the light-region above the sky. Much weaker are the ideas of the Greek mythology concerning that which will take place after death, though in course of time they become very elaborate. To the dying man Hermes came and led him to Hades, the realm of shadows, where the deceased live for ever, but live a bloodless life. Achilles said of it that he would rather be a swineherd on earth than the king of Hades. Later, the poets and philosophers tried to bring some life into this dead, monotonous, shadowy region. When the deceased had paid his obolos, a small coin which his children or friends had placed in his mouth, Charon would ferry him over the Styx, which flowed between life and death and surrounded Hades. Arrived at the other side of the Styx, he had to pass by Cerberus in order to gain the large plain where Minos sat to judge the coming. According as the judgment read, he then turned either to the left into Tartaros, where Tantalos, Ixion, and others were tortured, or to the right into the Elysian Fields, where there was a never-setting sun and spring twice a year. But these ideas of a final judgment and an eternal punishment or reward never obtained a fast hold of the conscience of the Greek people. They were a dream, not a conviction.

From Olympos, Zeus reigns over the world and mankind. After the fall of Cronos his three sons divided the realm. Zeus chose the upper region, the heaven; Poseidon, the ocean; and Pluton, Hades: the earth was common to them all. But, in spite of this division, Zeus is the highest ruler, the king and father of the gods. What the myths have to tell of him is mostly love-affairs, but in these stories courtship seems only to be a form by which different ideas, generally physical, are symbolically represented. Thus, he falls in love with Io, the wanderer, the moon. But his wife, Hera, the earth, being jealous, transforms Io into a cow, the crescent resembling a pair of cow's horns, and puts Argos with the thousand eyes, the stars, to watch her. Hermes, the god of the dawn which makes the stars wane, kills Argos, and Io escapes in the embraces of Zeus, as the moon vanishes in the resplendent light of the sun. Around the throne of Zeus stand Poseidon, Apollon, Ares, Hephæstos, Hermes, Hera, Pallas Athene, Artemis, Aphrodite, Hestia, and Demeter; in a somewhat lower sphere, Pluton, Hecate, Helios, Selene, Dionysus, Leto, Persephone, Themis, and Æolus; still lower, the Graces, Muses, Oceanids, Nereids, Nymphs, Dryads, and Hamadryads; and at last, on the outskirts of divinity, the monsters, Cerberus, the Gorgons, the Harpies, Pegasus, Chimæra, the Sphinx, the Centaurs, and the Sirens. Such deities as Ate, Adrastea, the Eumenides, and Nemesis occupy a peculiar position. They all refer to the feeling of justice. Nemesis does not occur in Homer. She is first mentioned by Hesiod, but later poets and philosophers developed the idea with a mystic grandeur which overawed Olympos itself. From Nemesis, the just measure, the inevitable consequence, the iron connection between cause and effect, no one was exempted, not even Zeus himself. It is also very remarkable that a principle of evil, such as Siva in the Indian, Ahriman in the Persian, and Loke in the Scandinavian mythology, is not found in the Grecian. Clemens Petersen.

Greece. Greece is the southern part of the most eastern of the three peninsulas of Europe which project into the Mediterranean Sea. The ancient Greeks called their country *Hellas*, and styled themselves *Hellenes*; and these names prevail among the modern Greeks. We have received the designations Greece and Greeks from the Romans, who gave the name *Græcia* to the country and *Græci* to its inhabitants from the name of a small tribe (*Graikoi*) in Epirus, with whom they first came in contact as they approached Hellas. Aristotle (*Meteor.*, i.) is the first Greek author who applies the term Græci to designate the Hellenes. The term Hellas originally designated only a small district in Thessaly, and was subsequently used to denote the entire country settled by the Hellenes.

Ancient Greece proper extended from 40° N. lat. to 36°

23′. It was bounded on the N. by the Cambunian Mountains, which separate it from Macedonia. The Ægean Sea was upon the E., the Cretan upon the S., and on the W. were the Ionian and the Adriatic. Its greatest length was about 250 miles, its greatest breadth 180 miles. Its area, exclusive of Epirus (4690 square miles), but including Eubœa (1410 square miles), was 21,121 square miles. (CLINTON, *F. H.* ii. 385.) Heeren, however, makes its superficial extent (including all the islands) 29,600 square miles. Modern Greece is more limited in extent. Contrary to the wishes of the Greek people, the great powers of Europe allowed not only Epirus and Macedonia (which did not belong to ancient Hellas), but Thessaly and a part of Acarnania, or more than one-third of the whole country, to remain under Turkish control. In 1834 the N. boundary was fixed on a line 137 miles long, following mainly the summit of the range of Mount Othrys from 39° 11′ N. and 22° 42′ E., on the Gulf of Volo (Pagasæ) to Menidhi at 39° 3′ N. and 21° 5′ E., on the Gulf of Arta (Ambracia) in the W. The Ionian Islands were also placed under the protection of Great Britain, and were not annexed to Greece until 1864. Modern Greece is about 200 miles long from N. to S., and about 180 miles in breadth from E. to W. Its area is 19,353 square miles, of which 7500 are N. of the Isthmus of Corinth, 8500 in the Morea (Peloponnesus) S. of the isthmus, and the islands (the Ionian Isles, Eubœa, and others) make up the remainder, or nearly 3500.

Greece is triangular in shape, and is almost surrounded by water. It is divided near the middle by the Corinthian and the Saronic gulfs, which are separated by the Isthmus of Corinth, only 3½ miles wide. The three natural divisions of ancient Greece were—Northern Greece, extending from the Cambunian Mountains to the Ambracian and Malian gulfs; Central Greece, between these gulfs and the Isthmus of Corinth; and the Peloponnesus (now the Morea), which lies S. of the isthmus. There were anciently seventeen states, varying greatly in extent and importance. In the N. were Thessaly on the E. and Epirus on the W. (which do not belong to modern Greece); in the centre were Locris E. and W., Phocis, Bœotia, Ætolia, Acarnania, Megaris, and Attica; in the Peloponnesus were Corinth, Sicyonia, Argolis, Achaia, Arcadia, Elis, Messenia, and Laconia. The islands are of three classes: (1) Those near the coast, as the Ionian Isles, Eubœa (Negropont), Cythera, Ægina, Salamis, etc.; (2) the Cyclades, around Delos, and the Sporades, scattered in the Ægean Sea; and (3) the large separate islands, as Crete and Cyprus. Ancient Greece had many colonies and dependencies on the coasts of Asia, Europe, and Africa, and the neighboring islands; modern Greece has none.

Greece is now divided into nomes (νόμοι), which correspond in names, and often in extent, to the states of ancient Greece. These nomes are divided into eparchies (ἐπαρχίαι), which are subdivided into demes (δῆμοι). There are now 13 nomes, 59 eparchies, and 353 demes. The devastation of the Greek revolution reduced the population to 612,608 in 1832; in 1853 it was 1,042,529, while the Ionian Isles had 230,000. In 1870 the total population was 1,457,894, while in European Turkey there were 6,000,000 Greeks.

Divisions and Population of Greece.

Nomes.	1860.	1870.
1. Attica and Viotia (Bœotia)............... Capital, Athens.	116,024	136,804
2. Evoia (Eubœa)............... Capital, Chalcis.	72,368	82,541
3. Phthiotis and Phocis............... Capital, Lamia.	102,291	108,421
4. Acarnania and Ætolia............... Capital, Mesolonghi.	109,392	121,693
5. Achaia and Elis............... Capital, Patras.	138,249	149,561
6. Arcadia............... Capital, Tripolitza.	113,719	131,740
7. Laconia............... Capital, Sparta.	96,546	105,857
8. Messenia............... Capital, Kalamæ.	117,181	130,417
9. Argolis and Corinthia............... Capital, Nauplia.	127,370	127,820
10. Cyclades............... Capital, Hermopolis (Syra).	118,130	123,293
11. Corcyra............... Capital, Corcyra.	99,533	96,940
12. Kephallinia............... Capital, Argostoli.	92,929	77,382
13. Zacynthus............... Capital, Zacynthus.	44,760	44,557

Army, 12,420; navy, 1315; sailors abroad, 7133. The males were 754,176; females, 703,718; total, 1,457,894.

Greece is exceedingly irregular in form. Its surface is greatly diversified by mountains, and its coast-line is very extensive in comparison with its surface. It has in this last respect the same characteristic among European countries that Europe has among the continents. Less than Portugal in extent, it has more extent of coast than "the whole Pyrenean peninsula." (THIRL., *H. of G.* i. 1.) Its mountain-system divided the country like a checker-board, and gave character to its people and their civilization. The Cambunian Mountains were the boundary between Macedonia and Greece; Pindus, a lofty chain running S., separated Thessaly (*Trikhala*) from Epirus (*Albania*), and at 39° sent off Othrys (*Gura*), now, in part, the N. boundary of Greece, and Œta (*Katavothra*), which ran S. E., and reached the sea at the noted pass of Thermopylæ; Pelion and Ossa are on the E. coast of Thessaly. The main chain, under the successive names of Parnassus, Helicon, Cithæron, and Hymettus, runs S. E. through Phocis, Bœotia, and Attica to Sunium, and Parnes separates Bœotia from Attica, joins Cithæron, and the united range extends nearly to the isthmus. The mountains of the Peloponnesus are sent forth from the central state, Arcadia. The highest are Cyllene (7788 feet) in the N. E. of the Peloponnesus, Erymanthus (7297 feet) in the W., Parnon (*Malevo*), (6355 feet), extending along the E. coast to Malea, Taygetus (*Pentedactylon*), (rising to 7902 feet), which separates Laconia and Messenia, and extends to Tænarum (*Matapan*). The Geranean Mountains are in Megaris; the other states and the islands are mountainous. Cithæron is 4630 feet high, Helicon 4963, and Parnassus 8000, while Olympus rises to the height of 9700 feet. The noted fortified hills of Greece were the Acrocorinthus (1886 feet high), Ithome at Messene (2631 feet), Larissa at Argos (900 feet), while the celebrated Acropolis at Athens is only 150 feet high. The valleys are generally very narrow. The plains are mostly small, and situated on the seashore and at the mouths of rivers or enclosed by mountains. Those of Thessaly, Bœotia, Messenia, Argos, and Marathon were the most celebrated, and are very fertile. Numerous lakes form in the spring, but they either dry up in the summer or degenerate into stagnant marshes. Copais in Bœotia, Trichonis in Ætolia, Stymphalus and Lycuria in Arcadia, and Ambracia (*Valto*) in Acarnania are the largest of the permanent lakes. There are no navigable rivers in Greece, and very few are perennial. The most important is the Achelous (*Aspropotamo*), which rises in Mount Pindus, flows S., and empties into the Ionian Sea. It is 130 miles long. The Cephissus and Ilissus, flowing past Athens, are exhausted in summer before they reach the Saronic Gulf. The Spercheus flows E. 60 miles from Pindus, between Othrys and Œta, to the Malian Gulf. The Cephissus bursts forth from the base of Parnassus, and flows E. through the fertile plain of Bœotia into Lake Copais. The Eurotas (*Vasilipotamo*) and the Alpheus (*Rofia*) are the chief streams in the Peloponnesus. The Peneus (*Salamoria*), which waters the fertile plains of Thessaly, and flows through the beautiful Vale of Tempe, is now in Turkey. The numerous gulfs running into the land supply the place of rivers.

The Pindus range is composed of primitive and metamorphic rocks, such as granite, mica-schist, serpentine, etc., while Parnassus, Helicon, etc. are mainly of a hard gray limestone, the characteristic rock of Greece, which often assumes the form of the most beautiful marble. There are no volcanoes, but traces of volcanic action are everywhere manifest in the forms of the mountains, fissures, caverns, mineral springs, etc. The hot springs of Thermopylæ and the mephitic vapors that inspired the priestess at Delphi are famous in history. Copper, lead, iron, silver, and even gold, are found. The silver-mines at Laurium in the S. of Attica were formerly quite valuable. Antimony, cobalt, manganese, and sulphur exist, and also salt. Gypsum and porphyry are quarried, but the most beautiful products of the quarries are the white marble of Mount Pentelicus and the green and red marbles of the Peloponnesus and some of the islands.

The climate of Greece was more salubrious in ancient than in modern times. It varies according to location, and the heat of summer may be found in the S., the warmth of spring in Laconia, and the severity of winter in Arcadia in March. Near the coast snow is rare; on some of the mountains it lies nearly the entire year. The cold N. wind prevails even in summer. The sirocco often sweeps over the southern portions, and the S. E. wind brings the rains of spring and autumn. But even in these rainy seasons the atmosphere is fresh and clear, except in Bœotia, the land of fogs and malaria, which affect body and mind. Attica has a pure, dry atmosphere, a sky of deep and beautiful blue; hence Athens is a most pleasant place of residence.

In ancient as in modern times the domestic animals of Greece were the horse, ass, mule, ox, sheep, goat, hog, and dog. Oxen are used for agriculture; sheep and goats con-

stitute the wealth of the rural population. In ancient times swine's flesh was the favorite meat: now it is mutton. The bear, wolf, boar, lynx, wild-cat, jackal, deer, etc. are found in the mountains: eagles, vultures, hawks, owls, etc. are numerous, and game is abundant. Many of the mountains have been stripped of their forests, so that the fertility of the soil and the climate have been unfavorably affected. Taygetus, Parnassus, Helicon, and others have not been denuded. The pine is the most common tree: the beech, chestnut, cypress, and oak are found. The soil is thin, and agriculture is backward. Irrigation is practised, but the implements generally are as primitive as in the days of Hesiod. Mountains and marshes occupy one-half of the land, and only one fifth of the remainder is cultivated. The state owns more than three-fourths of this, renting it on the "metayer" system, the oxen and seed being furnished by the proprietor, who receives a large percentage of the crop. Wheat, barley, and maize are raised: rice is produced in the plains of Argos and Marathon, and in the marshy regions. Cotton and tobacco grow in the plain of Argos and elsewhere. Vineyards are numerous, but the wine is poor. In Laconia, Messenia, and the islands the mulberry is cultivated for the sake of the silkworm. Almonds, figs, oranges, lemons, and other fruits abound. Olives are produced in all parts of Greece; the oil is used for light and instead of butter. The currant, or small Corinthian grape, is raised in large quantities along the shores of the Gulf of Corinth and on the islands. The figs of Attica and the honey of Hymettus are proverbially excellent. Manufactures are unimportant. In the towns they are of cutlery, earthenware, hardware, articles in leather, silk, hats, cotton and woollen cloths, brandy, vinegar, etc.; in the country cotton and woollen cloths are woven. Shipbuilding is carried on at the seaports, and salt is made in a few places.

The position of Greece, the conformation of the country, its numerous bays and islands, all tend to make the Greeks a seafaring people. For centuries it was in the pathway of commerce. Its exports have always been the simple products of the country. The imports are manufactured goods from Western Europe, such as cloths, hardware, and fancy articles; coffee, rice, drugs, and spices from Turkey. The grain-trade of the Black and the Mediterranean seas is almost exclusively in the hands of Greek merchants. The principal ports are Hermopolis (*Syra*), the centre of steam navigation in the Levant; Hydra, Spezia, Corcyra (*Corfù*), Zacynthus (*Zante*) on the islands; Piræus (the port of Athens), Patras, Mesolonghi, Nauplia, etc. They trade with Constantinople and Smyrna, Trieste, Palermo, Leghorn, Marseilles, and Liverpool. In 1821, Greece had 440 vessels, measuring 61,450 tons, most of which were destroyed in her revolution, when her navy became so distinguished. In 1871 her commercial marine amounted to 6135 vessels, with a capacity of 119,350 tons, and manned by 35,144 sailors. Imports are nearly $25,000,000; exports, $15,000,000. There are several lines of steamers, both Greek and foreign. The ports have been improved and lighthouses erected. There are no canals, but the Euripus between Bœotia and Eubœa has been rendered navigable, and since the success of the Suez Canal a contract has been made to pierce the Isthmus of Corinth, and thus complete within four years what was begun 1800 years ago. There are but few roads practicable for carriages in Greece, that from Athens to Thebes being the longest. In Jan., 1869, the first railroad was opened in Greece. It extends 7 miles from Athens to Piræus. Another of the same length stretches from the mines of Laurium to the port, and a third is projected from Piræus to Lamia, nearly 140 miles. There are about 1000 miles of telegraph lines, all owned by the government. The postal service is good. Horses, mules, asses, and even camels, are used for the transportation of merchandise and for travel.

The debt of Greece in 1870 was $60,000,000, contracted mainly in achieving her independence. Revenue in 1873, estimated at $6,000,000, expenditures at a little less. The revenue is derived from duties on imports, a tithe of the gross product of the farming lands, and a royalty of 25 per cent. as rent for the lands belonging to the state.

The *Government* is a constitutional hereditary monarchy. King Otho governed the country from 1833 to 1843 without a constitution. The liberty-loving Greeks effected a bloodless revolution on Sept. 14, 1843, and a national assembly was called, which framed a constitution that was approved by the king Mar. 16, 1844. It established hereditary monarchy—the Holy Orthodox Catholic and Apostolic Church, while tolerating others, but forbidding proselytism. All persons are equal before the law; personal liberty is inviolate; titles of nobility and slavery are forbidden; the right of petition, trial by jury, the freedom of the press, the public administration of justice, the independence of the judiciary, the security of letters and domicile, are all guaranteed. The king appoints his ministers, seven in number, who are responsible to the legislature and take part in its deliberations. At first there were a senate (Γερουσία), named by the king for life, and a house of representatives (Βουλή), elected by the people for four years. But in 1864, after the expulsion of Otho and the accession of George I., the senate was abolished and the legislative power was vested in the *boule*, to consist of not less than 150 members; there are now 190. The suffrage is universal, and elections are by ballot. A council of state examines all bills, and may offer amendments to the boule within a certain time. The king must be a member of the Greek Church, and so must the heir-apparent. The king receives about $250,000 per annum, and has a palace in Athens and a summer residence in Corcyra (*Corfù*). The present king is George I., second son of Christian IX., king of Denmark, b. Dec. 24, 1845. He accepted the crown from the national assembly June 5, 1863. He married Olga, daughter of the grand duke Constantine of Russia, Oct. 27, 1867. The crown prince, Constantine, was b. Aug. 2, 1868, and received the title duke of Sparta. There are two other sons and one daughter.

Administration of Justice.—The supreme court of Greece is called the Areopagus. The kingdom is divided into four judicial districts, each having a royal court of appeal; there are 13 primary courts of appeal, and 120 justices of the peace. The judicial legislation is excellent, and is based mainly on the Code Napoléon. Criminal cases and offences of the press are tried by jury. Judges and advocates must have received the degree of LL.D. from the University of Athens or from one of the universities of Europe, and must have passed a satisfactory examination before a special commission. The judges are appointed by the king, and removable, but they are noted for their independence and integrity. Punishments are fines, imprisonment, and in capital cases death by guillotine. The prisons are rather defective in construction and administration. Brigandage is only too common, and murder not infrequent, but drunkenness and immorality are rare.

The *Religion* established is the Holy Orthodox Catholic and Apostolical Church, to which nearly all the population belong. All religions are tolerated, but there are only 12,555 members of other Christian churches and 3199 Jews, Mohammedans, etc. The Church in Greece became virtually independent of the patriarchate of Constantinople at the time of the revolution (1821), and was organized by decree July 15 (27), 1833, upon the model of the Russo-Greek Church, but its independence was not acknowledged by the patriarch until 1850. Its supreme council is the Holy Synod of five members, appointed annually by the king. The metropolitan archbishop of Athens is *ex-officio* the president, and a majority must be archbishops or bishops. Two royal officials may assist in the deliberations of this body, which elects archbishops and bishops, who must be approved by the Crown. There are 16 archbishops and 13 bishops—one for each nome. There are four ecclesiastical seminaries, containing 115 students. A certain degree of instruction is now prescribed for all priests, and the higher dignitaries are selected only from those of the highest culture and blameless lives. The priest is generally married, but must have married while a deacon, and cannot marry a second time without demitting his office. The priests do not preach, but certain well-qualified persons appointed by the bishops. The archbishops and bishops are paid small salaries by the state, but the priests depend upon their flocks, and receive only a meagre support. The monks who inhabit the numerous monasteries are ignorant and degraded.

Education.—Popular education is widely diffused in Greece. "While her villages were burning and her fields were running blood her national assembly discussed under the orange trees of Epidaurus a law to systematize public instruction." Under Otho primary schools were established by law in every deme. Education is free even in the university. In 1835 there were 71 primary schools, with 6721 pupils; 21 Hellenic, with 2528 pupils; 3 incomplete gymnasia, and 1 inchoate university; now there are 1141 demotic schools, with 60,634 pupils (nearly 200 of which, containing 11,000 pupils, are for girls); 114 Hellenic schools, with 5000 pupils; 15 gymnasia, with 1800; universities at Athens and Corfù, the former with 1205 students; 4 ecclesiastical seminaries, with 115 students; 6 normal schools, with 83 students; and 12 private schools, containing 1000 girls; total, 69,837. Many pupils are in private schools. The demotic schools afford elementary instruction, the Hellenic schools prepare students for the ordinary pursuits of life or for the gymnasia, which are nearly equal to our colleges, and are manned by about 100 professors, each of whom must be at least a Ph. D. To enter the University of Athens, Greek students must have completed the course of the gymnasium. It opened in 1835 with 52 students; it now has 1205, of whom about one-half are from Greece. There are the four facul-

ties of theology, law, philosophy (literature and science), and medicine. There are 51 professors and 12 fellows. The course of studies requires three or four years, and the degrees are those of licentiate and doctor, and are essential for those who contemplate a profession. The university has a library of 100,000 vols. and valuable museums. Baron Sinna, a wealthy Greek of Vienna, erected an astronomical observatory on the Hill of the Nymphs at Athens. He and other Greeks have founded various other public institutions. Polytechnic schools exist in several places; archæological, medical, natural history, and other societies exist at Athens.

The press is free in Greece. There are 40 printing-presses in Athens, and as many more in other parts of the country. Upward of 30 newspapers are published in Athens, some of them daily, and there is not an important town without its journal. The political, literary, and religious newspapers are more than 120 in number. Only since her regeneration could Greece cultivate literature. Art is not much cultivated, and time alone can determine whether the Greeks have inherited the æsthetic nature of their ancestors.

All able-bodied men in Greece are held to military service for twelve years, three of which must be in the regular army. In 1873 this consisted of 12,397 men, all others in the service being styled national guards. The officers are chiefly graduates of the military school at Athens. The navy consists of 2 plated frigates, 8 screw-steamers, and a number of sailing vessels. There are 1315 sailors, who are obtained by conscription among the seafaring people. The police or gensdarmerie often need the assistance of the regular army against the brigands. Brigandage is a relic of the war of independence, for which the government is often unjustly blamed. H. C. Cameron.

Greece, Ancient History of. The early history of Greece is enveloped in the clouds of fable. In the exploits of imaginary heroes are presented the movements of nations, and the events of an era are shadowed forth in the traditions of a people.

The earliest inhabitants of Greece were probably the Pelasgi, an Aryan nation who came from the high tableland of Asia, passed around the Caspian Sea into Europe, and settled in Greece and Italy. They have left traces of their existence in the religion of the Greeks, in the names of places, and in the walls composed of huge stones found in various places. They were composed of various tribes, among whom the Hellenes were the most powerful, and before whom the others disappeared. Their original seat, according to Aristotle (*Meteor.*, i. 14), was near Dodona in Epirus, but they first appear in the southern part of Thessaly about B. C. 1384. The Hellenes represented themselves as the descendants of a common ancestor, Hellen, son of Deucalion and Pyrrha. The name Pelasgia was supplanted by that of Hellas, denoting at first a small district, and subsequently the entire land inhabited by the Hellenes. The names Greece and Greeks are derived from the Romans. The Hellenes were divided into Dorians, Æolians, Ionians, and Achæans, descended respectively from Dorus and Æolus, sons of Hellen, and Ion and Achæus, sons of Xuthus, the third son of Hellen. Hellen and his sons were purely mythical persons. These four divisions of the Hellenic people were distinguished from one another by their institutions, and even the peculiarities of their language. The physical features of the country exerted a powerful influence upon the people, determining their character, giving form to their political institutions, and assisting in the development of a peculiar type of civilization. High mountains and small enclosed plains open to the sea tended to produce a bold, adventurous people, who loved individual liberty, who were jealous of the rights of their little states or cities, but who could rarely unite for a grand purpose except under a conqueror or a pressing necessity. There are traces of Oriental influence in Greece, and tradition attributes the first elements of civilization to colonies from the East. To Cecrops, a native of Sais in Egypt, Attica is said to have owed the institution of marriage, religion, and the foundation of Athens. Argos is said to have been founded by Danaus, an Egyptian, and the Peloponnesus owes its name to Pelops, a Phrygian, son of Tantalus, who by his wealth and influence became king of Mycenæ. Cadmus, a Phœnician, is said to have built Cadmea, afterwards the citadel of Thebes, in Bœotia. The earliest forms of the Greek letters, and especially their names, show their Phœnician origin; weights and measures, and shipbuilding also, the Greeks probably received from the Phœnicians.

From the appearance of the Hellenes in Greece, about B. C. 1384, to the siege of Troy, B. C. 1184, is called *the heroic age*. These heroes were represented as of divine descent—superior to ordinary men in qualities of mind and body. Hercules was the national hero of Greece, and his labors represented in mythical form the triumph over physical and moral evil, the attainment of wealth and power. Theseus represented the establishment of civil government in Attica, and Minos the triumph of law and social order. So the expedition of the Argonauts under Jason presents the progress of commerce; and the Trojan war, the greatest of the heroic achievements, as sung by Homer in the *Iliad* and the *Odyssey*, gives not only a vivid picture of the manners and institutions of early Greek society, but also exhibits the contest between Greek and Oriental civilization. Although the Greeks were divided into many small communities, yet there were bonds of union in their community of blood and language, of religious rites and festivals, of manners and character. In these respects they were distinguished from all other people, whom they styled barbarians. Their most celebrated oracles were at Dodona and at Delphi, and public games (see Games) were held in honor of different gods at stated intervals. Thus, the Greeks were brought together and reminded of their common origin and mutual interests. The state of society in Greece in the earlier ages was not unlike that of the feudal ages in Europe. Each state had its own king, whose authority was not limited by laws, but was partially restrained by the council of chiefs, or *boule*. The *agora*, or assembly of the people, merely met to hear the decision of the kings and chiefs. There were three classes of persons—the nobles, powerful and wealthy; the freemen, some of whom possessed estates; and the slaves. The manners even of the highest class were simple; nobles were proud of their skill in the manual arts, and their wives and daughters discharged the various household duties. The Greeks dwelt in fortified towns adorned with palaces and temples, and the poems of Homer attest alike their skill in war and their culture in poetry and in art. War was their delight, and even piracy was honorable. Æolus, son of Hellen, succeeded his father, and his descendants occupied Central Greece, and even the W. coast of the Peloponnesus. The Æolians were widely scattered, and became a seafaring people. The Achæans in the heroic age were the most warlike of the Greeks, and their chiefs were the most distinguished in the Trojan war. At that time they dwelt in Thessaly, and also possessed Mycenæ, Argos, and Sparta in the Peloponnesus. The Dorians and Ionians were of small importance in the earlier history. The former were confined to Doris, a small mountainous district between Thessaly and Phocis; the latter were settled on the N. coast of the Peloponnesus and in Attica. In historical times these became the leading races of Greece, the Dorians being represented by Sparta, the Ionians by Athens. Thucydides (i. 12) speaks of the migrations that occurred among the Greeks. The Dorians overran the Peloponnesus B. C. 1104. This invasion was styled the "return of the Heraclidæ," because led by the descendants of Hercules, who had long been fugitives from Argos. The country was divided among the leaders, and the defeated Achæans drove out the Ionians from the N. coast of the Peloponnesus, which portion was henceforth called Achaia. The Ionians went to Attica, and thence to Asia Minor. The earliest migration from Greece was in B. C. 1124, when the Æolian clans proceeded from Thessaly and Bœotia to the N. part of Asia Minor and the islands of Lesbos and Tenedos. The Ionians followed B. C. 1040, and settled on the coast of Lydia and the islands of Chios and Samos. The Dorians soon after settled the S. part of the coast and the islands of Rhodes and Cos. Cumæ was founded B. C. 1050 by a colony from Cyme in Asia and Chalcis in Eubœa. Colonies were subsequently planted in the S. of Italy and in Sicily. So numerous and important were the colonies in Southern Italy that it was called Magna Græcia. Colonies were also planted at Cyrene in Africa, Massilia (Marseilles) in Gaul, and along the coast from Greece to the mouth of the Danube, at Selymbria, Byzantium, and many other places. These colonies show the hardy and adventurous spirit of the Greeks. The most noted in Asia were Smyrna, Ephesus, and Miletus; in Italy, Sybaris, Croton, and Tarentum; in the island Corcyra (Corfu); and Syracuse and Agrigentum in Sicily.

The two most important states of Greece were Attica and Laconia, generally designated as Athens and Sparta from the names of their capitals. The other states, as Arcadia, Bœotia, Locris, Phocis, etc., consisted simply of small independent cities. Sparta had supplanted Argos as the chief state in the Peloponnesus soon after the Dorian conquest. She owed her supremacy to the military and political institutions of Lycurgus, who flourished between B. C. 850 and 776. The Spartans were a mere handful of people surrounded by enemies, and hence were compelled to be soldiers. The ordinances of Lycurgus, and the severe gymnastic and military training to which the Spartans were subjected, changed their government and society, and made them almost irresistible. This discipline enabled Sparta to conquer Messenia, Arcadia, and Argos. Lycurgus, having obtained from his countrymen an oath to observe his

institutions until his return, disappeared, and the Spartans worshipped him as a god. (See Lycurgus.) The Spartans were descendants of the Dorians, and alone had political rights. The Perioeci were descended from the old Achæan population, and engaged in trade, while the Helots were the slaves. Sparta was nominally a monarchy under two kings, but was really an oligarchy in the hands of five ephori. The other states or cities of Greece became democratic. The change from monarchy to democracy usually pursued a regular course. An oligarchy of nobles would overthrow the monarchy, and then some one of the nobles would espouse the cause of the people and overthrow the oligarchy. He was styled a *tyrannus*—*i. e.* a "usurper"—in allusion to his mode of obtaining power, and not to his manner of exercising it. Resistance to his government incited violence on his part, and he became really a tyrant. His power was rarely transmitted to the third generation, and a democracy usually succeeded. Sparta was the type of an oligarchy; Athens, her great rival, the example of a democracy. Corinth was under the tyrants Cypselus and his son Periander from B. C. 655–585.

The early history of Athens is involved in obscurity. Tradition says that Cecrops divided Attica into twelve states, which were consolidated, with Athens as the capital, under Theseus, the national hero. The Dorians invaded Attica, and the Delphic oracle promised them victory if they spared the life of the Athenian king. Codrus entered their camp in disguise and provoked a quarrel with one of the soldiers, who killed him. The Dorians, learning the fact, withdrew, and the Athenians, from respect to the memory and patriotism of Codrus, abolished the title of king and instituted that of archon. (See Archon.) The people were divided into three classes—*eupatridæ*, or nobles, *geomori*, or husbandmen, and *demiurgi*, or artisans. The government of the eupatridæ was so oppressive that in B. C. 621, Draco was appointed to draw up a code of laws. They were so severe that they were said to have been written in blood. Cylon attempted a revolution B. C. 612, but failed. Some of his followers were murdered at the altar of the Eumenides or Furies, and this sacrilege was the source of constant trouble to Athens. Megacles, the archon, was of the family of the Alcmæonidæ, and they were afterwards banished because tainted with sacrilege. The people of Attica were divided into three factions—the *Pedicis*, or wealthy nobles of the plain; the *Diacrii*, or poor inhabitants of the hills; and the *Parali*, or merchants along the shore. The poorer classes were in poverty, their lands and persons being pledged to their creditors; many were reduced to slavery. Amid their dissensions the people turned to Solon, a man of great wisdom and patriotism. Solon became archon B. C. 594, with unlimited power. His legislation relieved the poor and repealed the laws of Draco, except those against murder, and divided the people into four classes, according to their income. The kind of military service and the right to hold office were alike determined by income. (See Solon.) Solon bound the Athenians by an oath to observe his laws for ten years, and set out upon his travels. In his absence the old local dissensions broke out again, and the result was the triumph of Pisistratus, the leader of the party of the Mountain, in B. C. 560. Twice driven out, he became tyrannus again in B. C. 537, and at his death (B. C. 527) left his power to his sons, Hippias and Hipparchus. He did much for the culture of art and literature at Athens. In consequence of a private quarrel, Harmodius and Aristogeiton slew Hipparchus, and the character of Hippias was completely changed. Clisthenes, of the family of the Alcmæonidæ, secured the Delphic oracle, which induced the Spartans to overthrow Hippias. Clisthenes returned, but controlled the state only by making the constitution more democratic. Athens now defeated Thebes, conquered a part of Eubœa, and, despite the opposition of Sparta, entered upon her glorious career.

We have already alluded to the migrations of the Greeks, which occurred shortly after the Trojan war. Colonies were of two classes—the one sent out under chosen leaders with religious ceremonies, and were really independent; the other were merely garrisons. The Greek settlements in Asia Minor and the adjacent islands consisted of Æolians in the N., Ionians in the middle, and Dorians and Achæans in the S. These colonies were conquered by Crœsus, king of Lydia, who ascended the throne B. C. 560. Cyrus, king of Persia, overthrew him B. C. 546, and also subdued the Greek cities except Samos. The Ionians revolted against the Persians B. C. 500, and the Athenians sent twenty ships and the Eretrians sent five to assist them. The combined forces entered, plundered, and accidentally burned Sardis. Great numbers were slain in the retreat. The Athenians returned home, and the enraged Darius, king of Persia, vowed vengeance upon them. He crushed the rebellion, and then sent Mardonius, his son-in-law, to punish the Athenians and Eretrians. He crossed the Hellespont, conquered Thrace and Macedonia, but losing 300 ships and 20,000 men in a hurricane at Mount Athos, he led his forces back to Asia (B. C. 492). Datis and Artaphernes were now sent with 600 galleys, besides transports, and 110,000 men. They captured Eretria, and landed on the plain of Marathon, under the guidance of Hippias. Sparta, the leading state of Greece, through superstition, did not send aid in time. Only the little town of Platæa sent 1000 heavy-armed soldiers to assist the 10,000 Athenians, and a few slaves as light-armed troops. Under the skilful leadership of Miltiades, assisted by Callimachus, Aristides, and Themistocles, the Athenians gained a most brilliant victory (B. C. 490). The Persians lost 6400, the Athenians only 192, who were buried on the field, and the mound over their remains still exists. The Persians sailed back to Asia. Athens had saved Greece and gained immortal glory. The conduct of Ægina in favoring Persia led to a war between her and Athens. This war and the foresight of Themistocles, the leading statesman of Athens, made her a maritime power. She prepared a fleet of 200 ships, to which 20 were annually added. In B. C. 480, Xerxes, the son of Darius, led an immense army against Greece. He threw a bridge over the Hellespont and cut a canal through Mount Athos. When he reached the pass of Thermopylæ his land and sea forces amounted to 2,641,610, and the attendants swelled the number to 5,283,220. So great was the terror inspired by this vast army that only a few cities of the Greeks took part in the congress which Athens and Sparta summoned to meet at Corinth. A stand was made at Thermopylæ (which see). Xerxes conquered Greece, except Delphi, as far as Athens, which was burned. The Persian fleet sustained heavy losses in storms on the Greek coast and in battle at Artemisium, but after the battle at Thermopylæ the Greek fleet retreated to Salamis. It was prevented from dispersing only by the skill and policy of Themistocles. The Persians had about 1200 vessels; the Greeks had less than 400, of which 200 were Athenian. The battle took place in the narrow strait between Attica and Salamis. Xerxes from his throne on the shore beheld the defeat of his fleet and the loss of 200 vessels. Becoming alarmed, he returned to Asia, leaving Mardonius with 350,000 men in Thessaly to conclude the war. He again invaded Attica, and the Athenians again abandoned their city. Their patriotism, and their intimation to Sparta that they might not continue this course, at last alarmed and aroused the Spartans. A Greek army of 110,000 defeated the Persians at Platæa (B. C. 479), and Mardonius was slain. On the same day the Persian army was defeated and their fleet burned at Mycale in Asia. The patriotism and sacrifices of Athens had made her the leader of Greece, and the treachery of Pausanias, the Spartan commander, confirmed her position. The confederacy of Delos was now formed against Persia, and delegates from the different states met regularly in the temple of Apollo and Artemis on that island. Aristides the Just, who had been ostracised, but returned to take part in the battle of Salamis, fixed the assessment in ships or money on the different states. The yearly amount was 460 talents, nearly $500,000, and the treasury was in Delos. Athens was now rebuilt, and through the energy and diplomacy of Themistocles was surrounded with walls, and Piræus became its port. From the battle of Marathon (B. C. 490) to the beginning of the Peloponnesian war (B. C. 431) was the most brilliant period of Athenian history. Themistocles had created her navy, Aristides had conciliated her allies, Cimon increased her reputation, and Pericles enlarged her resources, formed alliances, and conquered her enemies. The prosperity of Athens excited the jealousy of Sparta, and her treatment of her allies produced great dissatisfaction. She had freed the Greek cities in Asia Minor from taxation, but the death of Cimon, who had been recalled, brought an end to the Persian war (B. C. 448). Athenian power culminated in the defeat of the Thebans at Œnophyta (B. C. 456). Pericles revolutionized the Athenian constitution amid many struggles, making it completely democratic, impairing the power of the Areopagus or supreme court, and of the senate of five hundred. He endeavored to consolidate Athenian power, and but for her arrogance and unwise conduct she might have continued much longer to exercise the hegemony or leadership of Greece. A revolution in Bœotia and her defeat by the Thebans at Chæronea (B. C. 447) were the beginning of her reverses. She soon lost her control of Central Greece, and Pericles reconquered only Eubœa. By the thirty years' truce (B. C. 445) she abandoned all her acquisitions in the Peloponnesus. Pericles now devoted himself to the internal affairs of the city. He erected the Propylæa, the Parthenon, and the temple of Victory on the Acropolis, the Theseum and other buildings in the city. He built the long walls to the Piræus

and sent out colonies. Athens became the centre of art and literature. Architecture and sculpture reached their highest excellence. The greatest names in Greek literature adorn this century: in tragedy, Æschylus, Sophocles, and Euripides; in comedy, Aristophanes; in history, Herodotus and Thucydides; all of whom, except Herodotus, were Athenians, and even he resided at Athens.

Athens had lost her empire on land, and her allies in the confederacy of Delos were dissatisfied with the heavy tribute (now 600 talents) exacted by Athens, her misapplication of it, and the oppression of the members. Samos revolted, but was subdued and punished. Nearly all, however, waited only an opportunity to free themselves. A dispute between two Corinthian colonies led to the war that overthrew Athens. Corinth had sent a colony to Corcyra (Corfu), and Corcyra had established a colony at Epidamnus in Illyria, taking, however, a leader from Corinth. A war of factions broke out at Epidamnus, those in the city being assisted by the Corcyræans, those who had been driven out being aided by the Corinthians. The Corcyræans defeated the Corinthians in a naval battle (B. C. 435). The latter prepared to revenge their defeat, and as they were in alliance with the Lacedæmonians, the Corcyræans applied to the Athenians for help. To avoid breaking the truce the Athenians made only a defensive alliance. In the next battle the Corinthians were victorious, and a small Athenian squadron interfered to save the Corcyræans. A renewal of the battle was about to take place when twenty more Athenian vessels appeared. Thinking these to be the advanced guard of a large fleet, the Corinthians retired, and, although not attacked, returned home. These events occurred B. C. 432. The Corinthians, with Perdiccas of Macedonia, induced Potidæa, a tributary of Athens, to revolt. The Megarians also complained that Athens excluded them from her ports. The Lacedæmonians were urged by their allies to declare war against Athens. War was determined upon at Sparta B. C. 431, although it was precipitated by a treacherous attack of Thebes upon Platæa. This war was one of races and of principles; Athens represented the Ionian tribes, democracy, and progress; Sparta, the Dorians, aristocracy, and conservatism. Athens was a maritime power, and controlled Eastern and Asiatic Greece and most of the islands; Sparta was a land power, and controlled Western Greece, Southern Italy, and Sicily. The states with Athens were mainly subject allies; those with Sparta constituted a voluntary confederacy. Athens had great financial resources; Sparta depended upon occasional contributions. The Peloponnesians, except Argos and Achaia, were with Sparta, hence the name of the Peloponnesian war. It may be divided into three periods: (1) From its beginning to the Peace of Nicias (B. C. 431–421); (2) from the peace to its rupture by the Spartans (421–413); (3) from this rupture to the capture of Athens (413–404). Pericles pursued a defensive policy, and induced the rural population to retire within the walls of Athens while Archidamus, the Spartan king, ravaged the country. The Athenians sent out expeditions to retaliate, and made preparations for a long war. The invasion of Attica was repeated in 430 B. C., and a plague carried off one-fourth of the people in Athens. The people became dissatisfied with Pericles, but soon restored him to power. The epidemic carried off many of his friends and members of his own family. Depressed by his afflictions and weakened by the disease, he died of a lingering fever. Athens thus lost her greatest statesman and orator (B. C. 429). Nicias became the military leader, and was, upon the whole, successful, although the Peloponnesians invaded Attica five times in seven years. In B. C. 429 the memorable siege of Platæa began. It was taken in 427, and the Lacedæmonians put every prisoner to death. The town was transferred to the Thebans, who utterly destroyed it. Mitylene in Lesbos revolted from the Athenians, and domestic dissensions led to its surrender to the Athenians. It narrowly escaped the fate of Platæa proposed for it by the low Athenian demagogue Cleon. Scenes of horror were enacted by the popular party at Corcyra about this time. In B. C. 425 bad weather detained an Athenian fleet at Pylus in Messenia. Demosthenes, an active officer, threw up a rude fortification, and remained there with five ships and 200 hoplites. A large Lacedæmonian fleet and army were unable to dislodge him; and while preparing for a second attack an Athenian fleet appeared, defeated the Lacedæmonian fleet, and blockaded their army on the island of Sphacteria. The Spartans at last proposed a peace, but Cleon induced the Athenians to demand extravagant terms. Hostilities were renewed, and the Athenians made but little progress. Demosthenes made unfavorable reports, and the Athenians blamed Cleon for preventing them from making peace. He made boasts of what he would do if he were general, was taken at his word, and through ridicule was compelled to lead the force sent to assist Demosthenes. Cleon promised to take Sphacteria in twenty days, and either kill or bring all the Lacedæmonians to Athens. Fortune favored him. Demosthenes had prepared all things for the attack, and Cleon arrived in time to share the glory. Of the 420 Spartans, 292 surrendered, and the prestige of Sparta was destroyed. Cleon literally fulfilled his promise. Pylus was garrisoned with Messenians, and the Spartans repeatedly proposed peace, but the elated Athenians declined. In B. C. 424 they were defeated at Delium in Bœotia, and met with severe losses in Thrace. Brasidas, the Lacedæmonian, was very successful in Macedonia and Chalcidice. He gained Amphipolis before Thucydides could bring assistance from Thasos, and hence the latter was banished. Cleon was disgracefully defeated by Brasidas before Amphipolis (B. C. 422), when both commanders fell. Pleistoanax, the Spartan king, and Nicias in B. C. 421 concluded a peace for fifty years, called the "Peace of Nicias." The hatred of Corinth to Athens, and the influence of the brilliant but profligate Alcibiades at Athens prevented a sincere peace, and led to the renewal of the war. The Athenians assisted Argos, and (B. C. 418) Argives and Athenians were defeated at Mantinea by the Spartans without rupturing the peace. In B. C. 416 the Athenians conquered Melos and practised horrible cruelties. In B. C. 416, Segesta and Selinus in Sicily had a quarrel; Syracuse assisted Selinus, and Segesta appealed to Athens for aid. Alcibiades favored the appeal, and an armament was prepared. The mutilation of the Hermæ or marble statues of Hermes in the streets of Athens aroused the superstitious terrors of the Athenians, and arrested the sailing of the fleet. Alcibiades was charged with this crime and the profanation of the Eleusinian mysteries. He denied the crime, but was refused the immediate investigation he demanded. The fleet sailed under Nicias, Alcibiades, and Lamachus, and was intended to extend Athenian influence in Sicily. Alcibiades was recalled to stand his trial, but escaped to Sparta and revealed the plan of the Athenians. He was condemned to death in his absence. Lamachus and Nicias had been partly successful in Sicily, having taken Catana and Naxos and defeated the Syracusans. The siege of Syracuse took place the next year, reinforcements having arrived from Athens. Lamachus died, and Nicias seemed on the point of success when affairs were changed by the arrival of Gylippus, the Spartan commander, and the Athenians were really the besieged party. Reinforcements were sent to Nicias under Demosthenes and Eurymedon. The Spartans openly broke the peace (B. C. 413) by invading Attica. Disaster and disease overtook the Athenians at Syracuse. They prepared to abandon their position, when an eclipse of the moon occurred and deterred them. In a battle by land they were victorious, but at sea they were defeated and Eurymedon was slain. In a second naval battle in the harbor they were again defeated. The army of 40,000 men now attempted to retreat, but they were pursued, scattered, and at last compelled to surrender at discretion. Nicias and Demosthenes were put to death, and the soldiers were reduced to slavery. This disaster was a terrible blow to Athens. Her allies in Asia and the islands, except Samos, threw off the yoke. For a time the Spartan fleet was successful, but again the tide turned in favor of the Athenians. Alcibiades had lost the confidence of the Lacedæmonians and escaped to the Persians. He separated the Peloponnesians and the Persians, and secured his own restoration and a change of government through hope of Persian aid. An oligarchy of 400 was established at Athens B. C. 411, but they retained the power only four months, and the old constitution was restored. The Athenian fleet gained several victories—one at Abydos by the help of Alcibiades. Tissaphernes, the Persian satrap, changed his views and arrested Alcibiades, but he managed to escape. He joined the Athenian fleet, which defeated the Lacedæmonians and Persians at Cyzicus (B. C. 410). Thus masters of the Propontis, they could send provisions to Athens, although the Lacedæmonians held Decelea and ravaged the fields of Attica. The Athenians rejected the Lacedæmonian offers of peace, and soon after recovered Selymbria and Byzantium, chiefly through Alcibiades, who was recalled to Athens and magnificently received. Cyrus, the younger son of Darius II., now became Persian satrap, and Lysander, an able and energetic officer, commanded the Lacedæmonian fleet. Alcibiades took command of the Athenian fleet, but accomplished little. Conon, his successor, was defeated by Callicratidas. Reinforcements arrived from Athens, and the Athenian fleet was successful in a desperate battle at Arginusæ (B. C. 405). Lysander now became the real although not the nominal navarchus of the Lacedæmonians, and captured nearly the entire Athenian fleet at Ægospotami (B. C. 405). Conon escaped with a few vessels, but 3000 or 4000 prisoners and

the generals were put to death. This victory really closed the war. Lysander devastated Salamis and blockaded the Piræus, while the Peloponnesian army encamped at the gates of Athens. Famine compelled her to surrender in Mar., B. C. 404. She was completely humbled; her walls were demolished to the music of the flute, her ships were surrendered, and she was stripped of all her foreign possessions. Oligarchical principles triumphed with Sparta, and decarchies with a Spartan harmost were appointed in the Athenian cities. At Athens a committee of thirty, known as the Thirty Tyrants, supported by a Lacedæmonian garrison, supplanted the democracy, and a reign of terror ensued. Throughout Greece the rule of Sparta became more cruel than that of Athens had ever been, and a revulsion of feeling occurred in reference to Sparta and Lysander. Thrasybulus and other exiles seized Phyle on Mount Parnes, took the Piræus, defeated the force of the Thirty, and killed their leader, Critias. The Thirty were deposed and a committee of ten was appointed. Lysander came with a Lacedæmonian force, but was superseded by King Pausanias. Matters were finally arranged; a general amnesty was proclaimed, the obnoxious laws were changed, Thrasybulus and the exiles entered Athens, and the democracy was restored (B. C. 403).

It was at this time that Socrates, the wisest and best of the Greeks, a martyr for the truth, was put to death upon the false charge of infidelity and corrupting the youth. The Anabasis, or expedition of Cyrus the Younger to dethrone his brother, Artaxerxes, occurred B. C. 401. Xenophon led back from Cunaxa to the sea the 10,000 Greeks who were a part of the army. The weakness of Persia was thus revealed to the Greeks. A war ensued between Sparta and Persia. Agesilaus was called home from Asia by the troubles in Greece, which were aided by Persia. The Thebans defeated the Spartans and slew Lysander at Haliartus (B. C. 395), and compelled Pausanias to retreat. Athens, Corinth, Argos, and other states formed an alliance with Thebes against Sparta. Agesilaus defeated the allies at Coronea (B. C. 394), but Conon and Pharnabazus destroyed the Lacedæmonian fleet at Cnidus, and the Spartans lost their maritime supremacy. The combined fleet came to Greece, and Conon rebuilt the fortifications of the Piræus and the long walls. The war continued with varying success in Greece and in Asia until Sparta induced Persia to impose a disgraceful peace on the Greeks (B. C. 387). Sparta now attacked Bœotia, seized the citadel of Thebes by treachery, and conquered Olynthus. Her power on land was at its height B. C. 379, and her unpopularity was commensurate. Pelopidas and other exiles recovered Thebes; Athens and Thebes organized a confederacy of seventy cities against Sparta. A war of seven years ensued, and through Athenian jealousy of Theban success the Peace of Callias was made (B. C. 371). Thebes refused to sign the peace unless acknowledged as the head of Bœotia. In the war that ensued, Epaminondas, the great Theban commander, utterly defeated the Spartans at Leuctra (B. C. 370). This event electrified Greece. Epaminondas next ravaged Laconia, established an Arcadian confederation at the new city, Megalopolis, and restored the Messenians. Sparta fell at once from her high position, and even asked the aid of Athens. Pelopidas settled disturbances in Thessaly and in Macedonia, and Epaminondas again successfully invaded the Peloponnesus. Pelopidas with other deputies went to the king of Persia, who declared Thebes to be the head of Greece (B. C. 366). Pelopidas was slain in an expedition into Thessaly. A war broke out between Elis and Arcadia, the Mantineans and Spartans supporting the former. Epaminondas marched into the Peloponnesus to assist the Arcadians. He gained a decisive victory over the combined force at Mantinea (B. C. 362), but himself fell mortally wounded. The greatness of Thebes began and ended with this able man. Peace was now made, according to his dying advice. Greece was now completely exhausted by these struggles. Athens regained some of her former prosperity, but lost much in every way by a war with her allies, whose independence Persia compelled her to acknowledge (B. C. 355). A new power was now rising in the neighborhood of Greece. Macedonia lay N. of Thessaly; its people were despised as barbarous; its kings claimed to be of Hellenic descent. Philip, the youngest son of Amyntas II., became king of Macedon B. C. 359, at the age of twenty-three. He took Amphipolis and defeated the Illyrians. He conquered Pydna, Potidæa, and Thrace as far as the Nestus, thus gaining control of the gold mines of Pangæus, which yielded him 1000 talents annually. The Sacred war, between Thebes and Phocis, prepared the way for Philip's supremacy. The Amphictyonic Council imposed a heavy fine on the Phocians for cultivating sacred soil. Driven to desperation, they seized Delphi and appropriated the sacred treasure. Philip appeared as champion of the Delphic god, slew the Phocian leader, and became master of Thessaly. An Athenian army prevented him from passing Thermopylæ. Demosthenes, the great Athenian orator, now appeared as the opponent of Philip. When Philip threatened Olynthus, Demosthenes infused more energy into the Athenians. His *Olynthiacs* and his *Philippics* are among his most celebrated orations. Olynthus was taken B. C. 347, and many other towns fell into Philip's hands. By deceit and bribery he gained as much as by war. He induced the Athenians to make peace, but excluded the Phocians, who soon surrendered. They were ruined, and the Amphictyonic Council at Delphi gave him the seat of which the Phocians were deprived. He shared in the honor of presiding at the Pythian games, and in B. C. 346, Macedon became the leading state of Greece. His attempts on Byzantium, Perinthus, and the Chersonesus were successfully resisted by aid of the Athenians. He came into Greece to conduct a sacred war against Amphissa, but seized Elatea, showing that he aimed at Bœotia and Attica. Demosthenes aroused the Athenians to resistance. They united with the Thebans, and on Aug. 7, B. C. 338, was fought the battle of Chæronea, which crushed the liberties of Greece. Philip treated Thebes with severity, but offered advantageous terms of peace to Athens. A congress of Greek states, except Sparta, met at Corinth, declared war against Persia, and appointed Philip commander-in-chief. While making preparations for the expedition he was assassinated, and his son Alexander, then twenty years old, succeeded him. He was thoroughly educated in every respect. The courage and energy he displayed secured his appointment as leader of the expedition against Persia. He suppressed disturbances in Thrace and Illyria. Thebes revolted, and was utterly destroyed, save Pindar's house, and the inhabitants reduced to slavery. Greece was terror-struck, and leaving Antipater as regent he set out for Asia with 35,000 soldiers (B. C. 334). He marched along the coast of the Propontis, and defeated the Persians at the river Granicus. Turning S., he took Sardis, then Ephesus, Magnesia, Miletus, and many other places. In the spring he received reinforcements at Gordium, marched E. without resistance until he reached Issus, where he defeated the immense army of Darius, 600,000 strong. He conquered Phœnicia and Egypt in twenty months. With 47,000 troops he marched towards the centre of the empire, and encountered and defeated the immense army of Darius about 20 miles from Arbela. The capitals, Babylon, Susa, and Persepolis, with their enormous treasures, surrendered. Three years were spent in conquering the N. E. provinces of the Persian empire, and then Alexander advanced into India, conquered Porus, and overran what is now called the Punjaub. His army refused to go farther than the Hyphasis (Sutlej), and he then descended the Indus, and after terrible sufferings returned to Persepolis. At the height of his power, he now meditated the conquest of Arabia. After a banquet given in connection with the preparations he was seized with a fever and died (June 28, B. C. 323). His plans perished with him, and his empire was divided among his generals. Philip Arrhidæus, his half-brother, was proclaimed king, reserving, however, to Alexander's child by Roxana (whom he had also married), if a son, a share in the empire. Perdiccas eventually became the guardian of Philip, Roxana, and her son Alexander, but was murdered in Egypt. Antipater now became regent; Ptolemy received Egypt; Seleucus took the satrapy of Babylon; and Antigonus had Susiana, Phrygia, Lycia, and Pamphylia. Harpalus had wasted the royal treasures at Ecbatana, and fled when Alexander returned from the East. Demosthenes was falsely accused of receiving a bribe from Harpalus at Athens, and was fined and imprisoned, but managed to escape. Upon the death of Alexander, Hyperides in Athens and Demosthenes in exile endeavored to arouse the Greeks to revolt, but only the smaller states joined Athens. Antipater took refuge in Lamia, but was reinforced, and defeated the allies at Crannon in Thessaly (B. C. 322). Demosthenes had been recalled to Athens, but was now demanded as one of the conditions of peace. He escaped to Calauria, and in the temple of Poseidon took poison and died. Antipater died soon after, leaving the regency to Polysperchon, and not to his son Cassander. He, however, shortly became regent, and murdered Olympias, and finally Roxana and her son. Various changes occurred in the East. After the death of Cassander, Macedonia changed rulers repeatedly and rapidly, until Antigonus Gonatas gained control of nearly all Greece. His oppression caused the revival of the Achæan league 251 B. C. It was originally for religious purposes; it now embraced Athens, Corinth, Megara, Ægina, Salamis, and the Peloponnesus, except Sparta, Elis, and a few others. In B. C. 221, Sparta opposed the league, but by the assistance of the Macedonians was completely defeated. An Ætolian league had been formed in Central Greece which

defeated the Achæans, and Philip, king of Macedonia, was called in by the latter. He gained several victories, but soon made peace. Siding with Carthage in her struggle, he was defeated by the Romans. Philopœmen led the Achæans and defeated the Lacedæmonians, allies of Rome. The Romans made peace and retired, but at the close of the Second Punic war they declared war against Philip, and both the Ætolian and the Achæan leagues joined them. He was defeated at Cynoscephalæ (B. C. 197), and his supremacy was destroyed. Flaminius proclaimed the freedom of Greece (B. C. 196). The Ætolian league was crushed (B. C. 189). Perseus succeeded Philip (B. C. 179). War broke out, and L. Æmilius Paulus defeated Perseus at Pydna (B. C. 168), and led him to Rome to adorn his triumph. Thus ended the Macedonian empire, and Macedon became a Roman province. Sparta appealed to Rome against the Achæans, and in B. C. 147, Roman commissioners decided that Sparta, Corinth, and all the cities except those in Achaia should be independent. Riots ensued in Corinth, and the commissioners barely escaped. A second embassy was insulted, and Rome declared war. Metellus defeated the Corinthian leader, Critolaus, and Mummius overthrew his successor, Diæus, near Corinth. The inhabitants of the city were reduced to slavery, its priceless treasures of art were carried away, and the city was consigned to the flames. Greece perished B. C. 146, and henceforth was only a province of the Roman empire under the name of *Achaia*. Greece was conquered, but her civilization and culture conquered Rome:

> *Græcia capta ferum victorem cepit, et artes*
> *Intulit agresti Latio.*

HENRY C. CAMERON.

Greece, Modern, continued to form a part of the Byzantine Empire until the time of the fourth crusade (A. D. 1203). The old empire was then broken up, and its provinces divided among the Frankish princes. The dukedom of Athens belonged successively to several different families, from A. D. 1205 to 1453, when, on the fall of Constantinople, Greece came under the Moslem yoke. After the signal defeat of the Turks at Vienna (A. D. 1684) the Venetians joined the Christian league, and with a powerful fleet, under the command of Francesco Morosini, invaded Greece, conquered the Peloponnesus, and took possession of Athens (A. D. 1687). It was during the bombardment of the citadel by the Venetians at this time that the Parthenon, in which the Turkish garrison had stored their powder, was shattered by an explosion. But the Venetians did not take much trouble to keep what they had won. It was scarcely a dozen years ere they abandoned Athens, and by A. D. 1718 the whole of Greece was again in the power of the Turks. For a century longer the Greeks groaned under this cruel despotism. But in the spring of 1821 the war of independence began. The first battle, fought on June 19, was disastrous for the Greeks. Prince Alexander Ypselantes was defeated, with the loss of 400 men, most of whom were among the noblest and bravest youth of the country. In Jan., 1822, the first national assembly met at Epidaurus and framed a provisional constitution. In the same year occurred the terrible massacre in Scio, by which the population of that beautiful island was reduced, in less than twelve months, from 120,000 to not more than 16,000 souls. This year was also marked by several gallant and successful exploits of the little Greek navy, especially by the burning of the flagship of the Turkish commander by the fireships of Admiral Canares. The slaughter of Scio was thus at least partly avenged, for the Turkish admiral, who perished in dreadful agonies in this engagement, was the same who had led the bloody expedition against that ill-fated island. The next year (1823) witnessed the bold and successful midnight attack upon the Turkish camp at Carpenesion, in which 800 Turks were slain, with a loss of only 50 on the part of the assailants. But among these 50 was the heroic Suliote chief himself, Marcos Botzares. It was in this year also that Lord Byron arrived in Greece, or rather in the Ionian Islands, where he spent five or six months in correspondence and preparations. He arrived in Missolonghi on Jan. 5, 1824, and d. there on the 19th of the following April. It was there that he wrote, on Jan. 22, his thirty-sixth birthday, those melancholy lines beginning with "My days are in the yellow leaf," and ending with what seems like a presentiment of his approaching death. The funeral services were held in the same church where the body of the brave Botzares was resting, and an eloquent oration was pronounced by Mr. Tricoupes, the historian of the Greek revolution, and for many years the representative of Greece at the court of St. James. In Apr., 1825, this important fortress fell before the army of Ibrahim Pasha after a gallant defence and many instances of heroic valor worthy of Marathon and Thermopylæ. Nearly the whole of Greece was now at the mercy of the Turks. In July of this year they laid siege to Athens, which after an obstinate resistance fell into their hands in June of the following year. The cause of Greek independence seemed now hopeless, unless the Christian powers of Europe should interpose in her behalf. After many unsuccessful embassies on the part of Greece, and much fruitless correspondence between the courts of England, France, and Russia, a treaty was at last signed in London on July 6, 1827, by the plenipotentiaries of these three powers, providing that an immediate armistice should be established between Turkey and Greece, and proposing to place Greece on the footing of a tributary province, with the right to choose her own governors. Greece was in no condition to reject these humiliating terms; but, happily for her, the Porte was too proud or too obstinate to accede to them. The sultan's government indignantly resented any interference, and even refused to receive a written communication from the allied powers. These last now perceived that they must either adopt more rigorous measures or else stand before the world in a very humiliating position. They at once augmented their fleets in the Mediterranean, and instructed Admiral Codrington, who was chief in command, to prevent the landing of any more hostile troops upon the soil of Greece. Ibrahim Pasha, the commander of the Turco-Egyptian fleet, refused to comply with this demand. His force, consisting of 120 vessels, including 79 ships of war, and carrying more than 2000 guns, was lying in the harbor of Navarino. On Oct. 20 the allied fleets consisting of only 26 vessels, and carrying about 1300 guns, entered the harbor, but without intending to make an immediate attack. This was brought on, however, by the enemy, who fired upon a boat sent with a flag of truce, and killed several persons. After a bloody action of three or four hours the allies gained a complete victory. The Turkish squadron was almost annihilated. Not more than twenty or thirty vessels remained in a sailing condition: the rest were either burned or driven ashore. This was a decisive blow; the freedom of Greece was now secure. But the triumph was embarrassing to the victors. It was not their policy—at least not that of France and England—to weaken so fatally the Ottoman power. The king of England, in his address to his Parliament, expressed his regret at "this unfortunate collision with an ancient ally." The duke of Wellington spoke of it as an "untoward event." But Greece was exultant. It was nearly two years, however, before hostilities entirely ceased, the last battle having been fought in Bœotia on Oct. 7, 1829. In this engagement Prince Demetrius Ypselantes, the brother of him who was so disastrously defeated in the first battle of the war, gained a brilliant victory over a Turkish force of 7000 men.

What was to be done with the liberated territory? At the close of the war the government was in the hands of the Count Capo d'Istria, who had left the Russian service and assumed the presidency of Greece at the beginning of the year 1828. When the protecting powers had at last come to an agreement to erect Greece into an independent kingdom, Prince John of Saxony, a scholar and a poet, had the first offer of the throne. Upon his refusal, Prince Leopold of Saxe-Coburg was the next choice of the guardians of Greece. He accepted the crown on certain conditions, but some of these conditions being unacceptable to the allies, and other difficulties arising, he soon resigned the honor. He was nominally king of Greece only from Feb. 11 to May 22, 1830. Both these princes afterwards enjoyed prosperous and peaceful reigns, the former as king of Saxony (1854–73), and the latter as king of Belgium (1831–65). In October of the following year the president, Capo d'Istria, was assassinated at Nauplia. This event accelerated the negotiations of the protecting powers, and their third choice fell on Otho, second son of Louis, king of Bavaria. This choice was solemnly ratified by the national assembly of the Greek people, and in Feb., 1833, the young prince, then not quite eighteen years of age, arrived at Nauplia, then the seat of government. A Bavarian regency managed the government until 1835, in which year Otho, now twenty years of age, assumed the reins of government and transferred the capital to Athens. For ten years Greece was governed by the house of Bavaria without a constitution. The Greeks have never been lovers of despotism, and during all the stormy period of the revolution the forms of constitutional government had been generally observed. After much discontent and several unsuccessful insurrections the will of the people at last expressed itself in a manner not to be resisted. On the night of Sept. 14, 1843, the palace of Otho was surrounded by the entire garrison of the capital and a crowd of excited citizens. Gen. Kalerges, who commanded the military force, informed His Majesty that they had come to demand a constitution, and that they should remain until their demand was granted. There was no alternative; the king promised to call a national assembly at once to frame a constitution; and thus in one autumn night, without a drop

of bloodshed or an act of violence, Greece became a constitutional kingdom. The national assembly met on Nov. 20; its discussions on the articles of the constitution continued until Mar. 14, 1844; and on the 16th of the same month the constitution was definitively adopted and received the royal signature. Amid frequent complaints and several conspiracies Otho administered the government under—perhaps sometimes *over*—this constitution for twenty years longer. But in Oct., 1862, while the king and queen were indulging themselves in a short excursion in the royal yacht among the beautiful islands of the Ægean, Greece decided to change her master; and when their Majesties returned after about ten days they were met in the harbor of Salamis by a deputation, who informed them that the throne of Greece had been declared vacant, and that the provisional government would not allow them to come on shore. The royal pair were obliged to exchange their yacht for a British man-of-war, which bore them safely to Venice, whence they proceeded to the capital of Bavaria. Otho had no son to whom he could bequeath his reserved rights to the throne. On Dec. 1, the provisional government issued a decree ordering the election, by universal suffrage, of a new constitutional king. The vote resulted in the almost unanimous choice of Prince Alfred, second son of Victoria, queen of England. Out of 241,202 votes he received 230,016. Out of every 44 votes, 43 were polled for him. He was accordingly officially proclaimed the constitutional king of Greece, elected by the sovereign will of the Greek people. But former treaty stipulations between the three protecting powers forbade that any member of the royal family of either should ever wear the crown of Greece. A joint protocol of the three powers, dated May 27, 1863, declared the throne of Greece still vacant, and on June 5 another similar protocol offered the crown to Prince George of Denmark, second son of King Christian IX., and younger brother of Alexandra, princess of Wales. He accepted the offer on condition that the Ionian Islands, which had been since 1814 a nominal republic under the protection of the British crown, should be annexed to the kingdom of Greece. The protecting powers assented to this condition, and the national assembly of Greece ratified the whole proceeding, and declared the prince already of age, though he yet wanted six months of having completed his eighteenth year. Near the end of Oct., 1863, King George I. arrived in Athens, and took possession of his throne. On Oct. 27, 1867, he was married to Her Royal Highness the princess Olga, daughter of the grand duke Constantine and niece of Alexander II., emperor of Russia. Four children, three sons and one daughter, give good security that no future trouble will arise in regard to the succession to the throne.

A. N. ARNOLD.

Greece, post-v. and tp. of Monroe co., N. Y., on Lake Ontario. The township contains Charlotte, the port of Rochester, and numerous other villages. Pop. of Greece v. 737; of tp. 4314.

Greece City, post-v. of Butler co., Pa., 5 miles from Butler, at the extreme end of the lower oil-region. It has 1 school, a church, a bank, 2 hotels, 1 temperance paper, and 31 operating oil-wells. Pop. about 400. ED. "REVIEW."

Greek Church. I. *Name and Extent.*—The full title is the *Holy Oriental* (or *Eastern*) *Orthodox Catholic Apostolic Church*. The words *Holy Catholic Apostolic* are derived from the Nicene Creed, and are also claimed by the Roman Church in an exclusive sense. *Oriental* or *Eastern* designates the origin and geographical territory. The greatest stress is laid on the title *Orthodox*, and a special festival is devoted to its celebration—viz. "Orthodoxy Sunday," at the beginning of Lent, when a dramatic representation of the old œcumenical councils is given in the churches, and anathemas are pronounced against heresies. The popular designation *Greek* Church, though not strictly correct, refers to the prevailing nationality and language in which most of its creeds, liturgies, and theological and ascetic literature are composed and its worship mainly conducted.* The Greek Church embraces, however, also the Russian and other Slavonic nationalities. It has its seat in Western Asia and Eastern Europe, chiefly in Turkey, Greece, Russia, and some parts of Austria. It never spread southward and westward except in a few isolated congregations of Greek merchants and colonists, or in connection with the Russian embassy (at Vienna, Trieste, Geneva, Berlin, Paris, London, New York). The numerical strength of the Greek Church is estimated at eighty millions, which is about one-half of the Roman Catholic membership, and nearly equal to the Protestant population. She is behind both in intelligence, activity, and influence upon the course of history, but has an unconquerable tenacity, and may have an important future through the immense political power of Russia.

II. *Division.*—The Greek Church is divided into three great branches: 1. The Orthodox Church in TURKEY, under the patriarch of Constantinople, with the subordinate patriarchates of Alexandria, Jerusalem, and Antioch. Constantinople, the city of the first Christian emperor (New Rome), though now in the hands of the Turk, is still the natural centre of the whole Greek Church, and may become for the Eastern world, at some future day, in Christian hands what Gregory Nazianzen eloquently described it to be in the fourth century, "the eye of the world, the strongest by sea and land, the bond of union between East and West, to which the most distant extremes from all sides come together, and to which they look up as to a common centre and emporium of the faith." 2. The Orthodox Church in RUSSIA, under the permanent Holy Synod of ST. PETERSBURG and the czar, whose dominion now stretches in unbroken line across the two continents of Europe and Asia. The czar is the personal, as Constantinople is the local, centre of the whole Greek Church, and he keeps a lustful eye upon the city of the Bosphorus as his future capital, where at no distant day there must be a tremendous reckoning with Mohammedanism. 3. The National Church of the kingdom of GREECE, which since 1833 is governed likewise by a permanent holy synod, but less dependent upon the state than the Russian Church. 4. Distinct from these, and belonging to the Roman Church, are the UNITED GREEKS, scattered through Turkey, Hungary, Galicia, Transylvania, and Russia. They acknowledge the authority of the pope, and adopt the dogma of the double procession of the Holy Spirit, but are otherwise allowed to hold to their ancient discipline, marriage of the lower clergy, *communio sub utraque*, leavened bread, their liturgy, and the use of the Greek language. 5. The Greek, or rather Oriental SCHISMATICS, Nestorians, Jacobites, Armenians, Maronites, etc., are separated from the Greek and Latin Catholic Church mostly on the dogma of Christ's person, and have independent organizations, which rise up as the broken fragments of ancient national churches from surrounding Mohammedanism and heathenism in Western Asia and Africa.

III. *Historical Survey.*—The Greek Church has no continuous history like the Latin or the Protestant. She has long periods of monotony and stagnation; she is isolated from the main current of progressive Christendom; her languages and literature are little known among Western scholars; she has more interest for the antiquarian and traveller than for the historian and philosopher. Yet this Church is the oldest in Christendom, and for several centuries she was the chief bearer of our religion. She still occupies the sacred territory of primitive Christianity, and claims most of the apostolic sees, as Jerusalem, Antioch, Ephesus, and the churches founded by Paul and John in Asia Minor and Greece. All the apostles, with the exception of Peter and Paul, labored and died in the East. From the old Greeks she inherited the language and certain national traits of character, while she incorporated into herself also much of Jewish and Oriental piety. She produced the first Christian literature, apologies of the Christian faith, refutations of heretics, commentaries of the Bible, sermons, homilies, and ascetic treatises. The great majority of the early Fathers, like the apostles themselves, used the Greek language.‡ Polycarp, Ignatius, Clement of Alexandria, Origen, Eusebius, Athanasius, Basil, Gregory of Nazianzen, Gregory of Nyssa, Chrysostom, Cyril of Jerusalem, and Cyril of Alexandria, the first Christian emperors from Constantine the Great, together with a host of martyrs and confessors, belong to the Greek communion. She elaborated the œcumenical dogmas of the Trinity and Christology, and ruled the first seven œcumenical councils, which were all held in Constantinople or its immediate neighborhood (Nicæa, Chalcedon, Ephesus). Her palmy period during the first five centuries will ever claim the grateful respect of the whole Christian world, and her great teachers still live in their writings far beyond the confines—nay, even more outside of her communion, as the books of Moses and the prophets are more studied and better

* Owing to the long connection with the East Roman empire of Byzantium, or New Rome, the Greek Church is best known in the East as "Roman," not as "Hellenic," and till recently the Greeks distinguished themselves as "Romans" from the [illegible] Turks. The term Γραικός, used by Polybius as equivalent to the Latin *Græcus*, was by the Greeks themselves always regarded as an exotic. They called themselves *Hellenes*.

‡ The Jews were indeed converted before the Greeks [illegible], but the Jewish Christian church [illegible] lost into the Greek, and the majority of the converted Jews were Grecian Jews or Hellenists.

§ Even Clement of Rome, Hermas, Irenæus, Hippolytus, and others who belong to the Western Church, wrote in Greek. The early popes were Greeks. The very name of pope is Greek, and belongs to every priest in the East. The Roman congregation itself was originally a colony of Greek Christians, Hellenes and Jewish Hellenists. In this respect the maxim of Horace holds good: "*Græcia capta ferum victorem cepit.*"

understood among Christians than among the Jews for whom they wrote. But she never materially progressed beyond the standpoint occupied in the fifth and sixth centuries. She has no proper middle age, and no Reformation, like Western Christendom.

IV. We may distinguish three periods in the history of the Greek Church.

1. The *classical* or *productive* period, the first five or six centuries, which has just been characterized. The last great divine of the East is John of Damascus (about 730), who summed up the scattered results of the labors of the preceding Fathers into a tolerably complete system of theology. But he is an isolated phenomenon. The process of degeneracy and stagnation had already set in, and the former life and vigor gave way to idle speculations, distracting controversies, dead formalism, and traditionalism.

2. The *Byzantine* period, corresponding to the Middle Ages of the Latin Church, from the rise of Mohammedanism to the fall of Constantinople (A. D. 650–1453). Here we have the gradual separation from the West and from all progressive movements; dependence on the imperial court at Constantinople: continuation of a certain literary activity; philological and biblical studies in slavish dependence on the Fathers; commentaries of Œcumenius (A. D. 1000), Theophylact († 1107), Euthymius Zigabenus († about 1120); large literary collections, classical and Christian, of Photius (about 890), Balsamon, Zonaras, Suidas, and Simeon Metaphrastes; the liturgical works of Maximus, Sophronius, Simeon of Thessalonica; the Byzantine historians; the image-controversy (726–842); inroads and conquests of Mohammedanism (since 630) in Syria, Persia, Egypt, North Africa; temporary suspension of the patriarchates of Alexandria, Antioch, Jerusalem; finally, the conquest of Constantinople by the Turks and the extinction of the Greek empire (1453), which led to the emigration of Greek scholars (Chalcondylas, Chrysoloras, Pletho, Michael Apostolius, Theodore Gaza, George of Trebizond, etc.) to the West, the revival of letters, the study of the Greek Testament, and, aided thereby, the preparation for the Reformation. Yet during this period of decline in her original home the Greek Church made a great conquest in the conversion of the Slavonians—namely, the Bulgarians and Russians (in the ninth and tenth centuries), while the Latin Church converted the Celtic and Teutonic races.

3. The *modern* period, which may be dated from the downfall of the Greek empire (1453). It presents in Asia stagnation and slavery under the tyranny of the Turks, but with great tenacity and independence as to all internal affairs; in Europe rapid external growth through the rising power of Russia, with some reforms in manners, customs, and the introduction of Western culture; protests against Romanizing and evangelical movements; the orthodox Confession of Peter Mogilas (1642); the Synod of Jerusalem (1672); the Russian Church; the patriarchate of Moscow; the reforms of patriarch Nicon († 1681), and of the czar Peter the Great († 1725); the reaction of the "Old Believers" (Raskolniki); the Holy Synod of St. Petersburg (since 1721); the New Greek Church in Hellas (since 1827); modern influences from the West; prospects for the future.

V. *Doctrine and Theology.*—The Greek Church is in doctrine substantially agreed with the Roman, but upon the whole more simple and less developed, though in some respects more subtle and metaphysical. The only serious doctrinal difference is that on the PROCESSION OF THE HOLY GHOST (which see). She holds to the leading principles, but rejects many of the consequences or results, of Roman Catholicism. She adheres to the theology of the Fathers, and ignores the succeeding scholastic theology of the Schoolmen, who completed the Roman system. The Eastern theology is not properly systematized. It remains rigidly in the fragmentary state of the old councils. The resistance to the Western clause *filioque* implied a protest against all further progress both in truth and in error, and meant stagnation, as well as faithful adherence to the venerable symbol of the first and most important of the œcumenical councils. The Greek theology is most full on the doctrine of God and of Christ, but very defective on the doctrine of man and the order of salvation. The East went into all sorts of theological and Christological subtleties, especially during the long and tedious Monophysite controversies, which found little or no response in the West; but it ignored the Pelagian controversies, the development of the Augustinian and later evangelical theology. It took the most intense interest in the difference between *ousia* and *hypostasis*, the *homo-ousion*, the relations of the persons in the Trinity, the *perichoresis*, the relation of the two natures in Christ, the Nestorian, Eutychian, and Monophysite heresies, but was never seriously troubled with the questions about predestination and election, total depravity and freedom, vicarious atonement, justification and imputation, conversion and regeneration, faith and good works, merit and demerit, vital union to Christ, and cognate doctrines which absorbed the attention of Western Christendom. The cause for this difference must be sought in the prevailing metaphysical, rhetorical, and objective character of the Eastern Church, inherited partly from Asia, partly from Greece, as distinct from the practical, logical, and subjective tendency of the Western churches, which is derived from the Roman and the Teutonic nationalities. The difference is illustrated already by the Nicene Creed, with its metaphysical terms about the Son, as compared with the more simple and popular Apostles' Creed, which originated in the West and is very little used in the East.

VI. *Government.*—The Greek Church is a patriarchal oligarchy, in distinction from the papal monarchy. The episcopal hierarchy is retained, the papacy rejected. The Vatican decrees of 1870 have intensified the separation between the two churches. Centralization is unknown in the East. The patriarchs of Constantinople, Alexandria, Antioch, and Jerusalem are equal in rights, though the first has a primacy of honor. The Eastern hierarchy resembles the Jewish type. The Greek priest within the veil of the sanctuary is concealed from the eyes of the people, but in social respects he is nearer the people than the Romish priest. He is allowed, and even compelled, to marry once, but forbidden to marry twice. Celibacy is confined to bishops and monks. Absolution is given only in the form of a prayer, "May the Lord absolve thee!" instead of the positive form "I absolve thee." The confessional exists, but in a milder form, with less influence and abuse, than in Romanism. The laity are more independent, and the Russian czar, like the Byzantine emperor of old, is the head of the Church in his dominion. The unction of confirmation is made to symbolize the royal priesthood of every believer. The monastic orders, though including many clergy, are not clerical institutions; the community of Athos is a lay corporation with chaplains.

The administration of the churches as developed in the Byzantine empire is most complicated, and involves, besides the regular clergy, an army of higher and lower ecclesiastical offices, from the first administrator of the church property (ὁ μέγας οἰκονόμος), the superintendent of the sacristy (ὁ σκευοφύλαξ), the chancellor or keeper of ecclesiastical archives (ὁ χαρτοφύλαξ), down to the cleaners of the lamps (οἱ λαμπαδάριοι), the bearer of the images of saints (ὁ βασταγάριος). These half-clerical officers are divided into two groups—one on the right, the other on the left; each is subdivided into three classes, and each class has again five persons. Leo Allatius and Heineccius enumerate fifteen officials of the right group, and even more of the left. But many of these offices have either ceased altogether or retain only a nominal existence.

VII. The *cultus* is much like the Roman Catholic, with the celebration of the sacrifice of the mass as its centre, with an equal and even greater neglect of the sermon, and is addressed more to the senses and imagination than to the intellect and the heart. It is strongly Oriental, unintelligibly symbolical and mystical, and excessively formalistic. The Greeks reject organs, musical instruments, and sculpture, and make less use of the fine arts in their churches than the Romanists; but they have even a more complicated system of ritualism, with gorgeous display, semi-barbaric pomp, and endless changes of sacerdotal dress, crossings, gestures, genuflexions, prostrations, washings, processions, which so absorb the attention of the senses that there is little room left for intellectual and spiritual worship.* They use the liturgy of St. Chrysostom, which is an abridgment of that of St. Basil, yet very lengthy, and contains, with many old and venerable prayers, later additions from different sources to an excess of liturgical refinement.

The most characteristic features of Greek worship, as distinct from the Roman, are—the threefold immersion in baptism, with the repudiation of any other mode as essentially invalid; the simultaneous performance of the act of confirmation and the act of baptism, which in the West have been separated; the anointing with oil in cases of dangerous illness, which Rome has changed into extreme unction of the dying; infant communion, which the Latin Church has not only abandoned, but forbidden; the communion under two kinds (κατὰ τὰ δύο εἴδη, *sub utraque*); the use of leavened instead of unleavened bread in the Eucharist; the standing and eastward posture in prayer; the stricter separation of the sexes; the use of the screen or veil before the altar, and the withdrawal of the performance of the mysteries from the eyes of the people.

The worship of saints, relics, flat images, and the cross is carried as far as, or even farther than, in the Roman

* Stanley (*Eastern Church*, p. 32) characterizes the Greek worship as "a union of barbaric rudeness and elaborate ceremonialism."

Church, but statues, bas-reliefs, and crucifixes are forbidden. The ruder the art the more intense is the superstition. In Russia especially, the veneration for pictures is carried to the utmost extent, and takes the place of the Protestant veneration for the Bible. The picture with the lamp burning before it is found and worshipped in the corner (the sacred place) of every room, in the street, over gateways, in offices, taverns, steamers, railway and telegraph-stations, in the knapsack of every soldier—not as a work of art, but as an emblem, a lesson of instruction, an aid to devotion. The vernacular languages are used in worship—the Greek in Turkey and Greece, the Slavonic in Russia—but they have to a considerable extent become unintelligible to the people. The Oriental sects hold to their native dialects, the Syriac, Armenian, etc. The old Greek calendar, which is eleven days behind the new style introduced by Gregory XIII., is still retained in distinction from the Roman and Protestant churches.

VIII. As to Christian *Life*, the Greeks and Russians are very religious in outward observances and devotions, but almost destitute of what Protestants mean by subjective, experimental piety and personal direct communion of the soul with the Saviour. They are liberal and deceitful in unmeaning compliments. The Greek Christians surpass their Mohammedan neighbors in chastity, but are behind them in honesty. What St. Paul says of the Cretans (Κρῆτες ἀεὶ ψεῦσται) is still characteristic of the whole race. In Russia there is the same divorce between religion and morality. The towns are adorned with churches and convents; every public event is celebrated by the building of a church; every house has an altar and sacred pictures; every child his guardian angel and baptismal cross: a Russian fasts every Wednesday and Friday, prays early and late, regularly attends mass, confesses his sins, pays devout respect to sacred places and things, makes pilgrimages to the tombs and shrines of saints, and has the phrase *Slava Bogu* ("Glory to God") continually on his lips. And yet even the priests are grossly intemperate, and public officials even to the highest dignitaries are said to be open to bribery.

IX. *The Greek Church and the Bible.*—Concerning the extent of the canon of the Scriptures the Eastern Church is not quite consistent, and stands midway between the Roman and the Protestant view concerning the Jewish Apocrypha. The "Orthodox Confession" repeatedly quotes the Apocrypha as authority, and the Synod of Jerusalem mentions several apocryphal books (The Wisdom of Solomon, Judith, Tobit, the History of Bel and the Dragon, the History of Susannah, The Maccabees, and The Wisdom of Sirach) as parts of the Holy Scriptures. On the other hand, Metrophanes enumerates only twenty-two books of the Old Testament (according to the division of Josephus, who counts the twelve minor prophets as one, and combines several historical books), and eleven books of the New Testament (counting fourteen Epistles of Paul as one book, and so the two Epistles of Peter and the three of John), and then speaks of the Jewish Apocrypha as not being received by the Church among the canonical and authentic books, and hence not to be used in proof of dogmas. The Longer Catechism of Philaret likewise enumerates (with Josephus, St. Cyril, and St. Athanasius) only twenty-two books of the Old Testament and twenty-seven books of the New, and says that "the Wisdom of the Son of Sirach and certain other books" are ignored in the list of the books of the Old Testament "because they do not exist in the Hebrew." The use of the Apocryphal books is founded in this, that "they have been appointed by the Fathers to be read by proselytes who are preparing for admission into the Church."

As to the *circulation* of the Scriptures among the laity, it is not encouraged, and certain portions, especially of the Old Testament, are declared to be unfit for general use. But the Greek Church has never expressly prohibited the reading of the Bible to the people, like the Roman; and the Orthodox Church of Russia has always had a popular version of the Bible, first in the old Slavic, and now in modern. Alexander I., by a ukase of Jan. 11, 1813, allowed even the British and Foreign Bible Society to establish a branch in St. Petersburg. Through the labors of this society nearly 500,000 copies of the New Testament and the Psalms were scattered in thirty-two languages all over the empire, and read with great avidity. A recent traveller says: "Except in New England and in Scotland, no people in the world, so far as they can read at all, are greater Bible-readers than the Russians." (HEPWORTH DIXON, *Free Russia*, p. 291.) A priest told him, "Love for the Bible and love for Russia go with us hand in hand. A patriotic government gives us the Bible, a monastic government (Nicholas) takes it away." But it should be remembered that not more than one out of ten Russians can read at all. The Bible drove the Jesuits from Russia, who opposed it with all their might. In 1825, Nicholas, under the influence of the monks, or the black clergy, placed the book under arrest, and replaced it by an official "Book of Saints." But the present emperor, Alexander II., the emancipator of the serfs, has also emancipated the Bible, and restored in part, at least, the liberty of the Bible Society, but restricted it to the Protestant population. The printing and circulating of the Bible in the Russian language and within the Orthodox Greek Church is under the exclusive control of the Holy Synod of St. Petersburg.

X. *Missions.*—The Eastern Church spreads, through Russian influence, in Siberia, the Aleutian Islands, and wherever the civil and military power of the czar prepares the way. But, apart from the aid of government, she has little or no missionary spirit, and is content to keep her own. Her greatest mission-work was the conversion of Russia, and this was effected not by preaching, but by the marriage of a Byzantine princess and the despotic order of the ruler. In the midst of the Mohammedan East the Greek populations remain like islands in the barren sea, and the Bedouin tribes have wandered for twelve centuries round the Greek convent of Mount Sinai probably without one instance of conversion to the creed of men whom they yet acknowledge with almost religious veneration as beings from a higher world. (*Stanley*, p. 34.) If the Turks are ever to be converted to Christianity, it must be done by other churches. Mohammedans regard the Greek and Roman Christians as idolaters, and cannot but despise the monks who annually disgrace by their fights the traditional spot of the crucifixion, and have to be kept in order by Turkish soldiers.

The want of missionary spirit, however, accounts also for greater freedom from the curse of proselytism and persecuting intolerance. The history of the Greek Church is not disfigured by bloody tribunals of orthodoxy, like the Spanish Inquisition, or systematic and long-continued persecutions, like the crusades against the Waldenses, Albigenses, Huguenots, with the infernal scenes of St. Bartholomew's massacre. Yet the Greek Church of old has mercilessly expelled and exiled Arian, Nestorian, Eutychian, and other heretics, persecuted the Paulicians (835); and modern Russia rigidly prohibits secession from the orthodox national Church. Nobody can be converted in Russia from one religion or sect to another except to the national orthodox Church, and all the children of mixed marriages, where one parent belongs to it, must be baptized and educated in it.

Literature.—The chief sources are the acts of the first seven œcumenical synods (from the first of Nicæa, 325, to the second of Nicæa, 787); above all the creeds and canons of the Council of Nicæa, 325, and the Council of Chalcedon, 451. The writings of the Greek Fathers, especially Athanasius, Chrysostom, and John of Damascus. The Confession of Gennadius, patriarch of Constantinople (delivered to the Turkish sultan, Mahomet II., 1453); the Orthodox Confession of Peter Mogilas, metropolitan of Kief, 1643; the eighteen decrees of the Synod of Jerusalem and the Confession of Dositheus (1672, mainly directed against the Patriarch Cyril Lucar and his attempt to Protestantize the Greek Church); the Russian catechisms of Platon, and especially of Philaret (metropolitan of Moscow, d. 1867). The Longer Catechism of Philaret, issued by authority of the Holy Synod of St. Petersburg, 1839, is used in all the churches and schools of the Russian empire, and is by far the best modern exposition of the orthodox doctrine of the Eastern Church. It contains in questions and answers a commentary of the Nicene Creed, the Lord's Prayer, the Nine Beatitudes, and the Ten Commandments. Modern works: LEO ALLATIUS, on the consent of the Greek and Latin churches (Col., 1648); LE QUIEN, *Oriens Christianus*, 1740; JAC. GOAR, *Euchologium, s. Rituale Græcorum*, 1647; JOHN KING, *Rites and Ceremonies of the Greek Church in Russia*, London, 1772; JOHN MASON NEALE, *History of the Holy Eastern Church*, London, 1850; DEAN STANLEY, *Lectures on the Eastern Church*, London and New York, 1861 (3d ed. 1866); GASS, *Symbolik der Griech. Kirche*, 1872. On the Russo-Greek Church see also the works of STRAHL, MOURAVIEFF, PINKERTON, BLACKMORE (*The Doctrine of the Russian Ch.*, 1845), HAXTHAUSEN, PHILARET (*Geschichte der Kirche Russlands*, 1872), BASAROFF, BOISSARD (*L'église de Russie*, 1867, 2 vols.), and Lect. 11th and 12th of DEAN STANLEY'S work on the *Eastern Church*. PHILIP SCHAFF.

Greek Fire, a highly inflammable compound, probably made of naphtha, saltpetre, and sulphur, and much used by the Byzantine Greeks in defensive and offensive warfare; but there is much doubt as to its composition. It was thrown by means of a copper tube upon the enemy, or pledgets of tow were dipped in it and attached to arrows, which were discharged at hostile ships or towns. This material was also used in Western Europe and in Asia to some extent in the Middle Ages. Its invention was ascribed to Callinicus of Heliopolis, in Egypt, in 668 A.D.; and it was first used by Constantine Pogonatus against the

fleet of the caliph Moawia at the siege of Constantinople in 673, with the most complete success. It is, however, generally considered an Arabian or an East Indian invention. The use of similar compounds called by the name has been attempted in modern times, without much success, the new plan being to throw it in shells or grenades.

Greek Language. The Greek belongs to the South European branch of the Indo-European family of languages, its nearest relations being with the Italic tongues—Latin, Oscan, Umbrian, etc. The admirable genius of the Greeks built up their language to a surprising degree of perfection, its chief excellences being copiousness of inflection and vocabulary, and consequent capacity for fine distinctions, wonderful power of self-development, great vivacity, flexibility of expression, and freedom from arbitrary rules. Most noteworthy, however, is it that this rich development is hardly at all the result of literary culture and the conscious reflection of scholars; its growth was complete in all essential particulars long before the time of the Homeric poems; it was unconsciously formed in the mouths of a people, gifted, but of rude manners and utterly ignorant of the art of writing.

PERIODS.—We may distinguish two chief periods in the history of ancient Greek: (1) The classic period, of growth, from the earliest times to 330 B. C.; (2) the post-classic period, of decay, from this date to about 800 A. D.; with the end of the eighth century may be said to begin (3) the modern Greek period.

DIALECTS.—There must have been a time when the Greeks were one undivided people and spoke exactly the same language, of which original Greek the Doric of later times preserved a better likeness than the Attic familiar to us. But the time and place of this Hellenic unity is matter of conjecture. In historic times the language was by no means uniform. Though all Greeks felt their community of speech, and seem to have understood one another without difficulty, yet the dialectic variations were considerable; they are largely phonetic, following fixed rules, but affect also vocabulary and syntax. Most of these dialects were little cultivated by literary use, and though they are of the greatest importance to the linguist, it is only recently that by effective researches their true relations have been brought to light. Unfortunately, our knowledge of them is incomplete. Only two, Ionic and Attic, do we know through copious literary monuments; of all the others (aside from scanty literary remains handed down in a corrupt state) our knowledge depends chiefly on inscriptions. The number of these has greatly increased of late years, and new discoveries are constantly bringing more to light the astonishing multiformity of the Greek tongue. The primary division of the dialects, as of the people itself, is a twofold one—into an eastern (Ionic) and a western (Æolo-Doric) branch. This dualism, which is sharply defined, arose, if we accept E. Curtius's theory, in that at a very early period, while both stems dwelt together in Asia Minor, the western Greeks separated themselves from the eastern, and migrated through Thrace into the peninsula of Greece, the Ionians remaining on the Asiatic coast, and only sporadically and much later coming across by sea and gaining a foothold in Greece proper; thus the Ionians would be essentially Asiatic, and the Æolo-Dorians European Greeks. This theory cannot yet be considered as established. According to the common belief, which assumes the peninsula as the common home of all Greeks, the deep cleft between Ionians and western Greeks must be otherwise (though less easily) accounted for. The western branch further divides itself into Æolic and Doric; so arises the common threefold division into Ionic, Doric, and Æolic. The western dialects are far more conservative than the Ionic. Common to all Æolo-Dorians is long α in most words for Ionic η, the better preservation of the *w*-sound (digamma or vau), and the particle κα = ἄν. The following are the chief individual dialects, with some characteristics of each.

A. ÆOLIC.—The dialects classed as Æolic lack that unity which the Doric have; the tribes speaking them seem to have been early dispersed over all Greece. They possess in common a certain instability of the vowel sounds, including a love for close vowels (ι, υ), and a preference for the μι-form of conjugation. There are two groups of Æolic dialects. The first includes—

1. *Asiatic Æolian* (Lesbian) of Lesbos and the neighboring coast. Ἀπυ = ἀπό, κρετος = κράτος; αις οις from ανς ονς, thus accus. μοίσαις = μούσας, λόγοις = λόγους (the Lesb. datives being μοίσαισι, λόγοισι); fondness for doubled consonants, βόλλα = βουλή, ἔνεμμα = ἔνειμα; general retraction of the accent, and dislike for the rough breathing, ὔμμες = ὑμεῖς. This is the language of Alcæus and Sappho, often called simply Æolic.

2. *Arcadian.*—Ἐς for ἐξ, καν for κα (= ἄν), κατύ, ἀπύ, for κατά, ἀπό; ζέλλω, δέλλω for βάλλω; subjunct. 3 pl. in -ωνσι; genitive of 1st decl. in αυ, ζαμιαυ = ζημιας.

3. *Cyprian.*—Ἰν, ἰπέρ for ἐν, ὑπέρ; κίν for ξύν, ἐρ for ἄρα, θόρα for θύρα.

The second group comprises—

4. *Thessalian.*—Δαυχνα = δάφνη, ὄν = ἀνά; ου for ω, as τοῦν πολιτάουν = τῶν πολιτῶν, γνούμας = γνωμης; genitive of 2d decl. in οι, λογοι = λογου, and dative in ου, τοῦ κοινοῦ = τῷ κοινῷ; iota subscript omitted, τᾶ ἀρχᾶ τᾶ ἑαυτοῖ = τῇ ἀρχῇ τῇ ἑαυτοῦ.

5. *Bœotian.*—βανά, βανῆκος = γυνη, γυναικος; δ for ζ, as δυγόν, γραμματίδδω = ζυγον, γραμματιζω; 3 pers. pl. in νθι, as ἔχωνθι = ἔχωσι; a very peculiar vowel-system by which many of the long vowels and diphthongs are replaced by others, ει standing for η and ῃ, η for αι and ᾳ, ι for ει; in the later stage υ stands for οι and ῳ, ου for long and sometimes for short υ: examples, Ἡολεῖα = Αἰολῆα, Ϝελατιήυ = Ἐλατειαίῳ, τουχα = τυχη, τραγαϜυδος = τραγῳδος (ἀοιδος). Ε often becomes ι, Ϝέτια = ἔτεα. The dative sg. of 1st and 2d decl. ends in earlier times in αι and οι (ταῖ ὁδοῖ = τῇ ὁδῷ), but sometimes in the Latin-like diphthongs αε and οε (Πλαύχαε, Διωνυσοε); in later times in η and υ (τῆ ὁδῦ). Σαυκρατεις stands for Σωκράτης.

6. *Elean.*—Fondness for α sound; ἄδειρεν, Ϝάργον, πάρ, Ϝράτρα, μά, ἔα = ἔδειρεν, ἔργον, περί, ῥήτρα, μή, εἴη, words in which even the Doric has ε, η.

B. DORIC.—All Doric dialects have μες for μεν in 1st pers. pl.; ντι in 3d pers. pl. (λεγοντι for λεγουσι); future in σιω for σω; gen. pl. 1st decl. in ᾶν, gen. sg. masc. in ᾱ, πολίτα πολιτᾶν = πολιτου, πολιτῶν; all contract αε to η. The Doric dialects divide themselves into strict and mild; the strict having η and ω for Attic ει and ου in certain cases, as μῶσα, δάμω, τιθῆσα, ἦχον = μοῦσα, δημου, τιθεῖσα, εἶχον; the mild agreeing with the Attic.

1. *Strict Doric*, spoken in Crete, Magna Græcia, Laconia, Cyrene. Best known from the celebrated Heraclean tables, showing the dialect of Heraclea in Italy. The Laconian and Cretan dialects had much that was peculiar, the former σ for θ, ου for υ, and ρ or the rough breathing for σ (σιόρ = θεος, πᾶα = πᾶσα, μουσιδδει = μυθιζει), the latter θθ for σθ, ττ for ζ, νς preserved (Ϝειπαθθω = εἰπάσθω, Τῆνα = Ζῆνα, τὸνς πρειγευτανς = τοὺς πρεσβευτάς).

2. *Mild Doric*, spoken in Rhodes, Melos, and some other islands, in Megara, Argos, Corinth, Corcyra, and Sicily. The Megarian had χρῄδδω = χρῄζω, etc. The Argive preserved νς like the Cretan.

3. A special group is the *Northern Doric* of Phocis, Locris, etc. This, though counted among the mild dialects, approaches the strict in some points. Peculiar is the use of ἐν for εἰς with accus., of -οις in dat. pl. 3d decl., as Ϝετέοις = ἔτεσι. The Locrian has ἐ = ἐκ, στ for σθ in verbal forms (χρῆστω = χρησθω), πατάρα, ἀμαρα for πατερα, ἡμερα.

C. IONIC, including Attic, which is but a branch of Ionic. Characteristic of the Ionic is the wholesale change of long α into η, the particle ἄν = κα, κε, and the loss of digamma.

1. *Attic*, the chief literary dialect. It retains long α in certain positions (πράσσω, σοφία), and admits contraction freely, verging thus toward the Doric, but avoiding the monotonous frequency of the α-sound (πλατειασμός) in that dialect, as well as the Ionic predominance of the *e*. It was by holding this middle position the better fitted to become the universal Greek language.

2. *Ionic of the Asiatic coast*, often called simply Ionic, distinguished by dislike of contraction and tolerance of successive vowel-sounds (δηϊόῳεν), including—

(*a*) *Old Ionic* of the Homeric poems and all later epics, a partly conventional and artificial language, containing much that is extremely ancient (genitive in οιο, endings μι σι in subjunctive, futures and aorists with σσ, traces of digamma), side by side with forms of a later stage.

(*b*) The so-called *New Ionic*, the spoken language of the Asiatic Ionians; its local variations are no longer traceable. It is known to us by the writings of Herodotus and Hippocrates. It has κ for π in interrogatives. The predominance of vowels gives it a soft, effeminate character.

ALPHABET.—Though not strictly a part of the language, the alphabet may receive some notice here. The Greeks received their letters from the Phœnicians, at what time is uncertain, but our earliest, very rude and primitive inscriptions are not older than 650 B. C., and the Homeric poems make no mention of writing. The Phœnician alphabet of 22 signs, ending with Τ, was increased by a new vowel-sign Υ at the end, and later by the letters Φ, Χ, Ψ, but these last two were differently employed, the western Greeks using the sign Χ for the sound *x* (so too the Latins), and Ψ for *ch*, while with the eastern Greeks the Χ was *ch* and Ψ *ps*. The letter Ξ was employed by the eastern Greeks as *x*, but dropped by the western. The Phœnician alphabet furnished two signs for *s*; after some fluctuation one of these was dropped. The original forms of the letters were by no means those familiar to us; they varied much with times and places, and became fixed about as we know them in the fourth century B. C. The letters at first were turned (Ǝ, Ꙗ), and the writing proceeded from right to left; this, however,

was early reversed. E and O stood originally for the long as well as the short *e* and *o* sounds, H representing the rough breathing *h*. The Ionians first began the practice of using H for the long *ē*, and invented the sign Ω for the long *ō*. This mode of writing, and with it the complete Ionic alphabet, became general about 400 B. C., superseding the older alphabets. Breathings and accents were unused till long afterwards. Capitals only were known to the ancients; the cursive letters familiar to us developed themselves in the mediæval period.

PRONUNCIATION.—The vowels in the classical period were sounded as in Italian or German, except that υ had early assumed in most dialects the sound of the French *u*; the diphthongs, αι, ει, οι, αυ, ευ, υι sounded as in *ay*, *rein*, *boil*, *how*, *feu*, *we*; the ι in ᾳ ῃ ῳ was distinctly heard: ου assumed early a simple sound, as in *youth* = Roman *u*. The guttural nasal (*n* in *ink*) was expressed by γ, but sometimes by ν. The aspirates φ, θ, χ were at first tenues with following breathing, as in ha*ph*azard, po*th*ook, blo*ckh*ead; later they came to be merely spirants (*f*, Eng. *th*; Ger. *ch*), probably through the intermediate stage of *affricates* (tenues with following spirants, *pf*, *tth* (as heard in *eighth*), and *kch* (as in Ger. *häkchen*). F where pronounced sounded like Eng. *w*, ζ was like *dz*.

PHONETIC RELATIONS TO PARENT LANGUAGE.—The original Indo-European tongue had but three vowels, *a*, *i*, *u*. *E* and *o* were later developed as variations of *a*. Hence, Greek ε, ο, α all respond to original *ă*, and η, ω, ᾱ to original *ā*. Compare ἀπό, ἐπί with Sanscrit *apa*, *api*, ἅδα, ἡδύς, ὠκύς with Sans. *svād*, *svādus*, *āçus*. In some cases, however, Greek ο = original *ā* as contrasted with ε = original *ă*, thus φόρος = Sans. *bhāras* as opposed to φέρω = *bharāmi*. This interchange of ε, ο, α in root-syllables (τρέπω, ἔτραπον, τρόπος) plays an important part in Greek. Greek η is mostly of late origin, having been developed from α since the separation of the dialects; the Doric and Æolic dialects have mostly retained α, as ἁδύς for ἡδύς, yet not always, for θήρ, μή, μήδομαι, and many similar are Doric. Greek ι, υ come chiefly from original *i*, *u*, τις, ἴμεν = *kis*, *imasi*; ζυγόν = *jugam*; but in rare instances they are merely further attenuations of ε, ο, Ionic ἱστίη = ἑστία; νύξ = Lat. *nox*, orig. *naktis*; so Æol. ἰν, ἀπύ = ἐν, ἀπό. The diphthongs αι, ει, οι all correspond to original *ai*; αυ, ευ, ου to original *au*. They have to a large extent arisen from amplification of the simple *i* and *u* by the process known to the Sanscrit grammarians as *guna*; *e. g.* Fοῖδα, εἶμι (origin. *vaida*, *aimi*, Sans. *veda*, *emi*), from roots *vid*, *i*; πεύθεται = Sans. *bodhate* (i. e. *baudhatai*). Elsewhere the diphthongs have arisen from the accidental concurrence of two vowels, as γένει from γένεσι, by the dropping of σ. From the above rule of correspondence must be excepted the spurious diphthongs ει and ου, to be spoken of below. The so called *improper* diphthongs, ᾳ, ῃ, ῳ, ηυ, ωυ, are specifically Greek and of secondary origin, the result of contraction. Of consonants, σ, κ, γ, τ, δ, π, β answer in general to the same sounds in the parent language; the aspirates χ, θ, φ to original *gh*, *dh*, *bh*: compare ἐλαχύς, τίθημι, φημί with Sans. *laghus*, *dadhami*, *bhāmi*. The nasals μ, ν = Indo-European *m*, *n*, but ν final often represents an *m*; ζυγόν = Lat. *jugum*. Greek ρ = original *r*; λ responds to either *l* or *r* of cognate languages, though it is now mostly held that all *l*'s were originally *r*'s. To the semi-vowels *v* (*w*) and *j* (*y*) of the cognate tongues answer in Greek F and *j*; this last, though never written, was a Greek sound in the pre-historic period; it was afterwards partly vocalized to ι, partly lost, but has left many traces of itself. It should be noted that these two semi-vowels interchange freely with their related close vowels *i* and *u*. The double sounds ξ, ψ arose in various ways too complicated to be here detailed. Z is mostly the product of a union of δ or γ with following ι (*j*): when initial it responds to *j* of other languages: ζυγόν = *jugum*. The Greek rough breathing is (except where of secondary origin) a remnant of a lost consonant (σ, F, *j*), and never corresponds to Latin or Sanscrit *h*.

PRINCIPAL PHONETIC TENDENCIES.—1. *Disappearance of Consonants* was the most prolific cause of changes of form in Greek.—*J* was lost in the earliest times; F disappeared entirely in the Ionic branch, and to a great extent in the others; it remained most persistently when initial. Σ falls out between two vowels and at the beginning of a word; γένεος from γένεσος (Lat. *generis* for *genesis*), ῥόος from σρόFος. The rough breathing over initial ρ is usually a trace left of a lost σ or F. Many words have lost initial σF, as ἡδύς from σFαδύς (Lat. *suavis*, Eng. *sweet*). Other consonants than these do not fall out when standing alone, but difficult combinations of consonants may be lightened; τ, δ, θ regularly disappear before σ. The combination νς is especially disliked, and is got rid of by nearly all dialects, usually by dropping the ν. 2. *Changes of Consonants.*—I often turns a preceding τ to σ, though not in all dialects: εἴκοσι, πλούσιος (from πλουτος), φησι; but Doric Fίκατι, πλούτιος, φατι. Less often υ exerts the same influence: Doric τυ (Lat. *tu*) becomes συ. Τ, δ, θ before μ become σ, but not universally; Ionic ἴδμεν, Doric θεθμος or τεθμός for Attic ἴσμεν, θεσμός. Assimilation, either total, as ὄμμα, Æol. ὄππα for ὄπμα, or partial, as ἐσβάλλειν, γέγραπται for ἐνβάλλειν, γέγραφται, is frequent. Metathesis (transposition of a vowel and consonant) occurs in root-syllables, chiefly affecting liquids and nasals: θνῄσκω or θανοῦμαι [illegible]. Noteworthy is the spontaneous generation of β between μρ, μλ, and δ between νρ, νλ: ἀνδρός for ἀνερός, μεμβλωκα for μεμλωκα; so French *chambre*, *cendres* from *cam(e)ra*, *cin(e)res*: when initial the μ, ν are dropped; βλώσκω, βροτός for μλωσκω, μροτος, roots μολ, μορ. A tenuis occasionally develops aspiration without special reason; Ionic δέκομαι becomes in Attic δέχομαι; to these secondary aspirates the Attic is most partial. Not infrequent change of organ in mutes is seen in the comparison of the dialects or of kindred languages: ποῦ, Ionic κοῦ: βάλλω, Arc. δέλλω: πέσσω (i. e. πεκjω) = Lat. *coquo*; πέντε, Æol. πέμπε, Lat. *quinque*; τις = Lat. *quis*, etc. This is the result of the operation of *parasitic j* and *v* on the gutturals. In such cases the guttural is always the original sound, changed by *v* into a labial (*k*—*kv* (*qu*)—*p*) and by *j* into a dental (*k*—*kj*—*t*). The middle stage is often retained in Lat. *qu*: λείπω = *linquo*; other examples above: and a trace of it is seen in the doubled π and τ in Homeric ὅππως, ὅττι (ὁκFως, ὁκjι): cf. ἵππος (ἴκFος, *equus*). The vowel ι or its consonant form *j* unites with preceding δ or γ to form ζ, with κ, τ, χ, θ to form σσ or ττ. This is regularly the origin of σσ (= ττ) and ζ in Greek: πεζός = πεδjος, ἐλάσσων = ἐλαχjων; so Æol. κόρζα, ζά for καρδια, διά. The process is the same as in Italian *mezzo* (*medius*), French *face* (*facies*). *J* has furthermore the power of generating a δ-sound before itself, with which it unites to form a ζ; so ζ comes to stand for *j*, as ζυγόν = *jugum*, verbs in -αζω and -ιζω from αjω, ιjω. So Italian *già* from *d ja*; Lat. *jam*. The Bœotians and others dropped here the *j*, and said δυγόν, -αδδω. In the same manner the δ at the end of such feminine noun-stems as Ἑλλα-δ, ἐρι-δ represents an added *j*. 3. *Contraction of vowels*, which are brought together mostly by the loss of intervening consonants. The rules for Attic can be found in any Greek grammar, but the usage of the dialects differed much; thus, αε gave in Doric η, ἐνίκη = Att. ἐνίκα; εε, οο gave in strict Doric η and ω: ἀγῆται, ἵππω = Att. ἡγεῖται, ἵππου. The contraction of unlike vowels seems to have been preceded by assimilation, and the epic dialect sometimes preserves these intermediate forms, as ὁρόω, αἰτιάασθε, from ὁράω, αἰτιάεσθε. Contraction is only one means of avoiding hiatus (concurrence of vowels); others are synizesis (a forcible utterance of the two vowels in one syllable) and transfer of quantity, as νεώς for ναός; these last afford only a partial relief. At the end of a word hiatus may be removed by elision. 4. *Rejection of vowels.* Besides the loss of vowels between consonants (syncopation), common in all languages, the Greek especially drops the close vowels ι, υ between other vowels, changing them first into the semi-vowels F, *j*: Ἀθηναία, Ἀθηνάα; βασιλευος, βασιλεFος, βασιλέος. 5. *Vicarious lengthening of a vowel* in compensation for an omitted consonant, an important process but imperfectly understood till recently. There are two very different cases of it. (*a*) When μ, ν, ρ, λ (rarely σ) are dropped *before another consonant*, the preceding vowel is lengthened to compensate for its loss of position: the commonest case is (ν)σ. The dialects differ widely in respect of this process. The Lesbian often avoids it, contenting itself with assimilation of the consonants. Otherwise it replaces omitted ν by ι. Examples are ἐσμι, Lesb. ἔμμι, strict Doric ἠμι, Ionic and mild Dor. εἰμί; Aorist ἐμενσα, Lesb. ἔμεννα, str. Dor. ἤμηνα, mild Dor. Ion. ἔμεινα; ξενFος, Lesb. ξέννος, Ionic ξεῖνος, Attic and other dialects ξένος; πανσα, Lesb. παισα, other dial. πᾶσα; θενσα, str. Dor. θῆσα, other dial. θεῖσα; μονσα, Lesb. μοισα, str. Dor. μῶσα, mild Dor. Ion. μοῦσα; τονς retained by Cretans and Argives, other Dorians τως, τος and τοις, Ionic τούς, Lesb. τοίς. The Ionic, Attic, and mild Doric lengthen ε and ο to the false diphthongs ει, ου, which must be carefully distinguished from the genuine ει and ου, as they were, in early times at least, rather written not sounded as diphthongs. The same is true of the ει and ου which arose from the contraction of εε, οε, οο, εο. (*b*) When F or *j* disappears *between two vowels*, the former vowel may be lengthened, ε and ο becoming η and ω, never ει or ου. βασιλεFος becomes βασιλῆος. The length thus attained is inconstant, it often shifts to the other vowel (βασιλέως) or disappears altogether (βασιλέος). 6. *Transposition of Iota.*—I or *j* has the power of springing over a consonant and intruding itself into the previous syllable: τείνω for τενjω. So the verbal forms λέγεις and λέγει come from λεγεσι, λεγετι. 7. *Prothesis* of vowel at beginning of a word, to assist in the enunciation of a difficult consonant or combination, as in Italian, *isperanza*; French, *esprit* (*spiritus*); χθές or ἐχθές, often before F, where it remains after the latter's disappearance; ἄεθλον, ἐείκοσι for ἀFεθλον, ἐFεικοσι, even before a

simple liquid ἐ-ρυθρός = *ruber*. 8. *At the end of a word* vowels and consonants crumble away as in other languages; peculiar is the law that no consonant but ν, ρ, σ can end a word. The others mostly drop off: γάλα for γαλακτ; τ, δ, ϑ may become σ; δος for δοϑ(ι). A ν, sometimes fixed, sometimes movable, attaches itself to some final syllables: 1st pers. pl. -με-ν, Dor. μες, Lat. -*mus*; dat. pl. -σι or -σι-ν.

INFLECTION.—1. *Of Nouns.*—The eight cases of the Indo-European language are in Greek reduced to five (nominative, accusative, genitive, dative, vocative). The lost ones, ablative, locative, and instrumental, are preserved only in adverbial forms, though the Greek dative sing. of 3d declension and the dative plur. of all declensions are the original locative forms. Other locatives are οἴκοι, χαμαί (*humi*); instrumentals are κρυφῆ, ἅμα. The ablative is preserved in the common adverbs in -ως; σοφῶς, originally σοφωτ, like Latin *bonō(d)*. The Greek nominal stems end in long α (original ā) 1st declension, ο (orig. ă) 2d declension, and in close vowels diphthongs and consonants, 3d declension. The case-endings show the closest relation to those of the Sanscrit and the parent language. They are, in the oldest authenticated Greek forms, as follows: For ο and α stems; nom. sg. ς, gen. (σ)ιο, dat. αι, acc. ν, nom. plur. ι, gen. ων or (σ)ων, dat. ισι, acc. νς. For consonant and close-vowel stems; nom. sg. ς, gen. ος, dat. ι, acc. ν or α(ν), nom. plur. ες, gen. ων, dat. σι or ασσι, acc. νς or ας. Neuters in nom. acc. pl. have the ending α; in nom. acc. sg. they have in the consonant declension no ending, but the ο stems take the accusative ending ν. The Greek has retained the dual number more fully than most of the related languages, though only in two case forms; its endings are ε, οιν. Vocative cases proper have no ending. The union of stems and endings gives rise to many phonetic changes in accordance with principles explained above. 2. *Of Pronouns.*—The flexion of pronouns differs in many points from that of nouns, and is too complicated to be discussed here. The relations of the personal pronouns to those of the parent language may be seen thus: ἐγώ = orig. *agham*; με, σέ (Dor. τέ), σFέ = orig. *ma-m*, *tva-m*, *sva-m*; ἡμέες, ὑμέες = *asmajas*, *jusmajas*, etc. The Greek ὁ, ἡ, τό = orig. (Sans.) *sa*, *sā*, *tat*; τοῖο = *tasja*, τόν = *tam*, τήν (Dor. τάν) = *tām*, etc. The Dorians and most Æolians had τοί, ταί in the nom. pl., not οἱ, αἱ. The relative pronoun ὅς, ἥ, ὅ is the Sans. *ja-s*, *jā*, *ja-t*, and has nothing to do with the Lat. *qui*. The interrogative τις is Sans. *ki-s*, Lat. *quis*. 3. *Of Verbs.*—In no respect can the language claim greater pre-eminence than in the structure of the verb. First, in copiousness of significant variations of form; G. Curtius computes that the Greek finite verb (excluding infinitives, participles, and all periphrastic forms) has 249 different forms, in contrast with 94 of the Latin, 38 of the Gothic, 243 of the Sanscrit; the Sanscrit, though nearly as copious, being far inferior in the practical use of the inflections to express fine distinctions of sense. Secondly, the Greek alone of all Indo-European languages has preserved intact the original distinction of the tenses. It never allows the perfect to become a mere preterite, and it has, in its use of present and aorist, carefully kept up the distinction between continued and momentary action, which enables it, for example, to express directly such differences as "be ill" and "fall ill," "weep" and "burst into tears," which we accomplish only by circumlocutions. The Greek finite verb has three voices; besides the active and the passive, the *middle* voice, representing the subject as acting upon, for, or with himself; this is made the means of many fine distinctions. The middle and passive are distinguished in form only in future and aorist, and here the distinction is not very old, and not uniformly kept up. Besides the indicative and imperative moods, there are two oblique moods—subjunctive (conjunctive) and optative. The tenses fall into three groups, representing continued, momentary, and completed action. The distinction of time belongs to the indicative only; its seven tenses being thus classified:

	Continued.	*Momentary.*	*Completed.*
Present,	Present,	...	Perfect.
Past,	Imperfect,	Aorist,	Pluperfect.
Future,	Future,	...	Future Perfect.

The oblique moods do not distinguish time, and have three tenses only, the (wrongly-named) present for continued, the aorist for momentary, the perfect for completed action. The structure of most of these tenses is inherited from the parent language. The present and imperfect are often distinguished by some amplification of the stem of the verb; this is of several sorts, and furnishes the best ground for a classification of verbs. The so-called second aorist lacks this, and is thus distinguished from the present. The perfect and pluperfect have for their characteristic the reduplication, primarily a repetition of the initial syllable. All these tenses exist in two forms (called respectively the ω-conjugation and the μι-conjugation), as they are with or without a certain vowel (thematic or connecting vowel) appended to the stem: most verbs follow the former. The future and the so-called first aorist are composite tenses, formed by adding to the stem an old future and an old preterite of the substantive verb: these have in Greek the form of -σjω and -σα, originally *as-jāmi* and *as-am*. The future perfect is peculiarly a Greek formation; the same is true of the passive aorist and future, but their origin is less plain. The Greek has preserved dual forms of the verb in the 2d and 3d persons. The personal endings of the verb vary for the different moods and tenses, being more or less fully retained, but are reducible to the following oldest Greek forms: 1. For pres., perf., fut., and subj.; active sing. μι, σι, τι; plur. μες, τε, (α)ντι; dual τον; passive sing. μαι, σαι, ται; plur. μεσθα, στε, (α)νται; dual στον. 2. For past tenses and optative, active sg. ν, ς, τ; plur. μες, τε, ν; dual τον, ταν; passive sing. μαν, σο, το; plur. μεσϑα, στε, (α)ντο; dual στον, σταν. The imperative has separate endings. Participles and infinitives, the latter being the dative of a verbal noun, are formed from present, aorist, perfect, and future. There is also a rare future optative, a special Greek development.

FORMATION OF WORDS.—The suffixes by which nominal stems are formed from roots are part of the inheritance from the parent language. The chief ones are—α, ο, ι, υ; κο, το, μο, νο, ρο, λο, Fο, ιο (and the corresponding κα, etc.), ες, ας, εν, ον, τηρ, τορ, and various compounds of these. Nouns derived from verb-stems are called primary; those derived from other noun-stems are called secondary; thus, δό-σι-ς, κρι-τή-ς, πρεσβευ-τή-ς are primary, but δικα-ιο-ς, πρεσβυτη-ς are secondary, derived from δίκη, πρεσβύ-ς. The commonest secondary suffix is ιο (ια); before it ο is dropped; ἵππ-ιος from ἵππο-ς. Another is Fεντ (χαρι-Fεντ, nom. χαρι-εις), signifying "abounding in." The comparative suffixes ιον or ιος, τερο, and the superlative ιστο, τατο, deserve mention. To few of these suffixes can a uniform meaning be attached, as that of the *doer* to τηρ. In compound words two stems are united; the latter only is inflected, ἱππό-κομο-ς. The Greek is rich in compounds, but they rarely contain more than two members, avoiding the unwieldy and obscure combinations of the Sanscrit. Verbs (called denominative) are freely formed from nouns; they end mostly in αω, εω, οω, originally α-jω(μι), etc., the first vowel belonging to the noun-stem; φιλέ-ω from φίλο-ς, with ο changed to ε. A variation of αω is αζω; just so ιζω makes verbs from ι-stems. From the stems of denominative verbs other nouns may be formed in the same manner as from roots.

ACCENT.—The accent of the Greeks was not, like ours, a stress on a particular syllable, so much as an elevation in pitch. It is confined to the last three syllables of words. The ordinary tone of accented syllables is called *acute* (marked ´), and when it falls on long vowels extends to the end of the same. But long vowels in either of the two final syllables have sometimes the high tone restricted to the first half, the voice descending on the last half; this kind of accent is called *circumflex* (marked ˜). If the final syllable of a word be long, the tone can in no case stand farther back than the end of the penultimate vowel; that is, the circumflex cannot stand on the penult nor the acute on the antepenult—ἀνθρώποις, not ἄνθρωποις or ἀνθρῶποις. The accent of most words is *recessive*, going as far back as this rule will allow; but in some words it adheres to the ultimate or penult. An acute at the end of a word is lowered in pitch if other words follow in close connection; so arises a third variety of tone, called *grave* and marked `. Some short words (enclitics and proclitics) have no accent of their own, leaning on the preceding or following word.

SYNTAX.—The structure of Greek sentences is natural and unfettered, giving rise to many colloquial idioms, and admitting many slight inconsistencies which are not looked upon as blemishes. The rules are singularly flexible, the variety of possible constructions very great. As peculiarities of Greek syntax might be named the frequency of *attraction* of case in connection with relative clauses, the wide development of the *inner* accusative in its different varieties, the particle ἄν which plays an important part in the syntax of the verb. The genitive and dative cases have a complex office, the former having taken on itself, in addition to its own, most of the functions of the lost ablative; the dative in like manner those of the old locative and instrumental cases. To explain the Greek uses of these cases from a single fundamental notion is at present unscientific. The Greek is the only language of the Indo-European family which, retaining both the subjunctive and optative formations, has kept them distinct, and made them the basis of different shades of modality. They have each two uses—a primary use, in which they have the force of a modified future (opt. of wishing, subj. of request, and in protasis and apodosis of future conditions); and a secondary use, in general conditions only, in which they refer to indefinite frequency in present and past time respectively, the idea of futurity being given up: ἐὰν τοῦτο ποιῇ, εἰ τοῦτο ποιοίη—"if he (ever) does

(or did) this." The optative has yet another use in indirect quotations.

LATER HISTORY OF THE LANGUAGE.—From the time of Alexander (330 B. C.) on, literary and political influences gave the Attic dialect ascendency over all others; it became the language of the whole Greek world. The national dialects gradually disappear, first in public life and educated circles, last of all among the masses. The new universal speech takes the name of *common* (κοινὴ) *dialect*. It is a slightly modified Attic; thus, for [illegible], are said [illegible]; besides [illegible] comes into use. Outside of Greece, in Syria, Macedonia, Alexandria, the language was spoken with less purity, and many corruptions crept in, the blunders of foreigners using the Greek language, Ἑλληνισταί. The language of the New Testament and the Septuagint is tinctured with such peculiarities. So arose, besides the κοινή of the educated, many vulgar dialects. That of Alexandria, for instance, had ἠλθοσαν for ἦλθον, ἔλιπαν for ἔλιπον. The literary language resisted these vulgarisms, and kept itself comparatively pure. The pronunciation altered even more than the form of words. Among the earliest changes was that of ει to that of simple ι, and of ζ from *dz* to simple *z*. In the first centuries of the Christian era the same corrupting influences are yet more actively at work. B is softened to our *v*, and η yields to the prevailing *itacism*, and takes the sound of ι: these two corruptions are first detected in Alexandria. The diphthong οι came to coincide in sound with υ: much later both were attenuated to ι. Αι took the simple sound of ε. The diphthongs with υ modify or lose their second vowel. Δ and γ are softened in sound. The quantity of vowels is confused. The inscriptions of this period abound in singular misspellings —ἦτος (ἔτος), Εἶσις (Ἶσις), ἐπύησεν (ἐποίησεν), πρεσβοιτεροι (πρεσβύτεροι), κῖτε (κεῖται), [illegible] (-σμος), ἄτος (αὐτος), [illegible] (σκευάζειν). Many of these phonetic corruptions had taken place in the Bœotian language long before. Peculiar forms of this period are -ις and -ιν for -ιος, -ιον (Δημητρις, μαρτυριν), such accusatives as ἄνδραν, γυναῖκαν, confusion of cases (παρ᾽ ἐμοῦ [illegible] πατέρα, σὺν with genitive). The cleft between the vulgar tongue and the language of the *literati* widens. The Attic revival of the time of Hadrian affected of course very few. Roman words are largely adopted (ὀσπίτιον, πραικοψ, παλάτιον). The process of decay went rapidly on after Byzantium was made the head of the Hellenic world. The written language, though clinging stoutly to ancient models, cannot hold its own, and the spoken tongue verges gradually toward the Romaic or modern Greek. The use of diminutives for primitives, of the accusative for the dative, of ἵνα and subjunctive for infinitive, of εἰς for ἐν, of auxiliary verbs θέλω, ἔχω, are among the characteristics of this transitional stage. Long and short vowels are no longer distinguished, and word-accent is made the basis of versification. Inscriptions of the ninth century show the wildest confusion in orthography, as παναγήα Θεοτώκε (=παναγία Θεοτόκε), ἐπὴ τὸν ὑκιακὸν (=ἐπὶ τὸν οἰκειακόν).

The completest Greek grammar is that of Kühner (*Ausführliche Grammatik*, 2 vols.; 2d ed. Hanover, 1870). No full exposition of Greek historical grammar yet exists, but Curtius's work, *Das Griechische Verbum* (1st vol., Leipsic, 1873), will partly supply this lack. The Greek portion of Schleicher's *Compendium of Comparative Grammar* covers the ground in outline. The works of Krüger, Madvig, and Goodwin are important for the syntax. On dialects the standard work is Ahrens' (Göttingen, 1839–42), and on etymology, G. Curtius' (4th ed. Leipsic, 1873). The best defining lexicon is Liddell and Scott's (6th ed. Oxford, 1871).

F. D. ALLEN.

Greek Language, Modern. The language of Greece has undergone no *revolution* since the time of the Attic historians, philosophers, orators, and poets. Through all the successive invasions and conquests of the country, by the Romans, the Goths, the Huns, the Slavonians, the Crusaders, the Venetians, and the Turks, the basis of the popular or and the substance of the language have survived unchanged. The gradual decline which began from the Macedonian conquest continued down to near the end of the last century. In times of ignorance, such as prevailed during the four centuries of Turkish oppression, the language suffered, indeed, much corruption, not only in its syntax, but also in its vocabulary. Many foreign words were introduced. But there has never been a period when there were not some who wrote Greek with a fair approach to Attic purity. The impulse given by Christianity to the Hellenic mind arrested for centuries the degeneracy that had already begun. The Christian Fathers enriched their native tongue with many new and striking words and expressions, born of the sublime doctrines and conceptions of the new religion. Since the time of Homer the Greek has never been a dead language. Western Europe by that libel only proclaimed her own ignorance and shame. If there has been a time when even Athenians spoke a wretched patois, there were even at that time educated men and women in Constantinople who spoke and wrote the language in a style which would have been quite intelligible not only to Plutarch and Pausanias, but also to Pericles and Plato. There was never any very extensive introduction of foreign elements into the language of the educated Greek: its vocabulary was always essentially that of the ancient language. But its grammatical forms became vulgarized, and its syntactical construction was still more extensively modified. In the conjugation of the verb the dual number was soon dropped altogether (as it was also in the declension of nouns and adjectives); the optative mood, and to a great extent the infinitive also, was supplanted by the subjunctive; the future and perfect tenses were commonly expressed by auxiliaries; and other minor etymological changes took place. The personal pronouns were changed, chiefly by the addition of new syllables; the relative pronoun, so brief in the ancient Greek, was exchanged for an awkward trisyllable, with the article prefixed; the prepositions, such of them as remained in use, were nearly all construed with the accusative case; the old particles, which added so much to the delicacy and flexibility of the language, were either wholly dropped or else lengthened. The nouns and adjectives suffered less change; but the nouns very generally took on the *diminutive* neuter form—a sadly significant change. The syntax was materially modified, the nicer rules of the ancients in regard to the *arrangement* of words being very generally ignored, and the simple order of most modern languages being followed. Of these languages, the French is the only one that has in any very perceptible degree influenced the Greek. As to pronunciation and accentuation, there was no important change, except that the rough breathing is no longer heard at the beginning of words. In the written language, indeed, whatever barbarisms or provincialisms may have prevailed in the speech of the vulgar, there has been no change in accentuation since the time when the accent began to be used in writing. The pronunciation, too, as the most ancient manuscripts plainly testify, has remained what it was in the first centuries of the Christian era. The same consonants, vowels, and diphthongs which are confounded with each other in writing by an illiterate Greek of the present day were confounded in just the same way by illiterate or careless transcribers, copying from dictation, in the fourth and fifth centuries. The niceties of pronunciation, by which similar sounds were no doubt accurately distinguished by the Attic voice and ear, must have been lost very early. The sound of the continental *i* is now expressed, without the slightest variation, by six different written signs—the vowels η, ι, and υ, and the diphthongs ει, οι, and υι. The sounds of β and υ, when the latter is preceded by α, ε, or η, are also identical, except as the latter has, in certain cases, the sound of *f* instead of *v*.

Towards the close of the last century there commenced a systematic attempt to purify the Greek language from its foreign admixtures, to recall the ancient forms of words and the ancient syntax, so far as these had been abandoned or corrupted, and to restore the obsolete words of the classic Greek, not only to supplant the barbarisms that had crept in, especially from the Turkish and the Venetian Italian, but also to enrich the scanty vocabulary of the common speech, resulting naturally from popular ignorance. This movement was connected with the establishment of schools and other methods of arousing the Greek mind from its comparative torpor, and preparing the way for the civil regeneration of the nation. The leading spirit in this patriotic enterprise was Adamantios Koraes. (See under GREEK LITERATURE.) From that time there has been a constant and rapid improvement [illegible], and this improvement has been [illegible] the independence of Greece was established. The style of the best writers of the present day is such as to justify the claim on which they proudly insist, that they [illegible] Greek language. This [illegible] only admitted if we would only concede to the Greeks what is granted to every other nation, the right to regulate the pronunciation of their own language. When this educational reform, already happily inaugurated, shall have been accomplished, the educated foreigner who visits Greece will be able to converse with the people in their own still beautiful tongue.

It may help to show how far the Greek language has advanced in its progress [illegible] we subjoin an analysis [illegible] the modern Greek [illegible]. For this purpose let us take the last paragraph of the Olympian Oration delivered by Prof. Philippos Joannou on the second anniversary of the modern Olympiad, A. D. 1870. The subject of the oration is, "The Intellectual Progress of the Greek Nation from the War of Independence to the Present Time." In the clos-

ing paragraph, embracing about a page and a half of closely-printed octavo, there are about fifty verbs, every one of which is found in Liddell and Scott's ancient Greek lexicon; and the only departures from the regular forms of the ancient Greek are these four: first, the future tense, which occurs nine or ten times, is always expressed by the aid of the auxiliary *θέλει*; secondly, the form *εἶναι* of the substantive verb is used, not as the infinitive, but as the third person singular of the indicative; thirdly, the imperative is expressed by the subjunctive preceded by the sign *ἄς* (a contraction for *ἄφες*); and fourthly, the infinitive is resolved into the subjunctive, preceded by *νὰ*, an abbreviation of *ἵνα*. Of seventy-five or eighty nouns, all but one are found in the above-named lexicon, and this one is simply a modification of a well-known root familiar to Greek scholars, and represented by several cognate words (*παγιωτής*). The common word, *μέσον*, is also used in the sense of the English word, "means," a sense not justified by ancient usage. Of about fifty adjectives, all but one are found in the lexicon, and of this one the corresponding adverb is found. Indeed, the adjective itself is found in Pickering's lexicon. All the nouns and adjectives, without the slightest exception, are declined as in the ancient grammars. Among eight or ten different pronouns, personal, relative, demonstrative, and compound, occurring in all about twenty-five times, there is but one instance of departure from ancient usage. The enclitic *του* is three times used instead of *αὐτοῦ*. Of ten adverbs, the only one not belonging to the ancient language is the negative *δέν* (contract for *οὐδέν*), instead of *οὐ* or *οὐκ*. This modern form is used twice; and the ancient form *οὐχί* also occurs twice. The only particles not known to the ancient Greek are two, both already noticed as signs of the imperative and infinitive moods, and both obviously contracted from ancient Greek forms. So slight is the difference between the Greek language of B. C. 400 and that of A. D. 1870. A. N. ARNOLD.

Greek Literature. The literature of the Greeks is distinguished above all for freshness, originality, and perfection of form. While itself a spontaneous national outgrowth and independent of outside influences, it furnished an intellectual impulse which spread to other people, the force of which has never spent itself, and of which modern European literature is the result. Greek literature, the creation of a people gifted with wonderful artistic sense and productive force, has in one sense no infancy: that is, no period of unsatisfactory first efforts; each new type appears at once in full vigor. We distinguish four periods: (1) The ancient or classical literature, ending with Aristotle at the time of Alexander the Great; (2) The Alexandrian period, till the subjection of Egypt to Rome, 30 B. C.; (3) The Roman period, till the division of the empire, 330 A. D.; (4) The Byzantine period, till the capture of Constantinople, 1453. The last three are of subordinate importance.

I. THE NATIONAL CLASSICAL LITERATURE. — 1. *Epic Poetry.*—Before Homer, the Greeks must have had popular poetry and poets, for in the *Iliad* and *Odyssey* the bard and his art are no strangers. The hymn, the epic song, the dirge, the bridal-song must all have existed in these early days, the epic element certainly predominating in all these. In this pre-Homeric period the oldest national poetical measure, the dactylic hexameter, gradually formed itself out of a ruder metre, and multitudes of epithets and poetical formulæ fixed themselves in use as part of the stock of the professional bard. But of this period we have no direct knowledge; even the names (Orpheus, etc.) referred to it are certainly mythical. Greek literature begins with the Homeric poems, the *Iliad* and *Odyssey*, in which are found the vividest word-painting, most musical flow of language, great wealth of expression, with an inimitable childlike simplicity. The *Iliad*, Achilles its central figure, describes portions of the siege of Troy; the *Odyssey*, the adventures of Odysseus on his return home from the siege. The origin of these poems has been in recent times the subject of a sharp controversy. In 1795 appeared Wolf's *Prolegomena ad Homerum*, in which, maintaining that the poems were not reduced to writing before 600 B. C., he denied the possibility that a poem of such length, composed for oral recitation, could have previously existed as a whole; and thus opened the way for disbelief in the personality of any Homer. Since then much investigation has been directed to the subject, and inquiry into the nature and origin of unwritten ballad poetry as found among other people has played a conspicuous part in the discussion. Wolf's line of argument has been adopted and carried further by Lachmann, Köchly, Sengebusch, Kirchhoff, and others; the first named went so far as to attempt the separation of the *Iliad* into its component ballads. The doctrine of this school is, in outline, that the poems are aggregations of ballads relating to the favorite subject of the Trojan war; that they came into form in the hands of a guild of professional singers (Homeridæ of Chios), to whom Homer was a mythical *heros eponymos*, and were thus handed down from generation to generation; that different parts are of different ages; and that the present form of the poems, with what unity of plan they show, was given them at the time of Pisistratus by men employed by him to collect the scattered portions, and that they were first reduced to writing then or shortly before that time. Opposed to this skeptical tendency, many scholars—among them Nitzsch, Bergk, Mure, Gladstone—hold fast to the old view of the unity of the poems and a single author, their strongest ground being the undeniable evidences of systematic plan, especially in the *Odyssey*, and the uniformity of style and language. The question must yet be considered an open one, but it is not unlikely that the truth lies between these extremes. So much must, at any rate, be conceded to the Lachmann party, that even if the poems do bear the impress of one master-mind, and that a Homer's, this Homer used much material already on hand, both of matter and expression (many stereotyped formulæ show evidence of having arisen when the language was in a very different phonetic state from any known in the historic period), and that in the subsequent transmission of his work there was every likelihood of its being further changed in form. The poems have in any case passed through different phases, and the personal Homer, if there was one, is only one of several factors. The traditions of the ancients respecting the person of the poet are in every respect contradictory, and rest apparently on nothing but conjecture. Certain it is, however, that the poems originated among the sea-loving Ionians of the Asiatic coast. It should not be overlooked that doubts respecting the Homeric poetry existed even in antiquity; some of the Alexandrines referred the *Iliad* and *Odyssey* to different authors. Besides the *Iliad* and *Odyssey*, there are handed down, under the name of Homer, several hymns, which are certainly of later origin, although old. The *Batrachomyomachia*, or "Battle of the Frogs and Mice," a burlesque, is the product of an uncertain but very late age. Down to the time of Pisistratus epic poetry was widely cultivated, and a series of poems, known as the "Epic Cyclus," arose, clustering around the Homeric works, and aiming to embody in song the rest of these and similar myths. Though these works are now lost, they were only inferior to the *Iliad* and *Odyssey* in merit and popularity, and exercised great influence on subsequent literature, furnishing materials for the dramatists, Virgil, etc. The authorship of part of these poems is known. The *Cypria* of Stasinus introduced the *Iliad*, while the *Æthiopis* and *Sack of Troy* of Arctinus and the *Little Iliad* of Lesches continued it; the *Nosti* and *Telegonia* were connected with the *Odyssey*. Besides these there were the *Œdipodea*, *Thebais*, and others.

2. Hesiod, author of *Works and Days*, a didactic poem on husbandry and the calendar, is the first undoubted personality in Greek literature; he lived at Ascra in Bœotia, at what time is uncertain. The tone, subdued and of sententious brevity, differs greatly from the Homeric; the dialect is a modification of epic Ionic. The *Theogony* ascribed to Hesiod is, probably, as many of the ancients suspected, of different authorship, though of the same school.

3. *Elegiac and Iambic Poetry.*—During the decline of epic poetry these two new creations appeared simultaneously, both doubtless developments of germs already existing in the unwritten popular poetry. Like the epos, the new forms have their rise among the Ionians, at these early times the most intellectual of the Greeks. From 700 to 500 B. C. is the flourishing period for these types. The elegy is of a serious, reflective, but by no means always mournful tone, the didactic and moralizing element prevailing; its range of subjects was great; its metre is a modification of the epic hexameter. It stands in connection with the spirit of the times, the age of the "Seven Wise Men," and of the first beginnings of philosophic thought. The iambic verse, at first the medium of personal invective, is lively and epigrammatic in style. Of all these poems only scanty fragments have been preserved to us. Archilochus of Paros (about 700) was at once the inventor and the most famous author of iambi; some represent him as the earliest elegiac poet, while others assign that honor to Callinus the Ephesian. Nor were the verses of Archilochus confined to these two forms; he used trochees and dactylotrochees as well. A poet of great inventive powers and the most versatile talents, he gave an impetus to the new style which lasted centuries after. Distinguished as authors of elegies are Tyrtæus the Athenian and adopted Spartan (the lame schoolmaster of the popular fable), Mimnermus of Colophon, the famous Solon, and Theognis the Megarian. Of the last there has come down to us a collection of extracts, in all some 1700 verses. As iambic poets next to Archilochus, Simonides of Amorgus and Hipponax are distinguished, the latter the inventor of the choliamb,

or *limping* iambic verse, in which a humorous effect was produced by an unexpected rhythmic turn at the end.

4. *The Subjective Lyric.*—Hitherto every fresh impulse in literature had come from the Ionians of Asia Minor. Now the Æolians of Lesbos took the initiative in the cultivation of the *melos*, or song expressly composed for and inseparable from music. The former styles of poetry, though perhaps originally chanted in musical tones, had early emancipated themselves from such connection. The lyric poem, on the other hand, was always essentially musical. The way was prepared for it by great improvements made in music by the Lesbian composer Terpander, about 700. In Alcæus and the poetess Sappho, both Lesbians (about 600), the expression of individual thought and passion is predominant. The song is for a single voice with cithara accompaniment; the form, that of the short stanza, mostly of four lines; the subjects, erotic, convivial, even political; the dialect, their native Lesbian. The Rhegian Ibycus and Anacreon of Teos later continued this style of composition; the latter, known as an erotic poet, had a playful vein unknown to the earlier lyric poets; he lived in Samos and Athens in the sixth century. Little besides fragments of these has reached us; the extant ditties bearing the name of Anacreon are spurious compositions of many centuries later.

5. *The Choral Lyric* was first brought to perfection among the Dorians, who hitherto had taken no creative share in literature. Hence, the dialect of choral poetry was always Doric. The first impulses came even here from Æolians—Terpander, who came to Sparta about 700, and Arion, who flourished at Corinth a century later; both were Lesbians, chiefly musicians, and made great advances in the outward form of the lyric. As thus developed, choral poetry existed in a great variety of forms, all of which combined voices with instrumental music and orchestic action, and were often exceedingly complicated in their metrical and melodic structure. Important among the many forms was the dithyramb, a feature of Bacchic worship, performed by 50 singers round an altar, and early admitting a mimetic element which was the germ of the future tragedy. Arion was especially famous as the perfecter of this style. Other sorts were pæans, hyporchemata or ballets, various marching-songs for religious and military occasions, marriage-songs, dirges, and the like. Most of these took the character of a public spectacle. The subject-matter was quite varied; they were often narrative, often responsive or in dialogue form. The earliest names of importance are Alcman and Stesichorus; the former was a Spartan of the seventh century; the latter, of Sicilian birth, flourished about 580. Stesichorus was especially fond of mythical subjects, as the titles of his compositions show; they thus stood in an intimate relation to the epos. Later (556–467) Simonides of Ceos attained the highest distinction in choral composition; his life was passed mainly in Athens. The pathos of his dirges was particularly admired. Outside the limits of choral poetry he became famous for elegies and epigrams. Passing over names of less note, the list of famous choral poets closes with Pindar, the only one from whom any complete poems have come down to us. He was about forty years younger than Simonides, and a native of Thebes. We possess from him forty-five *epinicia*, or poems celebrating victors at the four national festivals. Loftiness of diction is Pindar's chief characteristic; he is deeply religious, always of a dignified earnestness; often obscure, yet abounding in poetical beauties. Besides these, his compositions embraced many other species, but nothing of them is preserved but fragments.

6. *Tragedy.* The dithyramb contained, as we have seen, a mimetic trait, and this was little by little developed, first by introducing a disguised personage apart from the chorus, who personated a character (at first doubtless Dionysus himself), and narrated in the first person instead of the third, and sustained a dialogue with the chorus; then by introducing this action at intervals in different characters (episodes), by extending the representations to other than Bacchic myths, by erecting at first a platform, and then a regular theatre for the spectacles, and improving the costumes and masks; lastly, by increasing the number of actors to two, and then to three, so that more than one character could appear on the stage at once, and the action thus progress without the chorus, the latter being diminished in numbers (to fifteen or twelve) and importance. This took place at Athens, and Athens remained the home of the tragedy; it was exotic elsewhere. Tragedy remained essentially a Bacchic solemnity, and was performed only at the Dionysiac festivals; it was sustained at the public expense, and partook of the nature of a contest, three poets contending together (each with three or four pieces) for the prize. The theatre was of immense size and uncovered, the stage narrow; the chorus moved in the orchestra below it. Stage machinery and scenery reached a certain degree of perfection. The chorus was an essential part, though its office became less and less important. The lyrical parts were sung with instrumental accompaniment and orchestic action, the dialogue recited, or probably intoned or chanted. The materials of plays were taken almost without exception from the national myths, the action simple, the conceptions highly ideal. The fifth century B. C. is the flourishing period of tragedy, marked by the three great names of Æschylus, Sophocles, and Euripides. Æschylus (525–456), after his predecessors, Thespis, Phrynichus, and others had made many advances, first gave the tragedy its complete form. A man of stern and serious nature, thoroughly penetrated with religious feeling, his plays abound in lofty ethical conceptions and powerful but sometimes stilted diction. Seven of them are preserved, the *Prometheus* and *Agamemnon* the best. Sophocles (495–405), if less lofty, has finer feeling for human nature, more dramatic life, greater versatility and power of affecting the sympathies. Both ancient and modern critics rank him highest of the three. We possess seven of his plays, of which the most powerful are the *Antigone*, *Œdipus Tyrannus*, and *Electra*. A marked decline from this high standard is seen in Euripides (480–405), who, though a poet of great talent, shows glaring faults, too little ideality, want of symmetry and unity in plot, too much moralizing, a reliance on single passages of brilliancy for effect. The sophistical tendencies of the age were unfavorable to poetry, and a great falling off in poetical taste begins from this time. Euripides was very popular in subsequent ages, and we possess eighteen plays of his, besides many fragments; a nineteenth, *Rhesus*, is spurious. We have no plays of the lesser tragedians, and all mention of them may be omitted. Their number was immense.

7. *Comedy* arose, like tragedy, from the Bacchic festivities; not, however, from the dithyramb, but from the *comus* or procession of licensed revellers at the country Dionysia, which mingled invocations of the deity with gibes at the bystanders. Its early history is obscure; it never received so large a share of public patronage as tragedy. It passed through three phases, known as Old, Middle, and New Comedy. Old Comedy flourished from 480 to 404; the chief poets were Cratinus, Crates, Eupolis, and Aristophanes. Only of the latter have plays, eleven in number, been preserved. Farcical extravagance and the utmost license in personal satire are the characteristics of the Old Comedy; with this the most brilliant though often the coarsest wit. Aristophanes, with all his buffoonery, yet shows always an earnest trait; each piece is written for a purpose. His fertility in the invention of the ludicrous is inexhaustible. In the *Parabasis*, a part where the action stopped and the chorus addressed the audience directly, the Old Comedy preserved the image of the original *Comus*. With the end of the Peloponnesian war the spirit of comedy changes; its farcical merriment is given up; political satire is now less its motive than the delineation of types of character and scenes of daily life. The Middle Comedy (400–338) was a transitional stage. The latest piece of Aristophanes, *Plutus*, properly belongs to it. The chief poet was Antiphanes. The New Comedy belongs chronologically in the next period, but in spirit in this, being the last phase of the national poetry. It has no chorus, its characters are types of every-day society; it stands very near the modern comedy. Menander (342–290) has the first place among the sixty-four authors of New Comedy; his works must have been masterpieces of their class. Others were Philemon, Diphilus, Posidippus. Literature has suffered a great loss in that no plays of these have been preserved. We can form some judgment of their merit from the imitations of Plautus and Terence. Separate from the Athenian comedy was the Sicilian, which attained some eminence in the hands of Epicharmus about 475, and Sophron somewhat later.

8. *History.* As in every literature, so among the Greeks, prose began long after poetry. The first beginnings were made by the Asiatic Ionians—attempts merely at preserving current reminiscences, without as yet any idea of independent investigation or criticism. They were confined at first to local traditions, then took a wider range. The language had still a poetical colouring, and much fable was mixed with facts. Such early prose writers were Cadmus and Hecatæus of Miletus, Hellanicus of Mitylene, and others. The dialect was Ionic even when the writer was not. The chief of these Ionic historians, and the only one whose works have come down to us, is Herodotus of Halicarnassus (b. 484), who undertook from the love of knowledge extensive journeys, and embodied the results of his inquiries in nine books of history, our chief source of information for the Persian wars and preceding periods, treating of almost all the known nations of the earth, and giving geographical and ethnological information, as well as historical. The style is of charming simplicity and the utmost vividness. His credibility has often been questioned; cer-

tain it is that, though sincerely aiming at truth and exercising far more criticism than any of his predecessors, his superstition and love of the marvellous have influenced his work in many ways. Especially is he unreliable in the past history of foreign nations. A genuine piety pervades his work; his conception of the Persian invasions and their causes is a religious and ethical one. Thucydides, the greatest historian of Greece, was an Athenian (470–396), and, no longer following in the hitherto beaten track, wrote in his native dialect. His work in eight books, treating of the Peloponnesian war down to 410, is a model of impartiality and conscientious research. Scorning the charm of mere style, he aims at the utmost brevity, and writes in a fashion obscure and crabbed, but which yet has a singular force. Speeches, partly imaginary, form an important part of the work, serving to set forth motives and the inner connection of events. The military career of Thucydides was unfortunate, and his work was written in banishment. A continuation of Thucydides' history is furnished by Xenophon (about 444–355), whose seven books of Grecian history (*Hellenica*) extend to 362 B. C. Superior to this work in style is his *Anabasis*, a simple and graphic account of the adventures of the body of Greek mercenaries who joined the ill-fated expedition of the younger Cyrus against Artaxerxes—adventures in which Xenophon himself had an important share. Xenophon is a plain, soldierly, and straightforward man, fond of the practical, but lacking in that intellectual grasp needful for a historian; a devoted adherent of Socrates, and inclined to favor Spartan rather than Athenian polity. Much of his life was spent abroad, partly in banishment. His literary labors were not confined to history; we possess the *Cyropædia* (a life of the elder Cyrus, a sort of historical romance) and the *Memorabilia* of Socrates, a collection of personal reminiscences of the great teacher, besides several smaller works, some of doubtful genuineness. Lost historians of this time are Ctesias, a Cnidian physician long employed at the Persian court, and the author of Persian annals, and Philistus, the historian of Sicily, both contemporary with Xenophon. Later were Ephorus and Theopompus, scholars of Isocrates, the former the founder of the general history.

9. *Philosophy.*—No philosophical writings before Plato have been preserved, though the two preceding centuries had been prolific of such. The first beginnings of philosophy are contemporary with those of history, and the Ionians, as in history, took the initiative. The Ionic philosophers occupied themselves with speculations on the physical universe; Thales, Anaximander, Anaximenes were the earliest of these. A little apart from these stood Heraclitus (500), and later Anaxagoras of Clazomenæ (500–428), the most advanced philosophic thinker before Socrates, long a resident of Athens, and exercising the most powerful influence on the great men of that day. Special schools, offshoots of the Ionic, were formed by Pythagoras, a Samian who emigrated to Croton in Italy, and Xenophanes of Colophon, the founder of the Eleatic school in Elea; both of the sixth century. The former, though eminent in mathematics, did not get beyond a vague mysticism in speculation; his followers were numerous and wrote in Doric, Philolaus and Archytas being noted among them. The Eleatics pursued the metaphysical tendency farther; they reverted to the poetical form in their writings; so Xenophanes, Parmenides, and Empedocles, the latter again busied with speculations in physics. Entirely new ground for philosophic thought was obtained by the fearless thinker and uncompromising moralist Socrates (d. 399), who, though he wrote nothing, gave that direction to speculation which resulted in the establishment of several schools. The first of these, the Academy, was founded by the celebrated Plato (429–347) of Athens, an enthusiastic, imaginative, almost visionary nature, educated by extensive travel, master of dialectics. His works are in the dialogue form, always with Socrates as chief speaker. As works of art they are unsurpassed; though ranging over the whole field of ethics, politics, and metaphysics, they possess a dramatic vivacity which never flags and a constant freshness of thought. Probably all are preserved; besides the longer works, *Republic* (10 books) and *Laws* (12 books), there are some forty shorter compositions, many of doubtful genuineness. The numerous works of Heraclides Ponticus, the scholar of Plato, are lost. The founders of the other Socratic schools, Euclid (Megarian school), Aristippus (Cyrenian school), and Antisthenes (Cynic school), were of little importance for literature. Aristotle (384–322), the founder of the Peripatetic school in the Lyceum, was a pupil of Plato, but very unlike him. His voluminous works were of less importance for literature than for science. Of clear judgment, great acumen and memory, he was pre-eminently a man of facts; his eagerness for knowledge extended into every part of the physical and metaphysical universe. Recognition of the importance of inductive research, as opposed to mere speculation, exactness of method and completeness of system, the introduction of accurate technical terms, are among his merits. About one-half his numerous writings are preserved, composed in a clear, pragmatic style, devoid of all ornament, often bald and compendious. Among the completest of these are the *Nicomachean Ethics*, the *Politics*, the *Logic;* besides these, his extant writings extend over literature, rhetoric, psychology, zoology, botany, mathematics, physics, and other departments. It may be said of Aristotle that he embraced in himself all the science of his age. Though contemporary with Demosthenes, he stands on the border of two periods, and in spirit belongs quite as much to the latter as to the former.

10. *Rhetoric and Oratory.*—The nursery of Grecian eloquence was Athens, and its flourishing period the fourth century, though the study of rhetoric as an art had been previously pursued during the period of the Peloponnesian war, especially under the influence of the class of men called Sophists. The Sophists were a peculiar product of that age, rhetoricians rather than philosophers, loose thinkers, though professedly teachers of philosophy and morals. Their province was words, not thoughts; their whole art, persuasion; their aim, rather outward semblance than inward reality. Athens was their chief field, though most of them were from abroad. The principal Sophists were Gorgias a Sicilian, Hippias of Elis, Protagoras of Abdera, Polus of Agrigentum, and Prodicus the Cean. Under the instructions of these men the art of oratory grew to maturity. The famous Attic orators are ten in number. The first department cultivated was the judicial; in this field distinguished themselves Antiphon (479–411) and Andocides. Of the former we have seventeen orations preserved, of the latter four, many of these written for others to speak. To a somewhat later period belong Lysias and Isocrates; their style shows more freedom and elegance. The latter brought to perfection the epideictic style, or speech of display. We possess of the one thirty-four speeches, of the other twenty-one. A little later flourished Isæus and Lycurgus. With Demosthenes (384–322) is reached the highest point in oratory. It was he who developed the political style, demanding not only the orator, but the statesman. Demosthenes, perhaps the greatest orator of all times, and, next to Pericles, the greatest statesman of Athens, attained his eminence, without great natural endowments, by the most unremitting diligence. Though he lacks the ease of some, his style is forcible beyond description, free from rhetorical trickery, although carefully studied, weighty, and earnest. Sixty orations of his are preserved. His contemporaries, Æschines, Hyperides, and Dinarchus, though able orators, are his inferiors in power. The famous contest on the Crown between Æschines and Demosthenes (330 B. C.) gave occasion for the masterpieces of the two orators.

11. *Medicine.*—The only works of a technical professional nature which have reached us from this period are the writings of Hippocrates of Cos (460–370), the founder of the science of medicine. They are in the Ionic dialect, brief and plain in language; parts are of doubtful authenticity.

II. ALEXANDRIAN PERIOD (330–30 B. C.).—Its characteristics are great diminution of originality, the cultivation of science at the expense of literature, the study and dissemination of previous works. The boundaries of the Hellenic world were greatly enlarged, and foreign influences made themselves felt. The two centres of literary activity were Alexandria and Athens.

1. *Poetry* became secondary to prose. Besides the New Comedy, already described, the only new type produced is the bucolic, the germ of which existed among the Sicilian peasantry; it was artistically developed by Theocritus, a Syracusan, about 270. These poems, called *idyls* (a word of uncertain meaning), were primarily pictures of rural life, many in dialogue form, in Sicilian Doric and the dactylic metre; the tone is tender and sportive; a feeling for nature not very common among the ancients pervades them. We have, besides thirty pieces of Theocritus, several by Bion and Moschus of a similar nature. The remaining poetry of this period is artificial in the extreme. The epic compositions are labored and learned imitations of Homer; the *Argonautica* of Apollonius, a grammarian of Alexandria (200), is preserved, but has little merit. Still less interesting are the didactic poems on astronomy and medicine of Aratus and Nicander: the latter wrote *Georgics* and *Metamorphoses* (now lost), imitated afterwards by Virgil and Ovid. The epigram is cultivated with more success; the *Anthology* contains many good ones of this period. Callimachus, the first Alexandrine librarian, distinguished himself in this style; we have also hymns of some little merit from him. Both the elegy and the tragedy received some attention, but all productions are lost. The *sillos*, or satiric poem, came also into vogue.

2. *Philosophy* was chiefly pursued at Athens, where, besides the Academy and the Lyceum, the Epicurean and Stoic schools (the latter, outgrowths of the Cyrenian and Cynic schools respectively) flourished, attracting pupils from all parts of the civilized world. Of the teachers the most important in a literary point of view are Theophrastus, pupil and successor of Aristotle, a man of most varied learning, from among whose many works a book on botany and an essay on types of character have reached us, and Chrysippus and Panætius the Stoics, both prolific writers on ethics. The latter's work on *Duties* was the model for Cicero's book on the same subject.

3. *Grammar*, in its widest sense, including the study of literature, was ardently pursued, especially at Alexandria under the Ptolemies. The famous libraries there collected, and the Museum, a kind of academy of sciences, were important means. The collection, cataloguing, criticism, and annotation of the literary relics of the classical period was the chief task; later came the systematic treatment of grammar. Scanty as are the remnants of these grammarians' works, whatever we possess of the classic literature has passed through their hands, and modern philology is greatly indebted to them. The greatest of these critics were Aristophanes of Byzantium (200) and Aristarchus (150); the former busied himself chiefly with the drama, the latter with Homer. A small grammatical textbook of Dionysius Thrax (110) has come down to us, also a short treatise on mythology by Apollodorus. A rival of the Alexandrine school was the Pergamenian, its representative scholar Crates.

4. *Other Sciences.*—The advances made, especially at Alexandria, in astronomy, mathematics, and geography were remarkable. In mathematics were distinguished Euclid, whose *Elements of Geometry* hold their place even yet, and who lived in Alexandria in the last part of the fourth and first part of the third century B. C.; and later Archimedes of Syracuse and Apollonius. Of others, Eratosthenes, a man of universal learning, the first scientific geographer (d. 194), and Hipparchus, the astronomer, may be mentioned. In Athens the Peripatetics and other philosophers also cultivated the sciences.

5. *History* is singularly neglected in this period: the only name of importance is Polybius (204–122), of whose history of Roman conquests only five books (out of forty) are preserved complete.

III. ROMAN PERIOD (30 B. C.–330 A. D.).—Literature centres at Rome, the ancient seats of learning losing their importance. The scientific spirit decreases, but there is returning taste for rhetoric and regard for form and style in composition, which had been singularly neglected in the preceding period; so results a remarkable revival of Attic prose, especially history. To the first century of this period belong Diodorus Siculus, only a small portion of whose *Universal History* is preserved; Plutarch, the biographer and essayist; Flavius Josephus, the Jewish historian; and Strabo, the descriptive geographer. From the rhetorician Dionysius of Halicarnassus we have a history of early Rome, as well as works on rhetoric and literature. Later were Arrian, Appian, Herodian, and Dio Cassius (the last three writers of Roman history), and Pausanias, the traveller, from whom we have a *Description of Greece*. Of rhetoricians, Dio Chrysostom, and later Longinus, deserve mention, but especially the witty satirist Lucian, whose works are of the most varied character. Less valuable are the writings of the two Philostrati and those of Ælian, the latter a collection of anecdotes. The *Deipnosophistæ* of Athenæus consists of table conversation; though a tasteless melange, it contains important material. The writing of imaginary letters ascribed to noted personages came into vogue, and was cultivated by Alciphron and others. The grammarians of this time are divided into Technicists and Atticists. Of the former were the Alexandrian Apollonius Dyscolus and his son Herodian, the last of the great ancient grammarians; of the latter, mere Attic purists, Phrynichus and Julius Pollux. The astronomer and geographer Ptolemy and the physician Galen are the chief names in physical science. The study of philosophy languished, and the Athenian schools died out; Epictetus the Stoic is the most eminent teacher. Philosophy degenerated on the one hand into the fantastic superstition of Neo-Platonism, whose chief apostle was Plotinus, on the other into the skepticism of Sextus Empiricus (about 200 A. D.). From Diogenes Laertius (about 200) we have a history of philosophy. In poetry this period is utterly barren; Babrius, the author of Æsopian fables in choliambics, is the only name worth mentioning.

IV. BYZANTINE PERIOD (330–1453 A. D.).—The literary centre is Constantinople. A brief renaissance in poetry and rhetoric is followed by a long decline, in which every spark of good taste and originality dies out. Learning grows less and less; many works of antiquity are forgotten and lost; careless compilations and excerpts replace original works. The writers of this period are for the most part devoid of literary merit, and of no importance except as sources of contemporary history, or from the fragments of older monuments which they may contain. It will suffice to mention a few: Nonnus (about 400), author of the voluminous *Dionysiaca*, not without originality and a certain merit, and Quintus Smyrnæus, are the best of a large number of poets. Anthologies, or collections of epigrams of various ages, are compiled. Rhetoric flourished under Julian, and the works of Libanius are no mean specimens of oratory. The romance was cultivated by Heliodorus and others. Stobæus' *Florilegium* and *Eclogæ*, collections of choice extracts, contain much that is valuable. In grammar and erudition, Chœroboscus, Eustathius, the commentator of Homer (bishop of Thessalonica, 1160), Photius, and the lexicographers Hesychius and Suidas may be mentioned. Zosimus, Procopius, Zonaras, Nicephorus Gregoras, are among the historians. Eusebius, the chronologist and Church historian, was contemporary with Constantine; Stephanus Byzantius, the geographer, lived some two centuries later. Of ecclesiastical writers, the most eminent are Justin Martyr, Clement of Alexandria, Origen, Gregory, John Chrysostom, Synesius, Socrates; the first three belong chronologically to the preceding period.

The study of Greek literature was revived in the West during the fifteenth century, chiefly through the influence of the learned Greeks who fled in considerable numbers to Italy, and labored there, favored by such men as Lorenzo de' Medici; among these were Theodore Gaza, Constantine and Janus Lascaris, and Marcus Musurus. Since then these literary relics have been studied with ever-increasing zeal. Among the many modern scholars whose labors in this field have been fruitful, are prominent Reuchlin, Erasmus (sixteenth century), and later (eighteenth century) Hemsterhuys and Valckenaer in Holland; in England, Bentley (d. 1742), and afterwards Porson and Elmsley; in Germany during the present century, Heyne, Wolf, Hermann, Böckh, Bekker, Dindorf, Müller, and Welcker. The principal histories of Greek literature are, in English, Mure's and Müller's (completed by Donaldson); in German, Bernhardy's, Nicolai's, and Bergk's, the last now (1875) just begun.

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Greek Literature, Modern. Prof. Sophocles, in his *Greek Lexicon of the Roman and Byzantine Periods*, divides what he calls the Byzantine Period into three epochs, the first extending from A. D. 330 to A. D. 622; the second, from A. D. 622 to A. D. 1099; and the third, from A. D. 1099 to A. D. 1453. It is only the writers of the last of these periods that can be considered as belonging, in any sense, to *modern* Greek literature. Most of these, indeed, wrote in the scholastic or would-be Attic style, rather than in the modern Greek.

Anna Comnena, distinguished alike for the graces of person and of intellect, was the daughter of Alexis I., emperor of Constantinople. Born in 1083, and educated with the greatest care, she was early married to Nicephorus Bryennius, descended from one of the noblest families in the empire, and renowned as a warrior, an historian, and a statesman. He was the author of a history of the empire in four books, modestly entitled *Materials for History*. It covers only about twenty years, from 1057 to 1078, and was left unfinished at his death, which occurred in 1137. His beautiful widow never ceased to mourn his loss. There is no parallel in the European history of those times to the uninterrupted domestic happiness, for more than [illegible], of two such eminent and noble authors. Anna survived her husband eleven years, dying in 1148. She wrote a biography of her father, entitled *Alexiad*, a work of great historic value, but somewhat disfigured by a pedantic style. In this respect it is a striking contrast to her husband's modest history.

George Gemistus, surnamed by himself *Pletho*, was one of the most remarkable men of his age. He was born in Sparta about the middle of the fourteenth century, and lived till near the middle of the fifteenth. A passionate admirer of Plato, he formed the bold design of establishing the supremacy of his philosophy, thereby supplanting not only the system of Aristotle, but also the religion of Christ. Visiting Florence, he lectured on the Platonic philosophy before Cosmo de' Medici the Elder, and he so inspired that distinguished patron of learning with such enthusiasm for the great Grecian that he afterward founded an academy at Florence for the purpose of teaching the Platonic philosophy. Gemistus wrote nearly forty different treatises, embracing a wide range of subjects—geographical, historical, astronomical, mathematical, philosophical, moral, and theological, including several poems. His most important works are those relating to the Platonic philosophy, especially that on the difference between the philosophy of Plato and that of Aristotle. He was so confident of the speedy success of his scheme of enthroning Plato as the

sovereign of human thought that he is said to have predicted that not many years would elapse before all the world would be of one religion; and that not Mohammedanism, not Christianity, but Platonism. His admiration of Plato was probably the reason of his adopting the surname of Plethọn as a synonym of Gemistus, and a near approach in sound to the name of his great master. Whether or not we assent fully to the verdict of his modern Greek biographer, that he was "the most learned man of the fifteenth century," there is no doubt that his learning was very extensive, and his influence in exalting Plato above Aristotle very efficacious. George Scholarius (1400–60) was one of the learned Greek ecclesiastics who took part in the Council of Florence, and was made the first patriarch of Constantinople after its conquest by the Turks. He was the author of between sixty and seventy theological works, mostly of a polemical character. Laonicus Chalcondylas (or Chalcocondylas) was an eminent statesman and historian in the last half of the fifteenth century. Little is known of the incidents of his life, nor is the year of his birth or of his death ascertained. We know that Athens was his birthplace, and that he was sent by the emperor John Palæologus VII. in the year 1446 as ambassador to Amurath (or Murad) II., and that he wrote a history of the Turks in ten books, from their origin to the year 1463. This history is regarded as high authority, and, in spite of its affectation of the classical style, has considerable literary merit. His account of the fall of Constantinople, of which he seems to have been an eye-witness, is pronounced by Prof. Felton far more graphic and affecting than the stately picture of Gibbon. Theodore Gazes (1370–1478) was one of the earliest and most influential of those Greek scholars who did so much to revive in Western Europe the study of the ancient Greek literature. Born in Thessalonica, he was already nearly sixty years of age when, on the subjection of his native city to the Turkish power (A. D. 1429), he migrated into Italy, made himself master of the Latin language, taught Greek first in Sienna, afterwards in Ferrara, where he was chosen professor of Greek in the Gymnasium, and in the year 1455 went to Rome on the invitation of Pope Nicholas V. Here he translated the works of Aristotle into Latin, and carried on a controversy with George Scholarius and other disciples of Gemistus, defending Aristotle against the attacks of the admirers of Plato. Besides translating the works of Aristotle into Latin, he translated from Latin into Greek Cicero's *Cato Major*, or *De Senectute*. He was also the author of an excellent Greek grammar. He lived to be more than 100 years of age, dying, according to the most probable account, in 1478, though others state that he survived till 1484. Constantine Lascaris, descended from a royal race, was born in Constantinople near the beginning of the fifteenth century. On the conquest of that city by the Turks he took refuge in Italy, teaching Greek first in Milan, and afterwards in Rome, Naples, and Messina, in which last city he died in 1493. He is the author of between thirty and forty different works, including several translations from Greek into Latin. He wrote largely on grammatical subjects, and his Greek grammar, published in 1476, is said to have been the first book printed in Greek letters, as it was probably the first book issued from the celebrated Aldine press in Venice. Lascaris was the intimate friend of the cardinals Bessarion and Bembo and of other distinguished Italian literati; and he too was among the foremost of those Greek refugees who contributed to the revival of Greek learning in Europe. He bequeathed his library, comprising many valuable manuscripts, to the city of Messina. It was afterwards removed to Spain and deposited in the Escurial.

The Greek writers thus far mentioned wrote in the scholastic style, and not in the common language of the Greek people of their time. Their works, therefore, though entitled to be ranked as belonging to the literature of modern Greece, had only an indirect, yet not inconsiderable, influence upon the development of the modern Greek language. We must now go back a little, to notice the earliest writers who composed their works in the popular dialect. Theodore Prodromos, nicknamed *Ptochoprodromos*, a learned monk of the twelfth century (1143–80), is regarded as the father of modern Greek as preserved in literature. He wrote some popular verses on the poverty of learned men, which he addressed to the emperor Manuel Comnenus. They have been preserved by Koraes in the first volume of his *Atakta*. An extract of thirty or forty lines from this poem, with a spirited English translation, may be found in *Geldart*, pp. 110–113. There appeared in the fourteenth century a remarkable poetical romance, entitled *Belthandros and Chrysantza*. Its author is unknown, but good judges have assigned it a place in the highest order of poetry, not unworthy to be compared with the productions of Dante and Goethe. "Did the modern Greek language," says Geldart, "possess but this single epic, to say that it is destitute of literature were a calumny indeed." We must pass over, with only the briefest mention, Maximus Margunius (1530–87) of Crete, the Venetian publisher, Anacreonic poet, and elegant letter-writer; and Cyril Lucar (1572–1638), the Protestant patriarch of Constantinople and martyr to his religious convictions. Leo Allatius (1586–1669), the Sciote scholar and poet, claims a somewhat more extended notice. Going to Rome at the age of sixteen, he studied philosophy, theology, and medicine. After having been appointed professor of Greek by Pius V., he was made librarian of the Vatican in 1661 by Alexander VII. He abandoned the Greek faith and accepted the doctrines of Rome, but the precise period when this change took place is not known. He was renowned for his extensive learning, his untiring industry, and his tenacious memory. His writings, more than 100 in number, treat of a great variety of subjects, and are composed in the Latin, Greek, French, and Italian languages, and in poetry as well as in prose. He was unquestionably one of the greatest scholars of the seventeenth century, and was in regular correspondence with most of the distinguished literary men of his time. George Chortakes, a Cretan poet of the seventeenth century, was the author of a tragedy entitled *Erophile*. It is chiefly remarkable for the abundance and vividness of its imagery. Franciscus Scuphos, also a Cretan, wrote a valuable work on rhetoric, published in 1681. Elias Meniates (1669–1714), a Cephaloniote, combined in himself the qualities of a successful teacher, an eloquent preacher, and an able diplomatist. He exercised his gifts in the two former directions simultaneously for many years in Venice and the Ionian Islands, until he was made bishop of Calavrita in 1711; after which he confined himself, for the few remaining years of his life, to his ecclesiastical duties. He left only two works, one entitled *The Rock of Offence*, an exposition of the causes of the breach between the Eastern and Western churches. This work has passed through many editions, and been translated into both Latin and German. His other work is a volume of discourses, of which five editions were printed in Venice between 1727 and 1800, and many others more recently. These discourses are characterized by force of argument, copiousness of expression, ardor of feeling, and aptness of illustration. As a preacher he had probably no superior in the Greek Church in the time in which he lived, and many were led to repentance and a religious life by his earnest and pungent sermons. Vincentius Kornaros, the Cretan poet, is generally assigned to the eighteenth century, for his single extant poem was first printed in 1756. But he appears to have been born about A. D. 1620. Very little is known of him, but his *Erotocritos* has gone through many editions, and he has been called the Homer of modern Greece. Kosmas the Ætolian (1714–79) was renowned for his bold earnestness as a preacher, whereby he made many enemies among the aristocracy; and for his zeal in the cause of popular education, whereby he made many friends among the common people. As the founder, directly or indirectly, of more than 200 schools in various parts of Greece, he is reckoned among the prominent harbingers and promoters of Grecian independence. Accused by his enemies of seditious plots, he at last suffered martyrdom at the hands of the Turkish authorities in Epirus. Still more prominent in the list of those who prepared the way for the national regeneration was Rhegas Pherraios. Born about the middle of the eighteenth century, he early devoted his life to the liberation of his country from Turkish oppression. By a secret society which he formed, by his stirring appeals to the European powers, and most of all by his patriotic songs, he kindled the love of country and of liberty in the hearts of the Greeks, and well earned the name of the modern Tyrtæus. Arrested by the Austrian authorities at Trieste in 1798, and delivered up to the Turks, he died a martyr to liberty. Eugenios Bulgaris (1716–1806) was born in Corfû, educated in Padua, and after teaching a while in Yannina, at Mt. Athos, and in Constantinople, he travelled in Germany, was ordained a priest in 1775, and the next year was appointed archbishop of Slavonia and Cherson. In 1787 he resigned his office, and passed the remainder of his days in private life. His works are numerous and various—scientific, didactic, polemical, and religious. Among them are a treatise on logic and a Greek translation of Virgil. He was well acquainted with the philosophy of Locke and Leibnitz. His scientific treatises are written in the scholastic language, and his more popular and practical works in the common dialect; for he wrote with equal facility in both. Nicephorus Theotokes (1736–1800) studied under the best masters—and there were at that time some of wide renown—in his native island of Corfû, and afterwards in the universities of Bologna and Padua. Returning to his birthplace, he preached and taught with such success that he was soon invited to Constantinople. After a short stay there he

removed to Jassy, and thence, in 1765, to Leipsic, chiefly for the purpose of publishing his writings. He succeeded Eugene Bulgares in the see of Slavonia, and was afterwards transferred to Astrakhan. He was a man of great learning, and wrote treatises on metaphysics and natural philosophy, besides many theological works, polemical and practical. Two of his most useful practical works bear the title *Kyriakodromion*, or expository homilies on the Sabbath lessons of the Greek Church, from the Gospels and from the Acts. There is no name in the history of modern Greek literature worthy of more honor than that of Adamantios Koraes (or Coray, as his name is often written). Born in Smyrna in 1748, he was destined by his father to be a merchant. After six or eight years spent in this business, he succeeded in obtaining his father's consent to devote himself to study. In 1788, after six years' study at Montpellier, he obtained his degree as doctor of medicine. Thrown upon his own resources, soon after he arrived at Montpellier, by the death of his father, he earned his livelihood by translating into French, German and English works on medicine. Shortly after taking his degree he removed to Paris, where he remained for nearly half a century, until his death in 1833. Patriotism was his ruling passion. Three things seemed to him indispensable to the liberation of his countrymen: first, to make known to all Europe their oppressed condition; secondly, to keep before their minds the glorious achievements of their ancestors; and thirdly, to purify and elevate their language. From these aims he never swerved. To the *Fatherly Advice* of the patriarch of Constantinople, published after the martyrdom of Rhegas, and exhorting the Greeks to bear meekly the Turkish yoke, he replied by his *Brotherly Advice*, summoning them to break that yoke. When Napoleon invaded Egypt in 1803, he published his *Salpisma Polemisterion*, which was indeed a trumpet battle-call to every true Greek. About this time also he began that series of editions of the classics, amounting in all to fifteen or twenty volumes, to which he prefixed soul-stirring prefaces, which had great effect in developing the sentiments of nationality and the passion for freedom. In 1803 or 1804 he was commissioned by the government of Napoleon, in connection with two French savants, to translate Strabo's *Geography* into French, and he performed his part in so satisfactory a manner that a pension of 3000 francs a year was settled on him for life. In 1828 he began to publish his *Atakta* (or "Miscellanies"). The last of his publications was entitled *Synekdemos Hieratikos* (or "The Priest's Vade-mecum"), an excellent practical commentary on the Pastoral Epistles, still valued and used by biblical scholars. He wrote also an autobiography, published in 1833, the year of his death. Goldart styles Koraes "the second Leo Allatius of Greece." "No country, certainly," he adds, "except Germany, can show such a literary Hercules as Adamantios Koraes." No one, perhaps not all others together up to the time of his death, did so much to improve and enrich the Greek language or to elevate the Greek race, and make it free and worthy of freedom, as Adamantios Koraes. Demetrius Galanos (1760–1833), an Athenian by birth, after studying eight or ten years at Patmos and Constantinople under the most celebrated teachers, went to Calcutta in 1786 as private tutor to the children of several wealthy Greek families. Here he studied English, Sanscrit, Persian, and several other Oriental languages, and not only acquired great reputation for learning and wisdom, but contrived at the same time to amass a handsome fortune. Having determined to devote the remainder of his life to the study of philosophy, he invested his property in a way to secure an adequate income from it, and betook himself to Benares, the sacred city of the Brahmans. Assuming their dress and mode of life, and studying under their most renowned teachers, he was initiated into all their mysteries, yet without renouncing—so the Greek writers tell us—the Christian faith, and became distinguished among the Brahmans and the people of India as not inferior to their most illustrious doctors. Such was the life of this extraordinary man for nearly forty years, until his death in 1833. After he had become thoroughly versed in the Brahmanical theosophy he undertook the Herculean task of translating the choicest works of the Indian philosophers and poets into Greek. At his death he bequeathed his manuscripts, his library, and nearly half his fortune to the National University at Athens. Of his translations, seven volumes were published between 1845 and 1853, including the *Mahabharata* and the *Gita Govinda*. Besides these, he translated the *Bhagavata*, and compiled a Brahmanic lexicon and two tri-glott lexicons—one of Persian, Brahmanic, and Greek, and the other of Brahmanic, English, and Greek. Among the dead of the year 1833 there was no European scholar superior to Koraes, and no Oriental scholar equal to Galanos. Anthimos Gazes (1764–1837) translated Benjamin Martin's *Philosophical Grammar* from English into Greek (Vienna, 1799, 2 vols.), edited a scientific periodical entitled *Logios Hermes*, devoted mainly to philology, and compiled a valuable dictionary of ancient Greek, with definitions in modern Greek (Venice, 1809–16, in 3 4to vols.). He was also active in the cause of his country during the war of independence, being a member of nearly all the successive congresses and national assemblies of that period. Athanasius Christopulos (1772–1847) was the author of a grammar and a lexicon of the modern Greek, but is best known as a lyric poet. He has been called the modern Anacreon, but he was no imitator. The name is appropriate only as expressing the subject and character of too many of his songs. Some, however, are devoted to the tender passion rather than to the wine-bottle, and these are exquisitely delicate and beautiful. His *Nightingale* is believed to have suggested Tennyson's *Swallow*, and is pronounced by a competent critic superior to the laureate's imitation. Neophytus Bambas (1770–1855), a Sciote by birth, after having studied in several of the best Greek schools, went to Paris in 1807, and there pursued mathematical and scientific studies under the best masters for about eight years. He held successively the positions of teacher of an academy in Scio (1815 to 1821), in Hydra, and in Cephalonia, professor of philosophy in the Ionian University in Corfû, rector of the Theological Seminary in the same island, principal of the Hellenic School in Syra (1834–37), and professor of theology in the National University at Athens for the last eighteen years of his life. He published many educational works on rhetoric, elements of moral science, elements of philosophy, internal evidences of the inspiration of the Scriptures, manual of pulpit eloquence, syntax of ancient Greek, notes on the orations of Demosthenes, discourses, etc. He was a hearty and efficient co-worker with the English and American missionaries in translating the Scriptures into modern Greek, incurring thereby no little odium from the more bigoted of his countrymen, both priestly and laic. Constantine Œconomos (1780–1857) was a Thessalian by birth, and, like the last named, a priest. He taught a philological gymnasium in Smyrna (1810–19), resided successively in Athens, Odessa, St. Petersburg, Germany, and Italy; and coming again to Athens in 1834, remained there until his death. He is the author of several volumes of sermons, a treatise on Greek pronunciation, a work on the three orders of the ministry, in opposition to what he regarded as the presbyterian tendency of some of his countrymen, and various funeral discourses. But his principal work was on the Septuagint version of the Old Testament, in 4 vols. 8vo (Athens, 1849), the most scholarly work that has been written on the wrong side of the controversy as to the credibility of the story of Aristeas, that the Seventy, being secluded in so many separate cells, each one of them translated the entire Old Testament, and when they came together to compare their work the translations were all found to be alike *ad literam*. Œconomos was a zealous polemic, an elegant writer, an able preacher, but of the opposite school from Bambas, as conservative as the latter was progressive. Theoclytus Pharmakides (1784–1862), also a priest, was an active participant in the revolutionary struggle, and was prominently connected with several educational enterprises. For two years (1825–27) he held the office of editor of the government journal and superintendent of the government press. In 1833 he was entrusted with the ecclesiastical organization of the new kingdom, in which service he showed great zeal for the independence of the Greek Church, in opposition to the assumptions of the patriarch of Constantinople. He was appointed secretary of the Holy Synod in 1833, removed from that office in 1839 by means of intrigue, but soon reinstated in it. He continued to hold it till his death. Pharmakides was one of the most vigorous of the modern Greek writers, formidable as a polemic and wielding a sarcastic pen. He wrote a work entitled *Apologia*, a severe attack on Œconomos, to whose influence he attributed his removal from the office of secretary of the Holy Synod, a series of commentaries on all the books of the New Testament, and a controversial work entitled *The Synodical Tomos*, in which he deals some heavy blows upon the rescript of the patriarch of Constantinople acknowledging the independence of the Greek Church.

We have now brought down these notices of the leading scholars and authors of modern Greece to our own times. It would enlarge the article beyond proper limits to notice in detail even the most eminent of the lately deceased and the still surviving portion of those whom we have commemorated. We can barely refer to such historians as Trikoupes and Paparregopulos, to such metaphysicians as Damalas and Braila, such philologians as Asopius, such antiquarians as Mustoxidi, and such poets as Salomos and the brothers Soutsos, among the lately deceased, and Rangabes, Zampelios, Zalacostas, and Valaorites among the living.

A list of the most important works on the subject of

modern Greek literature is here appended: SOPHOCLES' *Greek Lexicon of the Roman and Byzantine Periods* (Boston, 1870); FABRICIUS, *Bibliotheca Græca*; GELDART'S *Modern Greek Language* (Oxford, 1870); FELTON'S *Lowell Lectures on Ancient and Modern Greece*, vol. ii. (Boston, 1867); KORAES, *Atakta*; CONSTANTINE SATHA'S *Neoellenike Philologia* (Athens, 1868); PHILIPPOS IOANNOU'S *Logos Olympiakos* (Athens, 1870). (The last three are in modern Greek.)

A. N. ARNOLD.

Gree'ley, county in the E. of Dakota, on the Coteau des Prairies. Area, 8[illegible]0 square miles. It is mainly unsettled.

Greeley, county in E. Central Nebraska, in the Valley of the Pawnee Loup. Area, 576 sq. m. Cap. Scotia.

Greeley, post-v., cap. of Weld co., Col., on Denver Pacific R. R., halfway between Denver and Cheyenne, at the crossing of the Colorado branch of the Union Pacific, on the Cache la Poudre above its junction with the Platte, and 20 miles from the Rocky Mountains. Founded in 1870. It has 4 churches, 2 banks, 3 hotels, 2 saw mills, 1 grist mill, 20 stores, 2 newspapers, a school building that cost $30,000, 3 tanneries, mechanic shops, etc. In all deeds there is a forfeiture clause in case liquor is sold or given away, and one fence 45 miles long encloses the town and 50,000 acres of farming land (made legal by the legislature). It includes 5000 acres in cultivation. The town is a centre for trade and education for Northern Colorado. Pop. 480.

N. C. MEEKER, ED. "THE GREELEY TRIBUNE."

Greeley, post-v. of Walker tp., Anderson co., Kan. Pop. 145.

Greeley (HORACE), LL.D., was born in Amherst, N. H., Feb. 3, 1811. His father was a farmer in humble circumstances, and while yet a child Horace took an active part in the labors of the farm. It was his task to ride the horse to plough, assist in the spring planting, pick up stones from the field, and in the frosty autumn mornings watch the oxen as they fed on the grass beside the corn-field before they were yoked up for their day's work. At an early age he gave tokens of remarkable intelligence, and a singular love of learning. He could read before he was two years old, and had scarcely reached the age of ten before he had devoured every book that he could borrow within seven miles of his father's house. As soon as he was up in the morning he rushed to his book, and devoted to it every minute of the day which he could snatch from the work of the farm. He would read when he was sent to the cellar or the wood-pile, and, having despatched his errand, would take the book from his pocket, where it had been placed for the moment, and again fall to reading with increased zest. His third winter was spent at the house of his maternal grandfather in Londonderry, where he attended a district school for the first time. He at once attracted notice by the excellence of his recitations, and especially by his skill in spelling. When he was about ten years old his father removed with the family to Westhaven, Vt., where for about five years he was assisted by Horace in clearing up wild land and other severe manual labor. At the end of that time, in the spring of 1826, he became an apprentice to the printer of a weekly newspaper in East Poultney, Vt. This was a position which he had long coveted, having early set his heart on following the trade of Benjamin Franklin. He soon learned the art of setting type, and even before the first week was over his skill was superior to that of many an apprentice who had been in practice a month. After remaining in this situation about four years he had become master of the trade, and rendered valuable assistance in conducting the newspaper. In June, 1830, the paper was discontinued, and young Greeley, after spending a few weeks with his parents, who had removed to Erie co., Pa., obtained employment in some of the printing-offices in that vicinity. The work was hard and the pay poor, and he at length made up his mind to seek his fortune in New York. He arrived in that city on Aug. 17, 1831, with only ten dollars in his pocket, and a scanty stock of clothing in his bundle. After much difficulty he found employment as a journeyman printer. In this capacity he worked in several different offices until Jan. 1, 1833, when he entered into a partnership with Francis Story, and commenced the publication of the *Morning Post*, the first daily penny paper ever printed. The enterprise was unsuccessful, and the paper failed in about three weeks. The partnership, however, went on in the job-printing business until July, when it was dissolved by the sudden death of Mr. Story. His place was supplied by Mr. Jonas Winchester, and on Mar. 22, 1834, the new firm issued the first number of the *New Yorker*, a weekly journal devoted to literature, politics, and news. This was edited almost exclusively by Mr. Greeley, and published under his immediate supervision. It was considered at that time the best newspaper of its kind ever attempted in this country. In spite of its high character, it never gained financial success, and Mr. Greeley was obliged to engage in other labors. He supplied the *Daily Whig* with its leading articles for some months, and in 1838 undertook the editorial charge of the *Jeffersonian*, a political weekly newspaper, devoted to the interests of the Whig party, and published in the city of Albany. This journal, according to its original plan, continued in existence but one year, and in May, 1840, Mr. Greeley devoted himself to the editorship of the *Log Cabin*, a campaign journal established in the interest of Gen. W. H. Harrison, the Whig candidate for the Presidency. It obtained a large circulation, but in the autumn of 1841 was merged, together with the *New Yorker*, in the *Tribune*, with which Mr. Greeley's name is completely identified, and for which his previous newspaper enterprises had served as a preparation.

The first number of this celebrated journal was issued on Apr. 10, 1841. It was a small sheet, retailing for one cent, with no presses, no capital, and with only 500 subscribers. For the first week the expenses exceeded the income, but in the course of six months it was established on a sound financial basis, when Mr. Thomas McElrath became a partner and undertook the sole charge of the business of publication, leaving Mr. Greeley the exclusive care of the editorial department. In 1848, Mr. Greeley was elected to fill a vacancy as a member of the House of Representatives in the national Congress, and served in that body from Dec. 1 of that year to Mar. 4, 1849. He took an active part against the abuses of the mileage system and in favor of the establishment of homesteads in the public lands. In 1851 he visited Europe, and served as one of the jurors of the World's Fair in the Crystal Palace in London. He also appeared before the parliamentary committee on newspaper taxes, and gave full and important details concerning the newspaper press of this country. His letters during his absence are among his most interesting productions. In 1855 he made a second visit to Europe, chiefly for the purpose of attending the French exhibition, remaining abroad about three months. In 1859 he made a journey across the Plains to California, and was honored with a public reception at Sacramento and San Francisco. After having exerted himself for the prevention of civil war between the South and the North at the national Republican convention which met in Chicago in May, 1860, he took a decided stand in favor of its vigorous prosecution subsequent to the actual commencement of hostilities. In 1864 he made an attempt at reconciliation on a plan of adjustment proposed to Pres. Lincoln, which proved unsuccessful. In the same year Mr. Greeley was a presidential elector for the State of New York, and a delegate to the Loyalist convention at Philadelphia.

Upon the close of the war in the spring of 1865, Mr. Greeley became a strenuous advocate for complete pacification based on the conditions of impartial suffrage and universal amnesty. In pursuance of this end he consented to be one of the bondsmen for Mr. Jefferson Davis, the late President of the Confederacy, who was imprisoned by the Federal government on the charge of treason. In 1867, Mr. Greeley was a delegate to the New York State convention for the revision of the constitution, and in 1869 was brought forward as a candidate for the office of State comptroller, but was defeated in the canvass. In 1870 he stood for Congress as a candidate for the sixth New York district, and was again defeated, though receiving an exceptionally large number of votes.

The Liberal convention for the nomination of a candidate for the Presidency, which met in Cincinnati on May 1, 1872, after the fifth ballot gave a majority of votes for Mr. Greeley. He accepted the nomination, and in the month of July following was nominated for the same office by the Democratic convention at Baltimore. He was thus presented to the country as the candidate of two great parties for the highest office in the government, and an impassioned contest ensued; and he lost the election by a large majority. During the canvass Mr. Greeley performed an incredible amount of mental and physical labor. He constantly spoke, and in all parts of the country, to numerous and eager audiences, frankly discussing the great question at issue, and expressing his convictions with equal boldness and candor. His strong constitution at length became impaired by excessive toil and intense excitement. The loss of his wife, who had been a hopeless invalid for many years, and upon whose deathbed he attended during the last weeks of the canvass, served to complete the fatal work. He was attacked with inflammation of the brain, and, sinking under the disease, died on Nov. 29, at the residence of his physician, two or three miles from his own country-home at Chappaqua.

In addition to his labors as a journalist and public speaker, Mr. Greeley was the author of several works, the principal of which are the following: *Hints towards Reforms* (1850); *Glances at Europe* (1851); *History of the*

Struggle for Slavery Extension (1856); *Overland Journey to San Francisco* (1860); *The American Conflict* (1864); *Recollections of a Busy Life* (1869); Mr. Greeley was also the writer of the sketch of Henry Clay and of other articles in the *New American Cyclopædia*, and of the CONFEDERATE STATES and several other valuable papers in the present work, of which he was one of the original editors. The *Life* of Mr. Greeley has been written by James Parton (Boston, 1855; new ed. 1868), and a *Memorial* volume was issued by the *Tribune* Association in 1873. GEO. RIPLEY.

Green, county of Central Kentucky. Area 525 square miles. It is undulating and fertile. Limestone and salt-springs abound. Live stock, tobacco, grain, and wool are leading products. Cap. Greensburg. Pop. 9379.

Green, county of Wisconsin, bordering on Illinois. Area, 576 square miles. It is partly prairie and partly wooded hills, and is very fertile. There is good water-power. Cattle, grain, and wool are staple products. Carriages, harnesses, lumber, clothing, and metallic wares are manufactured. The county is traversed by a branch of the Chicago St. Paul and Milwaukee R. Rs. Cap. Monroe. Pop. 23,611.

Green, tp. of Mercer co., Ill. Pop. 1326.

Green, tp. of Woodford co., Ill. Pop. 933.

Green, tp. of Grant co., Ind. Pop. 1115.

Green, tp. of Hancock co., Ind. Pop. 1117.

Green, tp. of Jay co., Ind. Pop. 1115.

Green, tp. of Madison co., Ind. Pop. 954.

Green, tp. of Marshall co., Ind. Pop. 1097.

Green, tp. of Morgan co., Ind. Pop. 1345.

Green, tp. of Noble co., Ind. Pop. 1106.

Green, tp. of St. Josephs co., Ind. Pop. 964.

Green, tp. of Wayne co., Ind. Pop. 1293.

Green, tp. of Mecosta co., Mich. Pop. 616.

Green, tp. of Hickory co., Mo. Pop. 1217.

Green, tp. of Lawrence co., Mo. Pop. 1434.

Green, tp. of Livingston co., Mo. Pop. 903.

Green, tp. of Nodaway co., Mo. Pop. 1613.

Green, tp. of Polk co., Mo. Pop. 1074.

Green, tp. of Worth co., Mo. Pop. 703.

Green, tp. of Guilford co., N. C. Pop. 1119.

Green, tp. of Adams co., O. Pop. 1833.

Green, tp. of Ashland co., O. Pop. 1818.

Green, tp. of Brown co., O. Pop. 1490.

Green, tp. of Clinton co., O. Pop. 2492.

Green, tp. of Hamilton co., O. Pop. 4356.

Green, tp. and v. of Mahoning co., O. Pop. of v. 146; of tp. 1733.

Green, tp. of Monroe co., O. Pop. 1282.

Green, tp. of Ross co., O. Pop. 1898.

Green, tp. of Scioto co., O. Pop. 1882.

Green, tp. of Shelby co., O. Pop. 1254.

Green, tp. of Summit co., O., has beds of valuable coal. Pop. 1740.

Green, tp. of Wayne co., O. Pop. 2715.

Green, tp. of Erie co., Pa. Pop. 1395.

Green, tp. of Forest co., Pa. Pop. 226.

Green, tp. of Greene co., Pa. Pop. 739.

Green, tp. of Indiana co., Pa. Pop. 2160.

Green, tp. of Mercer co., Pa. Pop. 832.

Green, tp. of Pike co., Pa. Pop. 919.

Green, tp. of Randolph co., West Va. Pop. 893.

Green, tp. of Wetzel co., West Va. Pop. 931.

Green, tp. of Wapello co., Ia. Pop. 1252.

Green (ALEXANDER L. P.), D. D., b. in Sevier co., Tenn., June 26, 1807. He filled with success many of the most important offices of the Methodist Episcopal Church. He took a prominent part in the General Conference in New York in 1844, where measures were adopted for the division of the Church, and in the organization of the M. E. Church South; was one of the commissioners in the adjustment of the Church property question consequent upon the division; was one of the principal originators of the publishing house at Nashville and of the Vanderbilt University; was chairman of the book committee which supervised the interests of the publishing house; and for many years was a trustee of the Nashville University. He was noted as a preacher, platform speaker, and conference debater. He rose to the highest eminence in the Tennessee conference, which he joined in 1824; wrote largely for periodicals, and was well versed in Indian traditions and in piscatory matters, and at the time of his death was preparing a work on the fishes of North America, etc. He was a very useful minister, and d. in Nashville, Tenn., July 15, 1874, much lamented. T. O. SUMMERS.

Green (ASHBEL), D. D., LL.D., b. at Hanover, Morris co., N. J., July 6, 1762; entered the Revolutionary army 1778; graduated from New Jersey College in 1783 with the highest honors. Soon after leaving college he was appointed tutor, which office he held for two years; was 1785 chosen professor of mathematics and natural philosophy in New Jersey College; commenced preaching in 1786; was elected a member of the American Philosophical Society in 1787; pastor of the Second Presbyterian church, Philadelphia, 1787–1812; became president of Princeton College in 1812, and soon after received the degree of LL.D. from the Univ. of North Carolina. Author of *A History of Presbyterian Missions*, *Lectures on the Shorter Catechism*, and other works. Edited and largely wrote the *Christian Advocate* (1822–34), a periodical of great influence; was an able orator, and one of the leaders of Old School Presbyterianism for many years. D. at Philadelphia May 19, 1848.

Green (BARTHOLOMEW), b. at Cambridge, Mass., Oct. 12, 1666; is famous as being the first newspaper printer in North America. In the spring of 1704 he published the first number of the *Boston Newsletter*, which he edited until his death; was the publisher of the *Weekly Newsletter*, which he afterwards combined with his *Boston Newsletter*, calling the whole *The Boston Weekly Newsletter*. D. in Boston Dec. 28, 1732.

Green (DUFF), a distinguished lawyer, journalist, and politician, who edited the opposition organ at Washington during the presidency of Mr. J. Q. Adams and the administration organ (the *United States Telegraph*) during Gen. Jackson's first term. He exercised an immense power within his party, and was believed to influence very much the policy of the executive. D. June 10, 1875.

Green (HENRY WOODHULL), LL.D., an eminent jurist, was b. at Maidenhead (now Lawrence), N. J., Sept. 20, 1804; graduated at the College of New Jersey in 1820; was admitted to the bar in 1825, and practised law at Trenton, N. J., until 1846, when he was appointed chief-justice of the supreme court of the State; which office (after reappointment in 1853) he resigned in 1860 to accept the appointment of chancellor. This office he resigned in 1866 on account of impaired health, and travelled in Europe. In 1867 he was one of a commission to revise the laws of the State relative to taxation. From 1860–75 he was president of the board of trustees of Princeton Theological Seminary, and took an active part in the religious and educational movements of the day. D. at Trenton, N. J., Dec. 19, 1876. R. D. HITCHCOCK.

Green (HORACE), M. D., LL.D., b. at Chittenden, Vt., Dec. 24, 1802; graduated at the University of Pennsylvania and at Middlebury College, studying medicine afterwards in Paris. He was professor in the medical college at Castleton, Vt., 1840–43; was instrumental in starting the New York Medical College (1850), in which he was afterwards chosen president of the faculty, and professor of the theory and practice of medicine. Author of several medical works, among them *Treatise on the Diseases of the Air Passages* (1846); also *Pathology and Treatment of Croup* (1849), and others. D. at Greenmount, Sing-Sing, N. Y., Nov. 29, 1866.

Green (JACOB), b. at Malden, Mass., Jan. 22, 1722; graduated from Harvard University 1744, and from New Jersey College in 1749; was ordained at Hanover, Mass.; appointed vice-president of New Jersey College in 1757; was a member of Congress from Providence, R. I., in 1775; also chairman of the committee which drafted the State constitution. Author of several books, one of them, *A View of a Christian Church and Church Government*, being very popular. D. at Hanover, Mass., May 24, 1790.

Green (JACOB), M. D., b. at Philadelphia July 26, 1790; graduated at the University of Pennsylvania 1806. Soon after his departure from the university, he, in company with a friend, issued a treatise on electricity and galvanism, which gave him considerable reputation. He accepted in 1818 the professorship of chemistry, experimental philosophy, and natural history at the College of New Jersey. He held this chair four years, at the end of which time he was appointed professor of chemistry in Jefferson College, Philadelphia (1822), which office he held until his death. Published scientific works, among them *Chemical Philosophy* (1829), *Lectures on Electro-Magnetism*, *Astronomical Recreations*, etc. Was also an able botanist, palæontologist, and student of physics, etc. D. in Philadelphia Feb. 1, 1841; was a son of Ashbel Green.

Green (JOHN ORNE), A. M., M. D., b. at Lowell, Mass., June 7, 1841; was educated at Phillips Academy, Exeter, N. H., and at Harvard College, where he graduated 1863;

took his medical degree there in 1866; studied in Vienna; is (1875) aural surgeon in Boston City Hospital and lecturer on otology in Harvard University.

Green (LEWIS WARNER), D. D., b. 1806; graduated from Transylvania University; commenced preaching about 1825; became president of Centre College and of Hanover and Alleghany seminaries; also president of Washington College and Transylvania College at Lexington, Ky., from 1857 to his demise. D. at Danville, Ky., May 26, 1863.

Green (NATHANIEL), U. S. N., b. Jan. 22, 1836, in Pennsylvania; graduated at the Naval Academy in 1856; became a lieutenant in 1861, a lieutenant-commander in 1863; d. in 1873 at Reading, Penn. He served as executive officer of the gunboat Katahdin at the passage of Forts Jackson and St. Philip and capture of New Orleans, and is thus honorably mentioned by Lieut.-commanding George H. Preble in his official report of Apr. 30, 1862: "While exposed to the iron hail rained over us from both forts, and the simultaneous fire of the enemy's gunboats on the 24th, not a man flinched from his gun or hesitated in the cool performance of his duty. Where all performed so well, it is perhaps invidious to particularize. I may mention, however, as coming under my immediate notice, the deliberate way in which the first lieutenant, Mr. Green, gave his general superintendence to the serving and supplying the guns and the other duties assigned him."

FOXHALL A. PARKER.

Green (SETH), b. in Rochester, N. Y., Mar. 19, 1817. He received only a common-school education, but early manifested a taste for hunting, fishing, and woodcraft, which as he matured became a passion and determined his career. Almost constantly engaged with the rod and gun, he used his eyes as well, and became a careful observer. Determining to adopt these pursuits as the business of his life, he was for a number of years the proprietor of the only fish and game market near his home. His business increased from year to year, until he found himself the head of a large concern, with scores of agents scattered along the lakes and water-courses of the State. In 1838, being in Canada, his attention was arrested by the appearance of a number of salmon, and from their movements he judged that they were about to prepare a nest for their spawn. Perched in the branches of a tree, he carefully watched them continuously for forty-eight hours. He observed that as soon as the spawn was cast the male salmon and other fish ate all they could find, and that there were but a very few eggs unconsumed, and these the female was sedulously covering with gravel for concealment. He had never read upon the subject, but from what he there observed he became convinced that fish could be artificially hatched. From this time he devoted his entire attention to methods of improving the yield of fish from spawn. He found that 25 per cent. was the largest product of trout or salmon attained by artificial means, and he determined to increase this by avoiding defects which existed in the system then in vogue. He began in 1864 by gradually diminishing the proportion of water to milt, finding larger results from each diminution, until, by using the least possible quantity, he had raised the product to 95 per cent. In 1867, by invitation of the fish commissioners of four of the New England States, he experimented in the hatching of shad at Holyoke on the Connecticut River, and after many discouragements, and much opposition from fishermen, ascertained the precise position in the stream which the hatching-boxes invented by him should preserve in order to secure the largest result. He thus reduced the loss to a merely nominal amount, and in a fortnight hatched at this time 15,000,000, the next year 40,000,000. Similar results have since been reached by him in the Hudson, Potomac, Susquehanna, and other important rivers, where he has succeeded in artificially propagating fifteen of the more common species, and in introducing a largely increased product. In 1868 he was appointed one of the fish commissioners of his native State, but, shortly afterwards resigning, was made superintendent of fisheries therein. In the prosecution of this trust he has been untiring in his efforts to arouse public attention to the vast importance of the work in which he is engaged. He is in constant correspondence with eminent European fish-breeders, and has been decorated with two gold medals by the *Société d'acclimatation* of Paris. It may be safely said that to him, more than to any living man, are due the great advances of ten years past in pisciculture.

FRED. A. WHITTLESEY.

Green (WILLIAM HENRY), D. D., LL.D., b. at Groveville, Burlington co., N. J., Jan. 27, 1825; graduated at Lafayette College, Easton, Pa., 1840; studied at the Princeton Theological Seminary; became teacher of Hebrew there 1846; was ordained to the Presbyterian ministry 1848; became pastor of the Central Presbyterian church, Philadelphia, 1849; has held the professorship of Hebrew and Old Testament literature in Princeton Seminary since 1851; has taken a prominent part in the work of revising the authorized version of the Bible; is chairman of the "Old Testament Company," one of the two sections of the American committee of revision; declined the presidency of the College of New Jersey 1868. Author of a *Hebrew Grammar*, *Hebrew Chrestomathy*, *The Pentateuch Vindicated* (against Colenso), and *The Argument of the Book of Job Unfolded*.

Green (WILLIAM MERCER), D. D., LL.D., b. in Wilmington, N. C., May 2, 1798; graduated at the university of that State June 3, 1818; was ordained deacon in the Protestant Episcopal Church in 1820, and priest in 1821, by the Rt. Rev. Richard Channing Moore of Virginia. He was the first pastor of St. John's church, Williamsborough, and afterwards of St. Matthew's church, Hillsborough. In 1837 he was called to the chair of English literature in his alma mater, and in 1849 was elected the first bishop of Mississippi. His published works comprise little more than a brief *Memoir of Bishop Ravenscroft* and a few sermons, chiefly on the subject of ministerial authority and baptismal regeneration.

Green'back, a popular name designating the paper money of the U. S., first issued by the treasury department in 1862. Sometimes the term is used also to include the national bank-notes. (See CURRENCY, MONEY, FINANCE.)

Green Bay, in the N. W. part of Lake Michigan, extends 140 miles from N. N. E. to S. S. W., and is nearly 30 miles in average breadth. Its waters are about 500 feet deep, and of a green color. To the N. E. the Great and Little Bays de Noquet are its continuations. It is a beautiful sheet of water. Its shores are densely covered with pine.

Green Bay, post-tp. of Clarke co., Ia. Pop. 507.

Green Bay, tp. of Lee co., Ia. Pop. 664.

Green Bay, city and tp., cap. of Brown co., Wis., on the Milwaukee and Northern and the Green Bay and Lake Pepin R. Rs., on the E. bank of Fox River, about a mile from the mouth, and therefore at the terminus of the proposed navigable connection between the lakes and the Mississippi by the Fox and Wisconsin rivers. It has 3 national banks, a savings bank, 1 daily and 3 weekly newspapers, gasworks, street omnibus line, wooden pavements, 5 public school buildings, 2 steam fire-engines, 4 band companies, an iron furnace, 2 sash and planing mills, a large tannery, foundry, machine-shops, breweries, etc., 3 lines of railway, shipping, and lake steamers. It is one of the largest primary shingle-markets in the country, also a large exporter of staves, heading, and other hard-wood products. It is largely engaged in the fisheries, principally of white-fish and trout. It has some dozen different churches, and is the see of a Roman Catholic bishop. Great improvements have been made in the public thoroughfares and in public and private buildings. It is provided with numerous excellent hotels, and is becoming a place of summer resort. Pop. of city, 4666; of tp., exclusive of city, 1073.

GEO. E. HOSKINSON, ED. "DAILY STATE GAZETTE."

Green Bri'ar, tp. of Independence co., Ark. P. 1369.

Green'brier, county of West Virginia, bordering on Virginia. Area, 725 square miles. Its surface is composed of mountains, valleys, and plateaus, all fertile and having a delightful climate. Mineral springs abound. Grain, wool, and live-stock are leading products. Salt-springs exist at several points. The county is traversed by the Chesapeake and Ohio R. R. Cap. Lewisburg. Pop. 11,417, but its area has been reduced since the census.

Green Bri'er Moun'tains, in West Virginia, a ridge parallel to the main Alleghanies, and lying N. W. of them, continuous southward with the Great Flat Top, and northward with Shaver Mountains.

Green'brier Riv'er, in West Virginia, rises in lat. 38° 40′, and flows S. W. parallel to the main ridge of the Alleghanies, on the western slope of which its valley lies between that ridge and the secondary ridge of the Greenbrier Mountains. It unites with New River in about lat. 37° 40′, which, running nearly northward, unites with the Gauley and forms the Great Kanawha. These rivers and their valleys constitute the trans-Alleghany portion of the James River and Kanawha Canal route of the proposed connection between tide-water and the great valley of the Mississippi.

Green'burg, tp. of Westchester co., N. Y., lying between the Hudson and the Bronx rivers. It contains Tarrytown, Irvington, Hastings, Dobb's Ferry (which is now called Greenburg), and other villages; has a fertile soil, numerous manufactures, and quarries of marble. P. 10,790.

Green'bush, post-tp. of Warren co., Ill., contains beds of coal. Pop. 1270.

Greenbush, a v. of Greenfield tp., Warren co., Ia. Pop. 129.

Greenbush, post tp. of Penobscot co., Me., on the E. bank of the Penobscot and on the European and North American R. R., 23 miles N. of Bangor. Pop. 621.

Greenbush, post-tp. of Alcona co., Mich. Pop. 86.

Greenbush, tp. of Clinton co., Mich. Pop. 1486.

Greenbush, tp. of Mille Lac co., Minn. Pop. 294.

Greenbush, tp. of Rensselaer co., N. Y., on the Hudson River, opposite Albany, and including East Albany and the post village of Greenbush. It is on the Boston and Albany, the Troy and Greenbush, and the Hudson River R. Rs., has two weekly newspapers, active manufactures, and contains the mother-house of the Sisters of Mercy for the Roman Catholic diocese of Albany. The schools of this establishment have some 350 pupils. Pop. 6202.

Greenbush, a v. of Brown co., O. Pop. 42.

Greenbush, a v. of Preble tp., Preble co., O. P. 53.

Greenbush, post-tp. of Sheboygan co., Wis. P. 1939.

Green Camp, post-tp. of Marion co., O., on the Atlantic and Great Western R. R. Pop. 999.

Green Castle, tp. of Madison co., Ill. Pop. 120.

Green'castle, city and tp., cap. of Putnam co., Ind., is beautifully situated on a high table-land between two of the principal E.-and-W. lines of railroad—the Vandalia on the S. and the Indianapolis and St. Louis on the N. It also has one N.-and-S. line—the Louisville New Albany and Chicago. Eight miles to the W. is the celebrated block coal-region of Indiana. Adjacent to the city are fine bodies of timber, with sandstone and limestone, and some iron ore; also Big Walnut, a branch of Eel River. It has the best of facilities for the cheap and easy collection of materials for the manufacture of iron, glass, and articles of wood. The public schools are among the best in the State. Indiana Asbury University, with 450 students, is located here, also the Indiana Female College, a Presbyterian institution with over 100 students. The city has a street railway, 2 banks, 6 churches, 3 school-houses, and 2 weekly newspapers, an iron and nail mill, and many other manufactories. Pop. of city, 3227; of tp., exclusive of city, 1716.

G. J. LANGSDALE, ED. "GREENCASTLE BANNER."

Greencastle, tp. of Marshall co., Ia. Pop. 764.

Greencastle, post-v. of Bloom tp., Fairfield co., O. Pop. [illegible].

Greencastle, post-b. of Franklin co., Pa., on the Cumberland Valley R. R., 63 miles S. of Harrisburg. It has a national bank, a newspaper, 2 high schools, 5 churches, agricultural works, 3 hotels, 1 woollen mill, a town-hall, etc. Principal business, agriculture and huckstering. Pop. 1650.

GEO. E. HALLER, ED. "VALLEY ECHO."

Green City, village of Weld co., Col., on the South Platte River, 25 miles E. of Evans. Founded by D. S. Green, and settled by the "South-western Colony" in 1872.

Green Cove Springs, post-v., county-seat of Clay co., Fla., on the W. bank of the river St. Johns, 30 miles above Jacksonville. It has a large sulphur spring, resorted to for the cure of rheumatic troubles, and believed to be the "Fountain of Youth" of Spanish and Indian legends.

Green Creek, tp. of Sandusky co., O. It contains the village of Clyde. Pop. of tp. 3666.

Green Dyes. See DYESTUFFS and DYEING, by PROF. C. F. CHANDLER, PH. D., LL.D.

Greene, county in the W. of Alabama, bounded on the E. by the Black Warrior and on the S. W. by the Tombigbee River. Its surface is undulating, and well timbered with pine. Corn and cotton are leading products. It is intersected by the Alabama and Chattanooga R. R. Area, 500 square miles. Cap. Eutaw. Pop. 18,399.

Greene, county in the N. E. of Arkansas, bounded on the N. and E. by Missouri. The surface is rolling, the soil very rich, producing grain, tobacco, cotton, and other crops. The county is well timbered. Area, about 820 square miles. Cap. Gainesville. Pop. 7573.

Greene, county of N. Central Georgia. Area, 374 square miles. The surface is hilly, the soil productive. Grain and cotton are leading products. It is traversed by the Georgia R. R. Cap. Greensborough. Pop. 12,454.

Greene, county of the W. of Illinois, extending eastward from the Illinois River. The surface is well timbered and undulating, the soil very rich. Area, 500 square miles. It contains beds of coal. Cattle, grain, tobacco, and wool are staple products. Carriages and wagons are leading articles of manufacture. It is traversed by the Jacksonville and Alton and the Rockford Rock Island and St. Louis R. Rs. Cap. Carrollton. Pop. 20,277.

Greene, county of the S. W. of Indiana. Area, 540 square miles. It is intersected by the W. fork of White River. The surface is very rich prairie and timber land. Cattle, grain, tobacco, wool, and lumber are leading products. There are mines of good coal. The county is traversed by the Indianapolis and Vincennes R. R. Cap. Bloomfield. Pop. 19,514.

Greene, county of W. Central Iowa. Area, 625 square miles. It is a rolling prairie region, of which grain is the leading product. It is traversed by the Chicago and Northwestern and the Des Moines Valley R. Rs. Cap. Jefferson. Pop. 4627.

Greene, county of the S. of Mississippi, bordering on Alabama. Area, 864 square miles. It is in the great pine-region, and abounds in excellent timber. Corn and rice are produced. It is watered by the head-streams of the Pascagoula. Cap. Leakesville. Pop. 2038.

Greene, county in the S. W. of Missouri. Area, 660 square miles. It contains timber and prairie, is fertile, and has limestone and ores of lead. Cattle, grain, tobacco, and wool are leading products. The county is traversed by the Atlantic and Pacific R. R. Cap. Springfield. Pop. 21,549.

Greene, county of New York, extending westward from the Hudson River. Area, 686 square miles. Its surface is broken by the Catskill Mountains and by deep ravines called "cloves," but the soil is generally productive. Grain, cattle, wool, hay, and especially dairy products, are the staples. Metallic wares, brick, carriages, leather, and paper are leading manufactures. Stone and ice are extensively produced. Cap. Catskill. Pop. 31,832.

Greene, county of E. Central North Carolina, in the great pine-region. Area, 280 square miles. It is level and fertile. Marl is found. Grain, cotton, and forest products are the staples. Cap. Snow Hill. Pop. 8687.

Greene, county in the S. W. of Ohio. Area, 432 square miles. Its soil is very fertile. Limestone and marble are found. Cattle, grain, tobacco, and wool are important products. The manufactures include carriages, clothing, flour, etc. The county is traversed by the Cleveland Columbus and Cincinnati and other railroads. Cap. Xenia. Pop. 28,038.

Greene, the south-westernmost county of Pennsylvania, having West Virginia on the W. and S. Area, 600 square miles. It is well watered, hilly, and fertile. Bituminous coal and fictile clay are found. Cattle, grain, and wool are important products. Saddlery, iron, pottery, etc. are manufactured. Cap. Waynesburg. Pop. 25,887.

Greene, county in the N. E. of Tennessee, bounded S. E. by North Carolina. Area, 750 square miles. The surface is broken, well timbered, and fertile. Iron ores abound. Cattle, grain, tobacco, and wool are leading products. Leather is manufactured. The county is traversed by the Atlantic and Mississippi R. R. Cap. Greenville. Pop. 21,668.

Greene, county of Virginia, bordered on the N. W. by the Blue Ridge. The surface is uneven, the soil partly fertile. Tobacco is the principal crop. Area, 230 square miles. Cap. Stannardsville. Pop. 4634.

Greene, tp. of Parke co., Ind. Pop. 1122.

Greene, tp. of Randolph co., Ind. Pop. 1034.

Greene, post-v. of Butler co., Ia., on the Burlington Cedar Rapids and Minnesota R. R., 35 miles N. W. of Cedar Falls; has 1 weekly newspaper.

Greene, tp. of Iowa co., Ia. Pop. 1040.

Greene, post-tp. of Androscoggin co., Me., on the Maine Central R. R., 7 miles N. N. E. of Lewiston; has 3 churches, and manufactures of shoes and leather. P. 1094.

Greene, tp. of Platte co., Mo. Pop. 2245.

Greene, tp. of Sussex co., N. J. Pop. 868.

Greene, post-v. and tp. of Chenango co., N. Y., 19 miles from Binghamton, on the Chenango River and the Utica division of the Delaware Lackawanna and Western R. R. It has a bank, a foundry and machine shop, a newspaper, 4 churches, a flourishing union school, hotels, mills, shops, stores, etc. Pop. of v. 1025; of tp. 3537.

DENISON & ROBERTS, EDS. "CHENANGO AMERICAN."

Greene, tp. of Clarke co., O. Pop. 1464.

Greene, tp. of Fayette co., O. Pop. 879.

Greene, tp. of Gallia co., O. Pop. 1577.

Greene, tp. of Harrison co., O. Pop. 1547.

Greene, tp. of Hocking co., O. Pop. [illegible].

Greene, tp. of Trumbull co., O. Pop. [illegible].

Greene, tp. of Beaver co., Pa. Pop. [illegible].

Greene, tp. of Clinton co., Pa. Pop. 1102.

Greene, tp. of Franklin co., Pa. Pop. 3357.

Greene (ALBERT GORTON), b. at East Greenwich, R. I.,

1792; became a member of the Rhode Island assembly in 1815; he also represented his native State in the U. S. Senate, and was Speaker of the house of representatives; was major general of the state militia two years; became attorney-general in 1825–43, and U. S. Senator in 1845–51. D. at Providence Jan. 8, 1863.

Greene (ALBERT GORTON), b. at Providence, R. I., Feb. 10, 1802; graduated at Brown University 1820; held for many years the office of clerk of the municipal court of Providence, also clerk of common council. Published the popular ballad *Canonchet*, also *History of the Narragansett Church*, and others. He became judge of probate, and was for many years president of the Rhode Island Historical Society. D. at Cleveland, O., Jan. 3, 1868.

Greene (CHARLES GORDON), b. at Boscawen, N. H., July 1, 1804. At the age of nine he was assigned to the care of his brother Nathaniel, then manager of the *Patriot* at Haverhill, Mass., who sent him to the Bradford Academy near by, of which Benj. Greenleaf was then the principal; he was subsequently apprenticed in his brother's printing-office, and continued his apprenticeship in Exeter, N. H.; in 1822 he removed to Boston, and entered the office of the Boston *Statesman*; in 1825 he undertook the management for a year of the *Free Press* at Taunton, and was for a portion of the time its editor. Returning to Boston, he published *The Spectator*, a literary journal, which, however, he soon abandoned, and resumed his place in the *Statesman* office; in 1827 he removed to Philadelphia and published the *National Palladium*, which advocated the election of Andrew Jackson to the Presidency; and in 1828 went to Washington and was engaged upon the *United States Telegraph* until after Jackson was elected, when he returned to Boston and acquired a joint ownership in the *Statesman*, of which he became sole owner in a few years. In Nov., 1831, he established the Boston *Post*, which he continues to publish. He has been a member of the legislature, and Democratic candidate for various public offices; was naval officer of the port of Boston 1853–57.
G. C. SIMMONS.

Greene (CHARLES WARREN), A. M., M. D., b. at Belchertown, Mass., Aug. 17, 1840; educated at Phillips Academy, Andover, Waterville College (Me.), and Brown University; studied medicine at Harvard Medical School, Berkshire Medical College, Pittsfield, and the medical department of Dartmouth College, where he graduated M. D. in 1867; entered the U. S. volunteer service by enlistment July 19, 1862, and served in the army three years, attaining the rank of captain of volunteers, which he held for one year; practised his profession in Massachusetts 1868–72; in 1872 devoted himself to literary pursuits, having already for several years been an occasional contributor to periodicals.

Greene (CHRISTOPHER), b. at Warwick, R. I., 1737; served in Canada as colonel under Arnold and Montgomery; was taken prisoner at Quebec 1775; repelled the Hessians under Donop at Red Bank, N. J., 1777; was killed in an encounter with Tories in Westchester co., N. Y., May 13, 1781.

Greene (GEORGE S.), b. at Warwick, R. I., May 6, 1803; graduated at the U. S. Military Academy, second in his class, and entered the army as second lieutenant of artillery in 1823; from this date he was on duty at West Point, as professor of mathematics, in garrison, and on ordnance duty till 1836, when he resigned from the army and adopted the profession of civil engineer. As such he was employed on various public works in different parts of the U. S. till 1860, when he was appointed engineer of Croton waterworks and of Croton reservoir. He resumed his sword on the outbreak of civil war; was appointed colonel 60th N. Y. Vols., and brigadier-general of volunteers in the following April, participating in the battles of Cedar Mountain and Antietam, the defence of Harper's Ferry, and the battles of Chancellorsville and Gettysburg; transferred to the Army of the Cumberland in 1863, he was severely wounded at Wauhatchie, and disabled from duty in the field till 1865, when he joined the army of Gen. Sherman, and was engaged at Kinston, Goldsboro', etc., N. C. In Apr., 1866, he was mustered out of the volunteer service and resumed charge of the Croton waterworks, and in addition the construction of reserve reservoir in Putnam co., N. Y., besides being engaged on many other important public works.
G. C. SIMMONS.

Greene (GEORGE WASHINGTON), b. in East Greenwich, R. I., Apr. 8, 1811, a grandson of Gen. Nathaniel Greene; was educated at Brown University; lived in Europe 1827–47; U. S. consul at Rome 1837–45; was for some years instructor in modern languages in Brown University; became in 1872 professor of history (non-resident) at Cornell University. Author of *Historical Studies*, 1850; *History and Geography of the Middle Ages*, 1851; *Historical View of the American Revolution*, 1865; *Biographical Studies*, 1866; *Life of Nathaniel Greene*, 1867–68; and other works.

Greene (NATHANIEL), b. at Warwick, R. I., of Quaker parents, May 27, 1742. In early youth, chiefly by his own perseverance, he acquired a more than ordinary knowledge of many branches of education, the perusal of military history occupying much of his attention. In 1770 he was chosen a member of the assembly of Rhode Island, and from this date took an active part in the affairs of his country till the close of the war. The battle of Lexington excited his military ardor, and on receiving (in May, 1775) the appointment of brigadier-general and the command of the Rhode Island contingent army, he led them to Cambridge; for this he was formally excommunicated from the religious body of which he was a member. On the arrival of Washington at Cambridge, Greene expressed to his commander his satisfaction in his appointment, and soon won his confidence and esteem. In Aug., 1776, he was appointed by Congress a major-general. In the battle of Trenton he led a division, and bore an equally important part in the following battle of Princeton. At the Brandywine, where he commanded a division, he distinguished himself, and contributed largely towards saving the army from destruction by a rapid march and the firm stand he made against the enemy. At the battle of Germantown he commanded the left wing of the army. In Mar., 1778, he was appointed quartermaster-general, which office he accepted, at the urgent solicitation of Washington, on condition that his rank in the army should not be affected and that in time of action he should retain his command. This right he exercised at Monmouth, where he commanded the right wing, as also at the battle of Tiverton Heights. During Gen. Washington's visit to Hartford in 1780 Greene was in command of the army; was president of the court of inquiry upon Major André. After the disasters to the American arms in South Carolina he was assigned to the command of the southern department to supersede Gen. Gates. He found the army reduced by defeat and desertion, and greatly disorganized and in want. Having recruited his army and repaired its wants, he sent out a detachment under Gen. Morgan, which resulted in the victory of the Cowpens, Jan. 17, 1781. Greene effected a junction with Morgan Feb. 7, but finding his numbers altogether greatly inferior to the army of Cornwallis, he retreated with great skill to Virginia, where, being reinforced, he returned to North Carolina, and the battle of Guilford was fought, in which, though Greene was defeated, the loss of the British was the greater, and in a few days Cornwallis began a retreat towards Wilmington, followed by Greene; but changing his plan, Greene marched directly to South Carolina, where on Apr. 28 he engaged Lord Rawdon at Camden, and was defeated, but again with the results of success; on May 22 he commenced the siege of Fort Ninety-six, which was raised by the approach of Lord Rawdon. To the suggestion now made, that he had better retire to Virginia, Greene replied, "I will recover South Carolina or die in the attempt." Awaiting a favorable opportunity, he in turn pursued the forces of Lord Rawdon, resulting in the battle of Eutaw Springs, the hardest fought battle of the war, and the advance upon Dorchester. For his conduct at Eutaw Springs, Congress presented him with a gold medal and a British standard. During the remainder of his command he struggled successfully against the greatest difficulties in suppressing mutiny among his troops, who were insufficiently fed and clothed. North and South Carolina and Georgia made him valuable grants of property, and after spending a year in Rhode Island upon the return of peace, he sailed with his family to his estate near Savannah, where he d. June 19, 1786, from inflammation of the brain, occasioned by a stroke of the sun.
GEO. C. SIMMONS.

Greene (NATHANIEL), b. at Boscawen, N. H., May 20, 1797. Left dependent upon his own resources at an early age, he entered the office of the *New Hampshire Patriot* at Concord in 1809, and in 1812 became editor of the Concord *Gazette*; removed to Portsmouth in 1814, and for a year managed the *New Hampshire Gazette*; thence he removed to Haverhill, Mass., where for two years he conducted the Haverhill *Gazette*; in 1817 he started the Essex *Patriot*, which he continued until 1821, when by invitation he removed to Boston and established the Boston *Statesman*, at first a semi-weekly, but finally it became the leading Democratic daily in the State; in 1829 he was appointed postmaster of Boston, which office he held until 1840, and again from 1845 to 1849. In 1836 he published a translation of Sforzosi's *History of Italy*, *Tales from the German* in 1837, and *Tales and Sketches from the German, Italian, and French* in 1843. D. Nov. 29, 1877. G. C. SIMMONS.

Greene (ROBERT), M. A., b. at Ipswich (or, as some

say, Norwich), England, in 1550 (according to others, about 1560); took degrees at St. John's College (1578) and Clare Hall (1583), Cambridge; travelled in Italy and Spain; studied at Oxford, and (as some say) took holy orders in 1584. He soon went to London, where he was a dramatist and poet, one of the associates of Lodge, Peele, and Marlowe, all famous for their profligate debaucheries. He d. of a surfeit at London Sept. 3, 1592. His plays are mostly forgotten, but his pamphlets, tracts, poems, and tales show good abilities; but his style is often more euphuistic than that of Lyly, whom he imitated.

Greene (S. Dana), U. S. N., b. Feb. 11, 1840, in Cumberland, Md.; graduated at the Naval Academy in 1859; became a lieutenant in 1861, a lieutenant-commander in 1865, a commander in 1872. True to a name famous in the annals of the Revolution, Lieut. Greene, in Jan., 1862, *volunteered* to serve as the executive officer of the Monitor (the first of an untried type of vessels), which the majority of seamen, not without reason, as was afterwards proved, believed to be utterly unseaworthy. His services in fitting out the vessel, in her encounter with the Merrimack, etc., are fully narrated by Commander (now Rear-admiral) Worden in an unpublished report on the files of the navy department, dated Jan. 5, 1868, from which we extract the following: "I was ordered to the Monitor on the 13th of Jan., 1862, when she was still on the stocks. Prior to that date Lieut. S. D. Greene had interested himself in her, thoroughly examined her construction and design, and informed himself as to her qualities; and, notwithstanding the many gloomy predictions of naval officers and officers of the mercantile marine as to the great probability of her sinking at sea, volunteered to go in her, and at my request was ordered. From the date of his orders he applied himself unremittingly and intelligently to the study of her peculiar qualities, and to her fitting and equipment." . . . "Lieut. Greene, the executive officer, had charge in the turret, and handled the guns with great courage, coolness, and skill, and throughout the engagement, as in the equipment of the vessel and on her passage to Hampton Roads, exhibited an earnest devotion to duty unsurpassed in my experience; and for which I had the honor in person to recommend him to the department and to the board of admirals (some three years since) for advancement, in accordance with the precedent established in the case of Lieut.-Com. Thornton, the executive officer of the Kearsarge. I beg leave now, most respectfully and earnestly, to reiterate that recommendation." Toward the close of the engagement between the Monitor and the Merrimack a shell, striking the pilot-house of the Monitor, near the "lookout hole," through which Capt. Worden was then looking, exploded, "filling his face and eyes with powder, utterly blinding, and in a degree stunning him." By this casualty Lieut. Greene became the commanding officer of the vessel, and, taking his place in the pilot-house, gave orders to turn her head in the direction of the Merrimack, with the design of coming to close quarters with his antagonist. As he steered toward her, however, she declined the combat, and, "crippled and discomfited," retired to Norfolk, whither Lieut. Greene had the good judgment not to attempt to follow her, for had he done so, and met with disaster from the enemy's batteries or by grounding on one of the many shoals of the intricate channel leading to that city, he would have imperilled not only the vast amount of shipping at Hampton Roads and in Chesapeake Bay—more than half of which must have shared the fate of the Congress and Cumberland—but also Mansfield's army at Newport News, and perhaps even Fortress Monroe, the key to the Chesapeake and the James and Elizabeth rivers. Lieut. Greene had the good sense to perceive all this, and to resist the temptation, which must have been very great to a young and gallant officer, to pursue the retreating foe. Lieut. Greene remained in the Monitor until she foundered off Hatteras on Dec. 31, 1862, with a loss of four officers and twelve men. His conduct on this trying occasion is thus highly spoken of by his commanding officer, Com. J. P. Bankhead, in his official report of Jan. 1, 1863: "I would beg leave to call the attention of the admiral and of the department to the particular good conduct of Lieut. Greene and Acting Master L. N. Stodder, who remained with me until the last, and by their example and bearing did much towards inspiring confidence and obedience on the part of others." Thus we see that in tempest as in battle Lieut. S. Dana Greene displayed the highest qualities of the American officer—coolness, decision of character, prudence. There are many brave men, but not many who, like him, unite bravery with discretion and sound judgment. FOXHALL A. PARKER.

Greene (SAMUEL STILLMAN), LL.D., b. at Belchertown, Mass., May 3, 1810; graduated at Brown University 1837; superintendent of schools Springfield, Mass., 1840–42; instructer in the grammar and English high schools, Boston, 1842–49; agent for the Massachusetts board of education 1849–51; superintendent of public schools Providence, R. I., 1851–55, and at the same time professor of didactics in Brown University; professor of mathematics and civil engineering in Brown University 1855–64; of mechanics and astronomy since 1864; has been president of the Rhode Island State Institute, of the American Institute of Instruction, and of other educational societies. Author of *The Analysis of Sentences*, 1848, and of a series of English grammars and other works.

Greene (WILLIAM), b. in 1732; was Speaker of the assembly of Rhode Island; chief justice of the colony; governor of the State 1788–86; and d. at Warwick, R. I., Nov. 30, 1809.—Another WILLIAM GREENE became deputy governor of Rhode Island in 1740; was governor 1743–58; and long was the clerk of the county court at Providence. D. Feb. 23, 1758.

Green Ebony (*Jacaranda ovalifolia*), a South American tree of the order Bignoniaceæ. Its wood is quite hard and is olive-green in color. It is used by dyers, and gives yellows, browns, and greenish tints. It is also used in turnery and joiner-work to some extent. Other species of the genus yield medicinal agents.

Greeneville, post-v., cap. of Greene co., Tenn., on the East Tennessee Virginia and Georgia R. R., 75 miles N. E. of Knoxville. It has a good system of public schools and 2 newspapers. There are two furnaces in active operation, and Greeneville and Tusculum College is a few miles from the town. It is the home of Ex-Pres. Andrew Johnson. The narrow-gauge railroad leading to North Carolina terminates here. P. 1039. J. B. R. LYON, ED. "NEW ERA."

Green'field, tp. of Poinsett co., Ark. Pop. 261.

Greenfield, post-v. of Greene co., Ill., 55 miles from St. Louis, on the line of the Rockford Rock Island and St. Louis R. R. It has 4 churches, 1 large brick seminary, 1 private academy, 6 dry-goods houses, 8 grocery, 2 drug, 2 hardware, 1 jewelry, and 1 furniture store, 1 banking-house, 1 newspaper, 2 hotels, 2 harness-shops, 1 steam flouring-mill, 3 large warehouses, 1 planing-mill, 2 lumber-yards, 1 gunsmith-shop, a commodious town-hall, etc. It exports large quantities of grain, cattle, hogs, horses, and other produce. W. E. MILTON, PUB. "LOCOMOTIVE."

Greenfield, tp. of Grundy co., Ill. Pop. 1645.

Greenfield, post-v., cap. of Hancock co., Ind., on the Pittsburg Cincinnati and St. Louis R. R., 21 miles E. of Indianapolis. It has a bank, a printing-office and newspaper, 2 large flouring-mills, 1 furniture-factory, 3 very fine churches, a large number of fine stores, groceries, shops, etc., 2 hardware stores, 2 planing-mills, and a commodious school-house costing $25,000. Pop. 1203.

WILLIAM MITCHELL, ED. "HANCOCK DEMOCRAT."

Greenfield, tp. of La Grange co., Ind. Pop. 1078.

Greenfield, tp. of Orange co., Ind. Pop. 1439.

Greenfield, post-v., cap. of Adair co., Ia. Pop. of tp. 197.

Greenfield, tp. of Jones co., Ia. Pop. 1083.

Greenfield, tp. of Warren co., Ia. Pop. 1514.

Greenfield, post-tp. of Penobscot co., Me., 20 miles N. E. of Bangor. Pop. 317.

Greenfield, a post-v. and tp., cap. of Franklin co., Mass., 36 miles N. of Springfield, in the valley of the Connecticut River and on the Vermont and Massachusetts and the Connecticut River R. Rs. It derives its principal prosperity from the farming interests which surround it, being the main market for butter, cattle, sheep, etc. in the N. W. section of the State. Its manufactures are children's carriages, planes, bolt-cutting machines, and other small articles. There are 2 national and 2 savings-banks, 6 churches, a young ladies' seminary, and a large library. It has a fine court-house, a well constructed high-school building, a beautiful soldiers' monument, and 2 weekly newspapers. Pop. 3589. E. A. HALL, ED. "GAZETTE AND COURIER."

Greenfield, post-tp. of Wayne co., Mich. Pop. 2406.

Greenfield, tp. of Washtenaw co., Mich. Pop. [illegible].

Greenfield, post-v. of Centre tp., cap. of Dade co., Mo., 40 miles N. W. of Springfield, near the Turnback River, on the line of the Kansas City and Memphis R. R. It has a bank, 2 newspapers, 15 stores, 2 hotels, and 3 churches. P. 361. C. W. GRAHAM, PROP. "VEDETTE."

Greenfield, post-tp. of Hillsborough co., N. H., 30 miles S. W. of Concord. Pop. [illegible].

Greenfield, tp. of Saratoga co., N. Y., 6 miles N. of Saratoga, on the Adirondack R. R. It has manufactures of brick, paper, glass, etc., and quarries of limestone. P. 2698.

Greenfield, tp. of Fairfield co., O. Pop. 1944.

Greenfield, tp. of Gallia co., O. Pop. 1586.

Greenfield, post v. of Madison tp., Highland co., O., on the Marietta and Cincinnati R. R. It has 2 newspapers, and 1 national bank. Pop. 1712.

Greenfield, tp. of Huron co., O. Pop. 954.

Greenfield, tp. of Blair co., Pa. Pop. 1233.

Greenfield, post-tp. of Erie co., Pa. Pop. 1039.

Greenfield, tp. of Luzerne co., Pa. Pop. 823.

Greenfield, b. of Washington co., Pa. Pop. 386.

Greenfield, tp. of La Crosse co., Wis. Pop. 676.

Greenfield, post-tp. of Milwaukee co., Wis. P. 2281.

Greenfield, tp. of Monroe co., Wis., on the Milwaukee and St. Paul R. R. Pop. 519.

Greenfield, tp. of Sauk co., Wis. Pop. 746.

Green Finch, or **Green Linnet,** the *Coccothraustes chloris*, a bird of the family Fringillidæ, found throughout a large part of the eastern hemisphere. It is often kept as a cage-bird, but is a poor songster. It is also called the green grosbeak. It feeds on both seeds and insects.

Green Garden, post-tp. of Will co., Ill. Pop. 1202.

Green'heart, the very valuable timber of the *Nectandra Rodiæi* (order Lauraceæ), the same tree which yields the bebeeru bark, a valuable medicine. Its seeds also yield starch, which is used as food by the natives. The timber is imported from Guiana. It is very heavy and durable, takes a high polish, and is used in turnery. In Guiana it is used as ship-timber. It resembles lignum-vitæ, and is much employed in making fishing-rods.

Green Hill, post-tp. of Rutherford co., N. C. P. 1186.

Green'house, a glass structure designed to afford an artificial climate in which tender plants may be grown in countries too cold for their unprotected growth. The simplest structures of this kind are the cold-frames used by market-gardeners for forcing the early maturity of vegetables. Cold graperies, conservatories, orchard-houses, bark-stoves, etc. are among the varieties; but gardeners apply the name *greenhouse* more especially to those whose winter temperature is just high enough to keep tender plants alive, or perhaps to produce from the flowering kinds some blossoms, but not enough to stimulate growth. When a greater heat than this is kept up in winter (say over 65° F. by day or 42° by night), the structure is called a stove or hothouse. The glass serves for the imprisonment of a portion of the solar heat, and currents of cold air are excluded; but in order equably to maintain this temperature, it is necessary to employ artificial heat in some form. For the ruder cold-frames the fermentation of horse-dung mixed with dead leaves or other suitable organic matter is sufficient; and in the bark-stove very delicate plants may be forced by the fermentation of ground tan-bark and horse-dung, which affords not only a suitable heat, but a copious supply of moisture, which is another very favorable condition for plant-growth. But, ordinarily, flues or steam-pipes are employed for this purpose. The construction and management of greenhouses are the subject of many published works, and the business requires special training, and calls for no ordinary degree of intelligence and faithfulness on the part of those entrusted with its management. The regulation of temperature, light, air, moisture in air and soil, economy in the use of materials, the detection and destruction of the peculiar insect enemies and fungoid growths which attack greenhouse plants, are points which require diligent attention.

Green Isl'and, post-v. of Watervliet tp., Albany co., N. Y., is situated on an island in the Hudson River, between Troy and West Troy, and on the Rensselaer and Saratoga R. R. It is connected by bridges with these towns, and has 4 churches and extensive manufactures of railroad cars, machinery, castings, iron, and other goods. It is connected with Troy and Cohoes by a street railroad. Pop. 3135.

Green Isle, post-tp. of Sibley co., Minn. Pop. 437.

Green Lake, a small lake of Clear Creek co., Col., 3 miles S. W. of Georgetown. It is 10,000 feet above the level of the sea; is half a mile long and one-fourth of a mile wide. It is a pleasant resort.

Green Lake, county of S. E. Central Wisconsin. Area 380 square miles. It is fertile, and has an uneven surface. Cattle, grain, and wool are staple products; carriages and flour are leading manufactures. Cap. Dartford. Pop. 13,195.

Green Lake, tp. of Monongalia co., Minn. Pop. 234.

Green Lake, post-tp. of Green Lake co., Wis., on the Sheboygan and Fond du Lac R. R., 26 miles W. of Fond du Lac. Pop. 1102.

Green'land [Dan. *Grönland*], an island of vast but unknown extent, stretching from Cape Farewell, its southern extremity, in lat. 59° 49′ N., towards the north pole, separated by Davis's Strait, Baffin's Bay, and Smith's Sound from continental America on the W., and bounded on the S. and E. by the Atlantic and Arctic oceans. On account of the vast extent of land, the climate of these regions is much colder than that of corresponding latitudes farther E. In lat. 60° N. the mean temperature is lower than that of Lapland in lat. 72° N. In the two summer months, June and July, during which the sun is always above the horizon, the temperature rises to 53°; the snow melts; the icebergs detach themselves from the glaciers of both coasts, and float with the currents from the Arctic Ocean down into the Atlantic; and in the vales of the W. coast, along the fiords, vegetation begins its short and feeble life. The pine never becomes a tree, it remains a shrub, and the blubber of the whale and the oil of the seal must be used for fuel. Potatoes and a few other vegetables may be raised. A few herbs, flowers, and berries will grow. But the principal plant is the moss, which lives under the snow, and on which the reindeer feeds. During the winter the temperature sinks to —69° F. The eastern coast, which is the most inhospitable, was explored in 1822 by Capt. Scoresby, in 1823 by Capt. Clavering, in 1830 by Capt. Graah up to lat. 74° 30′ N., and in 1868–70 by German expeditions. It presents a range of precipitous cliffs from 2000 to 3000 feet high, covered with eternal snow and ice, over which the huge glaciers of the much higher mountains of the interior descend to the ocean. The western coast, along which most of the settlements have been made, was explored in 1853 by Dr. Kane up to lat. 81° 22′ N. The land was discovered in the ninth century by an Icelander, Gunbjörn, and shortly after it was visited by another Icelander, Erik the Red, who called it Greenland, and gave a very flattering report of it, which occasioned two Icelandic settlements to be made—West Bygd and East Bygd. These two settlements seem to have been quite flourishing, but in the middle of the fourteenth century both of them were utterly destroyed by the plague, by attacks of the natives, and by a foreign fleet. In the sixteenth and seventeenth centuries the western coast was visited by the English, by Frobisher, Davis, and Baffin, but the first regular European settlement was made in 1721 by the Norwegian clergyman, Hans Egede, who, with the support of the Danish government, removed himself, his family, and a few friends to Godthaab (which see), and began preaching Christianity among the native inhabitants, the Esquimaux (which see). Hans Egede's report of the land and the people is a very interesting and touching little book; and since his time the Danes have founded and supported 13 colonies, of which Godthaab, Julianeshaab, and Upernavik are the most important, and in which about 10,000 people (in 1871, 9825) are gathered—about 300 of them Danes, and the rest Esquimaux. Life in these colonies depends upon hunting and fishing, and the natives exhibit great skill in these occupations, though of late it has become the steady complaint of the Danish officers that the foreign fishing-fleets which come to these places introduce habits among the natives which make them unfit for the kind of life which alone can be led here; the consequences of which are often utter wretchedness and misery. Though vegetation is feeble in this climate, animal life is quite vigorous. The dog is the only domesticated animal, but reindeer, bears, foxes, and wild-fowl—among which is the eider-duck—whales, seals, and cod-fish abound. Great quantities of fish-oil, fur, and eider-down are exported, and lately cryolite and other minerals have become important items of exportation. Miocene lignitic coal of good quality exists. But the seal is the chief resource of the Greenlander's life. Its skin is his dress, his boat, his bed; its oil is his lamp and his stove during the long winter when the sun never rises; its flesh is almost the only kind of meat which gives his body a sufficient vital heat. When the Greenlander ceases to catch the seal, he must die; when for a bottle of whisky (the sale of which is prohibited) or a red ribbon he sells too much of his harvest, he must starve. The Lutherans and Moravians each maintain missions in Greenland. Clemens Petersen.

Greenland, post-tp. of Ontonagon co., Mich., has mines of copper. Pop. 548.

Greenland, post-tp. of Rockingham co., N. H., on the Concord and Portsmouth and the Eastern R. Rs., 6 miles W. of Portsmouth. Pop. 695.

Greenleaf, tp. of Sanilac co., Mich. Pop. 336.

Greenleaf, post-v. and tp. of Meeker co., Minn. Pop. of v. 54; of tp. 392.

Greenleaf (Benjamin), b. at Haverhill, Mass., Sept. 25, 1786; graduated at Dartmouth College 1813; was principal of Bradford Academy 1814–36, and of the Bradford Teachers' Seminary, 1839–48; represented Bradford in the legislature of Massachusetts in 1837–39. Published a series of *Arithmetics*, an *Algebra*, and *A System of Practical Surveying*. D. at Bradford, Mass., Oct. 29, 1864.

Greenleaf (Moses), LL.D., b. at Newburyport, Mass., 1778. Author of *Statistical View of Maine* (1816), *Survey of Maine* (1829). D. in Williamsburg, Me., Mar. 20, 1834.

Greenleaf (Simon), LL.D., b. at Newburyport, Mass., Dec. 5, 1783; studied law, and, after being admitted to the bar, commenced practice at Standish, Me., in 1806, removing to Gray soon after, and in 1818 to Portland. From 1820 to 1832 he was reporter of the supreme court in Maine, and published nine volumes of reports. In 1833 was appointed Royall professor of law at Harvard University, through the influence of Judge Story, whom he succeeded as Dane professor of law in 1846. Having resigned in 1848 his professorship, he was made emeritus professor. He was for many years president of the Massachusetts Bible Society. His most important work was a *Treatise on the Law of Evidence*, in 3 vols. (1842–53). A volume of *Overruled, Denied, and Doubted Decisions and Dicta* was published in 1840, and subsequently expanded to three volumes. In 1849 he edited Cruise's *Digest of the Law of Real Property*. He also published an *Examination of the Testimony of the Four Evangelists by the Rules of Evidence as administered in Courts of Justice, with an Account of the Trial of Jesus* (1846), and *Remarks on the Exclusion of Atheists as Witnesses*. His style is remarkably clear and elegant. D. at Cambridge, Mass., Oct. 6, 1853.

Green Moun'tain, a high grass-covered peak in Jefferson co., Col., composed of coal-bearing rocks. Near it are important mines of lignitic coal of good quality.

Green Moun'tains, a part of the Appalachian system of mountains, found in Vermont and Massachusetts, and continued southward in the hills of Western Connecticut and the Highlands of New York. The Taconic range of Massachusetts, New York, and Connecticut is an outlying western parallel range. North-eastward the Green Mountains pass into the Notre Dame Hills of Canada, and are traceable at least as far as the Gulf of St. Lawrence. The highest points are Mt. Mansfield, 4389 feet, Camel's Hump, 4188 feet, and Killington Peak, 4221 feet in height. The range contains marble, iron, slate, and some copper and gold. The country is generally a rich pastoral region, with valuable water power and abundant forests.

Green Oak, post-tp. of Livingston co., Mich. P. 994.

Gree'nock, a young but rapidly developing town of Scotland, in the county of Renfrew, on the Frith of Clyde. It has excellent harbors and docks, extensive establishments for sugar-refining, shipbuilding, and the manufacture of iron-work, and a very brisk trade with North America and the West and East Indies. Pop. 57,138.

Green'ough (Horatio), b. in Boston, Mass., Sept. 6, 1805. His father was a merchant of character and consideration; his mother, a native of Massachusetts, was a woman of great intelligence and sensibility. Horatio was one of several children. He received the best education the times afforded at public and private schools, and enjoyed early the society of cultivated people. At the age of sixteen he entered Harvard College, prepared to improve his advantages. The artistic bent appeared in him early and decidedly. The schoolboy's propensity to cut, carve, design, and model attracted attention, and secured for him interest and admiration. His high social position, his enthusiasm, his evident genius, and his winning manners won for him encouragement and help. At Cambridge he found in Washington Allston a stimulating and wise friend; his gratitude to Allston never diminished. Young Greenough was too much interested in studies connected with his chosen art to strive after academic honors; still, he was a faithful scholar, if not distinguished, and on leaving college was furnished with literary stores and culture far beyond other lads of his years. His sonnets, written while an undergraduate, sketches with the pencil, plaster casts, models, and designs—particularly one for a monument on Bunker's Hill—attest a remarkable creative power. Before the day of graduation Greenough went to Italy for serious study of the ancient masterpieces, repairing at once to Rome, the centre of art. There were the Academy, the Vatican, the gardens, and galleries; there Thorwaldsen was his friend. His studies impaired his health, and he spent a few months at home, executing portrait-busts of J. Q. Adams, Chief-Justice Marshall, and others. Already he had a reputation for talent. At Paris, whither he went for the purpose, he made the bust of La Fayette, by none admired more than by La Fayette himself. Returning to Italy, Greenough, after some stay at Carrara among the marble quarries, took up his residence in Florence as a sculptor. He was the pioneer of the great company who since have found fortune there. Powers, two months his senior, joined him in 1837. American travellers in Italy were then comparatively few; of American residents the number was very small. American art had no fame, its works were unknown and unpurchased. Solitary, unpatronized, unvisited, the artist knew poverty and depression. However, the patrons came; among the first, Cooper the novelist, who gave him not only the cheer of his presence and the encouragement of his praise, but a commission which proved to be the beginning of his larger renown. The group, two nude cherubs, came to Boston, and excited great admiration in influential quarters just at the time when the government was thinking of a statue to George Washington. The poet Dana, his friend Mr. Cooper, Allston, then at the summit of his fame, Edward Everett, who had known the artist in Italy, spoke effective words for him, and secured for him the commission. The statue is well known to all the visitors at the national capital. It was a work of great study, labor, and feeling, wrought in the poetical, not the historical spirit, and by those who thus approached it it was greatly admired. Edward Everett regarded it as "one of the greatest works of sculpture of modern times." His brother, Mr. Alexander H. Everett, declared that it surpassed his expectations, high as they were: "It is truly sublime." The work was not designed for the open air, and the placing of it was a disappointment to the artist, who was in consequence of that exposed to what he considered unjust criticism. Had Greenough designed a statue for a public square, he would have modelled a very different one; for although trained in antique schools, among the masterpieces of classic art, he was a modern man, and understood as well as anybody the conditions of living art. He gave his whole mind and nearly eight years of life to the execution of the statue, but to place it finally was not given to him.

Greenough was a man of ideas, imaginative, poetical. He loved ideal work. He made a bust of the Christ which was greatly praised. One of his earliest works was a statue of Abel. One of his latest, *The Rescue*, representing, under the design of an American settler grappling an Indian, the superiority of the Anglo-American to the savage, was executed between 1837 and 1851 on an order from the government. Greenough excelled in small pieces of sentiment and fancy—groups of children at play, portraits of children. These were never commonplace, and often were strikingly original. They belong to private families. He was a man of genius—not a sculptor merely, but a lover of art in general, an observer of nature, a student of man. Everything that concerned the conditions of human life interested him—social arrangements, modes of existence, building, government. His literary talent was remarkable, though exhibited only in fragments of prose and verse. R. W. Emerson pronounced his conversation "both brilliant and deep; and his writing so remarkable for its realism and its occasional splendor that I conceived the highest hope of what he should do, and cause others to do, by his speech and pen as well as by his chisel." Mr. Greenough passed the last year of his life in the U. S. The disturbed state of Italy made his home there disagreeable, and he came away in the autumn of 1851 on the pretext of erecting his group of *The Rescue* in Washington, but he never returned. It is thought that the excited condition of life, social and political, in America was too much for a sensitive man who had passed his best years in the world of the past; the transition from the serene atmosphere of Italy to the intellectual tumult of the New World was too sudden to be borne. In the winter of 1852 he was attacked at his home in Newport with brain fever. A removal to Somerville, near Boston, for medical treatment proved unavailing, and he d. there on Dec. 18. Among the best known works of Horatio Greenough are the *Venus Victrix*, the *Angel Abdiel*, the *Medora*. His smaller but most attractive pieces were numerous. O. B. Frothingham.

Greenough (Richard S.), brother of Horatio, was b. at Jamaica Plain, Mass., Apr. 27, 1819, and educated at the Boston Latin School 1829–32. The habit of drawing acquired in childhood and practised diligently took a decided bent from the sculptor Clevenger, under whose eye he finished a small bust, which gave so much promise that friends decided he should go to Florence and work with his brother. The winter of 1840–41 was spent in Venice, Ferrara, Bologna, and Florence, but ill-health compelled him to return to Boston. A portrait-bust of William H. Prescott, executed in [illegible], brought him orders for similar work, which kept him occupied till 1850, when he returned to Italy and worked, chiefly in Rome, on imaginative subjects—a head of Christ, *Moses and the Daughter of Pharaoh*, *Cupid* [illegible], [illegible] *Young Mother*. His best known work of this period is the bronze group, *The Shepherd Boy and the Eagle*, now in the Boston Athenæum. The bronze statue of Franklin in School street, Boston, executed in 1853 in Boston, and the marble statue of Gov. Winthrop in the chapel at Mount Auburn Cemetery, finished in Florence 1855–56, are the best known of Mr. Greenough's works. The period from 1856–68, spent in Paris, was full of industry, the busts, bas-reliefs, and imag-

inative pieces indicating much poetic feeling and delicacy of taste. For the past four years the artist has resided at Newport, R. I. Here he has done *Victory*, a memorial statue in honor of the Boston Latin School graduates who fell in the civil war, ideal heads of Beatrice and Portia, and a colossal statue of Gov. Winthrop, ordered by the State of Massachusetts for the Capitol at Washington.

O. B. FROTHINGHAM.

Green Pig′ments. In painting, the mixture of yellow and blue pigments in suitable proportions will afford the various shades of green. Among the most prominent of the pigments which directly afford green colors is *chrome green*, the sesquioxide of chromium, made by firing the chromate of mercury, and affording a very permanent and full-bodied opaque green paint. *Terre verte* or green earth, a native mineral, affords a neutral green, permanent and delicate, much used by artists. *Scheele's green*, the arsenite of copper, is a cheap and good green paint. *Schweinfurth's green* is the double arsenite and acetate of copper; it affords a very handsome color. *Sap green*, prepared from buckthorn-berries, is employed by artists. Many of the salts of copper are employed as green pigments. (See PAINTS and PIGMENTS.)

Green′point, now the 17th ward of the city of Brooklyn, N. Y., into which it was incorporated in 1852, has 13 churches, 2 banks, a daily and a weekly newspaper, ship-building, and other important manufacturing and business interests. Pop. of ward 17,353. (See BROOKLYN.)

H. G. LAMBERT, ED. "BROOKLYN DAILY POST."

Green′port, tp. of Columbia co., N. Y., on the Hudson River, has much fertile soil and extensive limestone-quarries. Pop., exclusive of HUDSON (which see), 1325.

Greenport, post-v. of Suffolk co., N. Y., on Shelter Island Sound, between Peconic and Gardiner's bays, 95 miles from Brooklyn, is the eastern terminus of the Long Island R. R. It has 5 churches, 5 hotels, 2 newspapers, 1 national bank, 20 stores, a good fire department, 2 shipyards, 3 sets of marine railways, a stereotype-foundry, and numerous minor branches of industry. Principal business, coasting and fishing. P. 1819. W. R. DUVALL, ED. "SUFFOLK TIMES."

Green Prai′rie, post-tp. of Morrison co., Minn. P. 201.

Green Riv′er, in Kentucky, rises in Lincoln co., and pursues a devious north-westerly course, uniting with the Ohio 6 miles above Evansville, Ind. It is navigable at high water 200 miles by means of locks and dams. The mouth of the Mammoth Cave, at an elevation of 225 feet above, is about a quarter of a mile from this river, a subterranean communication from which constitutes the famous "river" of that cave. A recent barometrical observation showed its level to be the same as that of Green River, while it is known to rise and fall with that of the latter.

Green River, of Massachusetts, rises in Windham co., Vt., and joins the Deerfield River at Greenfield. It affords good water-power, and there is fine scenery on its banks.—Another Green River flows from Hancock, Mass., through Williamstown, into the Hoosac.—Still a third rises on the borders of Massachusetts and New York, flows southward through West Stockbridge, Alford, and Great Barrington, and joins the Housatonic River near the northern boundary of Sheffield. It is this which forms the theme of the poet Bryant in his lines "To Green River" (written when he was a resident of Great Barrington).

Green River, of Utah, rises in Western Wyoming, and flows in a generally southward course into Utah. With Grand River it constitutes the Rio Colorado of the West. It drains a large portion of Utah E. of the Wahsatch Mountains, and a large area in North-western Colorado.

Green River, tp. of Henderson co., N. C. Pop. 709.

Green River City, post-v., cap. of Sweetwater co., Wyoming Ter., on Union Pacific R. R. and Green River. P. 106.

Green′sand, a term used by geologists to describe a sand that contains a large proportion of glauconite in the form of green grains. (See GLAUCONITE.)

Greensand, The, a term applied to a subdivision or subdivisions of the Cretaceous series of rocks. The (Cretaceous) greensand of America belongs to the Upper Cretaceous series, while the greensand of Europe is divisible into the Upper Greensand, belonging to the Upper Cretaceous, and the Lower Greensand, belonging to the Lower Cretaceous or Neocomian period. Lithologically alike, the Upper and Lower Greensands are palæontologically very distinct; the presence of the fault between them also evidencing the difference of their "horizons."

Greens′boro′, post-v. and tp., cap. of Hale co., Ala., a few miles N. of the canebrake-region, which was famous before the war for its productiveness. The Southern University, under the auspices of the Alabama Conference of the Methodist Episcopal Church, South, is located here, and is in quite a flourishing condition. The place is well supplied with merchants and professional men, and has 4 church edifices. The Selma Marion and Memphis R. R. passes through the suburbs of the place. Pop. of v. 1760; of tp. 2400. JOHN G. HARVEY, PUB. "ALABAMA BEACON."

Greensboro', post-v., cap. of Greene co., Ga., on the Georgia R. R., 87 miles from Augusta and 85 from Atlanta. It has a fine brick court-house, 4 churches for whites and 2 for colored, a number of brick stores and residences, male and female schools for whites and 1 for colored, a bank, 1 weekly newspaper, several hotels, a large tanyard, and beautiful fair-grounds and buildings. Pop. 913.

J. IRVING WESTERVELT, ED. "HERALD."

Greensboro', post-tp. of Henry co., Ind. Pop. 1488.

Greensboro', post-v., cap. of Guilford co., N. C., on the North Carolina R. R., 82 miles from Raleigh, and the terminus of the Richmond and Danville R. R., 188 miles from Richmond. It has 4 churches, 2 banks, 2 political and 1 religious paper, about 30 stores, 2 spoke and handle manufactories, employing about 400 men, 1 spoke-factory, 1 saw-mill, a planing-mill, a foundry, an agricultural-machine works, 2 splendid hotels, a Methodist female college with accommodations for 400 pupils, and several smaller schools. The products of the surrounding country are wheat, oats, corn, and fruit. Large quantities of the latter are dried and shipped South. Its mineral products are copper and iron, both being worked profitably. Pop. 497.

P. F. DUFFY, ED. "GREENSBORO' PATRIOT."

Greensboro', post-tp. of Orleans co., Vt., 28 miles N. W. of St. Johnsbury, on the Portland and Ogdensburg R. R. Pop. 1027.

Greens′borough, post-v. and tp. of Caroline co., Md., on the Maryland and Delaware R. R., 61 miles S. S. W. of Wilmington, Del. Pop. of v. 561; of tp. 2473.

Greensborough, post-v. of Sumner co., Miss., 110 miles N. by E. of Jackson.

Greensborough, post-v. of Greene co., Pa., in Monongahela tp., has extensive potteries, beds of excellent potters' clay, and remarkable deposits of coal. It is on the W. bank of the Monongahela River.

Greens′burg, post-v., cap. of Decatur co., Ind., 47 miles S. E. of Indianapolis, on the Indianapolis Cincinnati and Lafayette R. R. It has a furniture-factory, a pork-packing establishment, several flouring-mills, 2 carriage-factories, a woollen-mill, a foundry and machine-shop, 2 national banks, 1 fine hotel, and numerous mercantile business-houses. It contains fine stone-quarries, and extensive shipments of stone for business purposes are made. It is the shipping-point for a large agricultural district. It has 2 weekly newspapers. Pop. about 3700.

JAS. C. MCKEE, ED. "STANDARD."

Greensburg, post-v., county-seat of Greene co., Ky., on Green River, here navigable at high water some 200 miles from its mouth. Pop. 351.

Greensburg, post-v., cap. of St. Helena parish, La. It has a Masonic lodge, a temperance hall, and Methodist and Baptist churches. Pop. 160.

R. W. READ, OFFICE MANAGER OF "STAR AND JOURNAL."

Greensburg, tp. and post-v. of Knox co., Mo., 10 miles N. of Edina. Pop. 994.

Greensburg, tp. of Putnam co., O. Pop. 779.

Greensburg, post-b., cap. of Westmoreland co., Pa., 31 miles E. of Pittsburg, on the Pennsylvania R. R. at its junction with the South-western R. R. It has 4 weekly newspapers, 1 national and 2 deposit banks, hotels, stores, churches, etc. Principal business, merchandizing, including shipping grain, wool, coke, and agricultural products generally. It is in a rich agricultural region. Pop. 1642.

J. M. LAIRD & SONS, PUBS. "PENN. ARGUS."

Green Sea, tp. of Horry co., S. C. Pop. 1043.

Green's Fork, tp. of Randolph co., Ind. Pop. 2043.

Green's Grant, a tract of land in Coos co., N. H. Pop. 71.

Green′shank, the *Totanus glottis*, a wading bird of the group known as tatlers, is remarkable for its wide geographic range, being found in Asia, Europe, and North America, but rather rare in the U. S. It is as large as a woodcock, and has a much longer bill and legs.

Green's Mills, tp. of Henry co., Ala. Pop. 816.

Green Snake, a name applied to several harmless serpents of the U. S. *Cyclophis vernalis* is the little green or grass snake, very common throughout a large part of the U. S. *Cyclophis æstivus* is a long, slender tree-snake, of the Southern States, golden-green above, whitish-yellow beneath; the genus to which these belong is rather closely related to *Coluber*.

Greens'pond, a port of entry on an island of the same name N. of the entrance to Bonavista Bay on the N. E. coast of Newfoundland. The island is utterly barren, and soil for gardens has been brought from the mainland. The harbor is small, but safe, and the town is important as a fishing and sealing station. Pop. 1073.

Greens'port, tp. of St. Clair co., Ala. Pop. 518.

Green Spring, a v. of Seneca and Sandusky cos., p. o. in Seneca co., O., on the Cincinnati Sandusky and Cleveland R. R., 22 miles S. of Sandusky City. It has a national bank, a newspaper, water cure, diabetic-cure, a planing mill, a grist-mill, a hub and spoke factory, and the usual number of stores. Principal business, pork packing and lumbering. G. E. Sweetland, Prop. "Gazette."

Green Spring, tp. of Louisa co., Va. Pop. 2018.

Green'stone (*diorite*), a granitoid rock of the hornblende series. In appearance and texture it is much like syenite. It is very tough and of a greenish hue. It is composed of hornblende, mixed with albite or with oligoclase, which are varieties of feldspar.

Green'up, county in the N. E. of Kentucky, bounded on the N. by the Ohio River. Area, 180 square miles. Its surface is broken, but fertile and well timbered. It abounds in excellent coal and in iron ores. Some grain is produced, and iron is manufactured. The county is traversed by a branch of the Lexington and Big Sandy R. R. Cap. Greenup. Pop. 11,463.

Greenup, post-v. and tp. of Cumberland co., Ill., on the St. Louis Vandalia Terre Haute and the Indianapolis R. Rs., about midway between St. Louis and Indianapolis, on the most elevated point of land between the two places. It has 1 weekly newspaper, 3 hotels, 20 places of business, a grist-mill, a woollen-factory, and a well of excellent mineral water. Pop. of v. 555; of tp. 2128.

Ozier & Cooper, Pubs. "Mail."

Greenup, post-v., cap. of Greenup co., Ky., on the Ohio River, at the terminus of the Eastern Kentucky R. R. It has a bank, a newspaper, mills, an academy, fine public buildings, 4 churches, 9 stores, and 3 hotels. It is situated in an iron manufacturing country, and there are several iron furnaces a short distance from the village. Pop. about 870. G. A. Clrum, of "Independent."

Greenup, Col. Christopher, b. in Virginia in 1750; governor of Kentucky 1804–8; was at different times a member of the legislature, and M. C. 1793–97; appointed to the office of clerk of the State senate; an able lawyer. D. at Frankfort, Ky., Apr. 27, 1818.

Green'vale, tp. of Dakota co., Minn. Pop. 725.

Green Val'ley, tp. of Solano co., Cal. Pop. 592.

Green'view, post-tp. of Menard co., Ill., on the Chicago and Alton R. R., 8 miles W. by S. of Mason City. Pop. 373.

Green'ville, county in the N. W. of South Carolina, bounded on the N. by North Carolina. Area, 840 square miles. Its surface is diversified, the soil productive. Cattle, grain, cotton, and wool are the leading products. The county is traversed by the Greenville and Columbia R. R. Cap. Greenville. Pop. 22,262.

Greenville, county in the S. E. of Virginia, bounded S. by North Carolina. Area, 300 square miles. The surface is generally level and well wooded. Tobacco and grain are produced. The county is traversed by the Petersburg and Weldon and the Roanoke Valley R. Rs. Cap. Hicksford. Pop. 6362.

Greenville, post-v., cap. of Butler co., Ala., on the Mobile and Montgomery R. R., 45 miles S. of Montgomery, the capital of the State. It has 2 private banks, 2 colleges (male and female), 6 churches, several large mills, a shingle factory, a boot and shoe factory, 3 hotels, a theatre, numerous business-houses, and 2 newspapers. Principal business, cotton and timber. Pop. 2856.

J. R. Thames, Ed. "South Alabamian."

Greenville, tp. of Clarke co., Ark. Pop. 749.

Greenville, post-v., cap. of Meriwether co., Ga., 30 miles S. W. of Griffin. It has 12 stores, 3 churches, 2 schools, a female college, and a weekly newspaper. It was founded in 1828, and is noted for the intelligence of its citizens and the wealth of the surrounding country.

W. T. Revill, Ed. "Vindicator."

Greenville, post-v. and tp., cap. of Bond co., Ill., 50 miles N. E. of St. Louis, Mo., on the Vandalia R. R. It has 1 national and 2 private banks, Almira Female College, 4 churches, library association, Masonic, Odd Fellows, and Good Templars' lodges, 1 weekly newspaper, hotels, mills, shops, stores, grain warehouses, hay presses, etc. Pop. of tp. 1989.

Geo. M. Tatham, Pub. "Greenville Advocate."

Greenville, tp. of Bureau co., Ill. Pop. 901.

Greenville, post-tp. of Floyd co., Ind. Pop. 1814.

Greenville, post-v., cap. of Muhlenburg co., Ky., on the Louisville Paducah and South-western R. R., 92 miles E. of Paducah.

Greenville, post-tp. of Piscataquis co., Me., at the S. extremity of Moosehead Lake, 32 miles N. W. of Dover. It has good hotels, and manufactures of lumber. Pop. 369.

Greenville, city of Montcalm co., Mich., on the Flat River and the Detroit Lansing and Lake Michigan R. R., 144 miles from Detroit, and the Grand Rapids and Newaygo R. R., 34 miles from Grand Rapids. It has excellent water power, Flat River being dammed at two points within the city limits, 2 large flouring-mills, 4 saw-mills, 3 planing mills, 1 woollen mill, 2 machine shops, 1 tannery, 2 shingle-mills, 4 churches, 1 national and 1 private bank, 2 weekly newspapers, and public library. It is surrounded by a good farming country, and is a base of supplies for the Flat River lumbering. Pop. 1807.

E. F. Grabill, Ed. "Greenville Independent."

Greenville, post-v., county-seat of Washington co., Miss., is 100 miles N. N. W. of Jackson, and on the Mississippi River. It has 1 weekly newspaper and an active trade. Pop. 890.

Greenville, post-v., county-seat of Wayne co., Mo., 150 miles S. E. from Jefferson City, and on the river St. Francis. It has 1 weekly newspaper.

Greenville, former post-tp. of Hudson co., N. J., now merged into Jersey City. Pop. 2789.

Greenville, tp. and post-v. of Greene co., N. Y., is the seat of Greenville Academy. Pop. 2084.

Greenville, tp. of Orange co., N. Y. Pop. 1123.

Greenville, post-v. and tp., cap. of Pitt co., N. C. Pop. of v. 601; of tp. 3838.

Greenville, post-v. and tp., cap. of Darke co., O., on the E. bank of the Greenville Creek, at the crossing of the Dayton and Union and the Pittsburg Cincinnati and St. Louis R. Rs. It has 1 national and 1 private bank, 3 newspapers, 8 churches, a very large union school-house, 1 large furniture manufactory, 2 planing-mills, 3 hotels, 4 clothing stores, 2 book stores, 4 jewelry stores, 5 dry-goods stores, 3 drug stores, 1 brewery, 3 hardware stores, 3 stove and tin stores, and 10 or 12 groceries. Greenville was built as a fort in 1793 by Gen. Wayne, who concluded an important treaty with the Indians here, Aug. 3, 1795, at which 1130 Indians were present. Pop. of v. 2520; of tp. 5688. E. W. Otwell, Ed. and Prop. "Journal."

Greenville, post-b. of Mercer co., Pa., on the Erie and Pittsburg R. R., at the crossing of the Atlantic and Great Western. It is the terminus of the Shenango and Alleghany R. R., which leads to the coal and oil fields of Western Pennsylvania. It is at the head of the Shenango Valley, and is surrounded by a rich and fertile farming country. It has a rolling-mill and coalworks, and 2 newspapers. Thiel College of the Evangelical Lutheran Church is located here. The town lies on both sides of the Shenango River, which affords abundant water-power. Pop. 1848. Harry Watson, Ed. "Argus."

Greenville, tp. of Somerset co., Pa. Pop. 494.

Greenville, post-v. of Smithfield tp., Providence co., R. I., 12 miles N. W. of Providence. It has 1 national bank and several cotton-factories.

Greenville, post-v. and tp., cap. of Greenville co., S. C., at the terminus of the Greenville and Columbia R. R., and on the Atlanta and Richmond Air-line R. R. It is the seat of the Southern Baptist Theological Seminary, Furman University (which latter institution is to be free of tuition), and a female college. The U. S. court meets annually in Greenville. It is the third city in population and advancement in the State. It contains a large carriage and wagon manufactory, a national bank, 2 weekly newspapers, and 6 churches. Pop. of v. 2757; of tp. [illegible].

J. C. Bailey, Ed. "Enterprise and Mountaineer."

Greenville, post-v., cap. of Hunt co., Tex. It has 1 newspaper.

Greenville, tp. of Outagamie co., Wis. Pop. 1460.

Green'way, tp. of Clark co., Va. Pop. 1570.

Green'wich, parliamentary borough of England, in the county of Kent, is situated on the right bank of the Thames, and contains several establishments for the building of iron steamers and the manufacture of machinery. The two objects of greatest interest, however, are the Royal Observatory, from which the longitude of a place is reckoned on all English maps, and the hospital for old seamen, a splendid building erected by Christopher Wren, and containing 2400 beds. Pop. 167,632.

Greenwich, tp. and post-b. of Fairfield co., Conn. It is the most south-westerly township in the State. The town is finely situated on Long Island Sound and on the New York and New Haven R. R., 31 miles N. E. of New York. It has a savings bank, an insurance company, and is a favorite country residence. Gen. Putnam's daring ride at Horseneck in 1779 took place in this town. Pop. 7641.

Greenwich, post-tp. of Hampshire co., Mass., on the Athol and Enfield R. R., 17 miles S. of Athol. Pop. 665.

Greenwich, post-tp. of Cumberland co., N. J., on Delaware Bay, contains the village of Bay Side, the S. terminus of the New Jersey Southern R. R., 10 miles W. by S. of Bridgeton. Pop. 1262.

Greenwich, tp. of Gloucester co., N. J., on the Delaware River. Pop. 2342.

Greenwich, tp. of Warren co., N. J., on the Central R. R., 5 miles S. E. of Easton, Pa. The township contains several villages. Pop. 2587.

Greenwich, post-v. and tp. of Washington co., N. Y., on the Battenkill River, about 30 miles N. E. of Troy, at the terminus of the Greenwich and Johnsonville R. R. It has a national bank, a newspaper, a union graded school, a foundry, a japanned-ware factory, a knitting-mill, 2 machine shops, a thread-mill, 5 churches, 3 hotels, several grist and saw mills. Principal business, manufacturing and farming. Pop. of tp. 4030. Ed. "People's Journal."

Greenwich, tp. of Huron co., O. Pop. 881.

Greenwich, tp. of Berks co., Pa. Pop. 2151.

Green'wich Hos'pital, a refuge for old and disabled seamen at Greenwich, England, was founded by William and Mary in 1694, upon the site of a former royal palace. The buildings are very fine, and extend from the Thames to Greenwich Park. It is now under an entirely different phase of existence from that it previously had. A large portion of the pensioners formerly resident there now live with their friends, receiving their pensions for their personal use.

Greenwich Observatory. See Observatory.

Green'wood, county of Colorado, bounded on the E. by Kansas. Area, 6300 square miles. It is a great plain, better adapted to grazing than agriculture, except where irrigation is practicable. It is reported to contain good lignite. The county is traversed by the Kansas Pacific R. R. Cap. Kit Carson. Pop. 510.

Greenwood, county of S. E. Central Kansas. Area, 1155 square miles. It is a rolling and well-watered region. It has an excellent soil and abundance of timber, coal, and building-stone. Grain is the leading product. Cap. Eureka. Pop. 3484.

Greenwood, tp. of Bullock co., Ala. Pop. 3396.

Greenwood, post-v., one of the caps. of Sebastian co., Ark. It has 2 weekly newspapers.

Greenwood, post-tp. of El Dorado co., Cal. P. 557.

Greenwood, tp. of Christian co., Ill. Pop. 776.

Greenwood, post-tp. of McHenry co., Ill. Pop. 925.

Greenwood, tp. of Kossuth co., Ia. Pop. 280.

Greenwood, tp. of Franklin co., Kan. Pop. 1115.

Greenwood, post-tp. of Oxford co., Me., on the Grand Trunk Railway, 10 miles N. W. of Paris. Pop. 845.

Greenwood, tp. of Oceana co., Mich. Pop. 249.

Greenwood, tp. of St. Clair co., Mich. Pop. 898.

Greenwood, post-tp. of Hennepin co., Minn. P. 425.

Greenwood, post-v., cap. of Leflore co., Miss., on the right bank of the river Yazoo, 3 miles below the confluence of the Tallahatchie and Yallabusha rivers. It has 2 churches, a Masonic hall, court-house, jail, 2 hotels, a weekly newspaper, several stores, and a large business in cotton and merchandise. H. T. Martin, Ed. "Valley Sentinel."

Greenwood, post-v. of Jackson co., Mo., on the Missouri Pacific R. R., 18 miles S. E. of Independence. It is the seat of Lincoln College (United Presbyterian).

Greenwood, post-tp. of Steuben co., N. Y., has 4 churches and some manufactures. Pop. 1394.

Greenwood, tp. of Moore co., N. C. Pop. 1523.

Greenwood, post-tp. of Columbia co., Pa. Pop. 1588.

Greenwood, tp. of Crawford co., Pa. Pop. 1782.

Greenwood, tp. of Juniata co., Pa. Pop. 744.

Greenwood, tp. of Perry co., Pa. Pop. 1080.

Greenwood, post-v. and tp. of Abbeville co., S. C., on the Greenville and Columbia R. R., 85 miles W. N. W. of Columbia. Pop. 700; of tp. 2817.

Greenwood, tp. of Vernon co., Wis. Pop. 741.

Greenwood (Francis William Pitt), D. D., b. in Boston Feb. 5, 1797. He grew up under the religious care and teaching of Dr. Freeman, under whose charge the King's Chapel passed over from Trinitarianism to Unitarianism, and on graduating at Harvard College in 1814 studied theology with Dr. Henry Ware, Hollis professor in Cambridge. Immediately after finishing his studies he began his ministry in the New South church in Boston, but remained in it but a single year, a pulmonary attack forcing him to desist. The year of 1820–21 was passed abroad, chiefly in Devonshire, England. Two years after his return were passed in Baltimore. In 1824 he accepted an invitation to become colleague pastor with Dr. Freeman of King's Chapel. Three years later, in 1827, Dr. Freeman retiring from the active ministry, Mr. Greenwood became sole pastor, and, as far as his health would allow, discharged all the duties. In 1837 an attack of hæmorrhage compelled him to make a voyage to Cuba, but his strength was never restored. After a lingering illness, he d. Aug. 2, 1843, in Boston. Dr. Greenwood was a man of refined taste and pure evangelical spirit. He had a strong love for the natural sciences, especially for botany and conchology, and was one of the earliest members of the Boston Society of Natural History. He was a frequent writer for the Unitarian magazines and a contributor to the *North American Review* and the *Journal of Natural History*. His religious writings were pervaded by a spirit of deep piety. His *Sermons of Consolation* and *Sermons to Children* had a great popularity within the sect. He published, besides, *Lives of the Twelve Apostles*, less known, and a *History of King's Chapel*. Two volumes of sermons, prefaced with a memoir by Hon. S. A. Eliot, and a volume of *Miscellanies*, edited by his son in 1846, though not distinguished by intellectual originality, are productions of a beautiful and cultivated mind. O. B. Frothingham.

Greenwood (Miles), b. in Jersey City, N. J., Mar. 19, 1807; emigrated in 1832 to the West, and started upon the Miami Canal the Eagle Iron-works, which soon developed itself into the largest factory of the West. He was one of the originators of the Mechanics' Institute of Ohio, and one of the first to bring the steam fire-engine into use.

Green'wood Cem'etery, in the southern part of Brooklyn, N. Y. (partly in Flatbush), comprises 413 acres, having a surface varied with valleys, lakes, and hills, and is in large part covered with forest trees of natural growth. It was incorporated in 1838. Some of the eminences command extensive and interesting views, and many of the monuments are interesting as works of art. Few enclosures of this character excel Greenwood in size or natural beauty; and the additional charms which landscape-gardening, floral decoration, and costly monumental structures have bestowed combine to render it one of the most beautiful cemeteries in the world.

Green'wood Cen'tre, post-v., county-seat of Crocker co., Ia., on the E. fork of Des Moines River.

Greenwood Centre, a v. of Greenwood tp., Steuben co., N. Y. Pop. 100.

Green'wood Planta'tion, tp. of Aroostook co., Me. Pop. 47.

Greer, an unorganized county in the extreme N. of Texas. Area, 3480 square miles. It lies between the forks of the Red River, and doubts have been expressed as to whether it is really a part of Texas, the boundary-line being unsettled. It is reported to be nearly destitute of timber.

Greer, tp. of Warrick co., Ind. Pop. 861.

Greer (James A.), U. S. N., b. in Ohio; entered the navy as a midshipman Jan. 10, 1848; became a passed midshipman in 1854, a lieutenant in 1855, a lieutenant-commander in 1862, a commander in 1866. He commanded the iron-clad Benton at the passage of the Vicksburg batteries on the night of Apr. 16, 1863, where "the squadron was under fire two hours and thirty minutes," and "the enemy lighted up the river on both sides;" in the heavy engagement of five hours' duration with the Grand Gulf batteries on Apr. 27 of the same year; and in all the succeeding operations on the Mississippi River until the fall of Vicksburg, July 4, 1863. In many of the above fights the Benton carried the flag of Rear-admiral Porter, which made her a conspicuous target, and in all of them, according to the official reports, Lieut.-Com. Greer distinguished himself; so that when in 1873 he was chosen by the department to command the Tigress in the search for the missing Polaris, the navy concurred in the wisdom of the selection. Foxhall A. Parker.

Greers'ville, a v. of Knox co., O. Pop. 73.

Gregarin'idæ [from *Gregarina*, the typical genus], a family of microscopic Protozoa, considered, however, by many as extremely low forms of Vermes, or as possibly

Protophytes. They were described and named in 1828 by Léon Dufour. The simple Gregarina seems to be a cell, usually ovate and entozoic, but they are often seen to consist of more than one cell. These examples, however, are considered to be Gregarinæ conjugated for reproductive purposes. They have neither mouth nor intestine, but often have a beak, furnished sometimes with one, two, or many hooklets. The locomotive power is not conspicuous. The reproduction is by the bursting of the conjugated cells and the escape of vesicles sometimes called pseudo-navicullæ; these by alternate generation give rise to pseudo-amœbæ, which finally become Gregarinidæ.

Gregg, county in the N. E. of Texas, bounded S. by Sabine River. It is diversified and very fertile. The county has been formed since the U. S. census. Cap. Longview.

Gregg, tp. of Morgan co., Ind. Pop. 1041.

Gregg, tp. of Centre co., Pa. Pop. 1636.

Gregg, tp. of Union co., Pa. Pop. 821.

Gregg, tp. of Edgefield co., S. C. Pop. 3200.

Gregg (Andrew), b. at Carlisle, Pa., June 10, 1755; obtained a classical education, and was a tutor in the University of Pennsylvania; became a member of Congress in 1791–1807, and afterwards held the office of U. S. Senator 1807–13; was secretary of state of Pennsylvania in 1820. D. at Bellefonte May 20, 1835.

Gregg (David McM.), b. in Pennsylvania 1833; graduated at the U. S. Military Academy, and entered the army as brevet second lieutenant of dragoons July, 1855, receiving his full appointment as second lieutenant in September following. After serving a brief time in Jefferson Barracks, Mo., Gregg was ordered to New Mexico, and thence to California, marching there with his command, and continued on frontier duty against hostile Indians, being engaged in numerous actions, up to the outbreak of the civil war. In Mar., 1861, he was promoted to be first lieutenant, and in May following captain 6th Cavalry. In Jan., 1862, he was appointed colonel 8th Pennsylvania Cavalry, which command he led in the Virginia Peninsular campaign (1862), being engaged at Fair Oaks, Seven Pines, and the "Seven Days'" fight. Appointed brigadier-general U. S. volunteers Nov., 1862, he commanded a division of cavalry in the Rappahannock campaign in the raid toward Richmond under Gen. Stoneman; participated in the battle of Gettysburg and subsequent pursuit of Lee's army. In Gen. Grant's Richmond campaign (1864–65) he was actively engaged, and in command of the cavalry corps of that army from Aug., 1864, till Feb., 1865, when he resigned from the army. Brevetted major-general of volunteers for highly meritorious conduct. G. C. Simmons.

Gregg (John I.), b. in Pennsylvania; entered the U. S. Army as first lieutenant 11th Infantry 1847; promoted to be captain, and served during the Mexican war; disbanded Aug., 1848. On the outbreak of the civil war he was chosen colonel of the 5th Pa. Vols., which commission he resigned May, 1861, to accept a captaincy in the 6th U. S. Cavalry; was engaged in various actions in the Virginia Peninsular campaign 1862; appointed colonel 16th Pa. Vols. Oct., 1862, and in command of a cavalry brigade 1863–65, during which time he was engaged in the battles of Gettysburg, Cold Harbor, Deep Bottom (wounded), and the various actions of the Army of the Potomac up to the final surrender of Lee. Three days prior he was taken prisoner, and held till the surrender. For gallant conduct in battle he was brevetted major, lieutenant-colonel, colonel, and brigadier-general U. S. A. and major-general of volunteers; promoted to be colonel 8th U. S. Cavalry July, 1866.
G. C. Simmons.

Gregg (Maxcy), b. at Columbia, S. C., 1814; studied law and admitted to the bar in 1839, arriving at prominence in his profession; in the war with Mexico he served as major 12th Infantry; was a member of the South Carolina State convention in 1860, and of the committee to prepare the ordinance of secession. In the civil war he commanded the 1st S. C. Vols., which on the expiration of its term of service he reorganized; was subsequently made brigadier-general, and constantly and conspicuously in service. Killed at Fredericksburg, Va., Dec., 1862. At the time of his death he was governor-elect of S. C. G. C. Simmons.

Gregg's, tp. of St. Francis co., Ark. Pop. 160.

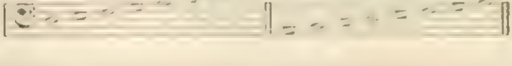
Greg'oras Niceph'orus, b. at Heraclea, in Pontus, probably in 1295; became a priest in Constantinople; went in 1326 as ambassador to the kral (the king) of Servia; proposed the reform of the calendar in a treatise (*Paschalium correctum*) still extant, and highly prized for its scientific accuracy; lost his estate on the accession of Andronicus III. (1328); pronounced the eloquent funeral oration of Andronicus I., 1332; opposed Barlaam's theories and Pope John XXII.'s plan of uniting the Eastern and Western churches; and late in life was involved in serious troubles arising from the new doctrines taught by Barlaam. He was alive in 1359, but the time of his death is not known. He was the author of many treatises on many subjects, but the most important of his works is the *Historia Byzantina*, written in a very diffuse style and in a strongly partisan spirit, but valued for the great number of facts it preserves. Not all his works have been printed.

Gregorian Calendar. See Calendar, by F. A. P. Barnard.

Grego'rian Mu'sic. The customary designation of the ancient music of the Church as regulated and improved by St. Gregory the Great, bishop of Rome, in the latter part of the sixth century and the beginning of the seventh. The information which has reached us relative to the music of St. Gregory's times is not only scanty, but obscure and perplexing. The art was then in its infancy. So far as we know, melody existed only in a rude and vague inflection of the voice through the range of a few intervals, while harmony, as now understood, was utterly undeveloped, and was probably confined to an irregular and unsystematic use of the octave, fifth, and third as occasion served. The ancients—as we have incontestable reasons for believing—had no accurate and intelligible system of notation; and for that reason the fragments of their music which we possess are almost as difficult to interpret as the strange and bewildering signs of a newly-discovered language. It has been thought by some that in the early days of the Church the Hebrew chant was brought in by the numerous Jewish converts, and that it became the basis or ruling form of the Church's songs. It is more probable, however, that, as the Church spread far and wide among other races and nations, this element gave way to the adoption of the musical system of the Greeks, as having more affinity with the languages of the Christian liturgies and the musical habits of a people largely composed of Gentiles. Whatever the system was, Jewish, Greek, or a blending of both, it is certain that St. Ambrose, bishop of Milan in the fourth century, found it in so confused and disorderly a condition as to render his interference desirable in the capacity of a musical reformer. Ambrose—who is described as an accomplished musician for his times—appears to have entered upon this work with energy and good judgment, and soon moulded into a more consistent shape the various and conflicting forms which music had assumed in the Church. In doing this he retained and made use of the four original Greek modes or scales—viz. the Dorian, or scale of D, the Phrygian, or scale of E, the Lydian, or scale of F, and the Myxolydian, or scale of G (all formed of the natural notes as they stand, without flats or sharps). These were known as the *authentic* modes, and the chant or ritual-song of the Church was based upon or composed of the elements forming these scales. The ecclesiastical music thus purified and systematized in the Church of Milan obtained the name of the "Ambrosian" chant, and was soon brought into extensive use.

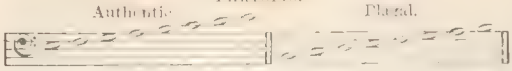
Two centuries later, St. Gregory, who then occupied the papal throne, entered upon a further reform in the music of the Church. It appears that the simplicity and plainness of the Ambrosian chants had been overlaid in the course of time with embellishments of too frivolous, ambitious, and fanciful a character to be congruous with the solemnity of divine worship. These innovations were promptly denounced by St. Gregory, who seems to have had little sympathy with the promoters of what was called figured song, or with the early experimenters in the florid style. He also collected and arranged in a methodical form such fragments of psalmody and ecclesiastical hymns as had been approved by former bishops in whose judgment he could confide. But the greatest improvement made by Gregory, or under his auspices, was the addition of four new modes or scales to those already in use. The old modes—viz. the Dorian, Phrygian, Lydian, and Myxolydian—were called the authentic modes, as already stated; and those now derived from or added to them received the name of *plagal*, relative, or collateral. Each plagal scale was formed by commencing on *the fourth degree below the first note* of the corresponding authentic. Thus, as the first authentic mode or scale consisted of D, E, F, G, A, B, C, and D, the octave, its plagal mode would be formed of A, B, C, D, E, F, G, and A. The three other authentic modes were in like manner attended by their respective plagal derivatives—the fourth note of the plagal always corresponding with the first note of the authentic, thus:

Dorian.



Phrygian.

Authentic. Plagal.

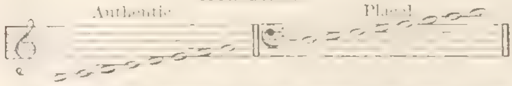


Lydian.

Authentic. Plagal.

Mixolydian.

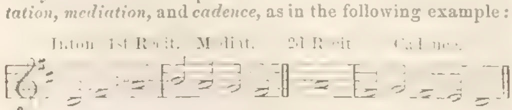
Authentic. Plagal.



These modes, composed of the natural intervals of the diatonic scale, without reference to the position of whole tones and semitones, are (with one exception) more or less imperfect, being neither major nor minor, but each having its own distinctive character as the result, indeed, of that imperfection. Thus, the Dorian has neither F♯ and C♯ to render it a true *major* scale, nor B♭ to form the true *minor*. Melodies, therefore, written on such scales differ considerably in their fitness to express various shades of feeling and sentiment. The Phrygian, *e. g.*, so far resembles our modern minor mode as to possess a certain plaintive and mournful character; the Dorian, though strongly minor in its general cast, is expressive of dignity, grandeur, and solemnity; the Mixolydian, closely approaching our G major, suggests peace, serenity, and joy; while the Lydian, with its irregular fourth occasionally corrected, has the gentle and soothing tranquillity of many modern pieces in F major. These various qualities may, however, be in part attributed to other causes. It has been thought very probable by several modern writers "that as these modes have their names from some Grecian nations, part of the very great effects ascribed to them may have depended on the particular melodies of those nations and their rhythms, more than on the mode in which they were composed; in the same manner as still the national dance-tunes of different countries—*e. g.* a Scotch reel, a polonaise, a Siciliano, etc.—are strongly characteristic merely by their rhythms." (*K*[illegible].)

The music of the Church, as thus modified and settled by St. Gregory, came into general use in the Western Church, and is commonly known as the "Gregorian." In each of the modes, scales, or gamuts (to which another has been added, under the name of irregular or peregrine) short chants or melodies for the psalms were prepared. These are commonly styled Gregorian *tones*, and are distinguished or spoken of as the first, second, or third tone, etc. These psalm-chants consist of two strains each; and the latter of these strains has frequently several terminations, which are called "endings." Of these endings, the first tone has six; the third tone, four; the fourth tone, four; the fifth tone, two; the seventh tone, six; and the eighth tone, two; while the second and sixth tones have each only one ending. Hence, in designating a psalm chant we say, *e. g.*, "First tone, third ending," etc. In each of these tones or chants a certain note called the *dominant* is more frequently used than the others, and is the reciting note in chanting. Preceding the dominant are two or more short introductory notes called the *intonation*, to be sung by the minister or precentor with the first division of the first verse of a psalm or hymn. The other portions of each strain are the *recitation*, *mediation*, and *cadence*, as in the following example:

Inton. 1st Recit. Mediat. 2d Recit. Cadence.



Gregorian music is still frequently written or printed in ancient character on the old stave of only four lines. Two *clefs* are used—viz. the F clef and the C clef. These are not permanently fixed on certain lines, like the clefs of modern music, but are placed on such lines as will bring the notes of the melody within the compass of the stave, and thus avoid the resort to ledger lines. The notes in use are chiefly three: 1st, the long, a black square (or oblong figure) with a stem; 2d, the breve, a black square without a stem; 3d, the semibreve, a black diamond-shaped note. These notes do not express exact measures of duration, as the ratios of 4, 2, and 1, but are very much dependent for their times on the sentiment and accent of the words sung. In most cases they are simply signs to express in an indefinite way the relations of long, shorter, and shortest. From this it will be readily understood that *rhythm* (as now understood) has no place in Gregorian music. There is no division into bars or measures; nor can music of this kind be brought, without great difficulty, within the limits and form of any regular musical movement.

In an adapted form the psalm-chants or tones (with some other music of the Gregorian school) are in common use in the Anglican Church, modernized, however, so much by the addition of harmony and more or less of rhythmical order, as to be recognizable only by the crudeness of their melodic phrases and the quaintness of not a few of their cadences. WILLIAM STAUNTON.

Gregoro'vius (FERDINAND) was b. at Neidenburg, in the province of Prussia, Jan. 19, 1821; studied theology and philosophy at the University of Königsberg 1838; and began his public career as a literary critic with *Wladislaw aus der Weisse Romantik* (1845), and *Goethe's Wilhelm Meister in seinen socialistischen Elementen* (1849). In 1848 and 1849 he published two minor works in favor of Poland—*Die Idee des Polenthums* and *Polen und Magyarenlieder*; and in 1851 his tragedy, *Der Tod des Tiberius*, and his first historical work, *Geschichte de Römischen Kaisers Hadrian und seiner Zeit*. In 1852 he went to Italy, of whose history, literature, and political and social circumstances he made a comprehensive and penetrating study, and on which he has written several works of great merit—*Corsica* (2 vols., 1854); *Wanderjahre in Italien*, a collection of several minor works (4 vols., 1871); *Die Grabmäler der Römischen Päpste* (1857); and his two most important works—*Geschichte der Stadt Rom in Mittelalter* (8 vols., 1859–72) and *Geschichte der Lucrezia Borgia* (2 vols., 1874).

Greg'ory, county of Dakota, separated from Nebraska on the S. by the rivers Keya Paha and Niobrara, and having the Missouri on the N. E. Area, about 1150 square miles.

Gregory I., POPE, a saint and doctor of the Roman Catholic Church, called GREGORY THE GREAT, a great-grandson of Pope Felix II., was b. at Rome about 540; became a senator, and in 573 a prætor, and soon after entered a monastery and devoted his great wealth to the founding of religious establishments; went as nuncio to Constantinople, and reconciled the emperor to the pope, and in 590 became pope himself; sent missionaries to Sicily, Sardinia, Lombardy, England, etc.; attempted the union of the Eastern and Western churches; strengthened and reformed the papal see; confirmed the celibacy of the clergy; extended greatly the monastic system; was confirmed in his primacy over the other patriarchs by the emperor Phocas; and reformed the liturgy. He has been called the father of the mediæval Church, the inventor of the mass and of the doctrines of purgatory and transubstantiation. Author of numerous works, of which his *Magna Moralia*, his *Homilies*, his *Pastoral*, and the liturgical treatises are the most important. D. Mar. 12, 604.—GREGORY II., SAINT, a Roman of high birth, became a Benedictine, and in 715 became pope; sent Corbinian and Boniface as missionaries to Germany; assumed the government of Rome in 726, and did much to establish the temporal power of the popes; engaged in a famous contest with Leo the Isaurian and the Iconoclasts, whom he anathematized. D. Feb. 10, 731.—GREGORY III., a Syrian, became pope in 731; opposed the Iconoclasts and the Byzantine emperors; assumed the rulership of the exarchate of Ravenna; exacted homage from Charles Martel, and contended with the Lombards. D. Nov. 28, 741.—GREGORY IV., a Roman, became pope in 827, succeeding Pope Valentine; was a grasping and tyrannical prelate; made the feast of All Saints a general one. D. Jan. 27, 844.—GREGORY V., a German, and nephew of King Otho III. His name was Bruno; became pope in 996, when twenty-four years old; treated with great brutality the antipope John XVI.; put Robert, king of France, under a terrible interdict for marrying within the forbidden degrees of consanguinity. D. Feb. 18, 999.—GREGORY VI., ANTIPOPE, assumed the papal title in June, 1012; expelled Benedict VIII., and was himself expelled (Dec. 25, 1012) by the emperor Henry II.—GREGORY VI. (*Johannes Gratianus*), POPE, an arch priest at Rome, purchased the papal chair in 1044 of Benedict IX., but the latter revived his claim, and Sylvester III. and John XX. were also elected (1044); but Henry III., the emperor, caused all to be deposed, and Clement II. to be elected, 1046. D. at Cologne in the summer of 1048.—GREGORY VII. (*Hildebrand*) was b. at Soana, in Tuscany, probably before 1020, and was a carpenter's son; became a monk at Cluny; was called to the priory of St. Paul, *extra muros*, at Rome, and was the chief adviser of Leo IX., who made him cardinal. Hildebrand assumed at once a commanding position in the affairs of Italy and the Church; repressed the interference of the laity and of the emperors in ecclesiastical affairs; punished simony and licentiousness, and stopped the marriage of the clergy; reformed the convents; restrained the progress of Berengarius's doctrine regarding the Eucharist, with which, nevertheless, it has been thought that Hildebrand sympathized; improved the manner of papal elections so as to prevent bribery (1058); engaged in a quarrel with St. Peter Damian; and in 1073 succeeded Alex-

ander II. as pope, after which he still more actively engaged in his reforms: forbade in 1074 all marriage and concubinage in the clerical ranks, in 1075 summoned a council at Rome which prohibited all lay investitures, although the princes and in some places the people had almost universally exercised a suffrage, more or less complete, in this matter. Thus, Gregory, by one of the boldest strokes recorded in history, attempted to cut the Church free from the domination of the German emperors, which a few years before had been absolute and almost unquestioned. Henry IV. thereupon called a diet at Worms, and declared the pope deposed; and in 1076, Gregory retaliated by excommunicating and deposing Henry and plunging Germany and Italy into terrible civil wars. Henry, everywhere overcome, humiliated himself to the earth, and received the papal absolution at Canossa (1077). But when the emperor had recovered sufficient strength, he shut up the pope in the castle of St. Angelo, whence he was released by Robert Guiscard; and Gregory, having for the fourth time excommunicated the emperor, retired to Salerno, where he d. May 25, 1085. Gregory planted the seed which grew into the tree of ultramontanism and overshadowed the whole Church. He was a man of excellent abilities, and his character is in many respects admirable. In its bearing on the destinies of Europe no pontificate was more important than that of Gregory.—GREGORY VIII., ANTIPOPE (*Maurice Bourdin*), a Frenchman, bishop of Coimbra, archbishop of Braga 1110; became papal legate to Henry V. of Germany 1111; was chosen by the emperor in 1118 as pope in opposition to Gelasius II., but was imprisoned, and d. at Fumona in 1122.—GREGORY VIII., POPE (*Alberto de Mora*), was b. at Benevento; became a cardinal in 1155; as papal legate absolved Henry II. for the murder of Becket 1172; elected pope Oct. 21, 1187. D. at Pisa Dec. 17, 1187.—GREGORY IX. (*Count Ugolino* of Legnia), a relative of Innocent III., succeeded Honorius III. Mar. 20, 1227. His reign is remarkable for his long and bloody wars with Frederick II. of Germany, whom he four times excommunicated. His *Decretals*, published in 1234, are an important compilation of the canon law. D. Aug. 21, 1241.—GREGORY X. (*Tebaldo Visconti* of Piacenza), chosen pope in 1271; promoted the Crusades; convened the Council of Lyons (1274), and reformed the conclave. D. at Arezzo Jan. 10, 1276.—GREGORY XI. (*Pierre Roger de Montroux*), was b. at Maumont, Limoges, in 1329, of a noble family; became cardinal in 1348, and pope at Avignon Dec. 30, 1370, removed to Rome in 1377; was a pacificator of princes, a violent persecutor of heretics, and a reformer of monasteries; but his pontificate was disgraced by nepotism. D. Mar. 28, 1378.—GREGORY XII. (*Angelo Corrario*), b. at Venice about 1326; became a cardinal-priest 1405; was elected pope in opposition to Benedict XIII. Nov. 30, 1406; deposed by the Council of Pisa 1409; abdicated his claim at the Council of Constance 1415. D. Oct. 18, 1417.—GREGORY XIII. (*Ugo Buoncompagno*), b. at Bologna Feb. 7, 1502; was a learned doctor of the university, and instructed Alexander Farnese, St. Charles Borromeo, and other eminent men in the law; became cardinal-priest in 1565; succeeded Pius V. May 13, 1572. The great events of this pontificate were the reform of the calendar, the *Te Deum* sung and medal struck in honor of the massacre of St. Bartholomew, the efforts made to spread the Church by missionary operations, and the publication of the *Decretum Gratiani*, with notes by the pope. Gregory was a man of convivial habits, and left a natural son. D. Apr. 10, 1585.—GREGORY XIV. (*Niccolò Sfondrate*), b. at Cremona 1535; became a cardinal 1583; succeeded Urban VII. Dec. 5, 1590. D. Oct. 15, 1591.—GREGORY XV. (*Alessandro Ludovisio*), b. at Bologna Jan. 9, 1554; became a cardinal in 1616; succeeded Paul V. Feb. 9, 1621; reformed the conclave 1621; established the Propaganda 1622; and zealously pushed forward the missionary work. D. July 8, 1623.—GREGORY XVI. (*Mauro* or *Bartolomeo Alberto Cappellari*), b. at Belluno Sept. 18, 1765; became in 1814 vicar-general of the Camaldules; cardinal-priest and prefect of the Propaganda 1826; succeeded Pius VIII. Feb. 2, 1831; extended the sway of his Church and promulgated Ultramontane principles. D. at Rome, June 1, 1846, and was succeeded by Pius IX. C. W. GREENE.

Gregory (FRANCIS H.), b. at Norwalk, Conn., Oct. 9, 1789; became a mariner, and in 1809 a midshipman U. S. N., a lieutenant in 1814, a commander in 1828, a captain in 1838, and in 1862 was retired with the rank of rear-admiral. D. at Brooklyn, N. Y., Oct. 4, 1866. He served with distinction under Chauncey in 1812–14 on the lakes; was distinguished in several contests with pirates in the Gulf and in the West Indies; commanded the frigate Raritan during the Mexican war; and was engaged in constructing iron-clads during the war of 1861–65.

Gregory (JAMES), F. R. S., b. at Drumoak, Aberdeenshire, Scotland, 1638; studied at Marischal College, Aberdeen; invented the Gregorian reflecting telescope (see TELESCOPE) when twenty-four years old; published *Optica Promota* in 1663; studied at Padua, and while there published *Vera Circuli et Hyperbolæ Quadratura* (1667), *Geometriæ Pars Universalis* (1668), and *Exercitationes Geometricæ* (1668); was professor of mathematics at St. Andrew's 1668–74, and at Edinburgh 1674–75, where he d. Oct., 1675, at the age of thirty-six. He was the inventor of many new and important mathematical processes, and the correspondent of Newton, Wallis, Huyghens, and other mathematicians of the first order of ability.—His grandson, Prof. JOHN GREGORY, M. D. (1724–1773), was a brilliant author; and Prof. JAMES GREGORY, M. D. (1753–1821), son of the latter, was a professional writer of high authority.—DAVID GREGORY, M. D., F. R. S. (1661–1708), nephew of the first mentioned, was successively mathematical professor at Edinburgh and Savilian professor of astronomy at Oxford. He published able mathematical treatises, and was the friend and associate of Newton.

Gregory (OLINTHUS GILBERT), LL.D., b. at Yaxley, Hunts, Eng., Jan. 29, 1774; became in 1798 a bookseller of Cambridge; in 1801 a master, and 1806–38 professor of mathematics at the Royal Military Academy, Woolwich. D. Feb. 2, 1841. His *Lessons, Astronomical and Philosophical* (1793), was published when he was but nineteen years old. He was also author of several mathematical textbooks, *Letters on the Evidences of Christianity* (1810), *Lives* of J. M. Good and Robert Hall, and was a man of devout religious character.

Greg'ory Nazian'zen, SAINT (*Gregorius Nazianzenus*), one of the Greek Fathers, and a doctor of both the Eastern and Western churches, b. at or near Nazianzus, in Cappadocia, probably about 330 A. D. He was a son of Gregory, bishop of Nazianzus, and of the devout St. Nonna; completed his school-studies at Athens, where he became the associate of St. Basil, his lifelong friend. In 361 A. D. he was ordained a presbyter by his father, but without his consent. After nine years of labor at Nazianzus, varied by retreats with St. Basil to the desert for devotional purposes, by contests with the Arians and with Julian the emperor, his school-fellow at Athens, pressed by Basil, he accepted in 372 A. D. the bishopric of Sasima, but remained at Nazianzus his father's coadjutor, and after the latter's death (374) as administrator of the see. He lived (375–379) in retirement at Seleucia, and then went to Constantinople to contend with the Arians and other heretics; and there his eloquence created the most profound effects, and contributed much to the restoration of orthodoxy, then unpopular at the capital. In 380 A. D. Theodosius made him bishop of Constantinople, and in 381 the first œcumenical council of Constantinople confirmed the appointment, although translations from one see to another were then uncanonical; and in consequence of the opposition thus excited he soon resigned and retired to his native town, and in 389 d. at Nazianzus. Gregory was a man of sensitive, retiring disposition, averse by nature to active life, into which, however, he was impelled by conscientious motives. His honesty and piety were perfectly sincere, and in that sincerity lay his power, rather than in great mental qualities. His earnestness often led him to the use of severe language. His learning was great. His sermons, letters, poems, etc. have been often printed. The Benedictine edition of Clemencet (1 vol., 1778; 2d vol., edited by Caillau, 1842) is the best. (See ULLMANN'S *Gregorius von Nazianz*, 1825.)

Greg'ory Nys'sen, SAINT, b. at Cæsarea, in Cappadocia, probably about 331 A. D., a younger brother of St. Basil the Great; was carefully educated, and became a teacher of rhetoric, but a letter (*Epist.* 43) from Gregory Nazianzen caused his return to a clerical life, and in 372 he was consecrated bishop of Nyssa in Cappadocia, and afterwards became one of the pillars of the Eastern Church. D. after 394 A. D. His writings, which fill three volumes, are doctrinal and practical religious treatises, sermons and other addresses, biographies, letters, etc. He is one of the ablest and most learned of the Greek Fathers. A good complete edition of his works [illegible]. See RUPP'S monograph, 1834, and MÖLLER'S essay, 1835.)

Gregory of Tours [illegible] (*Florentius*), SAINT, b. at Auvergne [illegible] Auvergne, about 540. He was of a noble Roman family, and after his conversion took the name of Gregory out of regard to his mother's grandfather, the bishop of Langres. About 573 he became bishop of Tours, and d. there Nov. 17, 594 (some say 595). His principal work is the *Historia Francorum* [illegible], which has earned for him the title of "Father of French history." Other works of his are [illegible] *Patrum*, [illegible], and [illegible] *tarii in Psalmos.* His Latin is barbarous, and his honesty

is equalled only by his credulity. The best edition of his works is by RUINART, Paris, 1699; reproduced in MIGNE's *Patrologiæ Latinæ*, vol. lxxi., 1858. Of monographs we have, in German, LOBELL (1839) and KRIES (1839); and in French, DUPUY (1854). (See *Gregor von Tours und Seine Zeit*, J. W. LOBELL, 2d ed. Leipsic, 1869.)

R. D. HITCHCOCK.

Greg'ory Thaumatur'gus, SAINT, and "wonder-worker," of heathen parentage, and originally called THEODORE, was b. at Neocæsarea, in Pontus, about 210 A. D.; when fourteen years of age lost his father, and became a Christian; in 231 fell under the influence of Origen at Cæsarea, in Palestine, and in 235 went with him from there to Alexandria; was made bishop of Neocæsarea in 244, when there were only seventeen Christians in the place, and d. there in 270, when, as it was said, there were only seventeen persons in the place who were *not* Christians. His biographer, Gregory of Nyssa, relates, in a legendary way, the miracles (chiefly of exorcism) which he was said to have performed. His principal literary work is *A Panegyrical Oration on Origen,* whose peculiar theological opinions he labored to establish in Pontus and Cappadocia. He also wrote *A Metaphrase on the Book of Ecclesiastes*, an important *Confession of Faith,* and some other pieces. The best edition of his works is in MIGNE's *Patrologiæ Græca*, vol. x.

R. D. HITCHCOCK.

Greg'ory the Illu'minator [in Armenian, *Lusavoritch*], SAINT, and apostle of Armenia, in regard to whom the old authorities are hardly to be trusted. The story is, that he belonged to the royal family of the Arsacidæ, who nominally ruled Armenia from 149 B. C. to 428 A. D.; that he was born about 258 A. D.; that his father Anak, having assassinated the king, Chosroes I., was put to death with all his family except Gregory, who, when two years old, was taken to Cæsarea, in Cappadocia, where he was brought up in the Christian faith, and whence he returned as a missionary to Armenia about 286 A. D.; that he baptized the king, Tiridates, in 289; that in 302, Leontius of Cæsarea ordained him patriarch of the Armenian Church; that in 331 he retired to a cave, and lived on some years longer, perhaps till 442 A. D. His *Homilies* were published at Constantinople in 1737, and again by the Mechitarists of San Lazaro at Venice in 1837. Many *Prayers* in the Armenian liturgy and thirty *Canons* are also ascribed to him. (See *Hist. of Armenia*, by MOSES CHORENENSIS, written about the middle of the fifth century; *Acta Sanctorum*, Sept. viii. pp. 295–413; and REV. S. C. MALAN's *Life and Times of S. Gregory the Illuminator, translated from the Armenian*, 1868.)

R. D. HITCHCOCK.

Greifen'berg, town of Prussia, in the province of Pomerania, on the Rega. It has manufactures of linen and leather. Pop. 5617.

Greif'enhagen, town of Prussia, in the province of Pomerania, on the Regliz. It has large cloth manufactures and distilleries. Pop. 6134.

Greifs'wald, town of Prussia, in the province of Pomerania, on the Ryk, near its mouth. It has a university and several other educational institutions, large salt-works, and manufactures of soap, oil, leather, and paper. Pop. 17,208.

Greig, post-tp. of Lewis co., N. Y., has manufactures of leather, lumber, paper, paper-pulp, and other articles. It has a wooden railroad 7 miles long, and abundant water-power. Pop. 2638.

Grei'ner (JOHN), b. at Philadelphia, Pa., Sept. 14, 1810; removed to Ohio; became distinguished as a temperance orator, and wrote popular Whig electioneering songs; State librarian 1845–51; Indian agent 1851–52; acting governor of New Mexico 1852; was a successful journalist of Columbus and Zanesville, O.; receiver in the U. S. land-office, Santa Fé, N. M., 1861–62; sub-treasurer there 1862–66. D. at Toledo, O., May 13, 1871.

Greiz, a town of Central Germany, the capital of the principality of Reuss-Greiz, on the White Elster. It is the residence of the sovereign prince, and has a fine palace surrounded by beautiful gardens. It has considerable manufactures of woollens, and large breweries and distilleries. Pop. 11,582.

Grena'da, an island in the West Indies, a colony of Great Britain, situated between lat. 11° 58′ and 12° 30′ N., and lon. 61° 20′ and 61° 35′ W. Area, 133 square-miles. It is 21 miles long and 12 broad. Pop. 37,684. It is of volcanic origin and very mountainous, the highest peaks rising to an elevation of 3000 feet; but it is very beautiful and fertile; cotton and sugar are the principal productions. The chief towns are St. George (the cap.) and St. Mark.

Grenada, county of N. Central Mississippi. Area, 375 square miles. The soil is fertile. Corn and cotton are produced. The county is traversed by the Mississippi Central and the Mississippi and Tennessee R. Rs. Cap. Grenada. Pop. 10,571.

Grenada, city, cap. of Grenada co., Miss., at the former head of navigation of the Yallabusha River, and at the junction of the New Orleans St. Louis and Chicago and the Mississippi and Tennessee R. Rs., the latter extending to Memphis. It has 6 churches, 2 hotels, 2 newspapers, 50 stores, grist, flour, planing, lumber, and rolling mills, and is an important business centre. It is compactly built, and the population has greatly increased since the census. Pop. 1887. J. A. SIGNAIGO, ED. "SENTINEL."

Grenade [Sp. *granada*, a "pomegranate"], a small shell, usually of iron, charged with powder and thrown into a mass of attacking troops by the garrison. They have a straight fuze, and are thrown by hand or rolled into the trench by a wooden trough or spout. They were formerly fired from a musketoon.

Grenadier' [once the name of a soldier who hurled grenades], in some armies a soldier of the first company of a battalion of foot-troops. Grenadiers are chosen for their tall stature and fine appearance. The first regiment of British foot-guards is called the Grenadier Guards.

Grenadines, or **Grenadilles,** a group of small islands in the West Indies, belonging to Great Britain and extending from Grenada to St. Vincent. The largest are Carriacou and Beguia. Total pop. 3000.

Grenard', tp. of Iroquois co., Ill. Pop. 541.

Gren'nell (GEORGE), LL.D., b. at Greenfield, Mass., Dec. 25, 1786; graduated at Dartmouth 1808; became a lawyer 1811; prosecuting attorney of Franklin co., Mass., 1820–28; State senator 1824–27; in Congress 1829–39; probate judge 1849–53; and afterwards clerk of the courts at Greenfield. He was the first to propose in Congress the recognition of the independence of Hayti. D. Nov. 20, 1877.

Grenoble [anc. *Gratianopolis*], town of France, in the department of Isère, on both sides of the Isère, which is crossed by two beautiful bridges and confined within elegant quays. Grenoble is fortified, and celebrated for its manufactures of gloves, liqueurs, brandies, and perfumes. It is a bishop's see. Pop. 42,660.

Gren'ville, county of Ontario, Canada, bordering on the St. Lawrence, and for judicial purposes united with Leeds co. Area, about 500 square miles. It is traversed by the Grand Trunk and the St. Lawrence and Ottawa Railways. Chief town, Prescott. Pop. of Leeds and Grenville cos., including Brockville, 57,912.

Grenville, post-v. and tp. of Argenteuil co., Quebec, Canada, on the Ottawa River, at the head of the Longue Sault Rapids and the Grenville Canal. (See CANALS OF CANADA, by A. J. RUSSELL, C. E.) Pop. of sub-district, 2223.

Grenville (GEORGE), b. Oct. 14, 1712; went first to Parliament in 1741; treasurer of the navy 1754; was a secretary of state 1762; first lord of the admiralty 1762; first lord of the treasury and chancellor of the exchequer 1763–65; introduced the plan for taxing the colonies, and is reputed the author of the Stamp Act; was an able statesman, but, according to Whig authorities, was the head of the worst administration Great Britain ever knew. Author of *Considerations on Commerce and Finances* (1767) and other writings. D. Nov. 24, 1770.

Grenville, or **Granville** (Sir RICHARD), a relative of Sir W. Raleigh, b. 1540; went in 1556 to fight the Turks in Hungary; entered Parliament, was knighted, and made high sheriff of Cornwall 1571; assisted Raleigh in planting the Roanoke colony 1585; vice-admiral 1591; attacked a Spanish fleet of 53 vessels with only 5 ships; sunk 4 ships, and after being twice wounded was taken prisoner, and d. soon after (1591).

Greppo (LOUIS), b. at Pouilly, near Lyons, Jan. 8, 1810, was brought up as a silk-weaver, and elected a representative for Lyons in 1848, in the national assembly, where he was the advocate of the most ultra-socialist doctrines. He was arrested on the *coup d'état* of Dec. 2, 1851, and banished from France, but he returned after the proclamation of a general amnesty in 1860. Greppo was elected again after the fall of the empire. FÉLIX AUCAIGNE.

Gresh'am (Sir THOMAS), b. in London 1519; was apprenticed to his uncle, a wealthy mercer, and then studied at Gonville Hall, Cambridge; succeeded his father as manager of Henry VIII.'s finances; became king's factor at Antwerp 1552; was knighted 1559; founded the Royal Exchange, London (opened 1570), and the Gresham College, London, which has lectureships on physic, divinity, geometry, astronomy, music, law, and rhetoric. He also founded eight almshouses and many other charities. D. in London Nov. 21, 1579.

Gret'na Green, a v., or rather a farmstead, in Dumfries-

shire in Scotland, near the English frontier, acquired at one time quite a curious celebrity. The English law acknowledges the validity of a marriage if it is contracted in accordance with the laws of the country in which it has taken place. Now, the Scotch law simply demanded that the mutual declaration of marriage shall be exchanged in presence of a witness, and thus it became fashionable for young couples in England, to whom it was not convenient to await the consent of their parents, the publication of banns, etc., to run away to Gretna Green, and declare their marriage in the presence of the owner of the farm, who was a blacksmith. On account of later changes in the English and Scotch marriage laws this custom has now died out.

Greuze (JEAN BAPTISTE), b. at Tournus, in Burgundy, Aug. 21, 1725; studied first with Graudon (or Gromdon) at Lyons; afterwards at Paris and at Rome. He was a genre-painter of domestic scenes or incidents of affection, and as such became an associate of the French Academy in 1755; but being elected a member in 1769 as a genre-painter, his single historical piece, *Severus Reprimanding his son Caracalla* (now in the Louvre), being disregarded, he resented the insult and retired from the Academy. D. in Paris, Mar. 21, 1805. The best known works of Greuze are *The Village Bride*, *The Broken Pitcher*, *The Little Girl with the Dog*, which engravings have made familiar. His pictures are in great demand with connoisseurs, and command high prices, the *Girl and Dog* having been sold in London in 1832 for $3125. The charm of his pieces is in their color, the grace of the grouping, the naturalness of the expression, and their sensibility.

O. B. FROTHINGHAM.

Greville (ROBERT KAYE), b. at Durham, England, in 1794; became renowned as a cryptogamic botanist. Author of *Scottish Cryptogamic Flora* (6 vols., 1822–28), a work of the first authority; *Flora Edinensis* (1824); *Algæ Britannicæ* (1830); and was joint author with W. J. Hooker of the splendid *Icones Filicum* (1829–31). D. at Edinburgh June 4, 1866.

Grévy (FRANÇOIS PAUL JULES), b. at Mont-sous-Vaudrez, department of Jura, Aug. 15, 1813; was a student in law when he took an active part in the three days' fight of the revolution in 1830. During the reign of Louis Philippe he often pleaded in political cases, especially for two friends of Barbas in 1839. Grévy was elected representative to the national assembly in 1848, and, without acting with the ultra-radicals, still sat on the benches of the Montagne. Under the empire, he was elected *bâtonnier* or president of the lawyers' corporation of Paris, and was sent as deputy to the Corps Législatif by the department of Jura. He acted there as a moderate republican, which character he maintained after the revolution of 1870, when he was elected again to the national assembly. Elected President of France Jan. 30, 1879.

FELIX AUCAIGNE.

Grey, county of Ontario, Canada, S. of Georgian Bay. Area, 2321 square miles. Cattle, grain, and timber are produced. Cap. Owen Sound. Pop. 59,395.

Grey, tp. of Pulaski co., Ark. Pop. 704.

Grey (CHARLES), second earl, b. at Fallowden, Northumberland, England, Mar. 13, 1764; was educated at King's College, Cambridge; entered Parliament as a Whig 1789; was one of the managers of the Hastings trial; was an early friend of parliamentary reform; opposed the Irish union 1799; became (as Lord Howick) first lord of the admiralty 1806, and soon succeeded Fox as secretary of foreign affairs; carried the bill for abolishing the slave-trade 1806; and being defeated in the measure for abolishing the oath which kept Roman Catholics from the holding of commissions in the army and navy, he dissolved the cabinet; took the title of Earl Grey 1807; long led the Reform party in opposition; was again premier in 1830–32 and 1832–34. The great event of his last administration was the passage of the Reform Bill of 1832. D. at Howick House, Northumberland, July 17, 1845.

Grey (SIR GEORGE), D. C. L., LL.D., K. C. B., b. at Lisburn, Ireland, in 1812; educated at Sandhurst Military College, and entered the army, from which he soon after retired, and in 1839 accompanied an exploring expedition to Australia, receiving the appointment of governor of South Australia in 1841, which position he held till appointed governor of New Zealand in 1846; his abilities in this capacity being acknowledged in 1848 by the bestowal of the title of K. C. B., and in 1854 by his advancement to the governorship of the Cape of Good Hope, returning, however, at the request of his government, to New Zealand in 1861, where he contributed to the suppression of the insurrection. In 1867 he returned to England. Among his published works are *Journals of Discovery in Australia* (1841); *Polynesian Mythology and Traditions of New Zealand* (1855); *Proverbial Sayings of the Ancestors of the New Zealand Race* (1858).

G. C. SIMMONS.

Grey (Sir GEORGE), BART., G. C. B., M. A., b. at Gibraltar May 11, 1799; graduated with honors at Oriel, Oxford; was called to the bar at Lincoln's Inn 1826, and came to the baronetcy 1828; entered Parliament 1832; under-secretary for the colonies 1834 and 1835–39; judge-advocate-general 1839–41; chancellor of the duchy of Lancaster 1841 and 1859–61; home secretary 1846–52, 1855–58, and 1861–66; colonial secretary 1854–55; was made privy councillor 1839, and G. C. B. 1849.

Grey (HENRY GEORGE), third earl, b. Dec. 28, 1802; was educated at Cambridge; entered Parliament 1826, and in the same year was called to the bar; was under-secretary for the colonies 1830–33; under-secretary for the home department 1834; was sworn of the privy council 1835; secretary at war 1835–39; came to his title 1845; colonial secretary 1846–52; has been lord lieutenant of Northumberland since 1847; received the Garter in 1863, and the grand cross of SS. Michael and George 1869. Author of *The Colonial Policy of Russell's Administration* (1853), *Essay on Parliamentary Government* (1858).

Grey (Lady JANE), daughter of Henry Grey, duke of Suffolk, and great-granddaughter of Henry VII. in the female line, b. at Bradgate, Leicestershire, 1537; married Lord Guildford Dudley, son of the duke of Northumberland, in 1553, having already, under the tutelage of Ascham and Aylmer, bishop of London, acquired a good knowledge of Greek, Latin, French, and Italian, and such proficiency in the Oriental languages as caused her to be regarded as a prodigy of learning, while her piety and excellence of disposition were equally remarkable. Edward VI., persuaded by Lady Jane's father and father-in-law, had set aside the claims of his sisters and declared Lady Jane his successor. Accordingly, after much persuasion, she reluctantly assented, and was proclaimed queen July 10, 1553. Ten days later Queen Mary was proclaimed, and Lady Jane and her husband were confined in the Tower. Nov. 30 she was tried for treason at the Guildhall, and pleaded guilty, and on Feb. 12, 1554, she and her husband were beheaded, chiefly, it is believed, on account of the fact that Suffolk had rashly taken arms against Queen Mary in his daughter's behalf.

Grey (ZACHARY), LL.D., b. in Yorkshire, England, 1687; was educated at Jesus College and Trinity Hall, Cambridge; became an Anglican clergyman; d. at Ampthill Nov. 25, 1766. Chiefly remembered for his edition of *Hudibras*, with copious notes (1744–52), and his valuable *Examination of Neal's History of the Puritans* (1736–39). He also wrote a *Defence of Ancient and Modern Historians* (1725–30), *The Ministry of Dissenters Null and Void* (1725), and many smaller works, chiefly violent polemics.

Greyfriars. See FRANCISCANS.

Grey'hound, a remarkable variety, or group of varieties, of the domestic dog, distinguished chiefly by slender, graceful build, quick sight, and great speed in the chase. In other points there is much lack of uniformity. For example, in India there are long-haired and even shaggy greyhounds, while China and Turkey have breeds with no hair, or next to none. Scotland, Ireland, and Russia have stocks of the greyhound which are keen of scent, but most greyhounds are very deficient in this respect, and follow the game by sight alone. Some strains are of very large size and treacherous disposition, while the little Italian greyhound is a gentle household pet. While the celebrated dog Gelert, a greyhound whose mythus is found in the folk-lore of several nations, was a most faithful servant, with but few exceptions his modern representatives are unintelligent, and do not attach themselves strongly to any master. The greyhounds of the present day are descendants of a long line of clearly-marked ancestry. Celtic, Teutonic, Latin, Greek, Persian, Indian, Egyptian, and Chinese literature and tradition testify to the antiquity of the race, which has of late been much modified by crossing with other breeds.

Grey'lock, the highest point of land in Massachusetts, is in the town of Adams, Berkshire co. It is the principal eminence of Saddle Mountain. Its height is 3505 feet. The sides of Greylock are covered with forests.

Grey Nuns. See CHARITY, SISTERS OF.

Grey'town, or **San Juan de Nicaragua,** a seaport of the Mosquito Territory, Nicaragua, Central America, on the river San Juan, lat. 10° [illegible]' N., lon. [illegible] W.

Grid'ley, post-v. and tp. of McLean co., Ill., on the Toledo, Peoria and Warsaw R. R. It has [illegible] churches, 2 elevators, 1 school-house, primary and grammar schools, [illegible] stores, and 12 other places of business of various kinds, and 2 weekly newspapers. Pop. of tp. [illegible]

GEO. W. KENT, ED. "GRIDLEY MONITOR."

Gridley (CHARLES V.), U. S. N., b. in Indiana; graduated at the Naval Academy in 1863; became a master in 1866, a lieutenant in 1867, a lieutenant-commander in 1868; served in the Oneida at the battle of Mobile Bay (Aug. 5, 1864), and is thus favorably mentioned in the official report of the executive officer of that vessel: "The conduct of Acting Ensign Charles V. Gridley is beyond all praise. He had charge of the master's division, and assisted in conning the ship from the top-gallant forecastle."

FOXHALL A. PARKER.

Gridley (JEREMY), brother of Richard, b. at Boston, Mass., Mar. 10, 1702; graduated 1725 at Harvard; became distinguished as a lawyer, scholar, and occasional preacher; was attorney-general of Massachusetts, distinguished for his opposition to James Otis; was nevertheless highly respected for his patriotism and virtue. D. at Brookline, Mass., Sept. 10, 1767.

Gridley (Maj. Gen. RICHARD), b. at Canton, Mass., 1711. He was chief of the corps of engineers in the reduction of Louisburg in 1745; was raised to the position of colonel of infantry in 1755; was instrumental in planning the fortifications around Lake George. In compensation for his services rendered at the taking of Quebec, the British government presented him Magdalen Island, with half-pay, which remained permanent through life; was wounded at Bunker's Hill, and appointed major-general by the provincial Congress Sept. 20, 1775. D. at Stoughton, Mass., June 20, 1796.

Grier (ROBERT), b. in Columbia co., Ga., 1779, was famous in Georgia, South Carolina, North Carolina, and Alabama as an almanac-maker for nearly half a century. The *Grier Almanac* is still published. D. May 4, 1848.

Grier (ROBERT COOPER), b. in Cumberland co., Pa., Mar. 5, 1794; graduated from Dickinson College in 1812; was taught classics by his father, who was a thorough scholar and clergyman; commenced the study of law in 1815; was the recipient soon of a large practice. In 1846 Pres. Polk appointed him one of the justices of the U. S. Supreme Court. D. at Philadelphia Sept. 26, 1870.

Grier (WILLIAM N.), b. in Pennsylvania in 1813; graduated at the U. S. Military Academy 1835, and appointed a brevet second lieutenant of dragoons in the army, receiving his full commission the following year. Prior to the civil war his service was almost constant with his regiment on the frontier, being frequently engaged with hostile Indians. On the outbreak of war, Grier, then a major, was assigned to duty with the Army of the Potomac as acting inspector-general, but in the Virginia Peninsula campaign of 1862 commanded his regiment. In 1863 he was appointed chief mustering and disbursing officer of the State of Iowa, on which duty he continued till 1865, when he was appointed to similar duty in Pennsylvania. In 1870 he retired from active service. G. C. SIMMONS.

Gri'erson (BENJAMIN H.), b. at Pittsburg, Pa., July, 1837; removed at an early age to Ohio, and subsequently to Illinois. During the civil war he served on the staff of Gen. Prentiss; was major, subsequently colonel, 6th Illinois Cavalry; appointed brigadier-general of volunteers in 1863, and major-general 1865. His services as a cavalry leader were conspicuous, as such conducting many important and successful operations, raids, expeditions, etc. In July, 1866, he was selected as colonel of the 10th U. S. Cavalry, which position he still retains. G. C. SIMMONS.

Gries'bach (JOHANN JAKOB), was b. at Butzbach Jan. 4, 1745; studied theology at the universities of Tübingen, Halle, and Leipsic; travelled in 1769 and 1770 through Holland, England, and France, and was appointed professor in theology at the University of Jena in 1776; which office he held till his death, Mar. 24, 1812. After finishing the ordinary course of theology, he devoted himself almost exclusively for many years to critical researches concerning the texts of the books of the New Testament, the result of which was his edition of the New Testament (Halle, 1775–77), which, properly speaking, was the first critical edition ever given, and which has been reprinted since in many editions. His works on other theological subjects are of less importance, though his *Populäre Dogmatik* (1779) reached four editions.

Grif'fenfeld (PETER) was born at Copenhagen, Denmark, in 1635. He was the son of a wine-dealer, and his family name was SCHUMACHER. He early came into the service of Bishop Swane as private secretary; and as Swane played a very conspicuous part in the Danish revolution of 1660, by which the power of the nobility was broken and the constitution of the kingdom changed into an absolute monarchy, a way was thus opened for the talent and ambition of the young Schumacher. The bishop recommended him to the king, Frederick III., who employed him in several responsible positions in the government offices. He was the author of *Lex Regia Danica*, promulgated Nov. 17, 1665. On his deathbed Frederick III. said to his son and successor, concerning Schumacher: "Give him power, but do it slowly;" but it was not in the character of Christian V. to do anything slowly. In the same year he became king (1670) Schumacher was ennobled under the name of Griffenfeld; in 1673 he was made a count and chancellor of the realm; in 1674, president of the supreme court and chancellor of the university. The king had great confidence in him, and his talents were noticed and respected at the courts of France and England. But his policy was in utter opposition to that of the court, and even to that of the king. The dynasty of Oldenburg, descending from Germany, always marrying into German families, and often holding German possessions, or at least claims of succession, never became truly Danish. It wished to take rank among German sovereigns and to make Denmark a German power. The personal sympathy of the individuals and the traditional ambition of the family centred in Germany. Now, the king wished to wage a war, for war belonged to the dignity of a king, as hunting to that of a nobleman; and the war had to be made in close alliance with the German powers, and against Sweden. Griffenfeld objected that Denmark was too exhausted to carry on a war with any degree of vigor; that Sweden was Denmark's only natural ally, with which it would be foolish to quarrel; and finally, that at this moment Sweden was too powerful, on account of its alliance with France, to be attacked with any prospect of success. He was overruled, and war was declared against Sweden. He then proposed to attack those provinces on the other side of the Sound which Sweden had taken from Denmark in 1660, and whose population still clung to Denmark with great affection; while the king and the court liked better to attack Pomerania and the other possessions which Sweden had held in Germany since the Thirty Years' war. He was overruled in this too; and it was easy to foresee that a minister so utterly in opposition to the instincts and traditions of an absolute monarch would not keep his place for a long while, the more as he was himself rather haughty and incautious. One day in 1676 he fell out with the king, and the courtiers hastened to have him bereft of his honors and put in prison. Some days after the king missed him badly, and the alarmed courtiers had him sent 1000 miles away, to Munkholm, a lonely rock-fortress in the fiord of Trondhjem. The king soon forgot him, and he remained imprisoned for twenty-three years. D. May 11, 1699, a martyr for common sense, the victim of a whim. CLEMENS PETERSEN.

Grif'fin [Gr. γρύψ], a fabulous monster, having the body and legs of a lion, joined to the back, wings, and often the feet of the eagle. It was believed, indeed, to be the offspring of the eagle and the lion. Learned writers, even after the revival of European learning, asserted its existence. Aristeas, a very ancient Greek poet, is credited with being the first to mention the griffin. Watchfulness, swiftness, and strength were its most marked characters. It is a common heraldic bearing.

Griffin, tp. of Conway co., Ark. Pop. 458.

Griffin, tp. of Pope co., Ark. Pop. 479.

Griffin, post-v., cap. of Spalding co., Ga., 40 miles S. of Atlanta, on the Macon and Western division of the Central R. R. It has 1 national bank, 2 savings banks, 2 daily newspapers, 7 churches, male and female colleges, free schools, 1 furniture-factory, and 1 carriage manufactory. A mineral spring of sulphur water has recently been discovered. It is a summer resort for planters of South-western Georgia. Principal business, cotton. The annual receipts vary from 25,000 to 45,000 bales. Pop. of district, 3421. A. M. SPEIGHTS, ED. "DAILY NEWS."

Griffin (CHARLES), b. in Ohio 1826: graduated at West Point 1847; entered the army as brevet second lieutenant of artillery, and served in the war with Mexico 1847–48; became a second lieutenant in Oct., 1847, and first lieutenant June, 1849, serving on frontier duty and against hostile Indians. Appointed captain in 1861, he served during the civil war at the first battle of Bull Run, being brevetted major for gallant conduct. Promoted to be brigadier-general of volunteers June, 1862, he commanded a brigade in the Virginia Peninsular campaign, and distinguished himself at Yorktown, Gaines's Mill, Malvern Hill, etc., and subsequently in the second battle of Bull Run and at Antietam. In the Rappahannock campaign he commanded a division at the battle of Fredericksburg, Dec., 1862, at Chancellorsville, May, 1863, and at Spottsylvania, assault and siege of Petersburg, and the various battles of the final campaign, 1864–65. For conspicuous gallantry in this latter campaign he was brevetted major-general of volunteers. Placed in command of the 5th army corps Apr. 1, 1865, he was appointed one of the commissioners to carry out the terms of the surrender of Gen. Lee at Ap-

pomattox Court-house Apr. 9, 1865. Being mustered out of the volunteer service Mar., 1866, he was in July following appointed colonel 35th Infantry, and commanded military districts in Texas and Louisiana. D. at Galveston, Tex., Sept. 15, 1867. G. C. SIMMONS.

Griffin (CYRUS), b. in Virginia 1749; educated in England, and became connected with a noble family there by marriage; a member of the Virginia legislature; member of the old Congress in 1778–81 and 1787–88, and became its president in 1788; elected president of the supreme court of admiralty; held the office of judge of the U. S. district court for Virginia from 1789 until his death, which occurred at Yorktown, Va., Dec. 14, 1810.

Griffin (EDWARD DORR), D. D., a pulpit-orator of commanding power, was b. at East Haddam, Conn., Jan. 6, 1770; graduated at Yale 1790; was settled at New Hartford, Conn., from 1795 to 1801, at Newark, N. J., from 1801 to 1809; was professor of sacred rhetoric in Andover Seminary from 1809 to 1811; was settled in Boston, Mass. (Park Street church), from 1811 to 1815; at Newark again from 1815 to 1821; was president of Williams College from 1821 to 1836; and d. at Newark, N. J., Nov. 8, 1837. He published several works, the most noted of which is a *Course of Lectures in Park Street Church* (1813). Sixty of his sermons, with a biography prefixed, were published in 2 vols. by Dr. William B. Sprague in 1838. R. D. HITCHCOCK.

Griffin (EZRA LEONARD), M. D., b. at Hillsboro', N. H., Sept. 21, 1821; educated at Dartmouth College; took his medical degree (1848) at Berkshire Medical College, Pittsfield, Mass.; removed to Fond du Lac, Wis.; became in 1875 pres. of Fond du Lac County Medical Society, and in 1873 vice-president of the State Medical Association. Author of professional papers, biographical memoirs, etc.

Griffin (GERALD JOSEPH), b. at Limerick, Ireland, Dec. 12, 1803; went in 1823 to London with a view of becoming a dramatist, but the failure to dispose of his tragedies *Aguire* and *Gisippus* obliged him to become a writer for periodicals. His *Holland Tide* (1826); *Tales of the Munster Festivals* (1827); *The Colleen Bawn* (1828); *The Invasion*; *The Rivals*; *The Duke of Monmouth*, and other novels were very successful and meritorious works. He also published some good poetry. In 1838 he became a postulant of the Christian Brothers, and took the name of Brother Joseph. D. at the North Cork monastery, Ireland, June 12, 1840. His *Life* has been written by his brother.

Griffin (GILDEROY W.), A. M., PH. D., b. in Louisville, Ky., Mar. 6, 1840; was educated at the University of Louisville; and in 1861 was admitted to the practice of law, and after some years of professional labor became one of the editors of the Louisville *Industrial and Commercial Gazette*, and was for a time literary and dramatic critic on the staff of the Louisville *Journal*. Mr. Griffin published in 1869 a biographical sketch of G. D. Prentice; edited the subsequent revised edition of *Prenticeana*, in which he wrote the *Life* of Prentice, which he afterwards rewrote and enlarged; was U. S. consul at Copenhagen 1871–74. Author of a *Life of C. S. Todd* (1873); *Danish Days* (1874); *A Visit to Stratford* (1875); has contributed largely to periodical literature, and delivered a lecture upon literary and other subjects; is a fellow of the Royal Society of Antiquaries, Copenhagen.

Griffin (HAMILTON), M. D., b. at Louisville, Ky., Sept. 21, 1832; was educated at South Hanover College, and took his medical degree at the University of Louisville, 1857; became a fellow of the College of Physicians and Surgeons 1858; professor of materia medica and therapeutics in Baker University, Leavenworth, Kan., 1859; surgeon in the Confederate service 1862–65; resumed practice at Louisville 1865; became in 1873 one of the physicians of the city hospital. Author of *Lectures on Materia Medica and Therapeutics* and many scientific papers.

Griffith (WALTER SCOTT), b. in New York City July 22, 1808; removed in early youth to Western New York; entered business-life in Rochester, where he became a successful wholesale merchant; assumed in 1842 the extensive but embarrassed forwarding business of his father, and removed to New York; was the founder and first president (1860–72) of the Home Life Insurance Co. of Brooklyn, N. Y.; director in various savings banks of Brooklyn; was for some years secretary of the Prospect Park commission; a useful and influential member of the State legislature and the New York Chamber of Commerce, of which in 1870 he became second vice-president; was prominent in the work of the Christian Commission, the American Board of Commissioners for Foreign Missions, and various other benevolent and business enterprises. D. at Brooklyn, N. Y., Nov. 23, 1872.

Grif'fith (WILLIAM), b. in England in 1810; studied at the London University; went to India in 1832 as an assistant surgeon; was a government collector of plants and birds in Tenasserim, Assam, Bootan, Afghanistan, and Malacca, where he d. Feb. 9, 1845. The name *Griffithia* has been given to a genus of rubiaceous plants.

Grif'fitts (SAMUEL POWELL), M. D., b. at Philadelphia, Pa., July 21, 1759; graduated from the College of Philadelphia, and pursued the study of medicine abroad for three years; returned to Philadelphia and commenced practice; was chosen vice-president of the College of Physicians in 1817, and held that office until his death; became professor of materia medica in the University of Pennsylvania from 1792–96. He rendered efficient aid during the terrible pestilence of 1793 and the epidemics of 1797–99, 1802, and 1805; and was instrumental in relieving the suffering and wants of the French immigrants from St. Domingo in 1793–94. Author of several articles on hygiene, etc. D. at Philadelphia May 12, 1826.

Griggs, tp. of Van Buren co., Ark. Pop. 593.

Griggs'ville, post-v. and tp. of Pike co., Ill., 30 miles E. of Hannibal, 4 miles W. of the Illinois River, on the Hannibal and Naples R. R. It has a national bank, a newspaper, a public library of about 2000 volumes, a carriage and wagon manufactory, 1 large flouring mill, 1 harrow and 1 plough manufactory, 3 churches, 2 large hotels, 1 wholesale dry-goods house, 15 stores, a good school, and a silver-plating manufactory. Pop. of v. 1456; of tp. 2645.
B. L. STROTHER, ED. "THE GRIGGSVILLE REFLECTOR."

Grigorio'pol, town of Russia, in the government of Kherson, on the Dniester, was founded by a colony of Armenian settlers in 1793, who are mostly engaged in the cultivation and manufacture of silk. Pop. 6477.

Grig'sby (HUGH BLAIR), LL.D., b. at Norfolk, Va., 1806; became chancellor of William and Mary College in 1871. He held the position of member of the Virginia Convention of 1829–30, respecting which he delivered an address in 1853 before the Virginia Historical Society, was a contributor to the *Southern Literary Messenger*, etc.

Grill'parzer (FRANZ), b. at Vienna Jan. 15, 1791; spent his life in a quiet way in his native city, where for many years he held a position in the imperial archives. D. Jan. 20, 1872. In 1816 he brought his famous tragedy *Die Ahnfrau* ("The Grandmother") on the stage, and at once he became the hero of the German theatre, a rival of Kotzebue. *Die Ahnfrau* is one of the wildest, most absurd, and most disgusting productions of the romantic school. It was the delight of the stupid mass of theatre-goers, who in this piece saw their own crude and senseless superstitions treated as deep, philosophical ideas. But among people of culture and taste it threw such a disgrace on the author's name that fifty years had to pass by before the eminent merits of his later works became fully acknowledged. He himself must have felt that he had made a mistake, for, although there still linger some faint vestiges of his early infatuations in *König Ottokar's Glück und Ende* (1825) and *Melusina* (1833), in all his chief works, *Sappho* (1819), *Medea* (1822), *Des Meeres und der Liebe Wellen* ("Hero and Leander") (1840), and *Esther* (a fragment), he threw off all allegiance to the ideas of the romantic school, and pursued an almost opposite direction. Goethe's *Iphigenie* became his model. For Grillparzer was not an original genius. He has created no types. But he had a talent of great power and perfect education, and the vein which Goethe had found he worked out with eminent success. There is in Goethe's *Iphigenie* a repose in the representation even of the strongest passions, and a simplicity in the expression even of the profoundest thoughts, which Grillparzer never has attained; but he understood how to communicate to the Greek statue, without hurting its antique character, a life whose warm pulsations charm us and excite our deepest sympathy, and the perfect clearness and sweet gracefulness of his diction make us forget the intricacies and subtleties of his ideas.
CLEMENS PETERSEN.

Grimal'di, an old Guelphic family of Italy, whose principal seat was at Genoa. They traced their origin to one Grimoald (d. 714), major-domo to Childebert III. (695–711), Merovingian king of Neustria and Burgundy. The Grimaldi were long (980–1731) princes of Monaco, but on the extinction of the male line of the princely house the title passed to the Goyon-Matignon line; and at present (1875) the princes of Monaco still bear the name Grimaldi, though not of the direct male line. The name became a common one in Italy, as well as France and Spain; and many poets, artists, scholars, churchmen, nobles, generals, and admirals bore this name in the Middle Ages.

Grimes, county of S. E. Central Texas. Area, 802 square miles. It is extremely fertile, consisting partly of prairie and partly of timber land. Live-stock, corn, cotton, and lumber are staple products. It is traversed by the Texas Central R. R. Cap. Anderson. Pop. 13,218.

Grimes (JAMES WILSON), LL.D., b. in Deering, Hillsboro' co., N. H., Oct. 20, 1816; d. at Burlington, Ia., Feb. 7, 1872. The youngest of eight children, and of Scotch-Irish extraction, he entered Dartmouth College Aug., 1832; commenced the study of law in Feb., 1835, with James Walker at Peterboro', N. H.; settled at Burlington (now in Iowa, then in the "Black Hawk Purchase," which was attached to the Territory of Michigan) May, 1836, and engaged in the practice of law, in which he was highly successful; for twelve years (1841–53) was partner with Henry W. Starr. His first public service was as secretary to an Indian commission held at Rock Island, Sept. 27, 1836, at which the Sacs and Foxes relinquished by treaty to the U. S. the lands lying between the then W. boundary-line of the State of Missouri and the Missouri River, which were subsequently added to that State. He was a representative of Des Moines county in 1838 and in 1843 in the legislative assembly of the Territory of Iowa, and in 1852 in the general assembly of the State. Reared among the Whigs, and sustaining their general principles, he earnestly opposed the repeal of the Missouri Compromise, and was one of the founders of the Republican party, while his whole career was marked by freedom from party bias. On several occasions he canvassed nearly the whole of Iowa and addressed the people upon public questions. He was chosen governor Aug., 1854, for the term of four years, having been nominated for the office at the last State convention of the Whig party ever held in Iowa, Feb. 22, 1854, and also by the Free-Soil Democracy. One of the commissioners for founding a hospital for the insane at Mt. Pleasant, he gave careful attention to that trust. He convened the general assembly in special session July, 1856, to act upon land-grants made to the State by Congress for the purpose of aiding in the construction of railroads, by which the material development of the State has been greatly promoted. In Aug., 1856, he addressed a remonstrance to Pres. Pierce against outrages perpetrated in Kansas upon former citizens of Iowa. By the effect of a new constitution his tenure of office terminated Jan., 1858, when he was chosen U. S. Senator for the term of six years from Mar. 4, 1859. In Jan., 1864, he was chosen for a second term. He resigned in consequence of a failure of health Aug., 1869. In the Senate a ready and vigorous debater, but rarely making a set speech, he gave close attention to public business, especially to subjects entrusted to committees of which he was a member, particularly pensions, the affairs of the District of Columbia, and naval affairs. He initiated the first practical act of emancipation after the outbreak of the civil war by securing an order from the secretary of war which set free a large number of escaped slaves confined in the jail of the District of Columbia July 4, 1861. His principal speeches in Congress were on the achievements of the Western naval flotilla Mar. 13, 1862, and on the surrender of slaves by the army Apr. 14, 1862. He became a recognized authority in all matters pertaining to the navy. He first suggested in the Senate the introduction of iron-clad vessels into the navy, July 19, 1861. The establishment of a navy-yard at League Island, the return of the Naval Academy to Annapolis from Newport, and the establishment of a national armory at Rock Island were largely due to his advocacy. In the impeachment trial of Pres. Johnson he regarded himself as acting, not in a representative capacity but as a judge, and gave his opinion that the President was not guilty of an impeachable offence by reason of anything alleged in the articles preferred against him. During that trial he was stricken down by an attack of paralysis, and came into the Senate chamber and recorded his vote as an act of public duty and in the exercise of severe fortitude and a determined moral energy. With reference to the obloquy cast upon him for this vote he said in a letter of Jan. 29, 1869, "Neither the honors nor the wealth of the world could have induced me to act otherwise than I did; and I have never for a moment regretted that I voted as I did. I shall always thank God that He gave me courage to stand firm in the midst of the clamor, and by my vote not only to save the Republican party, but prevent such a precedent being established as would in the end have converted ours into a sort of South American republic, in which there would be a revolution whenever there happened to be an adverse majority in Congress to the President for the time being." After long and painful prostration, and a residence of two years in Europe, with temporary intervals of improved health, he d. suddenly of heart disease. JOSEPH HENRY.

Grimes's, tp. of Pike co., Ala. Pop. 1600.

Grimké (FREDERICK), b. at Charleston, S. C., Sept. 1, 1791; graduated at Yale College (1810); judge of the Ohio supreme court 1836–41. Author of *Nature and Tendencies of Free Institutions*, also of an essay on *Ancient and Modern Literature*. D. at Chillicothe, O., Mar. 8, 1863.

Grimké (JOHN FAUCHERAUD), LL.D., a judge of the supreme court of South Carolina; was elected to the office of colonel in the Revolutionary war. Author of a *Revised Edition of the Laws of South Carolina to 1789*, *A Probate Directory*, etc. D. in 1819.

Grimké (THOMAS SMITH), LL.D., b. at Charleston, S. C., Sept. 26, 1786; graduated from Yale College in the class of 1807, and at once took up the study of law in Charleston, S. C., where he soon rose to eminence as a lawyer. In 1828 he delivered a speech in the State senate on the tariff question in favor of the general government, and an argument on the constitutionality of the South Carolina Test act of 1834. He became one of the best classical scholars in the country, yet maintained that neither classics nor mathematics should enter the list of studies for general education in this country. Author of several addresses before Sunday-schools, peace societies, etc.; *Reflections on the Character and Objects of all Science and Literature* (3 addresses with notes and appendix, New Haven, 1831). D. near Columbus, O., Oct. 11, 1834.

Grimm (FRIEDRICH MELCHIOR), BARON, a literary adventurer of more ambition than talent, and more shrewdness than character, a German by birth and education, but a Frenchman by residence, was b. at Ratisbon, Bavaria, Dec. 25, 1723, and studied at the University of Leipsic. Having failed sadly with his tragedy *Banise*, he went to Paris as tutor in a noble family, and here he succeeded. Rousseau made him acquainted with Diderot, D'Alembert, D'Holbach, and other literary celebrities. Count Friesen, to whom he had become private secretary, introduced him in the most elegant salons. Voltaire made him famous by exclaiming, after reading his pamphlet *Le petit prophète de Boemishbroda* (1753): "De quoi s'avise donc ce Bohémien d'avoir plus d'esprit que nous?" He now became the regular correspondent of Catharine II. of Russia, Gustavus III. of Sweden, Stanislas of Poland, and other sovereigns, and his letters give a minute chronicle of French literature from 1753 to 1790. In 1776 he was made a baron and ambassador from the duke of Saxe-Gotha to the French court, but in 1792 he had to leave France with the rest of the foreign diplomats. He retired to Germany, where Catharine II. gave him a pension and some shadow of a diplomatic position. D. Dec. 19, 1807. A complete edition of his *Correspondance littéraire, philosophique, et critique* was published in 15 vols. in Paris in 1829; the Germans have felt satisfied with an abridgment in 2 vols., 1823. It is very common to find this *Correspondance* praised both by French and German critics, but it is very rare to find it used. The reason of this last peculiarity is that it does not contain anything which cannot be had easier and better from other sources. The most interesting thing connected with Grimm is the picture which Rousseau gives of him in his *Confessions*, greatly exaggerated, but nevertheless strikingly true. CLEMENS PETERSEN.

Grimm (JAKOB LUDWIG), a celebrated German philologist and archæologist, was b. at Hanau Jan. 4, 1785; studied law at Marburg 1802; received in 1805 an office in the war department of Hesse; accompanied in 1814 the Hessian ambassador to the Congress of Vienna; went in 1815, under Prussian authority, to Paris to reclaim such manuscripts as Napoleon had carried away from German libraries; became in 1816 librarian at Cassel, and in 1830 professor at Göttingen. When in 1837 the Hanoverian king abolished arbitrarily the constitution, Grimm signed a protest against the measure, and was dismissed, but in 1841 received a chair at the University of Berlin, which he filled till his death, Sept. 20, 1863. He began his literary career in 1811 with *Ueber den altdeutschen Meistergesang*, which in 1819 was followed by his *Deutsche Grammatik* (unfinished), in 1828 by his *Deutsche Rechtsalterthümer*, in 1840 by his *Weisthümer*, and in 1844 by his *Deutsche Mythologie*. Each of these works was a new departure in its respective field, and exercised powerful influence not only over science, but on the people. But besides these, and a great number of minor essays and archæological researches and collections undertaken in connection with his brother, his two principal works are *Geschichte der Deutschen Sprache* (1848) and *Deutsches Wörterbuch* (1852). The former, a history of the German language, is not only a comprehensive, almost exhaustive, representation of its subject, but it is of paramount importance for all linguistical study on account of the brilliant discoveries it contains, by which some of the fundamental laws for the development of a language are established. The latter, a dictionary of the German language, is arranged on a broader plan than any other dictionary, and is executed with infallible correctness and an astonishing learning. Only the first volumes, to the word *Garten*, were finished when death overtook him, but very rich materials were left to his successors.

Grimm (KARL WILHELM), brother of Jakob Ludwig, was b. at Hanau Feb. 24, 1786; studied law at Marburg, and followed his elder brother as librarian and professor at Cassel, Göttingen, and Berlin, where he d. Dec. 16, 1859. Although a philologist and archæologist like his brother, and taking part with him in all his studies, and dividing the labor, he seems to have been more attracted to the poetical side of the questions which the two brothers raised and answered. The most important of his independent works are *Altdänische Heldenlieder, Balladen und Märchen* (1811); *Über die Deutschen Runen* (1821); *Die Deutschen Heldensage* (1829), his principal work; *Der Grosse Rosengarten* (1836); *Das Rolandslied* (1838); *Konrads von Würzburg* (1849); *Altdeutsche Gespräche* (1851). In connection with his brother he edited *Kinder- und Hausmärchen* (1812), one of the loveliest collections of fairy and other popular tales; *Altdeutsche Wälder* (1813–16); *Deutsche Sagen* (1816–18); and he took part with all his strength in the preparation of the dictionary.

Grim'ma, town of Germany, in the kingdom of Saxony, on the Mulde, has extensive manufactures of shoes and linens, and a trade in wood and yarn. Pop. 5879.

Grimm's Law, the principle laid down by J. L. Grimm that appears to regulate the interchange of consonants of the mute species among the Indo-European languages. For example, the consonants *p, b,* and *f* in (1) Latin, Greek, and Sanscrit become in (2) Gothic *f, p,* and *b*; and in (3) old High German, *b, f,* and *p*. So the dentals *t, d, th* (1) become (2) *th, t, d*; and (3) *d, z, t*; while (1) *k, g,* and *ch* become (2) *h, k,* and *g*, and (3) *g, ch,* and *k*. This rule, though useful, is far from being infallible.

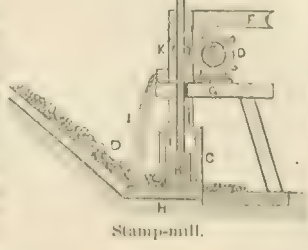
Grims'by, a post-v. and tp. of Lincoln co., Ont., Canada, on Lake Ontario and on the Great Western Railway, 19 miles E. S. E. of Hamilton. Fruit culture and the wine-manufacture are important industries. Pop. about 800.

Grin'delwald, a v. of the canton of Berne, Switzerland, 35 miles S. E. of Berne, in a valley just N. W. of the great mountains Eiger, Mettenberg, and the Wetterhorn, between which descend the upper and lower glaciers of Grindelwald. The manufacture of kirschwasser and the herding of cattle are the chief industries of Grindelwald, which is an interesting point for the tourist, and is therefore much visited in summer. Pop. 3155.

Grind'ing and Crush'ing Machi'nery. Grinding and crushing or pulverizing processes and apparatus are used in nearly every branch of industry, and a large variety of machinery belonging to these classes has been designed and constructed. The reduction of large masses to the state of powder usually involves the use both of crushing and of grinding apparatus. Crushing machinery usually reduces the size of masses or breaks up fragments by simple pressure. Such action is best in the reduction of hard, brittle, non-fibrous substances. Grinding machinery acts by compression, combined with a lateral action. Such attrition is better adapted to produce extreme fineness of division than simple crushing; and where the material to be ground is organic, particularly if fibrous and tenacious, this is the only satisfactorily efficient method. Pulverization of hard substances is also frequently effected by percussive action.

In breaking up hard materials existing naturally in masses—as, for example, minerals and the metallic ores—the first operation is usually that of blasting. Holes are drilled to a depth of from a few inches to twenty feet, according to the nature of the material and the scale upon which the work is prosecuted. For this work drills worked by steam or by compressed air are now frequently used, effecting very great economy over hand-labor. These holes are charged with explosive materials, which being fired, the mass is rent into fragments. The larger pieces are blasted again, and all, when sufficiently reduced in size to permit it, are broken up by the workmen with blows of heavy hammers or by crushing machinery. The *stamp-mill*, shown in Fig. 1, is one of the oldest and most generally known forms of crushing apparatus. A heavy mass of chilled cast iron B is secured upon the lower end of a strong vertical beam E, which also carries, near the upper extremity, a bracket K, which is engaged by a cam D, which lifts it to the required height. This beam is guided by a suitable frame F G, and the lifting is done by a cam or by a series of cams which are keyed upon and revolve with a horizontal shaft A, driven by a steam-engine or other prime mover. A shield C of wood or metal protects the workmen against injury by flying fragments. D represents the ore flowing under the stamp-heads, which crush it against the floor H. A stream of water I usually flows over the minerals, carrying off the fine particles, and also preventing the rising of dust. Usually, a series of such stamps are placed side by side, all operated by a single shaft, and forming what is called a "battery." In this case they are so arranged, by the adjustment of the elevating cams upon the shaft, as to make their combined action in resisting the driving power as uniform as possible. Where two are worked by one shaft, their cams are set opposite each other; where three or four or six form a battery, their cams are so set as to make angles of 120°, 90°, or 60° with each other. The stamps are also sometimes arranged in a circle about a central vertical shaft carrying a single lifting-cam which operates all. This form of stamp-mill is becoming very generally used in the U. S. Its advantages are obviously compactness, less cost with equal efficiency, and rather less driving power.

Fig. 1.



Stamp-mill.

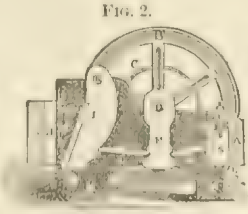
A modification of the steam-hammer, resembling somewhat that used in forging iron, is sometimes used as a steam-stamp. When properly designed it is very effective in breaking up boulders and masses too small to be cheaply broken by the use of gunpowder, and too large and too hard to be crushed by ordinary stamps or other breaking apparatus. The stamp-heads, in the ordinary form, are often made to revolve, so as to change their positions with each blow. A battery of five stamps, running on quartz, crushes about 200 bushels in ten hours. The pestles, or stamp-heads, weigh 250 to 500 pounds. They are mounted on white oak or hickory beams 6 inches square in section, and making 100 blows per minute, with a fall of 10 or 12 inches. As an average, two-horse power is required per head.

Cornish Crushers, or rolls, somewhat similar to those used in iron-works, are sometimes used for crushing ores and stones.

Where it is not essential that the material shall be completely powdered, or in the reduction to small pieces of masses already broken to moderate size, as in the breaking up of large pebbles in road-making, or in metallurgy in the preparation of coarse material for the more complete comminution effected by stamps or by mills, *stone-breakers* are much used. These machines, by the exertion of immense crushing force, crumble the hardest known rocks, and ores broken by them are generally better prepared for subsequent operations than are those treated by stamps. The fragments are given a more uniform size, have a cleaner fracture, and are freer from dust, than when produced by the latter machines. In all varieties of stone-breakers, the crushing force is exerted through an extremely small range, and intermittently.

Fig. 2 represents the Blake stone-crusher, an example of this variety of machinery, the drawing exhibiting a longitudinal section, such as would be obtained by removing one side of the main frame A A. The circle at D exhibits a section of the driving shaft, with the eccentric which actuates the pitman or connecting-rod F, giving it a vertical motion, and, through it, working the toggle joint C C. This elbow, or toggle joint, acting against the movable jaw J on the one side, and the fixed abutment, or frame of the machine, on the other, forces the former toward the fixed jaw H, crushing any material which may have been thrown into the intervening space from above. N is a wedge which by means of the screw attached can be raised or lowered to diminish or to increase the size of product. B represents the fly-wheel, and C the driving-pulley. The faces of the jaws are protected by removable plates, which sustain all of the wear produced by abrasion. A spring of rubber, L, withdraws the swinging jaw when it has made its forward movement, and the toggle releases it. The action of the machine is as follows: The material, being already broken to a size which admits of its being placed between the jaws, is thrown into the machine, and the movable jaw, swinging through a small arc at each revolution of the fly-wheel shaft, fractures the pieces, and they drop until caught in the narrower space below, and the next approach of the pendent jaw produces new fractures, and again it releases them. The pieces finally become sufficiently small to fall out through the opening at the bottom, which is adjusted by the wedge O to the proper width

Fig. 2.



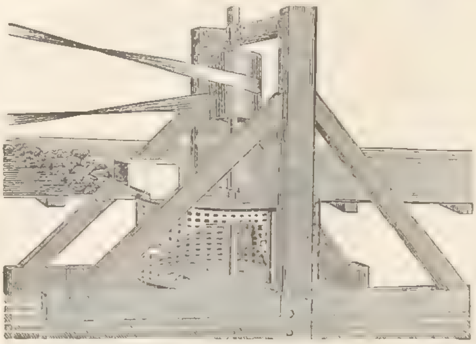
Blake Stone-breaker.

to suit the individual case. The momentum of the fly-wheel, which makes from 100 to 250 revolutions per minute, and the great leverage obtained by the use of the knee-joint, enable such a machine to exert a crushing force which is only limited by the strength of the frame. With argillaceous minerals water is used to ensure free discharge.

Various forms of rock-breaking machines have been designed, all of which embody the principles illustrated by the machine just described as a typical example of the class. The work done varies from a half ton per hour, in the smallest machines reducing to coarse sand, up to twelve or fifteen tons with the larger sizes doing less complete work. The power required varies from one half to one and a half horse-power per ton of product per hour.

Fig. 3 represents an example of that class of machinery

FIG. 3.

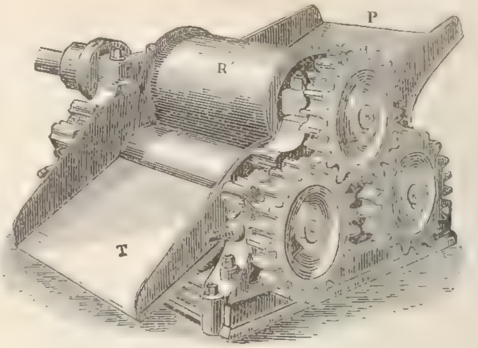


Whelpley & Storer Crusher.

in which crushing is produced by percussive action—the Whelpley & Storer crusher. It consists of a cylinder or tub-shaped vessel 30 or 40 inches in diameter, made in sections of heavy iron plates, and perforated with holes of three-fourths of an inch in diameter, or larger, as may be determined by the nature of the material and the fineness of division desired. The top of the cylinder is of thick cast iron, and contains an opening through which the material to be broken falls from a hopper placed above. The bottom of the cylinder is detached, and revolves about a vertical shaft, which is supported by a step-bearing below. It extends upward through the top of the cylinder, and is driven by a belt running upon a pulley at the upper end. On this cylinder bottom or table are bolted several heavy blocks of iron faced with steel. The cylinder just described is surrounded by an enclosure which receives and retains the crushed material thrown out by the machine. When in operation the table carrying the blocks or "hammers," and which forms the bottom of the cylinder, is set in motion, revolving at the rate of from 1000 to 1500 turns per minute. The material to be crushed is fed into the hopper, and, falling into the cylinders, meets the whirling hammers, and is at once broken up by collision with their edges and faces and by mutual impact, and is then thrown out, through the perforations in the sides of the cylinder, into the surrounding chamber. The size of the pieces is determined by the diameter of the holes in the cylinder. The larger proportion usually are of about two-thirds the diameter of these holes. The hammers and their steel faces are so attached that they may be readily removed when the former are broken or when the latter become worn out, and new ones may be put in their places. From 5 to 10 tons of material are crushed per hour by these machines in average work, when the entering pieces average between 4 and 5 inches in diameter. The power required to drive these machines is stated to average one and a half horse-power for each ton of broken material.

Materials requiring to be more thoroughly comminuted, or to be reduced to the state of fine powder or of flour, are usually ground in mills such as are hereafter to be described. Fibrous substances and organic materials generally are not readily crushed by the machinery above sketched. For simply crushing sugar-cane and similar substances, where the cellular or porous mass is to be compressed and broken to expel the contained liquid, a set of rolls such as are shown in Fig. 4 is used. These rolls are of cast iron, and are from one and a half to three feet in diameter, arranged as shown in the sketch, one being placed above and between the two others. The cane is fed between the rolls R R^1 from an apron P. Passing under the rolls, it is guided by a plate arranged for that purpose, between R and R^2, and then, the juice being thoroughly expressed, the crushed cane (or "bagasse," as it is called) falls clear, led by the tail-trough T. The effect of the action of the first pair of rolls R R^1 is to crush the cane, and the succeeding heavy pressure exerted by R^1 and R^2 expresses the juice very completely. The juice falls into a trough below, which

FIG. 4.

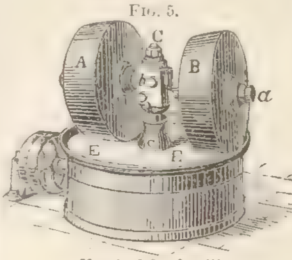


Rolls for crushing sugar-cane.

leads it to a reservoir conveniently situated to receive it. The heavier mills, which are made for large plantations, do the best work. A good mill expresses from 70 to 75 per cent. of the juice of the cane. The larger the rolls, the slower their speed, and the heavier the pressure exerted by them, the more perfectly is the work done. They are often made very large and immensely strong. A mill having rolls 40 inches in diameter and 6 feet long, making three revolutions per minute, requires a driving power of 60 or 70 horses, and expresses 20 tons of cane-juice per day.

Fig. 5 represents a form of mill which is also used principally for crushing organic materials, for expressing oil from seeds, and for similar work. It is also used in grinding chocolate, in mixing mortar, and in kneading clay for brick or porcelain manufacture. A and B are two millstones revolving on horizontal axes *a* *b*, which are held in position by bearings fastened by bolts to the framework of the machine. The vertical shaft C revolves in bearings steadied by the framework above, and its weight, with that of its appurtenances, is carried by a step at its lower end. Keyed upon this shaft

FIG. 5.



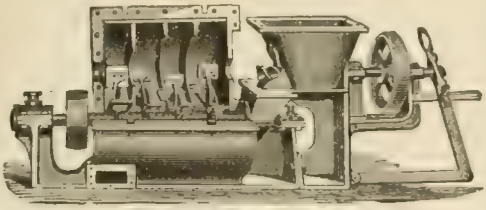
Vertical Seed-mill.

is a strong cast-iron disk, having a high flange around its edge. Fitted to this disk, and well bedded upon it, is a thick stone E E, upon which the mill-stones A B rest. The vertical shaft C is driven by a bevel-wheel at its lower extremity, and carries with it the horizontal table E E. The material to be crushed is thrown upon the table, and as the latter revolves the former is carried under the millstones, which revolve by contact, and is crushed and ground by the weight of the stones and by the slight twisting action arising from the combination of the relative motion of the two sets of stones in the vertical and the horizontal plane. In a better form of this mill the bed or table is fixed, and the axle carrying the vertical stones is attached to the vertical spindle and revolves with it. Where the stones are small and their orbit is of large diameter, the action is almost purely that of crushing, but where, as is customary, the millstones are of large diameter and revolve in small orbits, the action combines grinding with crushing. The hydraulic press is often used as a substitute for this form of mill. In crushing and kneading soft materials, as paints or chocolate, the stones have a diameter of 24 or 30 inches, but when designed for breaking ore or for crushing seeds containing oil, they are given a diameter of 5 feet. They make from three to five or six revolutions per minute. The stones are made of some hard rock, as granite, gneiss, or trap, or occasionally of cast iron. Making five revolutions per minute, the heavier stones require about five horse-power to drive them over materials offering moderate resistance.

When a thorough pulverization of materials is desired mills of various kinds, in which the action is purely that of grinding, are generally used. An exception to the general rule exists in the pulverizer of Whelpley & Storer, shown in Fig. 6. This machine is only intended for the reduction to fine powder or to dust of such materials as sand, gravel, or crushed ore. The material is fed regularly and automatically into the machine from the hopper above, and, entering the cylinder, encounters the swiftly revolving

"paddles," and, becoming entangled among the accompanying and surrounding eddies and whirlwinds of air,

Fig. 6.

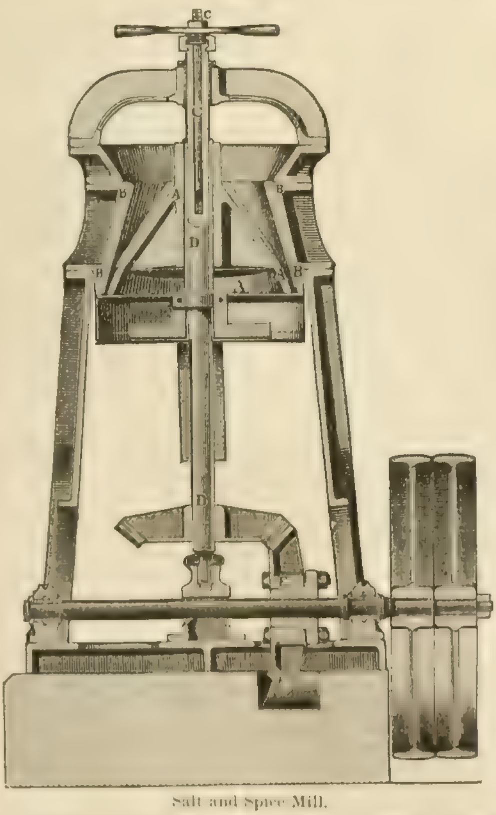


Whelpley & Storer Pulverizer.

the particles are, by mutual attrition and collision, ground into sometimes impalpable powder. The coarser particles thrown out are found to have rounded surfaces, instead of broken faces and sharp edges, as would be the case were they simply crushed. The velocity of the paddles is about two miles per minute. The dust is drawn out by a suction-fan or blower at the end of the cylinder opposite the feed apparatus. One of these machines, one foot in diameter, requires a power of three horses. Those of two feet, two and a half, and three and a half feet diameter are rated at nine, twelve, and eighteen horse power respectively. The weight of the product and its fineness are determined by the rate of feeding and the speed of the blowing-fan. It may be given any degree of pulverization, from that of fine sand to that of an impalpable powder.

For grinding coffee and spices, dry paints, soft ores, solid chemicals, and easily crushed substances in general, mills with grinding surfaces of cast iron are commonly used. In these mills the rubbing faces of the metal are usually corrugated or ribbed in a manner and to a degree which is determined by the nature of the work to be done. Fig. 7 exhibits a mill of this class, such as is designed specially

Fig. 7.

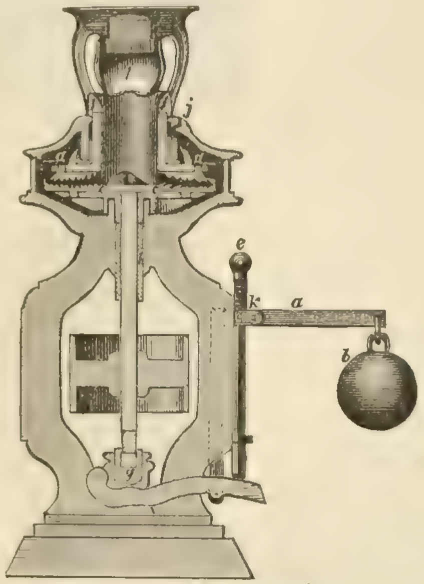


Salt and Spice Mill.

for grinding salt and soft ores. The cone-shaped grinding portion, or "stone," A A, is of chilled iron, and the surrounding casing B B is of the same material. The form given both surfaces is such that the actions of gravity and of centrifugal force combine to urge the ground material downward and into closer contact with those surfaces. The grinding cone is capable of adjustment vertically by means of the screwed bar C carried in the hollow portion of the vertical shaft D, and turned by means of the horizontal handle at the top. The connection between this bar and the cone is made by means of a "cotter" passing through a slot cut in the shaft, which has the necessary length to permit the vertical motion. The bevel-gear E on the horizontal driving-shaft is not keyed in its place, but is secured by taper keys which hold only by friction. Should too heavy a strain come upon the machine, it slips on the shaft, and thus prevents injury of the mill.

Another form of mill which has been extensively used in the U. S. is that of Bogardus. This is shown in section in Fig. 8, where *c c* is the lower plate driven by a vertical shaft revolving in the bearing *h*, and supported by the step *g*, and counterbalanced by the weighted lever *a b*, by means of which the required pressure is applied with steadiness and uniformity. The upper plate, similar in form to the lower, is capable of taking up a motion of revolution, also,

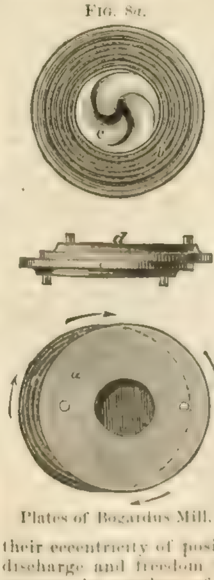
Fig. 8.



Section of Bogardus Mill.

about a centre out of line with the axis of the lower plate, being screwed by bolts *a a* to the loose collar *f f*. A shoe *l*, acting upon the collar, causes a vibration which shakes the material in the hopper, and sends it downward as rapidly as it can be ground. A screw *e* is so arranged as to prevent the weighted lever from forcing the grinding plates into actual contact when the supply of material to be ground has been nearly or quite exhausted. The counterbalance also acts as a safety attachment, allowing any foreign material too hard to be ground to separate the plates, and to leave the mill uninjured, should such substance by any accident enter it. Fig. 8*a* following shows the form of the plates used and their relative position when in place. They should be made of carefully selected and strong chilled iron. Their centres being out of line with each other, their peculiar form gives them a relative motion which is admirably adapted to grinding. These mills are driven from 600 to 800 revolutions per minute. The weight of material ground varies greatly with its character and with the degree of fineness of the product. Two tons of black lead, one to two tons of dry bones, three to four tons of iron ore, one and a half tons of white lead in oil, half a ton of bark, four to five tons of oil-cake, and twenty barrels of sugar per hour are said to represent the average work of a mill sixteen inches in diameter. The power required is stated at from three quarters to one and a quarter horse power. The peculiar form of the plates and their eccentricity of position cause an unusual rapidity of discharge and freedom from liability to choke, thus permitting the grinding of adhesive substances which would

Fig. 8*a*.

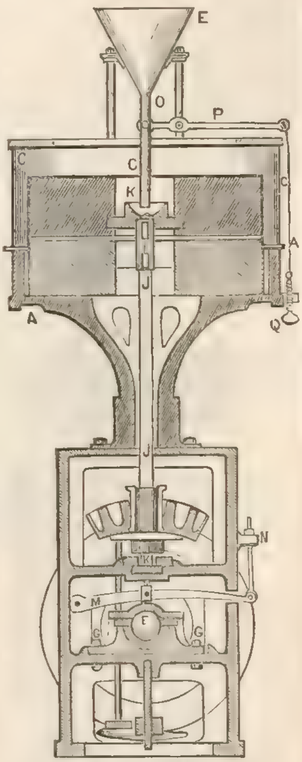


Plates of Bogardus Mill.

obstruct ordinary mills. These peculiarities produce also a uniform action over all portions of the grinding surfaces, and consequent durability.

For grinding grain the standard mill is shown in Fig. 9. The grinding surfaces are the faces of two stones, one of which is secured to the frame A which supports the hopper E, and carries the bearing C of the driving-shaft. The other stone revolves, in close proximity to the first, upon a spindle J, which receives its motion from the driving-shaft. The stones are surrounded by a cylindrical casing C C, which supports the hopper above. This casing is divided at the middle, in order that the upper portion may be removed to allow of the adjustment or repair of the top stone. The upper portion is made lighter than the lower, and frequently of thin sheet iron. The top is open to allow free access of air. The shaft F drives the spindle J by bevel gearing, as shown, or frequently the spindle is driven directly by means of belting. The upper stone is balanced upon the spindle, instead of being rigidly attached, in order that it may adjust itself freely to the slightly irregular distribution of grain between it and the lower stone. The spindle J rests upon a "step" of bronze or other alloy well adapted for machinery bearings. It is so fitted as to be capable of adjustment in all directions, and is supported by a lever M, which is raised or depressed by the screw and nut N, thus determining the pressure upon the substance passing through the mill and the degree of fineness to which it is ground. The hopper E receives the grain, and, falling downward, it passes through the tube O, flows over the "rhind" K—the piece of metal by which the upper stone is supported upon the spindle—and enters between the stones. The pipe O is supported by a lever P, and its height above the rhind can be adjusted by the screw Q upon the side of the standard above N, that screw being connected with the end of the lever by a chain or cord. The pipe being lowered upon the rhind, the flow of grain is stopped; being raised, it allows the feeding to go on with greater and greater rapidity as it rises clear of K.

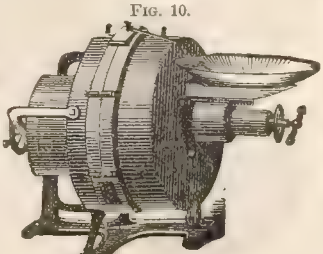
Fig. 9.



Corn Mill.

Many other forms of mill are in use, all, however, containing the essential details of the standard mill just described, and shown in Fig. 9. The framing and the hopper and feed-spouts were formerly, and are still frequently, made of wood. The feeding apparatus is often of different form, and the sizes of stones and speed of mill vary greatly. In some cases, as shown in Fig. 10, mills are constructed having the stones set with their axes horizontal, the special advantages being the convenience with which pressure may be adjusted, and the more rapid feed and delivery secured, which permits higher speed and reduces liability of choking. In other mills the spindle is vertical, as in Fig. 9, but the upper stone is stationary, and secured firmly in the casing, while the lower revolves. This gives somewhat more stability, and therefore increased speed and steadiness of motion. In both the latter forms the stones being less liable to strike and dull each other than in the preceding style of mill, they may be expected to wear longer. Their frames are light, yet strong; they occupy comparatively small space; their spindles are short; and the mill with horizontal spindles may be very conveniently driven from the line shafting. The journals of mills running at high speed should always be made long, to ensure freedom from heating. The bearings of the mills with horizontal spindles are often made eight or ten inches long.

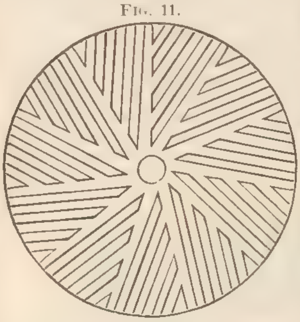
Fig. 10.



Forsman Vertical Mill.

The stones of the mill Fig. 9 are frequently four, or even four and a half feet, in diameter, and a foot in thickness. They are "built up," the lower half of the top stone being of pieces of French burr-stone, cut to fit well and cemented firmly together. The upper half is of plaster of Paris. The lower stone is of French burr also, the pieces firmly cemented and bedded upon the frame. In the other forms of mill the stones are usually smaller and are often made in a single piece. Where not of one piece, they are strongly cemented and surrounded by a strong iron band to prevent liability of being ruptured by the centrifugal force due to their high velocity of revolution. The fixed stone has usually a perfectly flat grinding face; the moving stone is hollowed towards the centre to allow the material ground to flow freely between the grinding surfaces, and in order that a more thorough comminution may be secured during its passage towards the circumference. The faces of both stones are cut, as shown in Fig. 11, with straight grooves, of wedge-formed section, and in directions inclined to the radii. The edges of the grooves are thus given a cutting action somewhat resembling that of scissor blades, and also a tendency to force the grain outward towards the circumference is secured, and thus the feeding is accelerated and choking is avoided. These grooves are usually cut by hand. Machines have been designed to do this work, but none have been generally introduced. They usually consist of a revolving horizontal shaft carrying diamond cutters, and capable of being adjusted and fed automatically along the proper lines.

Fig. 11.



Plan of Millstone.

The stone used in mills of the class just described are usually of French burr, a siliceous rock containing many small rough cavities, by which the grains are caught and retained until crushed. The stone is very hard, and wears very slowly. It therefore does not injure the flour or meal by mingling with it in fragments or powder. It is quarried of finest quality near La Ferté-sous-Jouarre, in the geological district known as the "Paris basin," where it forms a bed of from ten to fifteen feet in thickness. Great difficulty is found in getting out stones of large size, for which reason the stones of large mills are generally built up of fragments. Quarries of very good stone of the quality desired for millstones are worked near Andernach on the Rhine. This is supposed to be a kind of lava from a neighboring and now extinct volcano. In the U. S. there are several deposits of stone suitable for use in mills, but they are usually inferior to imported stones. A quarry has been worked many years in the valley of the Savannah River, about 100 miles above the city of Savannah, which has been stated to be nearly or quite equal in quality to the French stone. It has been extensively used from the time of Oliver Evans, who was one of the first to make use of it.

Mills, such as are illustrated in Fig. 9, with stones four feet in diameter, driven at the rate of 200 revolutions per minute, grind from seven to ten bushels per hour, the quantity varying with the degree of fineness. The power required is usually not far from one horse-power per hour for each bushel ground. In later styles, with smaller stones running at higher speed, the yield is greater and the power is less. With "twenty-inch stones," making 700 revolutions per minute, the power required varies from five to eight, and the product is from six to twelve bushels per hour. A stone two and a half feet in diameter, making 500 revolutions, grinds from fifteen to twenty bushels an hour with an expenditure of from ten to twenty horse-power, the meal produced being in the first case very coarse, and in the latter very fine. R. H. Thurston.

Grind'stone, a thick circular disk of stone, usually sandstone, used for bringing dull cutting instruments of steel to an edge, the blade being applied to the edge of the stone, which revolves around a central axis. The best

grindstones in the U. S. are brought from Berea, O., and from Nova Scotia. Various forms and materials are also used in making grindstones for cutting glass, gems, etc.

Grindstone Island, a small island near the head of the Bay of Fundy, in Albert co., N. B., has a lighthouse and grindstone-quarries, of which the products are sent to the U. S.—Another GRINDSTONE ISLAND is one of the Magdalen group, in the Gulf of St. Lawrence.

Grindstone Island, one of the Thousand Islands in the St. Lawrence, belongs to Clayton tp., Jefferson co., N. Y. Pop. 330.

Grinnell', post-v. and tp. of Poweshiek co., Ia., 120 miles W. of the Mississippi River, on the Chicago Rock Island and Pacific R. R., also on the Central R. R. of Iowa. It is the seat of Iowa College, has 5 churches, good public schools, a newspaper, a national bank, 2 hotels, several large flouring-mills, a foundry, a glove manufactory, and good stores. It is located in the midst of a thriving farming community. Pop. of v. 1482; of tp. 2389.

S. F. COOPER, ED. OF "HERALD."

Grinnell, tp. of Trego co., Kan. Pop. 40.

Grinnell (HENRY), b. at New Bedford, Mass., Feb. 13, 1799, son of Cornelius Grinnell and brother of M. H. Grinnell; was a partner in the firm of Grinnell, Minturn & Co., whale-oil shippers of New York, 1819–49, and after that time retired from business, but retained connection with several insurance companies and with the Seamen's Savings Bank, in which he was greatly interested; fitted out the "Grinnell expeditions" (1850, 1854, etc.) in search of Sir John Franklin; and was throughout life a most generous advocate of the interests of sailors. He was the first president of the American Geographical Society. D. June, 1874.

Grinnell (MOSES H.), b. at New Bedford, Mass., Mar. 3, 1803; obtained his early education at private schools and Friends' academy. He was influential in sending out Dr. Kane upon his Arctic expedition (1853–55); collector of the port of New York 1869–71; was elected M. C. 1839–41. D. in New York City Nov. 24, 1877.

Grinnell Land, in the Arctic Ocean, the northernmost land on the globe hitherto discovered, was first seen in 1850, and mapped in 1854 as far as lat. 82° 30′ N. in lon. 76° W. An open polar sea, entirely free of ice and abounding in animal life, is reported to extend 125 miles N. of its shores. High mountains were seen in the interior.

Grinnell's Island, one of the Thousand Islands in the St. Lawrence. It belongs to Clayton tp., Jefferson co., N. Y. Pop. 3.

Grippe. See INFLUENZA.

Gri'quas (called BASTAARDS by the Boers), a mixed race in South Africa, the offspring of Hottentot and Bushwomen by the Boers, or colonists of Dutch descent. Many of them are well-to-do breeders of cattle, and have adopted the habits and religion of Europeans, while others prefer the savage life. A large part of their territory (Griqualand) was in 1874 annexed to the Cape Colony against the wish of the people.

Gris'com (JOHN), LL.D., b. at Hancock's Bridge, N. J., Sept. 27, 1774; became principal of the Friends' monthly meeting school in Burlington, N. J., which office he held thirteen years. Taking up the study of chemistry, he pursued this branch of learning for many years, often giving representations of his proficiency before the public; in 1806 was elected professor of chemistry in Rutgers College, N. J. He published *A Year in Europe* after his return home in 1823 from a foreign tour; was instrumental in forming the society for the prevention of pauperism (1817), of which he issued the constitution and first report on the various causes and remedies of pauperism. D. at Burlington, N. J., Feb. 26, 1852.

Griscom (JOHN HOSKINS), M. D., b. in New York City Aug. 14, 1809; graduated from the University of Pennsylvania in 1832; studied medicine under Profs. Godman and Valentine Mott; became professor of chemistry in New York College of Pharmacy 1836–40, and has held the office of visiting physician of the New York Hospital since 1843. Author of *Animal Mechanism and Physiology* (1839), *Uses and Abuses of Air, and the Means for the Ventilation of Buildings* (1850), etc.

Gri'si (GIULIA), daughter of a topographical officer of the French empire, b. at Milan May 22, 1812; d. at Berlin Nov. 29, 1869. She studied at Milan and Bologna, where at the age of sixteen she made her first public appearance as Zelmira, and carried the audience away by the charm of her voice, manner, and person. Subsequently she achieved triumphs at Florence, Pisa, and Milan. At the Scala she first appeared as Norma. Her efforts to overcome defects of training were so successful that she ranked with Pasta and Malibran, and was admitted to the musical friendship of Lablache, Tamburini, and Rubini. For her the opera *Puritani* was written. In 1836 Grisi married a Frenchman, M. Gérard de Meley, but the union was unhappy and was legally dissolved. She was afterwards united to Signor Mario, the tenor, and had several children by him. In Aug., 1854, they visited the U. S. together, and sang in the principal cities. In later years her residence was in England. She appeared at Covent Garden as late as 1864. Before that time her popularity in Italy and France had been on the wane.

O. B. FROTHINGHAM.

Grisons [Ger. *Graubünden*] is the easternmost and largest, but at the same time the most thinly peopled, canton of Switzerland, bounded E. by Tyrol, S. by Lombardy, W. and N. by the cantons of Uri, Glarus, and St. Gall. Area, 2673 square miles. Pop. 91,782, of whom one-third speak German, and the rest peculiar Romanic dialects. The whole canton consists of a system of high and wild mountains, containing 240 glaciers, from which rise the Rhine, Inn, Ticino, and Adda; these rivers form valleys, and thereby give the country its geographical physiognomy. The southern valleys are fertile; wheat, vines, and figs are grown. But the highlands yield only pasturage, and dairying and cattle-rearing are the main sources of wealth. The name Grisons (Graubünden), "the gray league," is derived from the plain gray garment worn by the Swiss farmers who in the beginning of the fifteenth century formed a league and broke the yoke under which the nobility held them. The principal town is Chur (It. *Coira;* Fr. *Coire*), with about 5000 inhabitants.

Gris'wold, post-v. and tp. of New London co., Conn. The township contains Jewett City and other manufacturing villages. Pop. 2575.

Griswold (ALEXANDER VIETS), D. D., b. at Simsbury, Conn., Apr. 22, 1766; appointed rector of St. Michael's church at Bristol, R. I. The eastern diocese of the Protestant Episcopal Church was organized in 1810, and in May, 1811, Dr. Griswold was ordained its first bishop. Soon after he was elected chancellor of Brown University. He published *On the Reformation and the Apostolic Office* (1843), sermons, etc. D. at Boston, Mass., Feb. 15, 1843. (See *Memoirs*, by JOHN S. STONE.)

Griswold (JOHN A.), b. at Nassau, in Rensselaer co., N. Y., in 1822; was M. C. from New York 1863–69, and was mayor of Troy 1856. It was through his efforts that Ericsson's famous Monitor was built. He was an iron manufacturer; was Republican candidate for governor of New York 1868. D. at Troy, N. Y., Oct. 31, 1872.

Griswold (MATTHEW), LL.D., b. at Lyme, Conn., 1716; held the office of lieutenant-governor of Connecticut for several years; governor 1784–85; also judge of the supreme court; president of the convention which ratified the Federal Constitution, 1788. D. at Lyme, Conn., Apr., 1799.

Griswold (ROGER), LL.D., b. at Lyme, Conn., May 21, 1762; graduated from Yale College in 1780. He was admitted to the bar in 1783; became M. C. from 1795 to 1805; appointed judge of the supreme court of Connecticut in 1807, and was lieutenant-governor from 1809–11; governor 1811–13; was regarded as a man of great talents and great legal ability. D. at Norwich, Conn., Oct. 25, 1812.

Griswold (RUFUS WILMOT), D. D., b. at Benson, Vt., Feb. 15, 1815; spent much of his early life in travel, and at the age of twenty-one had visited the most interesting places of his own land and those of Central and Southern Europe; became a printer, then a Baptist preacher, and afterwards a journalist. In 1841 he brought out an anonymous volume of poems and a volume of sermons. Became the chief editor of *Graham's Magazine* in 1842–43, and of the *International Magazine* of New York in 1850–52. Author of *Poets and Poetry of America, Washington and the Generals of the Revolution, Curiosities of American Literature, Prose Writers of America, The Republican Court*, and other works, and published the first edition of Milton's prose works in America. He was also engaged as one of the editors of the works of Edgar A. Poe. D. in New York City Aug. 27, 1857.

Griswold (STANLEY), b. at Torringford, Conn., Nov. 14, 1763; graduated from Yale College in 1786; studied theology, and was settled to preach at New Milford, Conn., from 1790–1802, but resigned, owing to the animosity occasioned by his Democratic views. In 1804 he edited a Democratic paper at Walpole, N. H., with marked ability. Became U. S. Senator in 1809 from Ohio, and afterwards U. S. judge for the North-west Territory; appointed secretary of Michigan Territory by Jefferson in 1805. D. at Shawneetown, Ill., Aug. 21, 1815.

Gris'woldville, post-v. of Jones co., Ga., 12 miles E. by N. of Macon, on the Central R. R. leading to Savannah, noted before the war for its extensive cotton-gin manufac-

tory, and during the war for a pistol-factory. Here was fought on Nov. 22, 1864, a bloody battle between a portion of Gen. William T. Sherman's command, under Gen. Walcott, and a number of the Georgia reserves, under Gen. Howell Cobb, in which several hundred on both sides were killed and wounded, and among the latter Gen. Walcott.

Griswoldville, post-v. of Coleraine tp., Franklin co., Mass., has valuable water-power and active manufactures of cotton goods. It is on North River, 4 miles N. of Shelburne Falls, and on the unfinished Deerfield Valley R. R.

Grivegnée, town of Belgium, in the province of Liege, on the Ourthe, has large coal-mines and extensive manufactures of nails, wire, cutlery, and iron tools. Pop. 6234.

Gro'dek, town of Austro-Hungary, in Galicia, has 7381 inhabitants, mostly engaged in the cultivation of flax.

Grod'no, government of European Russia, bounded S. and W. by Volhynia and Poland, and N. and E. by the governments of Wilna and Minsk. Area, 14,700 square miles. Pop. 958,582. The ground is low and level; in the northern part, in the basin of the Niemen, of a light, sandy soil, covered with immense forests of pine and beech; in the southern part, in the basin of the Dnieper, of a swampy and marshy character. Rye, flax, hemp, and timber are exported in great quantities; cattle and bees are reared; wolves, bears, elks, and roebucks abound in the forests.

Grodno, town of Russia, cap. of the government of Grodno, on the right bank of the Niemen. Many of the palaces formerly belonging to Lithuanian noblemen are now decaying, though one built by Augustus III. is still in good repair, and is a magnificent structure. Grodno has extensive manufactures of weapons, silk, and cloth, and a lively trade. Pop. 26,187, of whom two-thirds are Jews.

Groes'beck, post-v. of Limestone co., Tex., on the Houston and Texas Central R. R. It has a weekly newspaper.

Gron'ingen, the northernmost province of the Netherlands, is flat and low, and protected against the inundations of the sea by dykes. It is fertile and well cultivated. Its south-eastern part is marshy, but affords good pasturage. Grass-culture, dairying, fishing, and shipbuilding are the main pursuits of the population. Its area is 896 square miles, with 230,357 inhabitants, of the Frisian race and belonging to the Reformed Church.

Groningen, town of the Netherlands, the capital of the province of Groningen, on the Hunse, which here forms a good port, accessible for large vessels, and communicating by canals with the Dollart and the Zuyder-Zee. Groningen is fortified, has a university founded in 1614, a public library, and a botanic garden. Pop. 39,015.

Grono'vius, or **Gro'nov,** the name of a distinguished Dutch family which produced many learned men. JOHAN FREDERIK GRONOVIUS, b. in Hamburg, Germany, Sept. 8, 1611; was educated at Leipsic, Jena, and Altorf, and in 1643 became professor of history and eloquence at Deventer; in 1658 professor of the Greek language and history at Leyden; published texts of ancient authors with notes, and wrote philological and archæological treatises. D. at Leyden Dec. 28, 1671.—His son, JACOBUS, b. at Deventer Oct. 20, 1645, went in 1668 to study in the English universities; was attached in 1672 to the Dutch embassy at Madrid; was professor of polite literature at Pisa, and in 1679 took the corresponding chair at Leyden. Published annotated texts, and wrote *Thesaurus Antiquitatum Græcarum* (13 vols., 1697–1702). D. at Leyden Oct. 21, 1716.—His son, ABRAHAM (1694–1775), a distinguished physician, was editor of several ancient authors and author of learned works.—His brother, JOHANN FREDERIK (1690–1762), was a distinguished jurist, botanist, and author.—LAURENTIUS THEODORUS (1730–78), a learned zoologist and author.—His grand-uncle of the same name was a distinguished student of the civil law, and author of a volume of corrections for the Pandects and of several archæological treatises.

Groome (JAMES B.). See FIRST BIENNIAL SUPPLEMENT.

Groo'te Ey'landt, the largest island in the Gulf of Carpentaria, North Australia. Its interior is mountainous and coasts flat and barren—diameter about 40 miles.

Gros (ANTOINE JEAN), b. at Paris in 1771; d. there in 1835. He was a pupil in the school of David; was patronized by Napoleon, whose portrait, full length, he painted in Italy, and the most impressive events in whose career—the battles of Aboukir, of the Pyramids, of Eylau, Napoleon visiting the sick at Jaffa, among them—he depicted by order of the government. These pieces are strong, but coarse. His miniature portraits are delicate and beautiful. The cupola of St. Génevieve at Paris shows his skill as a decorator. Gros was a member of the Legion of Honor and the order of St. Michael, and professor at the Institute and the School of Fine Arts. He drowned himself in a fit of melancholy. O. B. FROTHINGHAM.

Gros'beak [so named from their large bill], a popular name of several birds, principally belonging to the family Fringillidæ. The U. S. have the evening grosbeak (*Hesperiphona vespertina*), the pine grosbeak (*Pinicola Canadensis*), the rose-breasted grosbeak (*Guiraca ludoviciana*), the blue grosbeak (*Guiraca cœrulea*), and others of that genus. The cardinal grosbeak (*Cardinalis Virginianus*) is the Virginia red-bird, a fine songster, often seen in cages. The social grosbeak (*Loxia socia*) of South Africa builds a huge roof in some large tree, beneath which sometimes as many as 300 pairs of birds are lodged.

Grose (FRANCIS), b. at Greenford, Middlesex, England, 1731; resigned his office of Richmond herald 1763; was a paymaster of militia whose convivial habits are immortalized by Burns, who was for a time his associate. Grose published several freely illustrated antiquarian works, which are not of high value, but his *Classical Dictionary of the Vulgar Tongue* (1785) and his *Provincial Glossary* (1787) are of some merit. D. at Dublin May 6, 1791.

Gross (SAMUEL D.), M. D., LL.D., D. C. L., was b. in Pennsylvania July 8, 1805; studied medicine under Dr. George McClellan, and graduated in the Jefferson Medical College, Philadelphia, 1828; in 1835 was elected professor of pathological anatomy in the medical department of Cincinnati College, O., and in 1840 to the professorship of surgery in the University of Louisville, Ky. In 1850 he was selected to become Dr. Mott's successor in the University of New York, and in 1856 he succeeded Dr. Mütter in his alma mater, a position which he still occupies. In 1862, Dr. Gross was made a member of the Royal Medical Society of Vienna; in 1868, of the Royal Medico-Chirurgical Society of London, and of the British Medical Association. He has also been honored with the degree of LL.D. in this country, and with that of D. C. L. in Great Britain. In 1867 he was elected president of the American Medical Association. He commenced in early life to contribute to our medical literature, and is the well-known author of several professional works; above all, his *System of Surgery*, which in 1872 reached its fifth edition in two large volumes of about 2500 pages, closely printed and elegantly illustrated. It is a cyclopædia of this department of medicine.

PAUL F. EVE.

Grosse Isle, an island in the river St. Lawrence, 29 miles below Quebec, is 2½ miles long and 1 mile wide. It is the property of the province, and is used as a quarantine-ground.

Gros'senhain, town of Germany, in the kingdom of Saxony, on the Röder, has large manufactures of cloth and different kinds of woollen fabrics. Pop. 10,438.

Grosse Point, post-tp. of Wayne co., Mich. P. 2230.

Grosseteste (ROBERT), bishop of Lincoln (probably named *Grosseteste*, "great head," from his learning and ability), was b. at Stradbrooke, Suffolk, about 1175; studied law, physic, and divinity at Oxford and Paris, and is reputed to have held a professorship at Paris; was made archdeacon of Wilts in 1214; received other preferments, and in 1214 received the doctorate of theology and became *magister scholarum* at Oxford; defended (1232) the Jews against the king and people; became bishop of Lincoln 1235; reformed with vigor his large diocese; opposed successfully alike the intrusions of king, nobles, and the pope in local ecclesiastical affairs; was involved in a long controversy with Innocent IV., who strove to fill the richest places in all the Church with Italians and Provençals; was one of the most learned and popular preachers of his day, a voluminous author, and a successful instructor, Roger Bacon being among his pupils. In 1253 he was excommunicated by Innocent IV. D. at Buckden Oct. 9, 1253. He is one of the central figures in the history of the thirteenth century.

Grosse'to, province of Tuscany, Italy, on the Mediterranean. Area, 1710 square miles. Barren mountains and unhealthy and unproductive marshes occupy much of its surface. Cap. Grosseto. Pop. 107,457.

Grosseto, town of Italy, in the province of Grosseto, on the Maremmana railway, about halfway between Florence and Rome. It is surrounded by marshes, and suffers greatly from miasmata and bad water, though the recent efforts of the Italian government to improve the drainage of the Maremma have somewhat reduced its mortality. Promising indications of coal have been recently discovered in this vicinity. It is a bishop's see. Pop. 6310.

Gross-Glogau. See GLOGAU.

Gros'si (TOMMASO) was b. at Belluno, on the Lake of Como, in 1791, and passed his whole life as a notary in Milan, where he d. in 1853, greatly lamented by his friends, among whom most intimate was Alessandro Manzoni. He began his literary career by a poem in the Milanese dia-

lect, *La Princine*, which nearly cost him his life. In 1816 followed two short poems in the same dialect, *La Fuggitiva* and *La Pioggia d'Oro*, the first of which is a model of pathetic poetry. His *Ildegonda*, a romance in verse (1820), made that species of writing fashionable in Italy, and its success led Grossi to try to restore the epic, neglected since the time of Tasso, by his poem, *I Lombardi alla Prima Crociata*. But this poem, printed in 1826 by a generous subscription, did not equal public expectation, and was soon forgotten. In 1834, Grossi published his *Marco Visconti*, which soon became very popular, and three years later his *Ulrico e Lida*.

Grosswar'dein, town of Upper Hungary, on the Körös, 130 miles E. by S. by rail from Pesth. It consists of the town proper, which was formerly a fortress, and eight suburbs. Its cathedral is a magnificent building. It carries on a considerable trade in pottery, cattle, and wine, and has two Roman Catholic bishops—one of the Latin and one of the Roumanian rite. Pop. 22,443.

Gros Ventre Indians [Fr. "big bellies"], a tribe living with the Blackfeet and other tribes in the Milk River agency of Montana. They number 1100. They are hostile to the Sioux, are usually friendly to the whites, and are becoming quite industrious. They are called also Prairie Gros Ventres, and are a branch of the Arapahoes. The MINNETARIE INDIANS (which see) are also called Gros Ventres.

Grote (GEORGE), D. C. L., F. R. S., b. at Clayhill, Kent, Nov. 17, 1794, of German ancestry, studied at the Charterhouse, and in 1809 entered his father's banking house as a clerk; became a liberal political writer, and sat in Parliament for London 1832–41, and was distinguished by efforts in favor of the use of the ballot in elections. In 1823 he began to devote much attention to Greek history, and the fruit of his labors was his noble *History of Greece* (12 vols., 1846–56; new ed., 8 vols., 1862), written from a democratic standpoint, and enriched with the products of novel and important researches. His other principal works are *Plato and the other Companions of Socrates* (3 vols., 1865); *Aristotle* (2 vols., 1872); *Minor Works*, containing essays and reviews (1873). In 1860 he became vice chancellor of the London University, and in 1869 president of University College. D. in London June 18, 1871. (See *Character and Writings of G. Grote*, by ALEX. BAIN, prefixed to *Minor Works*, and *Memoirs*, by MRS. GROTE, London, 1873.)

Gro'tefend (GEORG FRIEDRICH), b. at Münden, Germany, June 9, 1775; studied at Göttingen 1795–97; announced his discovery (in 1802) of the meaning of certain Pehlevi inscriptions near Persepolis; was director of the Lyceum, Hanover, 1821–49; d. there Dec. 15, 1853. Among his publications are *Rudimenta linguæ Umbricæ* (1835–38); *Neue Beiträge zur Erläuterung der persepolitanischen Keilschrift* (1837); *Zur Erläuterung der babylonischen Keilschrift* (1840); *Zur Geographie und Geschichte von alt-Italien* (1840–42).

Gro'tius, or **De Groot** (HUGO), b. at Delft in 1583, where his learned father was the burgomaster, was sent to Leyden at the age of eleven, and after three years' residence at the university, under Joseph Scaliger and other eminent professors, accompanied the ambassadors of the states-general into France. Here he received notice on account of his precocious learning even from the king, Henry of Navarre. Returning to his native town in 1599, he was in the same year admitted to the bar at the Hague, and soon gained distinction by works in various departments of learning, such as editions of the classics, and by original compositions. In 1601 he was appointed historiographer of Holland; in 1607 he was made advocate general of the fisc for Holland and Zealand; and in 1610 the office of pensionary (paid counsellor) of Rotterdam was conferred upon him. By virtue of this office he had a seat in the States of Holland, and afterwards in the states general. In these years he gave several works to the world—in 1608, his *Mare liberum*, in defence of the freedom of the seas against the pretensions of Portugal and England; in 1610, his treatise in Latin—in which language nearly all his works were written—on the antiquity of the Batavian republic; and in 1612 he finished his annals and history of Belgian affairs, which, however, did not see the light until after his death. All the time from his first visit to France he had enjoyed the friendship of John of Barneveldt, the grand pensionary of Holland, the head of the states' rights party, and a favorer of Arminian opinions in theology. Grotius shared his opinions in theology and politics; and when, about the time of the meeting of the synod at Dort, the stadtholder Maurice, the head of the national party, with whom the Calvinists sided, caused the arrest of Barneveldt on unfounded charges of secretly plotting for the Spaniards, Grotius also was arrested and imprisoned. The result is well known. Barneveldt was put to death, Grotius was held in confinement, first at the Hague, then in the castle of Lowenstein near Gorkum, until Mar. 21, 1624, when he was conveyed, by a stratagem of his wife, in an empty book chest, to Gorkum, whence he escaped to Antwerp, and from there found his way to Paris. In his imprisonment he was not idle. He translated the *Phœnissæ* of Euripides into Latin verse, wrote an introduction to the jurisprudence of Holland, and composed his important commentaries on the New Testament, together with the treatise on the truth of Christianity. In France he had a pension from the king of 3600 florins. Here he published his treatise *De jure belli et pacis*, to which modern international law owes its first development. Experiencing some disgusts during his stay in France, he left that country and visited Holland in 1631, but finding his enemies still able and willing to make him trouble, he chose Hamburg for his residence in 1632, and ere long (*i. e.* in 1634), in compliance with the solicitations of Chancellor Oxenstiern, entered the service of Queen Christina of Sweden. He was made a privy councillor and the queen's ambassador in France. His diplomatic life becoming uncomfortable to him, in 1645 he asked for a recall. The queen offered him honorable employment, but he was unwilling to engage longer in the service of courts. He took ship for Germany, encountered a violent storm on the Baltic, and reached Rostock spent with fatigue, to die Aug. 28, 1645, in his sixty third year.

Grotius was perhaps the most universal scholar of his age. His editions of several of the classics, with his elegant translations into Latin verse of choice flowers from the Greek poets, gave him a place of eminence among classical scholars; his notes on the New Testament, marked by their purely philological character, and removed from theological biasses, would alone have given him a high reputation; his historical and legal writings were the occasional works of a great man; his original poems in Latin show his versatility, although they are forgotten; his treatise on the truth of Christianity was long a classic; his theological works prove him to be a believer in the atoning death of Christ for the sins of men upon an explanation of the doctrine different from that commonly received at the time, and they remove him from the doctrines both of Pelagius and of Socinus. But he will be remembered longest as having first brought system into the law of nature in his preface to the *De jure belli*, and into the law of nations in the body of that work. His mild Christian humanity led him to attempt to bring better principles than those of his age into the intercourse of nations, especially into the laws of war. His thorough knowledge of Roman law furnished the basis of the system, and his great familiarity with ancient history supplied him with copious, in fact with too copious and sometimes inapposite, illustrations. T. D. WOOLSEY.

Grot'on, post-v. and tp. of New London co., Conn., on the E. side of the river Thames, opposite New London, and on the Shore Line R. R. It has important manufactures. It has a fine monument to the memory of the patriots massacred here Sept. 6, 1781, by British and Tory troops after the surrender of Fort Griswold. Pop. 5124.

Groton, a pleasant post-v. and tp. of Middlesex co., Mass., traversed by the Worcester and Nashua, the Nashua and Acton, and the Peterboro' and Shirley R. Rs. It is the seat of Lawrence Academy (a thriving institution), and has several paper mills. Pop., before the separation of the town of Ayer, 3584.

Groton, post tp. of Grafton co., N. H., 45 miles N. W. of Concord, has manufactures of wooden wares, etc. P. 583.

Groton, post v. and tp. of Tompkins co., N. Y., 26 miles S. of Auburn, 40 S. of Owego, on the Southern Central R. R. It has a national bank, 4 churches, a union graded school, 1 newspaper, a hotel, several large machine-shops and other manufactories, including an immense cooperage and extensive carriage shops. Pop. of v. 865; of tp. 3512. L. N. CHAPIN, ED. "GROTON JOURNAL."

Groton, tp. of Erie co., O. Pop. 910.

Groton, post tp. of Caledonia co., Vt., 28 miles E. of Montpelier. It has a literary institute, and manufactures of leather, lumber, and starch. Pop. 811.

Grot'ta del Ca'ne ("Grotto of the Dog") is the name of a small cave, 10 feet deep, 4 feet wide, and 7 feet high, in Southern Italy, between Naples and Pozzuoli, remarkable for its exhalations of carbonic acid gas, in which a candle is instantaneously extinguished and small animals stifled. It received its name from the circumstance that small dogs are generally used to show the experiment. It is mentioned by Pliny, and the exhalations seem at his time to have been more powerful than now.

Grotta'glie, town of Italy, in the province of Lecce, on the high-road between Taranto and Brindisi. It has some cotton factories. Pop. 8717.

Grot'te, town of Sicily, in the province of Girgenti, about 12 miles E. of the ancient Agrigentum. It has a considerable sulphur-trade. Pop. 7306.

Grouchy, de (EMMANUEL), MARQUIS, marshal and peer of France, was b. at Paris Oct. 23, 1766, and entered the artillery in 1781. In 1793, on the outbreak of the Revolution, he was colonel of a regiment of dragoons, advanced to brigadier general, and fought in 1794 in La Vendée, but was discharged, like all officers of the nobility. After the fall of Robespierre he was reinstated in his former place, and fought with distinction under Joubert and Moreau in Italy and on the Rhine in 1799 and 1800, but was treated somewhat coldly by Napoleon on account of his sympathy for Moreau. On Oct. 26, 1806, he defeated the Prussian cavalry at Zehdenik, and after that time he was much and successfully employed in the campaigns in Prussia, Spain, Austria, and Russia; on the retreat from Moscow he led the body-guard of the emperor, a legion consisting of officers only. On the restoration of the Bourbons in 1814 he was banished from France, and although he was allowed to return in 1815, he was treated with suspicion. He joined Napoleon immediately on his return from Elba, received command, fought successfully in Northern France, and was made a marshal of France. After the battle of June 17, 1815, he was ordered to pursue Blücher with an army of 34,000 men and 100 guns, and although, on the 18th, he heard the cannonade from Waterloo, and was entreated by his staff to march in that direction, he adhered to his orders and pushed forward towards Wavre. As Napoleon sent no orders to recall him, it seems utterly unjust to lay the burden of the defeat on him. After the battle he collected the scattered remnants of the army and led it back to France, but resigned his command when the negotiations began between the allies and the provisional government. The Bourbons banished him a second time, but after residing for five years in the U. S., he was permitted to return to his estate near Caen. After the revolution of 1830 his rank of marshal was acknowledged, and he was created a peer of France. D. May 29, 1847. Besides a number of pamphlets, he published *Fragments historiques*, in vindication of his conduct in 1815, military and diplomatic.

Ground is in the idea what cause is in reality. That which actually causes the movement of the wings of a windmill is theoretically the ground of the phenomenon. Thus, *ground* and *sequence* express in one sphere exactly the same correlation as *cause* and *effect* in another. Ground and reason are so far identical as they belong to the same sphere, but a different field is ascribed to them. Reason is objective, and refers to a process; ground is subjective, and refers to the volition. Reason is scientific, ground is moral. The grounds for which I believe that a thing is so or so are reasons; the reasons why I act so or so are grounds.

Ground, or **Ground Bass,** in music, a given bass on which the student is required to write several original melodies or descants in succession, the whole forming a set of variations in different styles.

Ground Dove, a general name for those species of pigeon which seldom fly, but walk or run, often quite rapidly, upon the ground. The ground dove of the Southern United States (*Chamæpelia passerina*) is less than seven inches long. The genus comprises the smallest pigeons known.

Ground Ice, or **Anchor Ice** (called *ground gru* in parts of England), is the ice which forms in crystals at the bottom of streams. Its formation is probably due (1) to the current of the stream, which mixes the lighter cold water of the surface with the rest of the water, and brings the whole down nearly to the freezing-point; (2) to the asperities at the bottom, which favor the forming of crystals; and (3) to the comparative stillness of the water at the bottom.

Ground-nut, or **Pea-nut,** the fruit of the *Arachis hypogæa*, an annual plant of the order Leguminosæ, a native of Africa or of South America. In these countries it has long been cultivated for food. In the U. S. it is cultivated extensively for its oil also. The pods generally have two seeds, and have the remarkable habit of thrusting themselves under the soil and there ripening. The seeds ("nuts") when roasted are extensively eaten, and are liked by many. The oil is prepared by grinding, heating, and pressing the kernels, which yield over 20 per cent. of fixed, non-drying oil, useful as a lubricant, as soap-stock, and in woollen factories. Its specific gravity is .918. In lamps it is better than sperm oil, except in cold weather, when it thickens. When deodorized it is used for adulterating olive oil. France and Belgium manufacture large amounts of this oil from African nuts, and use the oil as a lubricant.

Ground Par'rakeet, a name applied to several beautiful Australian parrots, which live almost entirely upon the ground—such as the *Pezoporus formosus* and the *Nymphilus Novæ Hollandiæ*. The latter is of a yellow color, and is extremely abundant in parts of Australia.

Ground-Rent. See RENT, by PROF. T. W. DWIGHT, LL.D.

Ground Squirrel, a name applied to various rodents intermediate in character between the true squirrels and the marmots. They are of the genera *Tamias, Spermophilus*, etc. (See CHIPMUNK and GOPHER.)

Ground'sel Tree, a name given in the U. S. to *Baccharis halimifolia, angustifolia*, and *glomeruliflora*, handsome resinous shrubs of the order Compositæ. They grow chiefly near the sea-coast.

Grouse, the common name for birds of the order Rasores and family Tetraonidæ. The species are numerous, and many are American. Of these the spruce partridge or Canada grouse (*Tetrao Canadensis*), the *Centrocercus urophasianus*, or cock of the plains, the *Cupidonia cupido*, prairie chicken or pinnated grouse, the *Bonasa umbellus*, ruffed grouse (incorrectly called "partridge" and "pheasant" in some places), and others, are well-known game birds. Of these the more important are described under their alphabetical heads.

Grouse Creek, tp. of Cowley co., Kan. Pop. 153.

Grouse Valley, in Elko co., Nev., N. of Toano Station, is a good grazing region. Its elevation is 5600 feet.

Grousset (PASCHAL), b. in Corsica about 1845; became a journalist of Paris and the associate of Rochefort; wrote the articles in the *Marseillaise* against Pierre Bonaparte which led to the murder (by the latter) of Victor Noir. Grousset was for a time imprisoned; was afterwards editor first of the *Marseillaise*, and then of *La Bouche de Fer;* was prominent among the Parisian Communists, who made him their foreign minister; was sent to New Caledonia in 1872, but made his escape in 1874.

Grove, tp. of Jasper co., Ill. Pop. 1094.

Grove, tp. of Adair co., Ia. Pop. 137.

Grove, tp. of Davis co., Ia. Pop. 1230.

Grove, tp. of Pottawattamie co., Ia. Pop. 356.

Grove, tp. of Stearns co., Minn. Pop. 424.

Grove, tp. of Allegany co., N. Y. Pop. 1056.

Grove, tp. of Harnett co., N. C. Pop. 1093.

Grove, tp. of Cameron co., Pa. Pop. 440.

Grove, tp. of Greenville co., S. C. Pop. 1089.

Grove (SIR WILLIAM ROBERT), Q. C., F. R. S., b. at Swansea July 14, 1811; was educated at Brasenose, Oxford, and at Lincoln's Inn, and came to the bar in 1835; gave special attention to experimental physics, and invented valuable electrical appliances; was one of the first to advance as an hypothesis the doctrine of the correlation of forces; was professor of experimental philosophy in the London Institution 1840–47; became Q. C. 1853; a royal medallist 1847; president of the British Association 1866; a justice of the common pleas 1871; and knight bachelor in 1872. Author of many valuable scientific papers, and of an essay *On the Correlation of the Physical Forces* (1846).

Grove City, post-v. of Franklin co., O. Pop. 143.

Grove Hill, post-v., county-seat of Clarke co., Ala. It has 1 weekly newspaper. Pop. 200; of Grove Hill tp. 1360.

Grove Lake, post-tp. of Pope co., Minn. Pop. 292.

Groveland, tp. of La Salle co., Ill. Pop. 1561.

Groveland, tp. and post-v. of Tazewell co., Ill., on the Chicago Pekin and South-western R. R., 8 miles N. E. of Pekin. Pop. 1323.

Groveland, post-v. of Putnam co., Ind. Pop. 67.

Groveland, post-v. and tp. of Essex co., Mass., on the Merrimack River, opposite Haverhill, and on a branch of the Newburyport R. R., 43 miles N. of Boston. It has a savings bank and manufactures of shoes and woollen goods. It is a beautiful place, and has an iron bridge connecting it with Haverhill. Pop. 1776.

Groveland, post-tp. of Oakland co., Mich. Pop. 1180.

Groveland, post-tp. of Livingston co., N. Y. It contains a Shaker village. Pop. 1455.

Groveport, post-v. of Addison tp., Franklin co., O., on the Columbus and Hocking Valley R. R., 12 miles S. E. of Columbus. Pop. 627.

Gro'ver, tp. of Johnson co., Mo. Pop. 1233.

Grover (CUVIER), b. in Bethel, Me., July 24, 1829; graduated at the U. S. Military Academy July, 1850, and entered the army as brevet second lieutenant of artillery; promoted to be second lieutenant Sept., 1850; first lieutenant of infantry Mar., 1855; captain Sept., 1858; major Aug.,

1863; lieutenant-colonel July, 1866. His services prior to the civil war were principally on the frontier, being engaged on the Northern Pacific R. R. exploration 1853–54, and the Utah expedition 1857–58. On the outbreak of the civil war he was a captain of the 10th Infantry, and with his command in New Mexico. Returning E., he was (Apr., 1862) appointed a brigadier general of volunteers, and assigned to duty with the Army of the Potomac, participating in the various battles of the Peninsular campaign in Virginia and in the second battle of Bull Run. In Dec., 1862, he was in command of a division of the 19th Corps in the department of the Gulf, and engaged at Baton Rouge, Port Hudson, and various actions. In Aug., 1864, he was raised to the command of the 19th Corps, and in the Shenandoah campaign was engaged in the battles of Opequan, Fisher's Hill, and Cedar Creek, in the latter of which he was wounded; he subsequently commanded the district of Savannah, Ga., and was mustered out of the volunteer service Aug., 1865. Brevet lieutenant-colonel, colonel, brigadier-general, and major general U. S. A. for gallant conduct. Since the close of the civil war, Col. Grover has been engaged on duty on the frontier; in 1870 was transferred to the 3d Cavalry as lieutenant-colonel: in 1875 became colonel 1st Cavalry. G. C. SIMMONS.

Gro'vertown, tp. of Starke co., Ind. Pop. 71.

Groveton, Battle of. See BULL RUN, SECOND BATTLE OF.

Grow, tp. of Anoka co., Minn. Pop. 396.

Grow (GALUSHA AARON), b. at Ashford, Conn., Aug. 31, 1823; graduated from Amherst College in 1844; studied law, and was admitted to the bar in 1847; was M. C. from Pennsylvania in 1851–53, 1855–57, and 1859–63; he was chairman of the committee on territories 1859–61; was Speaker of the House of Representatives in the 37th Congress (1861–63); and was appointed delegate to the Baltimore convention in 1864. He is now (1875) president of a railway company, and resides in Houston, Tex.

Grow'ler, the *Micropterus nigricans*, or black bass, a good table-fish of the lakes and rivers of the U. S.

Groy'un (WILLIAM M.), M. D., b. at Londonderry, Ireland, Oct. 21, 1835; was educated at Pompey Academy, N. Y., and at the State Normal School, Albany; received his medical degree in 1867 from the Homœopathic Medical College, Philadelphia; was president of the Cayuga County (N. Y.) Homœopathic Medical Society 1871–72, vice-president of the Central New York Homœopathic Medical Society 1874–75. Residence, Throopsville, N. Y.

Grub, the larva of a coleopterous insect. Larvæ of dipterous insects are called *maggots*; those of Lepidoptera are *caterpillars*. Larvæ of the other orders of insects have no special popular names.

Grubbs (JOHN CLOUD), A. M., M. D., b. at Pittsburg, Pa., May 24, 1836; graduated at Willamette University, Or., 1861; was an officer of the 5th Pennsylvania Cavalry 1864; graduated M. D. in 1868 at the University of Michigan; has held the professorship of chemistry in Willamette University, and been editor of the *Medical and Surgical Reporter* of Oregon. Resides at Dallas, Or.

Gru'ber (JOHANN GOTTFRIED), a German writer of some note, was b. at Naumburg, Prussian Saxony, Nov. 29, 1774, and made from 1792 to 1797 extensive studies, though of a somewhat miscellaneous character, at the University of Leipsic. From 1803 to 1810 he resided in Weimar, where he became very intimate with Wieland, of whom he has written a good biography (2 vols., 1815). In 1815 he was appointed professor of philosophy at the University of Halle, and in 1818 he began, together with Ersch, the publication of the great *Allgemeine Encyklopädie der Wissenschaften und Künste*, which after the death of Ersch he conducted alone for many years. D. Aug. 7, 1851.

Gruet'li, post-v. of Grundy co., Tenn.

Gru'gan, tp. of Clinton co., Pa. Pop. 295.

Gru'mo Ap'pula, an old town of Italy, in the province of Bari. It has considerable trade in wine, oil, and grain. Pop. 8132.

Grün (ANASTASIUS). See AUERSPERG.

Grün'berg, town of Prussia, in the province of Silesia. It is famous for its wine, and has some manufactures of cloth and leather. Pop. 10,324.

Grundt'vig (NICOLAI FREDERIK SEVERIN), the Danish reformer, was b. Sept. 8, 1783, at Udby parsonage, in the island of Seeland, and studied language, history, and theology at the University of Copenhagen. In 1808 he attracted some attention by his book on the Scandinavian mythology (much enlarged in 1839), and still more in 1802 by a large and powerful picture in dramatic form of the contest between Christianity and heathenism in Denmark. His *World's Chronicle* (1812, much enlarged in 1877), which was written from a positive Christian standpoint, considering all events as divine rewards or punishment, involved him in a warm contest with A. S. Oersted, the jurist, who defended a more speculative view. His first large religious work was *Kirkens Gjenmæle* (1825), in which he attacked the rationalistic views then reigning in the Danish Church. The dispute was more than bitter, and brought Grundtvig under ecclesiastical ban; but afterwards he partly gave up his polemical standpoint, and confined himself to positive teaching and preaching. His *True Christianity*, his *Sunday-book*, and many minor essays and papers are principally of practical tendency. He possessed eminent gifts as a preacher, and filled the office of a minister in Copenhagen from 1838 till his death, Sept. 2, 1872; and he deeply touched the hearts of his countrymen by his sublime hymns and beautiful patriotic ballads. His party developed gradually into a school, and his school became a reform of the whole Danish civilization. (See DANISH LANGUAGE AND LITERATURE.) CLEMENS PETERSEN.

Grun'dy, county in the N. E. of Illinois. Area, 432 square miles. It is level and fertile. It contains little timber, but produces much bituminous coal. Cattle, grain, and wool are leading products. It is traversed by the Illinois River and by the Chicago and Alton and the Chicago Rock Island and Pacific R. Rs. Cap. Morris. Pop. 14,938.

Grundy, county in Central Iowa. Area, 504 square miles. It is undulating and fertile. Grain is the leading product. Cap. Grundy Centre. Pop. 6399.

Grundy, county in the N. of Missouri, in the valley of the Grand River. Area, 420 square miles. It is generally productive prairie-land. Cattle, grain, tobacco, and wool are staple products. It is traversed by the south-western division of the Chicago Rock Island and Pacific R. R. Cap. Trenton. Pop. 10,567.

Grundy, county of S. E. Central Tennessee. It has a broken surface; the soil is fertile. Some grain is produced. Bituminous coal of good quality is found. Area, 225 square miles. Cap. Tracy City. Pop. 3250.

Grundy, tp. and post-v., county-seat of Buchanan co., Va. Pop. 1152.

Grundy Centre, post-v., cap. of Grundy co., Ia., is the only town in the county. It has 2 hotels, a new school building, a weekly newspaper, stores, etc. It is the centre of a rapidly-growing agricultural district. Pop. about 500. REA & MOFFETT, EDS. OF GRUNDY COUNTY "ATLAS."

Grundy (FELIX), b. in Berkeley co., Va., Sept. 11, 1777; was educated at the Bardstown Academy by Priestley; studied law and became famous in criminal cases; was chosen a member of the convention to revise the constitution in 1799; was elected to the legislature in the same year; upon the resignation of Judge Todd was appointed chief-justice of Kentucky. Removed to Nashville, Tenn.; was in Congress 1811–15; U. S. Senator 1829–38. President Van Buren in 1838 selected him as attorney-general of the U. S.; in 1840 he resigned his office, and was re-elected to the Senate. D. at Nashville, Tenn., Dec. 19, 1840.

Grup'pe (OTTO FRIEDRICH), a German philosopher, archæologist, and poet of some note, was b. at Dantzic Apr. 15, 1804, and entered in 1825 the University of Berlin. In 1830 he became a contributor, especially of criticisms on literature and art, to the *Allgemeine Preussische Staatszeitung*, and his *Antæus* (1831), containing an open attack on the philosophy of Hegel, attracted some attention. In 1844 he was appointed extraordinary professor of philosophy at the University of Berlin. The most noteworthy of his poetical works are his tragedies, *Otto von Wittelsbach* (1860) and *Demetrius* (1861), the latter a completion of a fragment by Schiller. His archæological writings are very numerous and not without merit, but are not distinguished by any decided originality. D. Jan. 7, 1876.

Grüt'li, or **Rüt'li,** a small plateau on the western shore of the Lake of Lucerne, in the canton of Uri, Switzerland, renowned as the place where Stauffacher, Fürst, Melchthal, and thirty other confederates met on the night of Nov. 7, 1307, and started the insurrection against Austria which resulted in the independence of Switzerland.

Gruyère, or **Gruyères,** a small town in the canton of Freiburg, Switzerland. The cheese manufactured in its surroundings and bearing its name is the most famous cheese manufactured in Switzerland.

Grymes (JOHN R.), b. in Orange co., Va., 1786. He served at times as U. S. district attorney and attorney-general, also held a position in the State legislature and constitutional convention of Louisiana. He was a man of thorough learning and great eloquence. D. at New Orleans, La., Dec. 4, 1854.

Grys-bok [Dutch for "gray buck"], the *Calotragus*

melanotis, a small reddish gray antelope of the wooded mountains of South Africa. It is extremely active and timid, and its flesh is good.

Gua'ca, or **Hua'ca,** according to Herrera, is an ancient Peruvian word meaning "temple;" but Pedro de Cieza de Leon says, "It is the appellation of the devil, to whom an infinite number of temples are dedicated in Peru, having burial-places attached to or near them." The word is now in common use in Central and South America to designate an Indian grave, and from it comes *huacal*, an Indian cemetery. In 1859 great excitement was produced in the U. S. and Europe by the announcement that several *huacas* had been discovered at Chiriqui in the state of Panama, from which a number of golden images etc. had been extracted; and it was generally believed, by those who investigated the matter, that the unearthed treasures were the works of a people who preceded the Indians, and whose civilization greatly exceeded theirs. The Panama *Star and Herald*, one of whose editors had made an especial study of Indian antiquities, etc., and whose views were acquiesced in by antiquaries generally, published Sept. 10, 1859, the following: "In that portion of the state of Panama comprising the former provinces of Ayuero, Veraguas, and Chiriqui, Indian burial-places are of very common occurrence, but they appear to be most numerous in the district of Chiriqui. As far as we have been able to ascertain, they abound principally on the Pacific slope of the Cordilleras, and from their vast numbers prove that at one period this country must have been very densely inhabited by a race of people whose knowledge of the arts of working in metals and clay is evidence of a certain degree of civilization. That they preceded the people whom the first Spanish discoverers found in possession of the country is, we think, clearly proved by the images that have been brought to light; for whilst we find most of the animals of this part of the continent, such as jaguars, tapirs, deer, monkeys, bats, alligators, etc., skilfully represented, there has been nothing as yet discovered bearing any resemblance to the animals introduced from the Old World, such as horses, cows, pigs, etc.; neither in any instance that has come to our knowledge have there been found any of the toys and beads which the Spaniards bartered with the natives for gold; nor has any iron-work been met with; and it seems only reasonable to suppose that had they possessed such articles they would have been deposited along with the other treasures in the sepulchres of their deceased owners. Another instance of the great antiquity of these graves consists in the fact that in none of them has a body been found; and though, in some instances, portions of bones have been distinguished when the grave was first opened, they immediately crumbled to dust on exposure to the atmosphere. At most a few teeth and some fragments of bones have resisted the hand of time."

Now, the above statements, plausible as they seem, I cannot but consider as at variance with all history; for, according to the early Spanish historians, many of the tribes of Central and South America showed considerable skill "in carving emeralds and other hard stones, and were well acquainted with the art of casting and sculpturing metallic substances." Bernal Diaz, speaking of the Mexican Indians residing on the banks of the Grijalva, says: "On the last day of Mar., 1519, there came to us many chiefs and principal men bringing presents of gold, consisting of four diadems, a number of figures of little lizards, two resembling little dogs (*dos como perrillos*), five ducks, etc." In the province of Zenu vast numbers of graves were rifled by the Spaniards, which contained articles similar to those which were found in the burial-grounds of Chiriqui. In the land of Duytama, Gonzalo Ximenez fell in with several *adoratorios* or temples, which he plundered of $40,000 worth of gold and emeralds, "much of the gold being in the form of crowns, eagles, and other birds and animals." Columbus himself, as early as 1502, in his fourth voyage to the New World, "discovered many tombs in the houses of the Indians of Portobello, where were deposited dead bodies, dry and perfumed with myrrh, without any bad smell, and wrapped in blankets or cotton sheets; and over the tombs were boards, on some of which were placed the sculptured figures of animals, and on others the effigies of those who were buried there, together with the most precious jewels they possessed."

All these sepulchres, as well as those in Zenu, and some thousands of others in Mexico, Central America, and Peru, which were unscrupulously robbed by the Conquistadores, were spoken of by the Indians as the last resting-places of their great chieftains, whose treasures, consisting of vessels and images of gold, stone, and earthenware (*the work of their ingenious dependants*), as also their household servants and the most beloved of their wives, were almost invariably buried with them; "the devil," says the quaint old chronicler Herrera, "in all parts of the Indies, appearing to the natives, and giving them to understand that they would live in the next world exactly as they had lived in this."

The facts I have cited show conclusively, it seems to me, that the graves excavated at Chiriqui are of Indian origin; and if nothing was discovered in them "bearing any resemblance to the animals introduced from the Old World," it follows simply that the Indians, beholding their "mansions of the dead" everywhere desecrated by the Spaniards in their unhallowed search for gold, relinquished, *after the Conquest, their ancient mode of burial.*

That throughout the whole of this continent are to be found unmistakable traces of a highly-civilized people who preceded the Indians, as is so often asserted, I very much doubt; but, granting this, to reckon the *huacales* of Chiriqui among their monuments is absurd. *They* are unquestionably the work of the Indians; and when we consider that they may be fifty, *and must be three and a half, centuries old*, it will not appear surprising that "in none of them has a body been found, and that at most a few teeth and some fragments of bones have resisted the hand of time."

Taken in connection with what I have said, the subjoined accounts of Indian burials, translated from the Spanish, will not be found uninteresting perhaps to those who are studying the history, etc. of the unfortunate races inhabiting this continent at the time of its discovery: "When a chief of Darien died, his wives and servants committed suicide, in order that they might serve him in the next world, fully believing that the souls of those who did not kill themselves on the decease of their lords died with their bodies or were converted into air. As soon as the cacique expired his followers seated him on a stone, and, kindling a fire about him, they dried him until nothing but his skin and bones remained; after which they hung him up or fastened him against the wall of a room set apart for this purpose, adorning him with feathers and jewels of gold, and placing him by the side of his father or predecessor deceased. Thus, by his corpse was his memory preserved among his kindred; and when a chief was killed in battle the fame of his prowess was handed down to posterity in the songs which accompanied their *areitos* or dances." "When a chieftain of Uraba departed this life his friends and domestics met at his house, and in the dark drank strong liquor, weeping for the dead; and after many sorceries and ceremonies they placed him in the grave, with his wives, treasure, jars of wine, arms, and food; the demon giving his subjects to understand that he had to take provisions for his journey to another kingdom, which he had provided for him." "In Castilla del Oro they clothed a deceased ruler in his richest armor, and hung him over a fire to dry, the grease which dripped from him being caught in large vases appropriated to this purpose. While this process of drying was going on, twelve of the principal men of his house, enveloped from head to foot in black blankets, sat round the corpse, and from time to time one of their number struck a hoarse drum (*as we beat for a funeral*), commencing a low chant in the intervals of the beating, which his companions took up in regular succession, *after the manner of the responsory*. A little before daylight on each night of their vigil they gave a piercing yell, after which they relapsed into silence, while the drum was tapped quickly and lightly, *as one rings the passing-bell*. All the people of the house drank and made merry, save the twelve, who left not the corpse by day nor by night, unless compelled by some necessity to do so, when they kept closely veiled from the vulgar gaze. Pasqual de Andagoya, being present at the burning of the lord of Pocorosa in the province of Cuebra, asked what was said by the mourners in their chants. 'They sing,' replied an old Indian of the mountain, 'the history of the deeds of our great chieftain.' After the lapse of a year the mummified chief was carried to the great square of the town or village in which he had lived, and after the food which he had most liked in life had been placed before him, and his favorite wives slain, he was placed upon a large fire and entirely consumed, the Indians thinking that the smoke went to the abode of his soul in the other world; and being asked 'Where?' they pointed, without speaking, toward the skies." "In El Reino Misteco, when a great lord was taken sick, the priests made vows to make pilgrimages and observe fasts, which were conscientiously fulfilled; and if he recovered they had grand dances, both at his house and in the monastery. If he died, the funeral procession was very grand, the dead being surrounded by the whole body of the priesthood, and followed by thousands of his dusky warriors, while a slave, royally attired, preceded him, who with the chieftain's three best-beloved wives (previously made drunk and strangled), and two other slaves, was interred with him. He was buried at midnight in a vault above ground, with a mask on his face, golden earrings in his

ears, rings on his fingers, and a mitre on his head, and enshrouded in many cotton blankets." F. A. Parker.

Guacha'ro Bird [so called from the Guacharo cave, near Cumana, one of its chief abodes], the *Steatornis Caripensis*, called also **Oil-Bird** and **Trinidad Goatsucker,** a bird usually referred to the goatsucker family, but differing from the goatsuckers in its food, which consists of fruits entirely, while the goatsuckers feed upon insects only. It lives in the northern parts of South America and the Southern West Indies, inhabiting caves and coming out only in the night. The birds become excessively fat, and are caught in great numbers by the Indians, who try out their oil, which is sweet and limpid and used as food. The flesh is also eaten. It is probable that their caves will become important sources of the guano supply.

Guachinan'go, town of Mexico, in the state of Puebla, celebrated for the excellent vanilla which is raised in its vicinity. Pop. 6000.

Gua'chos, or **Gau'chos,** a class of mestizoes, descending from the earliest Spanish colonists and native Indians, and inhabiting the Pampas of South America, chiefly in the Argentine Republic. Their lives, led in miserable mud huts, and occupied solely in tending the immense herds of wild cattle and horses which roam over the Pampas, are, like their characters, rude and wild, but not without a peculiar romantic interest. Their skill in riding on horseback and catching wild cattle is marvellous, and their knowledge of the vast regions they inhabit most wonderful. They are very hospitable and courteous.

Guadalaja'ra, or **Guadalaxa'ra,** province of Spain, the northernmost part of New Castile. It is mountainous, fertile, without trees, but rich in minerals. Much wheat is raised here. Area, 4870 square miles. Cap. Guadalajara. Pop. 208,638.

Guadalajara, or **Guadalaxara,** town of Spain, the capital of the province of the same name, on the left bank of the Henares. It is picturesquely situated, well built, and contains the magnificent palace of the dukes del Infantado. Pop. 6535.

Guadalajara, or **Guadalaxara,** city of Mexico, the capital of the state of Jalisco, near the river Santiago. It is a large and handsome city, with fourteen public squares, and twelve large fountains provided with water from Cerro del Col by an aqueduct 3 miles long. Its cathedral is a magnificent building, though its appearance has been impaired by the destruction of the cupolas of its two towers by the earthquake in 1818. Its alameda or public walk is a beautiful promenade, and its manufactures of leather, earthenware, and shawls are quite considerable. It is a bishop's see. Pop. 19,500 in 1820; 46,804 in 1841; 68,000 in 1885.

Guadalaviar', or **Tu'ria,** a river of Spain, rises in the Sierra Albarracin, in South western Aragon, near the sources of the Tagus, and after a south-eastern course of 130 miles, through the gardens of Valencia, it falls into the Mediterranean.

Guadalquivir' [Arab. *Wad al Kebir,* "the great river"], a river of Spain, rises in the Sierra de Cazorla, in the province of Jaen, and after a south-western course of 260 miles through the provinces of Jaen, Cordova, and Seville, it falls into the Atlantic 18 miles N. of Cadiz. It is navigable to Seville, 12 miles below which it separates and forms two islands. Its lower course is sluggish, through a marshy, unhealthy, but fertile tract. Its affluents are—on the right, the Guadalimar and the Jandula; on the left, the Guadajoz and the Xenil.

Guadalu'pe, county of S. W. Central Texas. Area, 807 square miles. The surface is beautifully undulating, and is well timbered. Live-stock and corn are leading products. Lignite is found. Cap. Seguin. Pop. 7282.

Guadalu'pe Moun'tains, a range of N. W. Texas and of New Mexico, lying between the Rio Grande and the Pecos. They are a long spur of the Rocky Mountain system.

Guadalu'pe Riv'er, a branch of the San Antonio, rises in Edwards co., Tex., and after a course of 200 miles falls into the San Antonio 13 miles from its mouth, in Espiritu Santo Bay. It flows for the most part through a beautiful region.

Guadalu'pe-y-Cal'vo, town of Mexico, in the state of Chihuahua. In its vicinity are rich silver-mines worked by an English company. Pop. 10,000.

Guadeloupe, one of the Lesser Antilles, in the West Indies, situated in lat. 16° N. and lon. 61° 45' W., belonging to France, and connected with the neighboring islets Désirade, Marie Galante, and St. Martin under the same administration. Area, 634 square miles. Pop. 162,910. By Salt River, a narrow strait, it is divided into two parts. The western part, Guadeloupe proper, is of volcanic origin and mountainous, its highest peak, La Soufrière, an active volcano, being 5108 feet high. The eastern part, called Grande Terre, is a coral formation, low and flat. The soil is fertile. Sugar, rum, coffee, dyestuffs, cabinet-woods, and tobacco are exported. Cap. Basse Terre.

Guadia'na, a river of Spain, rises in the Sierra Alcaraz, in La Mancha, runs for a distance of 30 miles under ground, passes through La Mancha and Estremadura, enters the Portuguese province of Alemtejo, and falls into the Atlantic after a course of 420 miles. It is navigable only for about 35 miles. Its chief affluents are—on the right, the Giguela; on the left, the Javalon and the Ardila.

Guadix, town of Spain, in the province of Granada, on the river Guadix, is an old town, but well built, and contains a fine cathedral, a Moorish castle, and other handsome buildings. In the vicinity are several hot mineral springs. It is a bishop's see. Pop. 10,151.

Gua'duas, town of Colombia, South America, in Cundinamarca, is 8700 feet above the sea, among the Andes, near the Magdalena. Pop. 9000.

Guai'acum, a genus of trees, natural order Zygophyllaceæ, of which the important species are *G. officinale* and *G. sanctum,* small evergreen trees, with blue flowers, growing in the West Indies and adjacent mainland. The wood, commonly called *lignum-vitæ*, is exceedingly hard and heavy, sinking in water, and is much used in manufactures, as for ship-blocks, ten-pin balls, etc. It is imported from the West Indies in logs or billets, of which the sap-wood is yellow and the heart-wood greenish-brown. It has a peculiar odor when rubbed or heated. *Guaiac resin,* or *guaiac,* is the concrete juice of the same tree, obtained from the wood, and also imported from the West Indies. It comes in deep greenish-brown or olive-colored brittle resinous masses, of feeble fragrant odor, and, after melting in the mouth, of a hot, pungent taste. It is a complex body, containing three acids, a peculiar resin and other substances. It is completely soluble in alcohol, forming a deep-brown tincture. Guaiac readily oxidizes on exposure, turning green, and from the change of color produced by contact with some animal and vegetable substances is useful as a chemical test, as for detection of blood in stains. It is used sometimes in medicine as a so-called "alterative" in rheumatism and syphilis, and as an emmenagogue and sudorific, but its virtues are very feeble. *G. sanctum* grows in Florida. Edward Curtis.

Guaicurú Indians, found in the valley of the Paraguay, in Brazil. They live by horse-breeding, have some simple manufactures, despise agriculture, have a sort of caste, keep slaves, and are mostly heathens.

Guala'la, post-v. of Punta Arenas tp., Mendocino co., Cal. Pop. 236.

Gual'do-Tadi'no, town of Italy, in the province of Perugia, once fortified, and governing itself under the protectorate of Perugia; then it passed under that of Rome. In 1833 it was honored with the title of "the city of Pope Gregory XVI." Pop. 7799.

Gualeguaychú, thriving city of the province of Entre Rios, Argentine Republic, on a river of the same name. Beef, salted and dried, wool, superphosphate of lime, tallow, horns, etc. are largely exported. Pop. 25,000.

Gualeyguay', town of the Argentine Republic, in Entre Rios, on a navigable river of the same name, a branch of the Paraná. It has an active trade in wool, timber, and hides, and is very prosperous. Pop. 8000.

Gualtie'ri, town of Italy, in the province of Reggio nell' Emilia, on the left bank of the Po, near Parma. There is a tunnel of some interest in the neighborhood, constructed by a Bentivoglio in the sixteenth century for the purpose of draining the Vallis Putrida. Pop. 5681.

Gu'an, a name applied to various gallinaceous birds of the family Cracidæ, all natives of warm parts of America. One of these, the *Penelope cristata* of Brazil and Guiana, is domesticated in those countries and in Holland, and prized as food. The Texan guan of Mexico and Texas is the *Ortallida Maccalli,* a large bird, the only one of the family reported in the U. S. The *Ortalida motmot* of Guiana is there called the pheasant.

Guanabaco'a, an eastern suburb of Havana, Cuba, on the sea-shore. It has fine residences, sea-bathing establishments, hospitals, convents, schools, etc., and a railway connects with the city proper. Pop. 7000.

Guana'co (*Auchenia Guanacos*), a South American animal of the camel family, regarded by many as a distinct species, by others as merely a wild variety of the llama (*Auchenia glama*), a species of which the alpaca is also by some regarded as a variety. The guanaco is especially abundant in Patagonia and Chili, where it forms

large flocks. This beast is about three feet high at the shoulders, and is extremely swift. In domestication it is ill-tempered, and has a disagreeable habit of ejecting saliva upon unwelcome visitors. In its wild state it seldom drinks water. Its flesh is edible, and its skin is of considerable value.

Guanaha'ni, Cat Island, or **San Salva'dor,** one of the Bahamas, is a small island with 2278 inhabitants. It is fertile, but poorly cultivated. It was formerly generally believed to be identical with Columbus's San Salvador, but recent criticism seems to point out Watling's Island as his first discovery, and the latter has now received the official name San Salvador.

Guanajua'to, or **Guanaxua'to,** a state of Mexico, between lat. 20° and 22° N. and lon. 99° 40′ and 102° 40′ W. It is very high, partly a lofty plateau 6000 feet above the level of the sea, partly traversed by chains of mountains whose peaks reach a height of more than 11,000 feet. Area, 12,619 square miles. Pop. 874,043. It is very fertile. Maize and wheat are raised in great quantities; also red pepper, vines, and olives. But most important among its products are its minerals—gold, silver, copper, and lead; its silver-mines are considered the richest in the world.

Guanajua'to, or **Guanaxuato,** town of Mexico and the capital of the state of the same name. It has some manufactures of soap, linen, and tobacco, but its chief importance it derives from the silver-mines in its vicinity. It is situated at an elevation of 6017 feet above the sea, and curiously built with steep and tortuous streets, but many of its houses are very handsome. Pop. 63,000.

Guana're, city of Venezuela, in Barinas, near the river Guanare, exports hides, coffee, cacao, etc. It is some 220 miles S. W. of Caracas. Pop. 12,000.

Guan'ches, the aboriginal race of the Canary Islands, now extinct, though the chief families of the group boast of their Guanche blood. Conquered by Bethencourt (1402–05), they were compelled to embrace Christianity. They possessed some noble traits of character. A short vocabulary of their words indicates a Berber origin, but this has been questioned. Catacombs where they placed the embalmed and dried bodies of their dead are still shown.

Gua'nine ($C_5H_5N_5O$). This substance was discovered in guano by Unger in 1844; it does not occur in fresh excrement of birds. It is found in excrements of garden spiders, in the green organ of the river-crab, in the Bojanian organ of the pond-mussel, in the pancreas of horses, in the scales of the bleak, and in concretions of pork diseased with the guanine gout. Guanine is a white, amorphous powder, insoluble in water, alcohol, and ether. It combines with acids, bases, and salts, forming well-crystallized compounds. By digestion with hydrochloric acid and chlorate of potassa it yields guanidine and parabanic acid, with some other substances in lesser quantities. Guanidine has the formula CH_5N_3, is crystalline and alkaline, with a caustic taste. It combines with acids, forming crystalline salts.

W. H. CHANDLER.

Gua'no [from the Peruvian word *huano*, "dung"]. One of the oldest mentions of the word "guano" occurs in *The Natural and Moral History of Indies*, written by Father Acosta, a Jesuit priest, and published in Seville in 1590. The passage reads as follows: "On some islands near the coast of Peru may be seen, from a great distance, large hills of a white color, which look as if covered with snow; yet are they nothing but heaps of sea-fowls' dung, in so great a quantity that it rises yards and even lances in height, to an extent that would seem fabulous. Vessels go to these islands for no other purpose than to load this dung, for no other kind of produce is found on them. This dung is so efficient that the land manured with it will yield an abundant return of grain and fruit. This dung is called guano." Of still older date are the *Commentaries of the Incas*, written by Garcilaso de la Vega, who died in 1568. His mother was an Indian princess, and his father a Spaniard of good family. Garcilaso gives a very interesting account of the manner in which the birds producing the guano were protected by the laws of the Incas, by which it was made a crime punishable by death to kill the sea-fowl, gather their eggs, or even to visit the islands during the breeding-season. The writer then goes on to say how each island was divided by landmarks, apportioning it among the different provinces of the kingdom, to each of which was assigned the amount of guano to be used during the season. He greatly extols the fertilizing properties of guano, but does not call it by this or any other special name. The Peruvians to this day continue to employ guano as a fertilizer, and in fact it is the only manure they use. The government, to whom all guano deposits belong, allows those requiring it for home consumption to take what they may need free of any charges; yet even then the agriculturists in many localities in the interior have to pay as high a price for this fertilizer as it commands in New York, in consequence of the expense of transportation from the coast, which is generally effected on the backs of llamas or on donkeys. Humboldt called attention to the great value of guano, and the sample analyzed by Fourcroy and Vauquelin was sent to France by that savant in 1805. He stated that "the guano is deposited in layers 50 to 60 feet thick upon the granite of many of the South Sea islands, off the coast of Peru. During 300 years the coast-birds have deposited guano only a few lines in thickness. This shows how great must have been the number of birds, and how many centuries must have passed over, in order to form the present guano-beds."

About thirty years ago a quantity of guano was sent to England from Peru to test its worth as a merchantable article. It was consigned to a commission-merchant, by whom it was placed in the care of a broker, who advertised it and put it up at auction. Being unknown in the market, it found no bidders, and the commission-merchant, acting in the interest of his consignor, ordered the entire lot to be thrown into the Thames to avoid storage and other expenses. Another sample of guano was sent to England. On this occasion, however, it was not offered for sale, but was placed in the hands of agriculturists to test its merits as a manure. The result may be easily imagined. Wherever used it gave the most ample proofs of its fertilizing qualities, and a demand immediately sprung up, purchasers being found to take it at £20 (or $100 gold) per ton. The parties who thus became aware of the commercial value of guano purchased from the Peruvian government for the sum of $40,000 the exclusive right of taking it from the islands and exporting it to Europe; but they were not long allowed to enjoy this privilege, the government claiming the benefit of a law which authorizes the recession of any contract or sale when the value of the thing sold is greatly in excess of the consideration given for it. After this the government began to export guano on its own account through the agency of the house of Gibbs & Sons of London. This was in 1842, and from a few thousand tons that were at first imported annually the amount rapidly increased to its present figure—viz. from 400,000 to 500,000 tons per annum. Before the late war the importation of Peruvian guano into the U. S. had reached 80,000 tons per annum, the greater portion being consumed in the Southern States. At the commencement of the war this demand ceased, but at its close the trade at once revived, though it has not yet reached the former maximum quantity. Some few years since the right of exporting guano was granted, for certain considerations, to a stock company, who still hold this right, and whose agents are located in various guano-markets and manage this business. The high price which guano commanded soon led to the search for and the discovery of similar deposits in other parts of the world. Large deposits were found on the coast of Chili and Bolivia, in South Africa, and on numerous islands in the Pacific Ocean and Caribbean Sea; and the importation of them into England caused the price to fall to £9 10*s*. per ton. Yet the consumption increased, and the superior quality of the Peruvian over the other varieties being established, its price advanced, and Chincha Island guano was sold in Europe for £13 10*s*. per ton of 2240 pounds, and in this country for $67.50 gold. Excellent guano was formerly obtained from Ichaboe, an island off the W. coast of Africa, whose climate is much like that of the Peruvian coast. Guano of low grade is supplied by many islands of the Pacific. (See art. GUANO ISLANDS OF THE PACIFIC OCEAN.) Quite recently attention has been called to extensive cave-deposits of "bat-guano," consisting of the dung of bats and birds. This substance is formed in the caves of many warm countries, and may yet become important. The so-called "fish-guano" is the refuse of fishes caught for their oil. It has a high but unequal value as a fertilizer, and is prepared chiefly in Norway and on the Atlantic coast of the U. S.

Composition of Guano.—The composition of guano varies, as may be seen by inspecting the subjoined tables of analyses. The first table represents the composition of guanos containing more or less ammonia-producing compounds, and the second the composition of guanos in which these compounds are quite wanting. Of the former class, the Guañape and Ballista only are found in our markets to any extent; and of the latter class, the South Carolina phosphates have quite usurped the market by reason of their cheapness. Extensive deposits of this latter class occur in various portions of the world, and are largely used in the manufacture of the class of fertilizers termed superphosphates. The Guañape Islands are situated a few miles off the coast of Peru, in lat. 8° 27′ S., and the Chinchas about 300 miles farther S. These islands, as well as Ballistas, Lobos, and Macabi Islands, all of which are situated off the same coast, are the property of the Peruvian government.

Ammoniacal Guanos.

	Chincha Islands					Guañape Islands			Ballestas Is.	[illegible]
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Date of shipment	1804	1852	1853	1857	1870	1869	1870	1870	1870	1858
Ammonia	10.54	15.24	16.25	16.39	15.97	11.24	13.18	11.92	10.74	10.03
Phosphoric acid, soluble	11.35	9.70		4.17	5.02	13.58	6.09	3.35	2.95	5.19
" " insoluble		10.00	8.11	10.57	7.90		8.24	13.18	13.59	6.35
Potash	2.96	3.24								5.52
Water		8.50		12.68	14.35		19.72	19.32	12.85	27.47

1. Carried to Europe by Humboldt, and analyzed by Fourcroy and Vauquelin. 2, 3. Imported into England, and analyzed by Dr. Andrew Ure. 4. Average of analyses of four lots of guano imported into this country, analyzed by Prof. S. W. Johnson. 5. Average of analyses of two cargoes imported into New York, analyzed by Prof. C. F. Chandler and F. A. Cairns. 6. Analyzed by Prof. S. W. Johnson. 7. Average of analyses of nine cargoes imported into New York, analyzed by Prof. C. F. Chandler and F. A. Cairns. 8. Average of analyses of six cargoes imported into Savannah, Ga., analyzed by Dr. A. Means and F. Bruckman, E. M. 9. Imported into Savannah, Ga., analyzed by Dr. A. Means and F. Bruckman, E. M. 10. From the coast of California, analyzed by S. W. Johnson. Analysis of Lobos Island guano shows 13 per cent. of ammonia.

Phosphatic Guanos.

	Sombrero Isl.	Swan Island			Redonda Isl.	So. Carolina.	Baker's Isl.
	1.	2.	3.	4.	5.	6.	7.
Lime	49.82	41.77	19.46	0.61	6.57	35.71	42.71
Magnesia		0.70	1.57	0.14			2.54
Sesquioxide of iron		1.42	5.17	9.04	14.40	15.01	
Alumina		1.91	10.12	14.04	16.60		
Phosphoric acid	37.83	33.38	25.39	31.05	45.20	24.95	39.70
Sulphuric "		0.12	0.03			2.40	1.30
Carbonic "	5.04	3.08	0.38	0.10		2.55	
Silica and insoluble matter	0.40	5.68	21.16	24.80	1.60	11.67	
Water expelled at 212° F.	2.62	2.58	2.87	3.62	24.00	9.15	2.92
" " above 212° F.	3.50	2.70	8.30	13.81			8.32
Organic matter		2.57	5.02	1.74			
Undetermined matter	0.79	1.09	0.53	1.05			2.48
	100.00	100.00	100.00	100.00	100.37	101.44	100.00

1. From Sombrero Island, West Indies, lat. 18° 36′ N., lon. 63° 27′ W. from Greenwich, imported into this country in 1859, analyzed by S. W. Johnson. 2, 3, 4. From Swan Island, West Indies, lat. 17° 22′ N., lon. 83° W., imported in 1866, analyzed by C. F. Chandler and F. A. Cairns. 5. From Redonda Island, West Indies, imported in 1869, analyzed by C. U. Shepard. 6. From Ashley River, S. C., analyzed by C. U. Shepard in 1858. 7. Baker's Island, lat. 0° 13′ N., lon. 176° 22′ W., analyzed by J. D. Hague, 1862.

Navassa guano belongs to this class, and has yielded as high as 37 per cent. of insoluble phosphoric acid. This island is situated in the West Indies, E. of Jamaica, lat. 18° 25′ N., lon. 75° 5′ E.

In the tables of analyses the ammonia is calculated as dry ammonia gas (NH_3), the phosphoric acid as phosphoric anhydride (P_2O_5), and the potash as oxide of potassium (K_2O).

Origin of Guano.—It is generally conceded that guano is the accumulated droppings of birds, which in numberless flocks frequent at the present time secluded localities. These deposits were formerly supposed to belong to a previous geological epoch, but recent study has brought to light, deeply imbedded in the guano, well preserved remains of aquatic birds and other animals of the present epoch. The phosphatic character of these deposits is due to the fact that these animals feed largely upon fish. The ammoniacal compounds are most abundant in the guanos found in situations where the rainfall is very light and the subsoil of a compact, clayey nature, conditions which exist at the Peruvian islands. When the rainfall is abundant, these substances are decomposed and leached out, and the earthy constituents remain. Such is the condition of the West Indian deposits, where ammonia-producing compounds are mostly wanting. Between these extremes the various grades of guano range.

Valuation of Guano.—The constituents in guano of value to the agriculturist are ammonia and ammonia-forming compounds, soluble and insoluble phosphoric acid, and potash. By considering the various commercial supplies of these materials, the following values may be assigned to them per pound:

Ammonia	25 cents.
Soluble phosphoric acid	12 "
Insoluble " "	4 "
Potash	7 "

To calculate from these figures the value of a guano, take, for example, Analysis No. 8 of Guañape guano, per ton of 2240 pounds:

Ammonia	11.92 per cent.,	265 lbs.	at 25 cts.	$66.25
Sol. phos. acid	3.35 " "	75 "	" 12 "	9.00
Insol. " "	13.18 " "	295 "	" 4 "	11.80
				$87.05

Giving thus $87.05 as the commercial value of a long ton of this guano, as compared with other sources of the same constituents.

Adulteration of Guano.—This practice is by no means uncommon, and consists in adding to a genuine guano of established reputation earth which resembles the original guano in appearance. Sophistication of Peruvian guano is frequent, this article being the best-reputed article in the market. Guañape Island guano, which is the variety of Peruvian guano now in the market, is sold at wholesale by the cargo for $60 gold for 2240 pounds; Chincha Island guano, now quite exhausted, brought $67.50 gold. This material has by some jobbers been adulterated with worthless yellow earth and the less valuable West Indian or South Carolina phosphates, and thrown upon the market as genuine. South Carolina phosphates have been sold as low as $12.50 per ton. The advantage to the jobbers is thus evident, and the disadvantage to the agriculturist is appreciable on inspecting the paragraph upon the *Valuation of Guano*. In a recent examination of eleven samples of so-called Peruvian guano, bought of as many dealers, the composition varied from ammonia 4.54 per cent. and phosphoric acid 6.04 per cent. to ammonia 11.19, phosphoric acid 15.85 per cent., the tests being made by Mr. Habirshaw, chemist of the New York Board of Trade. In purchasing guano, therefore, one must patronize reliable dealers, as it is not possible by any examination within the scope of a practical farmer to distinguish the genuine from the adulterated article. Any good chemist, however, can easily determine the percentage contents of ammonia and phosphoric acid, soluble and insoluble, and from these data the farmer may, by use of the system of valuation explained in this article, and by comparison with the table of analyses, determine its value.

Application of Guano.—No definite rules can be given for guano as to what soils will be most benefited, or the necessary quantity. This must be determined by experiment. Peruvian guano should not be applied to crops in its pure state, but should be previously mixed with four times its weight of good soil, thus avoiding the danger of injury to the seed. For wheat, grass, oats, and similar crops from 1000 to 1500 pounds of the above mixture should be sowed broadcast in the early spring; this is equivalent to from 200 to 300 pounds of guano. For corn, cotton, beans, peas, etc. the above mixture is placed in the hill, covered slightly with earth, and the seed dropped upon it and covered as usual. The equivalent of guano per acre varies up to 250 pounds per acre. The guano is best applied in all cases in damp weather. For application to flowering plants it is sometimes suspended in water and sprinkled around the roots.

The Guano Trade.—The exportation of Chincha Island guano to Europe commenced in 1841, and has amounted some years to nearly 500,000 tons, of which Great Britain was the largest consumer. At the present time the consumption in the U. S. of this quality of guano is about 35,000 tons. The Chincha Islands, after yielding from 12,000,000 to 15,000,000 tons of guano, are now quite exhausted. In 1868, when the exportation from the Guañape Islands began, the amount of guano upon these and the other Peruvian islands was estimated at 5,000,000 tons. It is probable, therefore, that in the year 1880 these sources of guano will be exhausted. In various localities upon the W. coast of South America, in Bolivia and Chili, there are extensive deposits of guano, but of a quality inferior to that obtained from the Peruvian islands. In 1870 there were exported from the Peruvian islands 461,299 tons, as follows:

Great Britain	178,870
France	100,186
Belgium	68,857
Germany	36,412
Spain	34,366
United States	30,798
Holland	6,521
Italy	5,306

In regard to the trade in the phosphatic guanos, these have been obtained from many localities in all parts of the world. The South Carolina deposits were first mined in 1867, and on July 1, 1872, there had been mined a total of 242,415 tons, valued at $1,700,000. During the last named year nearly 100,000 tons were mined. The South Carolina phosphate, from its cheapness and abundance, has quite usurped the market for this quality of guano.

An act of Congress, passed in 1856, granted protection to Americans who should occupy and operate unclaimed deposits of guano, and in 1859 no less than 48 islands had been thus secured by citizens of this country.

W. H. CHANDLER.

Guano, or **Villa Guano,** town of Ecuador, 100 miles S. W. of Quito, on the Rio Guano, province of Chimborazo. It has varied manufactures and some trade. Pop. 9000.

Guano Islands of the Pacific Ocean. By this designation must be understood those small low islands of the far western Pacific upon which within twenty years past the valuable fertilizer known as guano has been discovered and worked. These islands must therefore not be confounded with the guano islands upon the coast of Peru, as the Chinchas, Guañape, and the Macabis, which contain guano of an entirely different character from that found upon the low coral islands which form the subject-matter of this article. The principal guano-producing islands of the western Pacific are ten in number, and may be classified as follows:

Worked Out and Abandoned.

(1) McKean Island, lat. 3° 35′ S., lon. 174° 17′ W.
(2) Phœnix Island, " 3° 47′ S., " 170° 43′ W.

Worked at the Present Time (1874).

(3) Jarvis Island, lat. 0° 23′ S., lon. 159° 54′ W.
(4) Baker Island, " 0° 13′ 30″ N., " 176° 29′ 30″ W.
(5) Howland Isl., " 0° 49′ N., " 176° 40′ W.
(6) Enderbury Isl., " 3° 09′ S., " 171° 08′ W.
(7) Starbuck Isl., " 5° 37′ S., " 155° 56′ W.
(8) Malden Island, " 4° S., " 155° W.

Occupied, but not Worked yet.

(9) Christmas Isl. (Company's station), lat. 1° 57′ 16.8″ N., lon. 157° 26′ 49.5″ W.

Not Occupied as yet, in consequence of the Guano being deemed of Inferior Quality.

(10) Canton or Mary Island, North Pt., lat. 2° 44′ 35″ S., lon. 171° 42′ W.

To describe one of these islands is to describe nearly all of them; therefore a brief description of those best known, as Baker, Howland, Jarvis, Enderbury, and Starbuck, may be deemed sufficient for the purpose of conveying a clear idea of their general character. All are low and of coral formation; all but Christmas and Canton islands, which are large atolls, are very small (say, 3 miles long by ¾ to 1 mile wide); all contain phosphatic guano, and numerous vessels are annually chartered by the various companies referred to to load at the several islands which have been mentioned as in working condition. The *climate* of these islands is similar and very equable; the trade-winds are almost constant, and blow in the summer from E. by S. to S. E., and in the winter from E. by N. to N. E. Westerly winds are rare except at Baker and Howland, and even there only in the winter, which lasts from November to March, at which season Baker Island is dangerous to ships loading, and in fact many wrecks have taken place there. The sky is generally clear and cloudless, and the temperature quite even, ranging from 76° at sunrise to 88° F. at the hottest period of the day in the shade. In the sun at noon, the thermometer frequently rises to 100° F. Broad-brimmed straw hats, very light clothing, and green goggles (to protect the eyes from the blinding glare of the dazzling white coral sand) are absolute necessities to the white occupants of the islands. Rain falls in light showers not unfrequently, but generally at the full and change of the moon. Heavy showers are rare, and rainy days unknown except (at long intervals) at Baker Island. During an observation of four winter months at the latter island rain fell 23 times, generally in light showers or squalls: the least of these showers, as shown by a conical rain-gauge, was 0.005 inch on a level; the greatest was 0.258 inch. The greatest rainfall noted occurred in 1859. Between the 14th and 20th of December of that year inclusive, the total rainfall was 0.65 inch, and the total amount in five months was 1.849 inches, of which 0.85 inch fell in December. At the other islands the rainfall is not nearly so great. Although the rainfall in the summer is very much less than in the winter, there are occasional days even in summer on which showers have fallen as heavily as at any other season of the year. Rain falls most frequently in the night and just before daybreak; sometimes also by day (especially if the sky has been much overcast) a raincloud will pass over the island. At all the islands may be seen the remarkable phenomenon of a rainsquall approaching with great rapidity, and then just before reaching the windward side of the island separating into two parts, one of which passes N. and the other S., not a drop of rain reaching the island, the nimbus having been cleft by the column of heated air rising from the white coral sand. In many instances the two portions of the rainsquall have been observed to reunite when several miles to leeward of the island. The position of these islands, being so near the equator, and remote from any high land, makes them exceedingly favorable for studying the meteorology of this region. The Equatorial Current is also a matter of great interest. Its general direction is to the W. and W. by S., its average velocity about 2 knots (nautical miles) per hour. In the vicinity of Christmas Island it varies between 1½ and 3½ nautical miles per hour. It is least in the vicinity of Malden and Starbuck islands, they being farther removed from the equator. In the neighborhood of Starbuck Island the velocity is rarely greater than 1 nautical mile per hour. At all the islands, especially during the winter months, the swell and surf is very heavy on the windward side. During the summer there is little or no surf on the lee side, and the water is very smooth, and landing is therefore easy. Enderbury and Howland islands are the only ones on which even passable fresh water is to be found, and all the islands are comparatively destitute of vegetation.

About fifteen or twenty varieties of birds may be distinguished as frequenting these islands, of which the principal are gannets, boobies, frigate-birds, tern, noddies, petrels, and tropic-birds, both white and red-tailed. On some of the islands game birds are found, as the curlew, snipe, and plover. All these birds are, however, much scarcer than formerly, when the islands were unoccupied, though even at this time they may be reckoned by myriads, at times absolutely darkening the air, and at the season of incubation literally covering the ground. Rats are found on all the islands, especially at Enderbury and Howland, where they are astonishingly numerous, and prey upon the birds and their eggs when they cannot get access to the stores of the guano company. There is no anchorage at any of these islands except Christmas and Canton, and the general features of the coral reef are common to all. None are over 28 feet, or less than 8 feet, above the sea; the highest is Enderbury, the lowest Christmas Island. Their surface generally contains a growth of coarse grass, portulacca, mesembryanthemum, and a few other species of plants. On a few of the islands are found some cocoanut trees, and low coarse, spongy wood bushes. Fish are numerous, some being of excellent quality, but the sea swarms with a voracious race of sharks, which haunt the vicinity of every ship with greedy and persistent devotion. Strange to say, the dark-skinned Polynesian has no fear of these monsters, but will fearlessly plunge into the sea and swim unmolested with a line in his teeth to a mooring-buoy, returning unharmed.

The vicinity of these islands was thirty years since the great rendezvous of the sperm-whalers, and the discovery of the guano or phosphate on Baker (then known as New Nantucket) Island was the result of an accident: a sailor from a whale-ship dying in the vicinity of the island, was buried upon it; the upturning of the soil to make the grave revealed the presence of the guano. When the American company was first formed to work Baker Island, the U. S. ship Independence (64), Commodore Mervine, was sent to examine the locality, but the report was unfavorable, it being alleged that the guano on the island could be of no value in consequence of the rains prevailing at the period of the vessel's visit; that if good, it could not be boated off through the surf; and that if boated off, the enterprise would not pay for the extra cost; while, there being no anchorage, the ships loading must lie "off and on" while awaiting cargoes. Consequently, the enterprise was inaugurated under rather unfavorable auspices, as some of these statements were undeniably true, though the deductions (especially as regards the value of the guano) were erroneous. In 1856 the Congress of the U. S. passed an act, which was approved Aug. 18th of the same year by Pres. Pierce, in consequence of which Commander (now Rear-admiral) C. H. Davis of the U. S. sloop St. Mary's (20) took formal possession of Jarvis and Baker islands Aug., 1857. This was the virtual inauguration of the guano enterprises of the western Pacific, and since this occurrence many hundreds of thousands of dollars of American and English capital have been invested in working the several islands.

The practical difficulties in the way of procuring and shipping the guano will be understood by what follows. All of these islands are surrounded by a double ledge or shelf of coral rock called "the fringing platform." The first or shallow ledge extends from high-water mark some

200 or 300 feet, and has usually from 3 to 5 feet water on it. The second ledge pitches abruptly downward from the first, and extends out about 300 feet, with a depth ranging from 50 to 200 fathoms. The downward trend of this ledge is so great (frequently 45°) that an anchor let go from a ship will not grapple the bottom, but falls away from the ledge into unfathomable depths, and of course, as no ship could anchor on the first ledge, it became necessary to devise some method of mooring the ships coming to load at these islands; and this is the arrangement practised with little variation at all of them: A large anchor is imbedded as firmly as possible in the shore above high-water mark, and has a very strong chain attached to it, this chain being long enough to allow another and a heavier anchor to be carefully lowered down on the second ledge in a depth of 70 fathoms. Of course the first anchor effectually prevents the second one from sliding off the steep ledge into deeper water. To the ring of the second anchor is secured a chain to which is attached a large mooring-buoy, so that ships can make fast with perfect safety. One or more of these moorings are laid down at each island, and the wind being fresh and almost constant from the eastward, and the moorings on the lee side of the island, of course a vessel cannot (except in a calm or westerly wind) swing in toward the dangerous first ledge unless the master and officers of the vessel are grossly negligent of their duty. A number of vessels, however, have been lost at Baker Island, which is the most dangerous of all the guano islands, in consequence of its "trending" in such manner as to give a less perfect lee for ships; but in the majority of these cases a little prudence or vigilance would have averted disaster. Yet when a vessel once swings round and strikes the hard coral ledge, she goes to pieces in the surf very speedily, and in most cases slides down the reef into deep water, and carries the company's moorings with her. A dangerous change of wind is almost always preceded by a dense dark mass of clouds appearing on the western horizon, and the aneroid barometer is also an unfailing guide. No prudent shipmaster who avails himself of the signs of the glass and sky need ever lose a ship at these islands; and in fact with moderate care a vessel is safe at any of them all the year through, with the single exception of Baker Island, which is undeniably dangerous in the winter months.

At Howland, Jarvis, Enderbury, Malden, and Starbuck islands there are fixed wharves or jetties for convenience of loading, but at Baker no fixed wharf is possible on account of the heavy surf. So there is a movable one on rollers, which is run to the beach and placed in position whenever it is necessary and the surf is favorable. These fixed wharves or jetties are light and strong, the framework being supported by iron piles screwed into the coral ledge. The wharf extends beyond the line of rollers, and a tramway is laid from the guano-beds to its termination, upon which platform cars convey the guano. At Starbuck Island these "trollies," as they are called, are propelled from the beds to the wharf to leeward by means of sails. The guano is transferred in bags to the lighters which convey it to the ship secured to the mooring-buoy. If the weather is favorable a ship will load rapidly, taking in an average of 100 tons per day. In many instances 125, and even 150 tons, have been taken in in a single day.

The guano is free from odor, and resembles brown dust in appearance, in this particular presenting a strong contrast to the Peruvian and African guano. Enderbury Island is the most remarkable of those now occupied, and though in its general features it resembles the others, it has some points of difference. It once contained a lagoon of considerable size, which has in a long course of years gradually filled up, while the entire island seems to have undergone some elevation. Immense slabs of coral rock lie piled in great masses here and there, especially at the northern end of the island; all this being evidently the result of upheaval combined with the long-continued action of the sea. The interior of this island (and Jarvis also) presents a shallow basin-like appearance as one views it from the highest point, the surface being much depressed from the outer edge of the coral wall towards the centre. On the eastern side of the island the first shelf is more abrupt than on the western or leeward side, and some distance beyond high-water mark the beach is very steep, with many ridges and deep furrows, all parallel to each other, and all evidently ancient beach-lines or water-marks. Great quantities of shells, beautiful fragments of coral of different colors, and some pebbles are found on the windward shores of these islands. With reference to the guano itself at Enderbury, it is best when discovered below a light layer of coral sand and shells. At Howland and Baker the guano rests solidly on a hard coral rock-base. At Jarvis Island, in the central and lower parts, the surface is composed of sulphate of lime, and on this foundation it is that most of the Jarvis guano rests. This feature in Jarvis is important to consider in studying the difference between the guano found on it and that at Baker and other islands, for it explains the appearance of the sulphate of lime remarked by those who have investigated the Jarvis guano, while the unequal mechanical mixture of its guano with this underlying sulphate accounts for the lack of uniformity in the samples. At Baker and Howland, on the contrary, the guano, resting on a hard rock-foundation, has undergone only such changes as the climate has produced. Of the origin of this sulphate of lime at Jarvis there can be little doubt. While the lagoon was filling up there was a gradual elevation of the island, and thus the communication between the outer ocean and the inner lake became constantly less easy, and large quantities of sea-water must have been evaporated in the basin. (This process is even now going on on a large scale at Christmas and Canton islands.) By this means deposits were probably formed containing common salt, gypsum, and other salts peculiar to sea-water. From these the more soluble parts were doubtless washed out by the occasional rains, leaving the less soluble sulphate of lime as it is found here. In fact, on Jarvis Island, as a proof of this process having gone on, there is a crescent-shaped bed 600 feet long by 200 feet wide, having a surface very slightly depressed from the outer edge towards the middle. On its border are incrustations of crystallized gypsum and common salt, ripple-marks, and similar evidences of the gradually disappearing lake. The whole is composed of a crystalline deposit of sulphate of lime, which around the borders is mixed with common salt, while near the centre, where rain-water sometimes collects after a heavy shower, the salt is almost entirely washed out, leaving the gypsum by itself, closely but not hard packed, and very wet. There is on Enderbury Island a description of guano or phosphate called "rock guano;" the best of this has yielded 86 per cent. of pure phosphate of lime.

At several of these islands, and at Enderbury and Jarvis in particular, there can be no doubt that the deposit of the birds has only partially contributed to the formation of the guano, the gradual evaporation in the lagoon and the slow decomposition of the coral rock having had as much to do with the formation of the phosphate as the excrement of birds. None of these guano islands resemble the Ichaboe islands of the W. coast of Africa or the guano islands on the coast of Peru. They are as different in their character as the deposits found on them. While the Peruvian and African islands are comparatively high, those of the western Pacific are low. The Peruvian and African guano has been produced almost wholly by the sea-fowl, and is white and pungent in odor; the guano of the western Pacific islands is brown and entirely inodorous.

The following is the report of the analytical chemists of the Smithsonian Institution on the Baker and Jarvis islands guano:

Percentage on Specimens from Baker Island.

Specimen.	Water	Organic matter.	Residue of fixed salts.
A	21.07	6.6	72.33
B	28.30	6.7	65.00
C	33.04	6.0	61.00
D	30.40	6.5	63.00
E	28.80	6.5	64.70
F	27.30	6.4	66.30
G	28.00	6.9	65.00
H	25.80	7.4	67.00
I	27.94	7.7	64.36
Average	27.87	6.744	65.41*

The Howland Island guano is about the same as the above; the Enderbury rather better.

Percentage on Specimens from Jarvis Island.

Specimen.	Water.	Organic matter	Residue of fixed salts.
K	17.20	11.80	71.00
L	23.60	7.70	68.70
M	18.00	11.20	71.00
N	14.88	9.90	75.00
O	13.50	12.00	74.50
P	18.00	11.40	70.60
R	21.00	10.25	69.75
S	21.04	6.80	72.00
Average	18.2775	10.156	71.57†

These specimens contained a larger percentage of lime than bones contain, and had also rather more phosphoric acid than bone-earth, and were in a finely divided condition, so that the useful matter could be readily taken up when applied to crops. Of course, phosphate of lime, being an important constituent of all cereals, is a most desirable addition to the soil. This will be the better understood when it is remembered that nearly the whole of the

* This residue consists of from 80 to 90 per cent. of phosphate of lime (tribasic), and from 10 to 20 per cent. of other phosphates.

† This residue consists of from 64 to 72 per cent. of tribasic phosphate of lime, the remainder being sulphate of lime and of other bases, chloride of sodium, and carbonate of lime.

bone of all animals is originally derived from the bone-earth in vegetable food.

On all the occupied islands roughly built but comfortable houses have been erected for the accommodation of the employés of the company, who consist of four or five white men, and from 30 to 60 Polynesian laborers. There is a superintendent (generally the ex-master of some whale-ship), a mooring-master, a carpenter, and on some of the islands an analytical chemist. The laborers work ten hours a day, and receive good food and fair pay and treatment. They are generally enlisted for a specific term, usually one year, at the end of which time the relief vessel carries them back to their native island. Water and provisions are supplied by relief vessels, which touch at the island regularly every three months. A large supply of water and provisions is always kept on hand, however, and at some of the stations, as at Baker, there are fresh-water distillers in use. About 140,000 tons of guano have been shipped from Baker Island since the inauguration of these guano enterprises, and about 20,000 tons of fair guano still remain on that island. Enderbury still contains about 140,000 tons of good phosphate, and Howland about 25,000 tons. On the other islands the amounts vary from 20,000 to 50,000 tons.

Richard W. Meade.

Guara'na, a substance prepared from the seeds of *Paullinia sorbilis,* a climbing shrub of Brazil, order Sapindaceæ. The seeds are dried, powdered, then moistened and made into a paste; this, mixed with more of the seeds, either whole or merely bruised, is rolled into cylinders, which on drying form a strong, hard, mottled, reddish-brown mass. The essential ingredient of guarana is a crystallizable principle apparently identical with caffeine. Guarana is habitually consumed by the South American Indians, mixed with their food or made into a drink, and has lately been introduced into medicine, principally as a remedy for "sick headache." Like all remedies for neuralgic diseases, it often cures and often fails utterly. Edward Curtis.

Guar'anty, a special promise to be responsible for the payment of some debt or the performance of some obligation or duty in case of the failure of another person, who is primarily liable to such payment or performance. It is less broad in its meaning than Suretyship (which see), as that term includes implied as well as express promises. It requires all the elements essential to give contracts validity. The party promising must labor under no legal disability, and there must not only be a proposal upon his part, but a sufficient acceptance of the offer by the promisee. It is not necessary that acceptance be expressed in a positive declaration, since it may be presumed from acts evincing a readiness to comply with the request or demand upon which the promise was based, as if a shopkeeper should deliver goods to some person through faith in the guarantor's assertion that he would be responsible for the payment if the receiver of the goods were guilty of default. But unless the offer of the guarantor be absolute in its terms, there must generally be notice of acceptance given him, that he may know that the liability which he was ready to assume has become fixed and definite. The promise must be founded upon a valid and sufficient consideration. This may be of but trifling amount, but must have been operative as the inducement to the guarantor's action. If indebtedness had already been incurred, an engagement to pay it in case it were not satisfied by the one primarily liable would be nugatory, on account of the lack of consideration. In such a case as this, a new and independent consideration would be necessary. It would be sufficient if the creditor should agree to postpone the collection of the debt for a specified or a reasonable time. If the giving of the guaranty were contemporaneous with the formation of the contract for which the guarantor proposed to be answerable, the consideration which supported the principal agreement would support the collateral one also. It is not requisite that any benefit be received by the party giving the guaranty. It is sufficient that the person in whose favor it is given receive a benefit, or if the person to whom it is given put himself to some inconvenience, or part with some property, or undertake some obligation on the faith of the guarantor's promise. If a person in the form of a guaranty assume an obligation for a claim which would not be enforceable against the original debtor, as if he should promise to be responsible for articles, other than necessaries, supplied to married women or infants, he becomes himself a debtor. The reason is, that as the promise of the infant, etc. is void, there is but one valid promise, and that is his own. A guaranty may be resorted to not only as a means of ensuring the satisfaction of pecuniary liabilities, but also to secure the faithful performance of duty on the part of public officials, private agents, etc.

After a valid guaranty has been given the rights and obligations of the guarantor are determined upon somewhat peculiar principles. As his engagement is undertaken for the benefit of others, rather than his own, the law is scrupulous in protecting his interests. Hence, if any attempt be made to materially change the nature or extent of his liability by subsequent agreement between his principal and the party to whom the guaranty was given, he is, in general, relieved from liability. An instance of this kind would occur if he should guarantee a contract with certain stipulations in which an alteration was afterwards made by agreement between the debtor and creditor. Upon a similar principle, a guaranty of the good conduct of a clerk to a partnership would ordinarily be extinguished by an introduction of new members into the firm as to all subsequent acts performed by the clerk. But a guarantor might consent to any change which might be desired by the principal parties, and his liability would then continue.

The contract of guaranty does not impose a primary, but only a secondary, liability; and it is a just and reasonable requirement that diligent efforts be made to collect the sum due of the principal debtor. A mere delay or indulgence to his principal would not necessarily be sufficient for the guarantor's discharge, since he might not be injuriously affected in consequence. He might, if he desired, discharge the debt himself, and bring an action against the debtor at any time. There is in this connection an important distinction between a guaranty of *payment* and of *collection* of a debt or claim. In the case of a guaranty of payment the creditor may proceed at once against the guarantor without any reference to the principal debtor. In a guaranty of collection he must, as the term imports, strive to *collect* the debt from the debtor before resorting to the guarantor, and will be bound to proceed with diligence in his efforts to make such collection. If there should be in any case a valid agreement, without the guarantor's assent, between the creditor and the debtor for indulgence, preventing a resort to legal proceedings for a certain length of time, the guarantor would be discharged. If a guarantor should at any time pay the debt, he would be entitled to be substituted in the creditor's place as to the right to retain any property which the latter held in pledge to secure the claim. This is called in law the doctrine of Subrogation (which see). Sometimes a guaranty is extinguished or discharged because the creditor gives no due notification to the guarantor that the debtor has refused to pay on demand. The rule requiring notice is not, however, so strict as in the case of indorsers of negotiable paper, and the guarantor would not be discharged unless there was an unreasonable delay. The general principle would be the same as that which has been stated as applying to notice of acceptance of the guaranty by the creditor. If the guarantor had made a positive categorical promise, no notice would, in general, be necessary to bind him, but otherwise he ought to be speedily informed, in order that he might be enabled to take advantage of every available means to secure reimbursement from his principal. On this matter of notice the law of the various States is, however, not uniform.

The English Statute of Frauds, which has been substantially re-enacted throughout the U. S., requires that "upon any special promise to answer for the debt, default, or miscarriage of another person, the agreement, or some memorandum or note thereof, must be in writing and signed by the party to be charged therewith, or some other person thereunto by him lawfully authorized." A contract of guaranty must accordingly be in writing to be of any legal validity. But in the determination of the question whether certain promises are to be deemed guaranties or original engagements, which might be enforced even though made orally, very nice distinctions have been taken. The form of the undertaking here becomes important. There must of necessity be two promises—one of the principal debtor; the other, of the guarantor. If the transaction results in only one promise, the apparent guarantor will be in fact the true debtor, and no writing will be necessary. If A should say to B, "Let C have so many goods, and I will pay you," there will be but one promise (that of A), and writing will not be required. If A had said, "Charge the goods to C, and if he does not pay you I will," his promise would be void, as it would be collateral to that of C, who would be the true debtor, and would need to be in writing. It is a further rule that the promise need not be in writing unless it is made to the creditor himself. So it has been considered that a promise apparently collateral is not within the statute whenever the leading object of the promisor is not to discharge the debtor, but to subserve some interest of his own distinct from a payment of the debt. An instance of this kind would occur if any person, A, should pay his creditor, B, by an order upon his (A's) debtor, C, with a guaranty that the latter should discharge the debt. This would be, in effect, but a peculiar method adopted by A of discharging his own obligation. This rule, however, has been sharply criticised in some of its aspects by able jurists as

working, in many instances, a practical evasion of the Statute of Frauds. (Consult FELL on *Guaranties*; PARSONS on *Contracts*; CHITTY on *Contracts*; KENT'S *Commentaries*, etc.) GEORGE CHASE. REVISED BY T. W. DWIGHT.

Guaranty. In international law it has been more or less the practice for a third power to add its guaranty to a treaty between friends, but the term has special application where such third power promises its aid in the event that certain specific promises made in the treaty by one of the powers are violated. Such a guaranty may refer to the promise to pay a sum of money or to cede territory, to one relating to the integrity of a state, the right of succession, religious franchises, etc. (See WOOLSEY'S *Introduction*, § 105.) A guaranty requires the party making it to give the kind and amount of aid promised in a case to which, in his judgment, the promise applies. If the promisee declines his aid, he is under no obligation to give it; but general guaranties are dangerous, because they furnish pretexts for interference. If a debt is guarantied, and is not paid, Vattel holds that the promiser is not bound to make it good, but only to do his best to induce the party owing the debt to fulfil his engagement. A *surety* would be obliged, says the same author, to do what the principal party has failed to do, but not the guarantying party. In the Middle Ages vassals or towns sometimes attached their seals to a political engagement of their sovereign, and persons watched over the execution of treaties, called conservators. Out of these usages modern political guaranties have grown. T. D. WOOLSEY.

Guaratinguetá, town of the province of São Paulo, Brazil, 120 miles W. of Rio de Janeiro, and on the Parahyba. Pop. 7000.

Guardiagre'le, an old town of Southern Italy, in the province of Chieti. Belisarius surrounded it with a turreted wall as a defence against the Goths. It was often besieged during the Middle Ages, and in 1799 was mercilessly sacked and burned by the French. Some interesting old churches, however, escaped the flames, and the town has partially recovered its prosperity. Pop. 8776.

Guar'dian. The custodian of any one who is unable to take care of himself is sometimes called a guardian, but the term as usually employed designates a person who has the care and control of the person, property, or both, of a minor child during either a portion or the whole of his minority. Guardians are of various kinds, and may be divided into two general classes: I. Those who become so by operation of law, without the need of any specific appointment. II. Those who are appointed by courts or by a parent, either in pursuance of some inherent power residing in the appointing tribunal or in accordance with the provisions of particular statutes.

I. The first class includes those kinds of guardians existing at common law, which were four in number: (1) guardian by nature; (2) guardian by nurture; (3) guardian in socage; (4) guardian by estoppel. These forms of guardianship still have a recognized existence in England, and also in the U. S., so far as the fundamental changes which have been made in the laws of inheritance render them admissible in the latter country. (1) A *guardian by nature* was originally one who had charge of the person, but not of the property, of an heir-apparent until he became twenty-one years of age. This authority was vested primarily in the father, but in case of his death could be exercised by the mother. As in the U. S. all the children of a family inherit equally, guardianship by nature appertains to no particular one among them, but includes the whole number, and, as regards a parent's authority and duties, constitutes the same legal relation that is usually considered in law under the topic of PARENT AND CHILD (see this title). (2) A *guardian by nurture* had charge of the persons of the younger children, who were not heirs-apparent, but his authority terminated when a child reached the age of fourteen. The laws of equal inheritance in this country cause guardianship by nurture to be identical with guardianship by nature, so that, as a distinct relation, it has virtually become obsolete. (3) A *guardian in socage* had custody not only of an infant's person, but also of his lands. Whenever a child under the age of fourteen acquired socage lands by descent, that one of his relatives who could by no possibility inherit the estate had the right to undertake the control of his person and the management of his inheritance until that age was reached. If the child possessed personal property, the guardian might take charge of this also as incidental to his principal trust. The infant upon reaching the age of fourteen had the right to choose a new guardian, but if he failed to exercise this privilege the previous guardianship continued. In the U. S. this form of guardianship is generally superseded by the appointment of guardians by will or action of the courts, though in default of such appointment it is sometimes retained, with important modifications. Thus, capacity to inherit the lands would no longer be regarded as a disqualification in the guardian. (4) *Guardianship by estoppel* takes place when a stranger or a wrongdoer interferes with the management or disposition of a minor's property, as by receiving to himself the rents and profits of land. He will then be compelled in a court of equity to account as a guardian, and will be *estopped* from denying a fiduciary relation to the minor's estate. (See ESTOPPEL.)

II. Guardians who are appointed by courts or parents are much more frequently met with than those just described. When the appointment is made by virtue of an inherent power residing in a particular court, the guardian is either (1) a guardian in chancery or (2) a guardian *ad litem*. Other guardians are selected by virtue of statutory provisions, and when appointed by courts are either (3) guardians appointed by probate or surrogate courts, or (4) those appointed by other courts under special statutes. Statutory guardians appointed by parents are termed (5) testamentary guardians.

(1) The English court of chancery assumed the power to appoint guardians as incidental to its general jurisdiction over minors and their estates, and this has long constituted one of its important prerogatives. In the U. S., courts exercising equity powers have generally retained the same authority, though in some instances the right has been defined anew by statute or in some degree qualified. The guardianship continues until the ward reaches the age of twenty-one. If the appointment is made when he is over fourteen, his selection is commonly allowed to guide the decision of the court, but when he is under that age the court exercises an independent discretion. The wishes of parents and friends will, however, be considered. The guardian is required to give bonds for the faithful management of the ward's estate. (2) Every court in which an infant is one of the parties to a particular suit has a special and necessary power to appoint a guardian *ad litem* (*i. e.* "for the litigation"), to protect the infant's interest during the course of the proceeding. A general guardian will not be permitted to act in such a capacity unless he receives a particular appointment for the purpose. An attorney-at-law is frequently selected, particularly in cases before courts of equity. (3) The ecclesiastical courts of England, which correspond with the probate or surrogate courts of this country, had no inherent power to appoint general guardians, and it was therefore necessary for the authority to be conferred by statute. Powers of this kind have been quite generally created throughout this country. The surrogate's jurisdiction is confined to the county or other locality of which he is an officer. The same principles generally apply to appointments when the infant is above or under fourteen as have been stated in reference to chancery guardians. Courts of equity often exercise a supervisory control over the action of surrogates or probate officers, and may remove guardians appointed by them if good cause be shown, as well as those appointed in other modes. (4) In some States statutes have been passed giving particular courts designated the power to appoint guardians in special instances. Reference must be made to the statutes themselves, and the fact need only be alluded to here for the sake of completeness. (5) Testamentary guardianships are created by the last will of a father, and give the appointee rights superior to the claims of other guardians, and continue until the ward arrives at majority. They are, however, under the control of the court of chancery, may be held to account there, and may be removed if unfaithful. They were introduced by statute in the reign of Charles II. to remedy a defect in the law growing out of the abolition of military tenures whereby children were permitted to enter upon their estates at the early age of fourteen. Statutes have been generally enacted in this country containing substantially the same provisions. The right of appointment is personal to the father, and cannot be delegated. It is sometimes qualified, as in New York, by a requirement of the consent of the mother. Testamentary guardians are under the control of courts of chancery in the same manner as other guardians.

The authority of a guardian over the person of his ward is in many respects the same as that which a parent possesses. He has a right to direct the child's education, both in the common branches of learning and in religious training. He may, moreover, act as a parent in changing the child's domicile. If a ward marries, the guardianship of the person terminates, and in the case of a female child the same has been held true of the property. In the management and disposal of personal property, a guardian has very extensive powers, but his only right in the control of a ward's real estate is to receive the rents and profits accruing, and to place the land upon lease so that it may continue profitable. All additions to the infant's personal

property, as legacies and distributive shares, pass into the guardian's control, and he possesses power to sell chattels without obtaining the consent of the court, but must at the same time exercise prudence and a wise discretion. The erection of buildings or other improvements upon the ward's land with the ward's money is not allowable at the guardian's discretion; and if the guardian uses his own money for the purpose he can have no claim for its recovery. Authority to perform such acts must be derived from the court of chancery. At common law there was no power to sell the infant's land. A special act of Parliament was necessary. But by statute enacted generally in this country, authority has been conferred upon the proper court to grant permission of sale upon petition when it appears by judicial investigation that the ward's interests demand such a course. The subject is regulated in detail by statute and by rules of court. The power of a guardian, in all cases, is local, being confined within the jurisdiction of the court by which he is appointed.

The duties of a guardian are the same in nature as those of all trustees, since guardianship is in reality a personal trust. His action must be guided by a constant purpose to subserve the interests of his ward, and not to promote his own advantage. He cannot act for his own benefit in any proceedings which he undertakes to enforce his ward's rights or to increase the value of his ward's property, and if he should, in such cases, receive personal emolument, it would enure entirely to the advantage of the infant. Property must be kept in a productive condition, and if money is received it must not be suffered to lie idle, but should be profitably invested. Rules of court are sometimes established or statutes enacted pointing out the kinds of securities in which a ward's money may be invested, and these requirements must be strictly followed. If the guardian is guilty of undue neglect in employing the funds received as his duty demands, he will be charged with simple interest, and in cases of gross delinquency with compound interest. The court of chancery has power to enforce an accounting by a guardian at reasonable intervals in order to exhibit the condition of the estate, and he may also be called to account by the ward when the latter deems it necessary or when he attains majority. Dealings between a guardian and his ward are very carefully scrutinized by the courts, on account of the position of authority which the former possesses and his power to coerce his ward into unreasonable and imprudent bargains. Hence, even after the relation has terminated the guardian is permitted to derive no advantage from contracts made with his ward, unless so long an interval has elapsed that the presumption can reasonably be entertained that no unfair advantage was taken. The amount of compensation which a guardian shall receive for his services is usually determined by statute, and is estimated at a certain percentage upon moneys received and paid out.

George Chase. Revised by T. W. Dwight.

Guards, in the British army, the household troops, whose nominal duty it is to guard the person of the monarch. The cavalry guards are two regiments of "Life Guards," one of "Horse Guards," and seven of "Dragoon Guards." These, like the foot guards, have better pay and their officers higher relative rank than those of other regiments. There are also three regiments of foot guards—the "Grenadier Guards," the "Coldstream Guards," and the "Scots Fusileer Guards." The "Body Guards" for special ceremonial occasions are the "Yeomen of the Guard," the "Gentlemen at Arms," and the "Royal Archers." The actual guard of the British sovereign's person is detailed from one of the first three regiments of heavy cavalry.

Guard National (French). See National Guard.

Guarne'rius, or **Guarne'ri,** the family name of certain violin-makers of Cremona in the seventeenth and eighteenth centuries. The most famous of the family was Giuseppe Antonio (1683–1745), known as Guarneri del Gesù, whose best works rank with the finest Amati and Stradivari instruments. The other Guarneri hardly attained the first rank as violin-makers.

Guastal'la, town of Italy, in the province of Reggio nell' Emilia, which, together with several large villages—so near as to be almost suburbs—formed the little duchy of Guastalla. This duchy was given in dower by Napoleon I. to his sister Paulina. Afterwards it was adjudged by the allied powers in 1815 to the ex-empress Maria Theresa, and in 1860 it annexed itself to the new kingdom of Italy. Pop. 10,618.

Guastal'lines, called also the **Angelic Order,** a congregation of nuns founded in 1534 by the countess Torelli of Guastalla.

Guatema'la, or **Guatimala,** republic of Central America, situated between lat. 13° 45′ and 17° 45′ N., and between lon. 88° 10′ and 93° 12′ W., and bounded by the Pacific, Mexico, the Caribbean Sea, Honduras, and San Salvador. Area, 44,800 square miles, with 1,180,000 inhabitants, of which 900,000 are Indians, 260,000 mestizoes, and 20,000 white men. The country is high and the surface very varied, the Andes traversing it in its whole extension. The main range runs along the Pacific, containing many active volcanoes (Sapotitlan, 13,050 feet high, and Atitlan, 12,500 feet high), and sending out branches towards the Caribbean Sea which form plateaus and valleys. The climate, different according to the differing elevation, is generally healthful and beautiful, and the soil exceedingly fertile. Maize, wheat, and rice of a superior quality are produced, besides cotton, sugar, vanilla, and tobacco; but the most important article among the products of the country is cochineal. The government of the state is an oligarchy, in which a few leading families are actually in possession of the whole power. The president is chosen for four years. The Roman Catholic religion is the only one tolerated, but since 1872 Jesuits have been excluded. Liberty of the press is also established.

Guatemala (New), the capital of the republic of Guatemala, situated at an elevation of 4961 feet above the sea, on a rich and spacious plain. It is a well-built town, very extensive, as the houses are generally only one story high, on account of the frequent earthquakes, but often handsome. It has manufactures of muslin, silver-ware, etc., and a lively trade, and is the see of an archbishop. Pop. 40,000.

Guatemala (Old), formerly cap. of Guatemala, stands about 30 miles W. of the new town. Founded by the Spanish in 1524, its frequent calamities from earthquakes and the eruptions of the neighboring volcanoes have from time to time almost depopulated it; but its beautiful site and the fitness of its vicinage for the production of cochineal has caused it to be rebuilt. Pop. 18,000.

Guatu'so In'dians, a brave and unconquered tribe of Central American native Indians, of supposed Aztec race, living S. of Lake Nicaragua. They are heathens, and are vulgarly reputed to have red hair and pale complexions. They dwell near the Rio Frio.

Gua'va, the fruits of *Psidium pyriferum, pomiferum, Cattleyanum, pygmæum, albidum,* and other species of the genus, which consists of trees and shrubs of both Indies, mostly natives of the New World, though cultivated in nearly all warm climates, where they yield important dessert fruits, that of *P. pyriferum* (white guava) being the best. From this the guava jelly is made, a conserve extensively exported, and highly prized for its flavor. It is cultivated to a considerable extent in Florida. The guavas belong to the Myrtaceæ.

Guayaquil', department of the republic of Ecuador, South America, bounded W. by the Pacific and E. by the Andes, which here recede from the coast and leave a broad belt of low, level land, fertile and well cultivated. Area, 14,400 square miles. Pop. 92,696.

Guayaquil, city of Ecuador, South America, the capital of the department of the same name, is situated in lat. 2° 20′ S., at the mouth of the river Guayaquil, which is navigable here, and forms a good port, the best on the W. coast of South America. The city is not healthy, as it lies very low, and is not well provided with good drinking-water; neither is it beautiful, most of its buildings, with the exception of the cathedral, the two hospitals, and the two colleges, being insignificant wooden structures. But it is a very lively trading-place. In 1866 its exports were valued at £669,420, its imports at £430,000. Cacao, India-rubber, timber, and tobacco are exported; cottons, wine, and hardware are imported. It is a bishop's see. Pop. 20,000.

Guay'as, province of Ecuador, bounded W. by the Pacific Ocean. It has a hot, wet, and sickly climate, a fertile soil, and dense forests. Cap. Guayaquil. Pop. 35,000.

Guay'mas, a port of entry of Mexico, in Sonora, on Yaqui Bay, an arm of the Gulf of California, has a fine harbor, a good trade, and profitable fisheries, but is unhealthy. Pop. 2500.

Gub'bio [anc. *Iguvium*], town of Italy, in the province of Perugia, about 27 miles from Urbino. It was an Umbrian city anterior to Rome, by which it was ultimately conquered. During the Middle Ages it was for a time a small independent republic of 50,000 inhabitants, then fell into the hands of the dukes of Urbino. Dante found refuge here between 1316 and 1318. Interesting remains of the ancient fortress, of the theatre, and of Etruscan tombs still exist. There are some remarkable old churches, and the municipal palace, of the fourteenth century, is one of the finest existing examples of Renaissance architecture. This palace contains the famous *Tavole Eugubine,* consisting of seven bronze tablets covered with inscriptions in a very ancient Umbrian character. These tablets were found in a temple of Jupiter not far from Gubbio, and their interpretation

has been the subject of much discussion among archæologists. (See LEPSIUS, *Inscriptiones Umbricæ et Oscæ*, Leipsic, 1841.) In the same building are a valuable library and many fine pictures, including examples of almost every great master from Giotto to Titian; also a collection of antique vases, coins, etc., together with specimens of the beautiful ware decorated by Maestro Georgio da Gubbio and known to connoisseurs as the "Gubbio majolica." The modern town is supplied with good water by an aqueduct, with a very large and strongly built reservoir called the Botticione. It has some commerce, and is a bishop's see. Pop. 22,757.

Gu'ben, town of Prussia, in Brandenburg, on the Neisse. It has extensive manufactures of woollen and linen hosiery and yarn, and a very brisk shipping trade on the Neisse, whose banks here are planted with vines, and produce a very good red wine. Pop. 21,423.

Guberna'tis, de (ANGELO), was b. of an old and noble family in Turin in 1840. He passed through the academic grades in the University of Turin, and in 1862 was sent by the Italian government to perfect himself in philological studies at Berlin. In 1863 he was appointed professor extraordinary of Sanscrit in the superior institute at Florence. In 1865 he associated himself with the Russian revolutionist, Michael Bakunin, but after two months separated from him and returned to his professorship. In 1869 he was appointed to a full professorship of Sanscrit, and having edited the *Rivista Contemporanea* of Turin during the previous year, he now purchased it and founded the *Rivista Europea*. Prof. de Gubernatis is the Italian correspondent of many foreign literary journals, among others of the London *Athenæum*, the New York *International Review*, and also of literary periodicals in Leipsic, Berlin, St. Petersburg, etc. Besides numerous critical essays published by him in *Il Diritto*, in *L'Italia Letteraria*, in the *Rivista Contemporanea*, *Il Politecnico*, the *Perseveranza*, the *Rivista Orientale* (founded by him in 1869), the *Rivista Europea*, etc., he is the author of *Life of Santorre Santarosa; Il Re Nala* (Trilogia drammatica in versi), *La Morte del Re Dassarata* (dramma in versi), *Cenni sul Sanscrito; I primi venti Inni del Rigveda* (tradotti ed annotati, etc.); *Piccola Encyclopedia Indiana; Zoological Mythology* (in English); *Letture sopra la Mitologia Vedica*, and other literary and philological works of value.

Gud'geon, the *Gobio fluviatilis*, a very common freshwater fish of Europe. It is of the carp family, is a bold biter, and is taken in large quantities with nets. It seldom exceeds eight inches in length, and is marketed alive, being kept in water until sold. The Niagara gudgeon (*Gobio cataracta*) is caught in the Niagara River, and is only five inches long.

Gudgeon, or **Journal,** the metallic end of a revolving shaft in machinery, or a piece attached to the end of a shaft to receive the wear and tear of friction. Gudgeons ply in journal-boxes, or upon brass, Babbitt metal, lignumvitæ, or other bearings, and receive various lubricating applications. (See FRICTION, by PROF. R. H. THURSTON, C. E.)

Guebres. See PARSEES.

Guebwiller. See GEBWEILER.

Guelder Rose. See SNOWBALL.

Guelph, post-town, cap. of Wellington co., Ont., Canada, on the river Speed and the Grand Trunk and the Buffalo and Guelph branch of the Great Western Railway, is 47 miles W. of Toronto. It has a large trade, fine waterpower, and first-class manufactories of many kinds of goods, such as woollens, farmers' tools, sewing-machines, lime, and musical instruments. There are 2 daily and 3 weekly newspapers. Excellent building-stone is quarried. Pop. of town 6878; of tp. 2955.

Guelph and **Ghib'elline.** There is still much obscurity in regard to the origin of the names of these two mediæval factions. It is known that these distinctive appellations were first employed in the twelfth century, and that in the contest between the empire and the Church the name of Guelph was equivalent to a partisan of the Church, and the name of Ghibelline to a partisan of the empire. The vulgar tradition says that Guelph and Gibel (called Gibel and Gualef in the chronicle of Pietro Azario in the collection of Muratori) were two brothers who lived in Pistoia, one of whom took the side of the pope, the other that of the emperor, and that hence were formed two great parties in Italy which assumed the names of their separate founders. But this tradition has no historical value. Another states that in the battle near Weinsberg, fought in Germany in 1140 between the troops of Conrad III. of Suabia and those of the duke of Bavaria, Welf VI. (Guelfus), the former took for their war-cry *Hie Gieblingen* (Gieblingen or Waiblingen was a Suabian fortress, and the Hohenstaufens and their followers were called Waiblingen); and the latter, on the other hand, had for their cry, *Hie Welf!* It is probable, then, that these two designations may have passed into Italy, or at least made their way towards it, with the Hohenstaufen Suabians, or Waiblingen, against whom the Italians fought under the guidance or the inspiration of Alexander III. and his successors. The German followers of the Suabians, Waiblingen or Ghibellini, having come into Italy, may themselves have given the name of Guelphs to their new enemies; and the rather as a branch of the Bavarian family of the Guelphs, the last heir of those princes, had married a descendant of the Italian house of Este, at that time very powerful in Padua. It would seem, then, that this might somewhat explain the reason why *the name* and *the thing*—that is, the party names and the contests of Ghibellines and Guelphs—especially prevailed in Upper Italy, and more particularly in Lombardy and in Venetia, where the Ezzelini had become all powerful as vicars of the Suabian emperors. The fury of partisanship was such that simply to call one's self Guelph or Ghibelline became perilous, and Pope Benedict XII. in 1334 found it necessary to prohibit, under pain of banishment, the employment of these epithets, which excited such furious indignation and such sanguinary conflicts. The Guelphs took for their device an eagle tearing a blue dragon, which, in place of a crown, wore upon its head a red or yellow lily, the badge of the Ghibellines; this lily was sometimes exchanged for the red rose. The towers of a palace indicated the party of the owner: if a Guelph, the battlements were *square*; if a Ghibelline, they were *swallow-tailed*. Even in Tuscany the factions of the Guelphs and Ghibellines became very violent, and as in Northern Italy the house of Este had taken to itself a descendant of the Guelph house of Bavaria, so in Tuscany a Guelph (Welf V.) had married the famous countess Matilda, the powerful supporter of the papacy against the emperor Henry IV. The occasion of the new party-appellations as bestowed on the imperialists and the papists in Italy may have been, either that the partisans of the pope in Tuscany from the time of the countess Matilda called themselves Guelphs in honor of the Guelphian husband of the countess, and that this epithet was still more firmly fixed upon them on the arrival in Italy of those Suabians (Waiblingen) who in Germany had already fought against the Bavarian Guelphs; or, on the other hand, that, being once in Italy, the Waiblingen, meeting with opposition from the Italians devoted to the pope, called them Guelphs in memory of the Guelphs against whom they had already contended in Bavaria. Whoever wishes to form an idea of the fury with which the Guelph and Ghibelline factions combatted each other may read with much profit, among other things, the Bergamasc *Chronicle* of Castello Castelli, extending from 1378 to 1407, and the *Cronica anonima of Bergamo*, from 1402 to 1448, both which were published by Canon Giov. Finazzi at Bergamo in 1870. Muratori, in the preface to the *Chronicle* of the Ghibelline Castelli, inserted in the 16th vol. of his *Scriptores Rerum Italicarum*, speaking of the Guelphs and the Ghibellines, wrote: "Fortasse Bergomates, si Brixiensem populum excipias, præteris in vesana et infelici hac animorum dissolutione ac furore excelluerunt." It is to Bergamo that the pulpit-orator, afterwards St. Bernardino di Siena, alluded when he wrote, "Here more than elsewhere the greatest cruelties are practised; and so attached are our citizens to the superstitions of party spirit that, having for the most trifling cause taken their banners into their houses and fixed them over their doors, suspended them from their walls, raised them upon their towers, upon their palaces, over the city gates, and upon their country-houses, they have come at last to carry them even into the churches; they stamp their devices upon the holy vessels, upon the sacred pavements, upon the altars, and upon the sepulchres. Some foolishly think that the Church is Guelph, and they suppose that there was a certain St. *Guelph*; others, that it is Ghibelline, etc.; there are some, even, who are so impious and insane that they have ventured to make a partisan of the Divine Majesty itself, the King of Glory and of Eternal Peace!" It will be remembered that two of the streets of Florence are still named from these factions, Via Guelfa, Via Ghibellina. In Florence the Bianchi united themselves with the Guelph party, and the Neri with the Ghibellines: notwithstanding this, the Neri repossessed themselves of Florence by the aid of Pope Boniface VIII., and the Bianchi, being driven out of Florence, became Ghibellines. The names Guelph and Ghibelline were afterwards generally used to indicate two hostile factions in whose mutual quarrels the person of the pope or the emperor had little concern. They were, for the most part, rivalries between family and family, quarter and quarter, village and village, town and town, and in order to give a specious pretext for their sackings, their plunderings, and their assassinations, they invoked in their defence the imperial cause or the rights of the Church. While the

latter had manifested a fierce zeal in the wars against the Suabians in the thirteenth century, now, having taken refuge in Avignon, she showed herself entirely indifferent to the conflicts of the Italian partisans who affected to fight either for or against her. The chronicler Pietro Azario, confessing that he had seen "pejores Guelfos inter se quam contra Gibelinos," throws a very sinister light upon the character of these factions, which, far from contending for an idea, were incited by the most vulgar interests and the most savage passions. Matteo Villani, who was a Guelph, suggesting a strange etymology, says that this word was equivalent to *guardatori di fe* (guardian of the faith); and that in the name Ghibelline might be read the words *guida belli*, as much as to say, *guidatore di battaglie* (leader of strifes). But it would be difficult to show which of the two factions had caused, not the most benefit, but the most mischief to Italy and to civilization; both were certainly very fatal. The Guelphs formed the first *Company of the People* to oppose the tyranny of the Ghibellines; but when the Guelph party had obtained the ascendency it showed itself even worse than the Ghibellines, by favoring those Guelph princes who desired to acquire dominion over certain towns; by creating plebeian governments, which are the least durable because they are the worst; by converting the political question into a social question; and by often calling in against dangerous nobles a fatal foreign intervention. Dante Allighieri, himself in his youth first with the Guelphs and afterwards with the Ghibellines, when verging upon old age boasts in his *Paradiso* "that he had made a party for himself," and declares "the Guelphs and the Ghibellines to be the cause of all the miseries of Italy."

Omai puoi giudicar di que'cotali
Che io accusai di sopra, e de'lor falli
Che son cagion di tutti i nostri mali.
L'uno al publico segno i gigli gialli
Oppone, e quel s' appropria l' altra parte,
Si che è forte a veder qual piu si falli.

(See Longfellow's translation of *Il Paradiso*, canto vi. lines 97 to 102.) The word Guelph has been revived in our century by the institution of the order of the Guelphs, founded Aug. 12, 1815, on the anniversary of the birth of the prince regent of England, in order to celebrate the new reign of the Guelphs in Hanover. F. A. P. BARNARD.

Guelphs, Order of (usually but incorrectly called the **Guelphic Order**), an order of knighthood founded in 1815 by George IV. of England, as regent of Hanover, for his German subjects, but conferred upon many British subjects by George IV. and William IV. Its members are not reckoned as knights in Great Britain, and since the extinction of Hanover the Prussian government does not recognize its existence.

Gue'mal, the *Furcifer Huamel*, a deer found in South America near the eastern coast. It has been called "the cloven-footed horse."

Guérande, town of France, in the department of Loire-Inférieure, on the Loire. It has large linen manufactures. Pop. 8524.

Guerara, town of Algeria, in the oasis of Wady-Mzab, in lat. 32° 45′ N., and lon. 5° E. It is the rendezvous for all the neighboring tribes, and horses, asses, ivory, gold-dust, and ostrich feathers are exchanged for cottons, woollens, silk, and cutlery. Pop. estimated at 12,000.

Guerci'no (GIOVANNI FRANCESCO BARBIERI), called GUERCINO from a squint he had, an Italian painter, b. at Cento, near Bologna, in 1590; d. 1666. His finest works, the *S. Petronilla*, the *Aurora*, the *St. Philip Neri*, are in Rome. His style varied much at different periods. His best pictures belong to the second period; they are distinguished by dignity of design and striking effects of color. His large pictures numbered 250; of smaller works in oil and frescoes he painted very many, and he left a vast collection of drawings. O. B. FROTHINGHAM.

Guêret, town of France, the capital of the department of Creuse. It carries on a large trade in cattle. Pop. 5139.

Gue'ricke (HEINRICH ERNST FERDINAND), PH. D., D. D., a staunch champion of old Lutheranism, was b. at Wettin, Prussia, Feb. 23, 1803, and since 1829, with an intermission of five years (1835–40), has been a professor in the University of Halle. He has published *De Schola quæ Alexandriæ floruit* (2 vols., 1824–25); *Handbuch der Kirchengeschichte* (3 vols., 1833; 9th ed. 1866–67), admirably translated by Prof. Shedd (2 vols., 1857–70); *Allgemeine christliche Symbolik* (1839; 3d ed. 1861); *Historisch kritische Einleitung in das Neue Testament* (1843); *Isagogik* (1854; 3d ed. 1868); *Lehrbuch der christlichen Archäologie* (1847; 2d ed. 1859), translated by MORRISON (1851), and some minor works. D. Feb. 4, 1878. R. D. HITCHCOCK.

Guericke, von (OTTO), b. at Magdeburg, Germany, Nov. 20, 1602; was burgomaster of that town 1646–81; invented the air-pump 1650; also first constructed the "Magdeburg hemispheres," and made a rude barometer. His principal works are upon physics, etc. Of these, the *Experimenta Nova* (1672) is the most noteworthy. D. at Hamburg May 11, 1686.

Guérin, de (EUGÉNIE), sister of Maurice, b. in 1805 at Cayla, Languedoc; devoted her life mainly to the care of her brother. She was a woman of saintly life and of fine intelligence. D. May 31, 1848. Her *Journal and Letters* (1862) are remarkable for the rare genius displayed, as well as for the delightful style and devout spirit in which they are written.

Guérin, de (MAURICE **du Cayla**), b. in 1810 in Languedoc, France, and d. in 1839. He was a poet of rare power and of great original talent. His *Reliquiæ* (2 vols., 1860, with a life by Sainte-Beuve) contain his poetical fragments, letters, etc. He was the friend and associate of Lamennais.

Guern'sey, the westernmost and (except Jersey) the largest of the Channel Islands. It has a varied, fertile surface, a fine healthful climate, and a thrifty population, who speak a Norman-French dialect, and, though subject to Great Britain, have their own legislature. Cap. St. Peter Port. Pop. in 1871 (including the isles of Herm and Jethou), 30,667.

Guernsey, county in the E. of Ohio, in the Muskingum Valley. Area, 460 square miles. It is hilly, but fertile, producing cattle, grain, tobacco, and wool. Bituminous coal is mined. Saddlery and carriages are the leading manufactures. The county is traversed by the Ohio Central and the Marietta and Pittsburg R. Rs. Cap. Cambridge. Pop. 23,838.

Guernsey (HENRY NEWELL), M. D., b. at Rochester, Vt., Feb. 10, 1817; was educated at Royalton, Vt., and in New York, where he took his medical degree in 1844; professor of obstetrics and diseases of women and children in the Homœopathic Medical College of Pennsylvania 1861–68, of materia medica in the Hahnemann College of Philadelphia 1872–74, and dean of both the above faculties. Author of a treatise on *Obstetrics and the Diseases of Women and Young Children*, and of many professional brochures; member of several American and foreign professional societies, etc.

Guernsey (WILLIAM NOAH), M. D., b. at Litchfield, Conn., Jan. 30, 1849; graduated at the University Medical College, New York, 1870; took the degree of master of obstetrics at Vienna; was chosen in 1874 lecturer upon the diseases of children in the New York Homœopathic Medical College, and professor of diseases of the throat and lungs in the New York Medical College for Women; member of various societies, and author of professional papers.

Guéroult (ADOLPHE), b. at Radepont, France, Jan. 29, 1810; entered the St. Simonian society 1830; was for years a foreign correspondent of the *Journal des Débats* and writer on social and political economy; French consul at Mazatlan 1842–47, at Jassy 1847–48; became one of the editors of *L'Industrie* 1851; sub-chief of the *Crédit foncier* 1852; founded the *Opinion Nationale* 1859; was in the Corps Législatif 1863–69, and was a distinguished opponent of Ultramontanism. D. at Paris July 22, 1872. Author of *Lettres sur l'Espagne* (1838), *De la question coloniale* (1842), *Discours prononcés au corps législatif* (1869), etc.

Guerra'zzi (FRANCESCO DOMENICO) was b. at Leghorn in 1804. While studying law at Pisa he made the acquaintance of Byron, who produced a strong impression upon him. His eulogy of *Cosimo del Fante* showed the lion's claws; and the police restricted Guerrazzi to Montepulciano, where Giuseppe Mazzini went to visit him and gave him a new political impulse, as Byron had already given him a poetical one. At the age of twenty-two Guerrazzi published his *Battaglia di Benevento*, an imaginative romance glowing with a sinister light and filled with protests against tyranny. His turbulent restlessness kept the eyes of the police upon him; he was imprisoned in 1831, and banished to Portoferraio, in the island of Elba, in 1834. There he wrote his masterpiece, *L'Assedio di Firenze*, which reveals in a remarkable degree all the good and all the bad qualities of Guerrazzi's genius. It is written as if in the heat of battle, and it powerfully incited the Italian youth to rise against the foreigner. *Isabella Orsini*, *Veronica Cybo*, and the *Nuove Tartufi* followed; then his *Autobiographical Letter* to Giuseppe Mazzini. In 1848 he was elected deputy, and finally, on the overthrow of the Capponi ministry, he was chosen triumvir with Giuseppe Montanelli and Giuseppe Mazzini; afterwards, on the flight of the grand duke, he was proclaimed republican dictator. As a statesman he failed; his violence irritated the people, who on the restoration of the grand duke turned against the ex-dictator. He was illegally arrested, iniquitously prosecuted, and, in spite of his admirable *Apology*, was finally condemned to per-

petual exile. He went first to Corsica, where, in a state of hypochondria, he wrote the terrible *Beatrice Cenci*; afterwards followed the *Torre di Nonza* and *Fides*. After some time he returned to Genoa, where he wrote *Il Buco nel Muro*, a most graceful and humorous little work, the *Asino*, a bitter political and social satire, and several other smaller stories. After the proclamation of the kingdom of Italy, Guerrazzi was several times elected to Parliament, and he had just finished his romance entitled *Il Secolo che muore*, now in course of publication, when he d. suddenly, on Sept. 25, 1873. The city of Leghorn decreed him a magnificent funeral, and is about to erect a monument in his honor. F. A. P. BARNARD.

Guerre'ro, state of the republic of Mexico, organized in 1849. It borders on the Pacific, and its southern part consists of the declivities of the Mexican plateau, well watered, hot only in the deep valleys, but mostly covered with primitive forests. Its northern part belongs to the Sierra Madre, and is a wild, mountainous region. The soil throughout the whole state is described as very fertile, but the land is yet very thinly peopled. Mining, which formerly was a flourishing industry in these regions, has now nearly ceased, though the country abounds in useful metals, and there are silver-mines of some importance. Area, 32,000 square miles. Pop. 300,029. Cap. Guerrero.

Guerrero, or **Tixtlan,** city, cap. of the Mexican state of Guerrero. It has some rude industrial and mining interests. It is in a hot, unhealthy mountain-valley, 150 miles S. W. of the city of Mexico. Pop. 6501.

Guerrero (VICENTE), b. at Guerrero, Mexico, of mixed negro and Spanish stock, was a slave; took part in an insurrection 1809; became in 1818 leader of patriotic troops, and in 1827 was candidate of the *Yorkino* or liberal party for president, but was not elected. Civil war thereupon broke out, but Mr. Poinsett, the U. S. minister, succeeded in effecting a compromise, by which in 1829 Guerrero was declared president. The Spanish troops soon invaded Mexico, and Guerrero was declared dictator. The invaders were totally defeated and slavery abolished, but Bustamente, the vice-president, marched against Guerrero with an army because Guerrero was regarded as not disposed to give up the dictatorship. Accordingly (1830), Guerrero resigned his office, which Bustamente assumed. After an unsuccessful attempt at revolution, Guerrero was captured and shot at Cailapa Feb. 14, 1831.

Guerri'lla [Sp., literally, a "little war"], properly the name of partisan warfare, but now applied to men serving in a war in an irregular, unauthorized manner. The name was first given to an irregular partisan soldiery of Spain, especially to that which opposed Napoleon's armies between 1808 and 1815. From Spain the name was brought to Spanish America, and thence to the U. S. In the late civil war guerrilla-parties were common at various times and places in the Border States. Though often a great annoyance to an invading army, they seldom are of much real service to their own side. In Napoleon's wars in Spain, however, his armies met for a time with much serious trouble from guerrilla-parties, who were favored by the mountainous nature of the country, which gave them great advantages.

Guerrilla-Party [Sp. *guerra*, "war;" *guerrilla*, "a little war"]. In military law this is defined as a self-constituted set of armed men in time of war, who form no part of the organized army, take up arms and lay them down at their own will, and carry on an independent, irregular, unauthorized warfare. If guerrilla-men are taken captive in open warfare, they should be treated with the privileges of war, unless they are proved guilty of such special crimes as murder, or the killing of prisoners, or the sacking of places, in which cases they are deemed to have forfeited such privilege. G. CHASE. REV. BY T. W. DWIGHT.

Guess (GEORGE or **Sequoyah**), a Cherokee half breed, inventor of the syllabic Cherokee alphabet, b. about 1770; was known as an ingenious silversmith previous to his invention of the Cherokee alphabet in 1826. The alphabet contains 85 characters, all of which are applied to writing and printing with complete success. D. at San Fernando, Northern Mexico, in Aug., 1843.

Guest, in law, a transient lodger at an inn or hotel. It frequently becomes important in legal practice to determine whether a person remaining at an inn is a guest or a boarder, as the legal rights of the parties are not the same. Thus, a guest may insist that as to him the innkeeper is an insurer, while the boarder can only claim that he is to exercise ordinary care. So the innkeeper has a lien for his compensation upon the goods of a guest, but has no such lien, except by statute, upon the effects of a boarder. The legal distinctions between the two classes of persons will be noticed under the topic INNKEEPERS. T. W. DWIGHT.

Guest (JOHN), U. S. N., b. in Missouri; entered the navy as a midshipman Dec. 16, 1837; became a passed midshipman in 1843, a lieutenant in 1850, a commander in 1862, a captain in 1866, a commodore in 1873; served on the E. coast of Mexico during our war with that republic, and participated in several sharp engagements with the enemy on shore; in 1854 was second in command of the seamen and marines of the U. S. S. Plymouth in a severe but victorious fight with the Chinese "rebels" at Shanghai, who threatened to plunder the foreign residents of that city. Commanded the Owasco of Porter's mortar flotilla in the bombardment of Forts Jackson and St. Philip prior to and during the passage of Farragut's fleet by the forts on its way to New Orleans (Apr. 24, 1862), and afterward at the bombardment of Vicksburg in summer of same year, and received the commendation of his superior officer. In command of the Iosco took part in both the Fort Fisher fights. D. Jan. 12, 1879. FOXHALL A. PARKER.

Gueux [Fr., "beggars"], a name applied by the count of Barlaimont in 1566 to the confederated nobles and others of the Low Countries who opposed the tyrannies of Philip II. The malcontents at once adopted the title, and calling themselves *Gueux*, they for many years opposed the Spanish king by sea and land with varying success.

Gue'vei, a name applied to quite a number of African antelopes, mostly of the genus *Cephalopus*.

Gug'genbühl (LOUIS), M. D., b. at Zürich 1816; graduated in medicine 1836; devoted himself to the study of cretinism; purchased the Abendberg, a mountain near Interlaken, and in 1841 started a school for the instruction and treatment of cretins, which had noteworthy success. Author of a volume (1851) and some pamphlets on cretinism. D. Feb. 2, 1863.

Guglione'si, town of Southern Italy, in the province of Campobasso. Pop. 5286.

Guia'na [Fr. *Guyane*; Sp. *Guayana*] is the name of a large territory of the north-eastern part of South America, situated between lat. 8° 40' N. and 3° 30' S., and between lon. 50° and 68° W., and bounded by the Atlantic and the rivers Amazon and Orinoco. Politically, this territory is divided between Brazil, Venezuela, Great Britain, France, and the Netherlands, of which powers the two former have incorporated their portions as provinces, while the three latter keep theirs as colonial dependencies. Along the Atlantic, Guiana presents a belt from 10 to 40 miles broad of low, flat coast-land, consisting of shallows which stretch far into the sea, and mudbanks which at high tide are only at a level with the water. This dreary-looking flat has been formed by the rivers which in great number enter the Atlantic, such as the Essequibo, Demerara, Berbice, Corentin (which forms the boundary between English and Dutch Guiana), the Maroni (between Dutch and French Guiana), and the Oyapok (between French Guiana and Brazil), and consists of a bluish clay mixed with decayed vegetable matter and impregnated with marine salts. This soil is exceedingly fertile, but the ground, when drained and consolidated, sinks nearly a foot, and must be protected against the ocean by dykes. Back from this alluvial flat stretches a range of low sandhills, behind which the interior gradually rises until in the south-western part of the territory the ground swells into a wild mountainous region, the Sierra Parime and the Sierra Pacaraima. These mountains consist mainly of granite and gneiss, but sometimes of white quartzose rock, which, from the great quantity of mica contained in it, shines like gold. In former days they were a geographical fable-land. Here lay El Dorado, to which Ulrich von Hutten and Sir Walter Raleigh made their expeditions. But recently they have lost all their mythical splendor by the researches of Robert Schomburgk, published in Leipsic in 1848. They are rather barren.

The climate of Guiana is hot (the mean temperature being 81°) and moist, but it is more equable and less dangerous to the European race than that of the West Indies; the enormous death-rate of these regions is probably caused not so much by the climate as by the irregular habits of the colonists. There are two wet and two dry seasons, the former reigning during the months of June, July, August, and December, January, February; and the change of season is generally accompanied by violent thunderstorms, but without hurricanes. Among the various products of Guiana, sugar, rum, and molasses are the principal. Cotton and coffee were formerly grown to some extent, but improvements in method and in machinery have made sugar production much more profitable. Next in importance range the different kinds of woods, of which Guiana possesses a great variety and an enormous quantity. Much timber is exported, and many kinds are ranked among the finest and most valuable in commerce. The mira tree is a giant among trees, attaining the height of 150 feet, and looking at a distance like a forest covered hill; its

timber is said to equal that of the teak. Fine fruits (among which are the banana, pineapple, guava, etc.) and gorgeous flowers (among which is the *Victoria regia*, one of the largest of the water-lilies) abound. Among the animals of the country are specially noteworthy the tapir, the ant-eaters, and different kinds of turtles; the parrots, humming-birds, and flamingoes; several kinds of poisonous snakes, anacondas, alligators, iguanas, and a multitude of gorgeous but annoying insects; finally, a great variety of excellent fish.

British Guiana occupies the westernmost part of Guiana, between Venezuela and Dutch Guiana, from which it is separated by the river Corentin. Its boundaries are not well defined. Its area is about 76,000 square miles, with 193,491 inhabitants, of whom 11,488 are white, about 10,000 aboriginal Indians, and the rest negroes, Chinese and East Indian coolies, and persons of numerous mixed races. It is divided into three counties—Essequibo, Demerara, and Berbice. The principal towns are Georgetown and New Amsterdam.

Dutch Guiana, or *Surinam*, lies between British and French Guiana, and between the rivers Corentin and Maroni. It is called Surinam after the main river flowing through it. Area, 45,000 square miles. Pop. 50,310, of whom 6000 or 7000 are white, and about 40,000 negroes, without reckoning the 1000 aborigines and the Maroons, descendants of runaway slaves, 7500 in number. Cap. Paramaribo.

French Guiana lies between Dutch Guiana and Brazil, and between the rivers Maroni and Oyapok. Area, 18,000 square miles. Pop. 25,151. French Guiana differs somewhat from the rest of Guiana. It has only two seasons—the rainy season lasting from November to June, and the heat is less oppressive on account of the trade-winds. On the island of Cayenne, just off the coast, lies the capital of the whole colony, of the same name as the island. France uses this colony as a penal settlement. C. PETERSEN.

Guib Antelope, or **Harnessed Antelope,** the *Tragelaphus scriptus*, a fine antelope found in great herds in Western Africa. Its reddish sides are marked with white stripes, which make it appear as if harnessed.

Guicciardi'ni (FRANCESCO), b. at Florence, Italy, Mar. 6, 1482; became professor of jurisprudence there in 1505; ambassador to Spain 1512; to Leo X. 1513; governor of Modena 1518; defended Parma, as the pope's lieutenant-general, against the French 1521; was made president of the Romagna 1523; governor of Bologna 1531–34; was a partisan of the Medici family. D. at Arcetri May, 1540. Left much correspondence and other writings, portions of which have been published, but is chiefly memorable for his *History of Italy* (1561–64; best edition, 10 vols., Pisa, 1819–20), which by common consent occupies the first place among Italian histories; but it lacks spirit, and is too diffuse. It has been translated into English by Sir G. Fenton (1579) and by A. P. Goddard (10 vols., 1755–59).

Gui'ccioli (TERESA), COUNTESS, b. in Italy in 1801, daughter of Count Gamba; married the Count Guiccioli 1817, she being only sixteen and he over sixty, his wealth and her beauty being the motives to the match. In 1819 she fell in with Lord Byron, who from this time till 1822 was her constant associate. In 1851 she married the marquis de Boissy (1798–1866), who often spoke of her as "my wife, formerly Lord Byron's mistress." She d. at Rome Mar. 26, 1873. Her *Recollections of Lord Byron* (1869) is of very small value.

Gui'cowar's Ter'ritory, or **Baroda,** state of Hindostan, lying between lat. 20° 40′ and 24° N., and between lon. 69° and 74° E., in the province of Guzerat. It is an independent dominion belonging to the native ruler called the Guicowar, but subsidiary to British India and subordinate to the presidency of Bombay. Area, 4399 square miles, with 325,526 inhabitants, consisting of Hindoos, Mohammedans, and wild aboriginal tribes. In 1874 the Guicowar was deposed, and in 1875 tried by a court of inquiry on a charge of having poisoned Col. Phayre, resident at Baroda. It is a most fertile region, producing cotton, indigo, grain, tobacco, and flax. Cap. Baroda.

Guide, or **Direct',** in music a mark (w) placed at the end of a stave (as an assistance to the eye), to indicate the position of the first note in the stave succeeding, or over the leaf.

Guido d'Arezzo. See GAMUT, by REV. WILLIAM STAUNTON, S. T. D.

Gui'do Re'ni, b. at Bologna in 1575. He was the son of a musician, who, finding him uninterested in his own art, placed him in the school of Denis Calvart, whom he left to become a pupil of the Caracci. Here, in opposition to Caravaggio, then becoming famous for his vehement mannerisms, Guido learned the gentle, sweet, harmonious style to which he owes his reputation. The extraordinary talents of the young man, his quickness, brilliancy, and ambition, exciting the jealousy of his masters, he was dismissed from their school. His fame having reached Rome, Guido was invited there, and went with his friend Albano. His first picture, *The Martyrdom of St. Cecilia*, raised high expectations, but awoke new jealousies among his rivals. Decorations for the private chapel in the palace of Monte Cavallo, done by order of Pope Paul V., added to his reputation; but being disappointed in the price he expected to receive, he returned to his native city, where he painted several pictures, the most celebrated of which are *The Murder of the Innocents*, in the church of St. Domenico, and the *Repentance of St. Peter*, for the Casa Sampieri. Again he went to Rome at the solicitation of the pope, who wished to employ him in decorating the chapel of S. Maria Maggiore. His most eminent works of this period are the *Aurora*, the *Fortune*, the *Rape of Helen*, and the *Magdalen*, in the Barberini palace. A short visit to Naples, whence he was driven by his enemies, intervened between his second stay in Rome and his final return to Bologna, where he passed the remainder of his years, till his death in 1642. Guido was an artist of immense productiveness, but of unequal merit. The productions of his pencil are found in all the principal collections in Europe. There are several in the English National Gallery. In the latter portion of his life his popularity was such that even his fertility could not meet the orders that came in. He did a great deal of poor work, and it is said, in order to raise money to supply his gambling propensities, retouched paintings of his pupils and sold them as his own. His manner changed in different periods. His earliest works were done in the style of Caravaggio, with strong effects of light and shade. The productions of the second period were marked by gentleness, grace, and beauty, by sweetness of tone and harmony of color. The last period was loose and careless. He excelled in the treatment of pathetic and devout subjects, and in treating others brought their more gracious aspects into prominence. Even in his best works there is some lack of vigor in drawing and color; his average work is tame, monotonous, at times insipid, however redeemed by elegance of tone and delicacy of touch. His numerous *Madonnas* have a sameness of expression that is wearisome. Guido, besides painting on canvas and in fresco, modelled in clay, and is said to have executed statues. He amused himself also with making etchings, of which a considerable number remain. Many of his pictures are familiar in engravings. The *Magdalene*, the *Aurora*, the *Michael vanquishing Satan*, are known to all frequenters of print-shops. The portrait of Beatrice Cenci, one of the most remarkable of his paintings, must be seen to be appreciated, the so-called copies of it being fancy pieces, with hardly the faintest semblance to the original. O. B. FROTHINGHAM.

Guienne, or **Guyenne,** one of the old provinces of France, lying N. of Gascony, with which it formed the ancient Roman province of Aquitania, of which its name is supposed to be a corruption. (For its history see GASCONY.) It is divided into the departments of Gironde, Lot-et-Garonne, Dordogne, and Aveyron, and includes parts of Tarn-et-Garonne and of Landes.

Guignes, de (JOSEPH), F. R. S., b. at Pontoise, France, Oct. 19, 1721; obtained early distinction as a Chinese scholar; became F. R. S. (London) 1752; was chosen to the Academy of Inscriptions 1754; became Syriac professor in the Collége de France 1757; keeper of the antiques in the Louvre 1769. D. at Paris Mar. 22, 1800. The *Histoire générale* (of the Huns, Turks, Mongols, etc.) is his principal work. The elder De Guignes was a man of noble and exalted character. This cannot be said of his son, CHRÉTIEN LOUIS JOSEPH (1759–1845), a distinguished Sinologist, who published as his own a Chinese, French, and Latin dictionary, taken mainly from the manuscripts of Father Basile de Glemona, a Franciscan missionary, whose papers were deposited in the Vatican library.

Guigniaut (JOSEPH DANIEL), b. at Paray-le-Monial, France, May 15, 1794; studied at the Lycée Impérial, at the École Normale (1811–13), and the Lycée Charlemagne (1813–17); was *maître des conférences* in history at the Normal School 1818–22; held the corresponding chair in Greek letters 1826–28, and then became director of the same school and professor of Greek in the faculty of letters. In 1835 he left the Normal School, and became professor of geography in the faculty; was chosen to the Academy of Inscriptions 1837, and in 1847 received the cross of an officer of the Legion of Honor; was secretary-general of the council of the university 1845. Wrote much upon Greek literature and antiquities; published text and variations of the *Prometheus Bound* of Æschylus (1829), and *Les Religions de l'antiquité* (1825–51, 10 vols.), based

upon the *Symbolik* of F. Creuzer. In 1862 he became honorary professor of history, commander of the Legion of Honor, and perpetual secretary of the Academy of Inscriptions.

Guijar′, or **Guixar′**, a lake of Central America, in San Salvador. It is 60 miles in circumference, receives several affluents, among which is the Mitlan, and sends its water to the Pacific through the Lempa. On a large island, called by the natives Zacualpa ("the old city"), are ruins of large buildings.

Guild [Ang.-Sax., *gild*, "tribute," since the members contributed to the common fund], among the English Saxons, appears to have been either a mutual-relief society, or more probably an association to meet the expense of the frank-pledge system; but some authors believe that it sprang directly from the *collegia*, or guilds of the ancient Roman artisans. Religious guilds, precisely similar to the modern Roman Catholic confraternities and sodalities, were also organized at an early date. The property of the religious guilds was sequestrated by Henry VIII. The laws of Athelstane mention trade-guilds as early as 939. The Steelyard Merchants' Guild dates from before 967, and the Saddlers' from about that time. Trade-guilds were early called livery companies. Mercantile guilds followed soon after. The guilds originally had something of the character of trades' unions, but they were unions of master craftsmen who carried on business for themselves, not of journeymen to protect themselves against the tyranny of capital. As the guilds grew in importance, they were frequently united into one general guild or corporation. Hence arose the power of the burgess class, the great bulwark of freedom in mediæval times. Hence, as in the towns of Scotland at the present day, the dean of a guild became a municipal magistrate. Many of the old guilds still exist, as in London, but their old exclusive privileges have been abolished, and trade and manufacturing have been perfectly free since 1835. A similar system of guilds existed throughout a great part of Europe, and some archæologists hold that the original lodges of Freemasons were simply guilds, whose members were *free* from the taxation which bore so heavily upon most of the guilds.

Guild (Reuben Aldridge), LL.D., b. at West Dedham, Mass., May 4, 1822; graduated at Brown University 1847, and became its librarian in 1848. He has published *The Librarian's Manual* (1858), *Life, Times, and Correspondence of James Manning, and the Early History of Brown University* (1864), *A Biographical Introduction to the Writings of Roger Williams* (1866), *History of Brown University, with Illustrative Documents* (1867), etc.

Guil′derland, post-tp. of Albany co., N. Y., on the Albany and Susquehanna R. R., 14 miles N. W. of Albany. It has 5 churches and some manufactories. Pop. 3132.

Guild′hall, the town hall of London, and the place of meeting of several municipal courts. It was built in 1411; was nearly destroyed by the Great Fire 1666; rebuilt in its present form 1789, its main hall being 153 feet long, 48 broad, and 55 high. Noteworthy are the lord mayor's and other civic feasts held here since 1500. In 1873 a public library was opened here.

Guild′hall, post-v. and tp., cap. of Essex co., Vt., 72 miles N. E. from Montpelier, on the Connecticut River, opposite Northumberland, N. H. It has 1 hotel, 2 stores, 2 churches, 1 weekly newspaper, an academy, mills, etc. Principal business, lumber-trade and farming. Pop. of tp. 483. Osmon B. Boyce, Ed. "Essex Co. Herald."

Guild′ford, town of England, cap. of co. Surrey, on the Wey. It is a quaint old town, but it has a considerable trade in grain. It is a municipal and parliamentary borough, and sends one member to Parliament. Pop. 9801.

Guil′ford, county in N. W. Central North Carolina. Area, about 625 square miles. It is an undulating, fertile, and well-wooded region, producing large quantities of grain, tobacco, wool, and live-stock. Flour and leather are manufactured. Gold is found, and copper and iron are abundant. The county is traversed by the North Carolina and other railroads. Cap. Greensboro'. Pop. 21,736.

Guilford, post-tp. and b. of New Haven co., Conn., on the Shore Line R. R., 16 miles E. of New Haven, and on Long Island Sound. It is a beautiful place, and has a fine stone school-house and 5 churches. Pop. 2576.

Guilford, post-tp. of Jo Daviess co., Ill. Pop. 1079.

Guilford, tp. of Winnebago co., Ill. Pop. 1062.

Guilford, tp. of Hendricks co., Ind. Pop. 2193.

Guilford, tp. of Monroe co., Ia. Pop. 873.

Guilford, post-tp. of Wilson co., Kan. Pop. 604.

Guilford, post-v. and tp. of Piscataquis co., Me., 8 miles W. of Dover, has 3 churches, and manufactures of lumber, woollens, etc. Pop. 818.

Guilford, tp. of Wabashaw co., Minn. Pop. 812.

Guilford, tp. and post-v. of Chenango co., N. Y. The township contains a number of manufacturing villages. Guilford Village has some mills, a machine-shop, foundry, etc. It is on the Midland R. R., 115 miles S. E. of Oswego. Pop. 331; of tp. 2806.

Guilford, post-tp. of Medina co., O. Pop. 1809.

Guilford, tp. of Franklin co., Pa. Pop. 3097.

Guilford, post-v. and tp. of Windham co., Vt., 5 miles S. of Brattleboro', has a mineral spring, large and valuable quarries of roofing-slate, and manufactures of children's carriages and other articles. Pop. 1277.

Guilford, tp. of Surry co., Va. Pop. 2240.

Guilford Court-house, Guilford co., N. C., some 5 miles from Greensboro', famous as the locality of a battle fought between the armies of Gen. Greene and Lord Cornwallis. The army of Gen. Greene, to which he had succeeded a short time previous, had been reinforced by militia from Virginia and North Carolina, until it numbered nearly 4500 men, of whom nearly 3000 were inexperienced militia. With this force he started in pursuit of Cornwallis, whose army comprised some 2500 veteran British troops, and whom he came up with in the vicinity of Guilford Court-house, where, on Mar. 15, 1781, the battle of this name was fought. The North Carolina militia were the first to receive the charge of the British troops, before which they gave way; the Virginia troops, next in line, held out for a time, and did effective service, but in turn fell back. The pursuing British were now met by the Continentals in the third line, and before a destructive fire of the 1st Maryland, followed by a charge of the cavalry, were in turn repulsed. Not wishing to risk another attack with his disorganized militia, Greene withdrew his army, but such was the damage inflicted upon the British army that Cornwallis not only did not pursue, but himself fell back upon Wilmington.

Guillaume (or **William**) **de Champeaux**, Doctor Venerabilis, b. at Champeaux, near Melun, in France; studied dialectics under Anselm of Laon (1030–1117); became archdeacon of Notre Dame; founded in 1113 the abbey of St. Victor, which became a famous scholastic centre; was made bishop of Châlons-sur-Marne in 1113; was a realist, and the instructor, and afterwards the adversary, of Abelard. He wrote a number of treatises, several of which exist in MS., and a few have been printed.

Guillemin (Jean Antoine), b. at Pouilly-sur-Saône, France, Jan. 20, 1796; studied botany with P. de Candolle; made important collections of plants, woods, fruits, gums, and other vegetable products in Brazil 1838–39. Author of many valued papers and several volumes upon his favorite science. D. at Montpellier Jan., 1842. The genus *Guilleminia* (Amarantaceæ) was named in his honor by Kunth.

Guil′lemot, a name applied to various sea-birds of the auk family, chiefly of the genera *Uria* and *Brachyrhamphus*. The former are common to both shores of the North Atlantic, where their feathers and eggs are extensively gathered. The other genus comprises six species of the short-billed guillemots of the North Pacific. The foolish guillemot (*Uria troile*) and the black guillemot (*Uria grylle*) are among the best known.

Guil′lim (John), b. in Herefordshire, England, 1565; was a student of Oxford; rouge croix pursuivant 1617–21; and d. in London May 7, 1621. In 1610 he published the famous *Display of Heraldry*, which was, however, according to Anthony Wood, mainly the work of John Barcham (1572–1642), a divine and antiquary, some time student of Exeter College, Oxford.

Guillotine [Fr., from *Dr. J. I. Guillotin* (1738–1814), its reputed inventor], a machine for inflicting capital punishment by decapitation, which acquired a terrible fame during the first French revolution. A very similar instrument had, however, been employed at times in various parts of Europe (Naples, Germany, Holland, Scotland) for more than 500 years. In Scotland it was called the "maiden," in France the "demoiselle." In this machine a heavy blade of steel falls in a grooved frame upon the neck of the victim. The inclined edge of the blade constitutes mainly the superiority of the *guillotine* over its predecessors. As a *machine*, the guillotine does its work with more certainty than the axe of the headsman.

Guimarães, town of Portugal, in the province of Entre Douro e Minho. It is one of the oldest and most beautiful cities of Portugal, as interesting for its architectural monuments as for the beauty of its surroundings. Its most remarkable buildings are a church dating from the fourteenth and the palace or castle from the twelfth cen-

tury. In the neighborhood are several warm springs much used for bathing. Pop. 8000.

Guinand (François), a noted mechanic, b. in Neufchatel, Switzerland, in 1745; distinguished as the inventor of the best-known process for preparing glass for telescopic lenses. This process is still a secret one, the Messrs. Chance of England, the famous lens-makers, being among the possessors of the secret. Guinand furnished lenses for Fraunhofer and other distinguished makers; had previously made telescopes as an amusement. D. about 1840.

Guin'ea, a former coin of Great Britain, originally coined of gold brought from the Gold Coast of Guinea, whence the name. It was first struck in 1664 in Charles II.'s time, and in 1817 it ceased to be coined. Subscriptions, professional fees, and the like are still estimated in guineas. It was coined for 20 shillings, but passed for 21 up to 28 shillings, the value varying considerably.

Guinea is the common name of a large tract of coast-country of Western Africa, from Cape Verga in lat. 10° 18′ N. to Cape Negro in lat. 15° 45′ S., along the Atlantic and the Gulf of Guinea. The coasts are low, forming a belt of well-watered and very fertile land of varying breadth; among the rivers are the Niger or Quorra, the Calabar, the Zaire or Congo, and the Coanza. In the interior rise lofty ranges of mountains, among which the Kong Mountains in the N. are the best known. These mountains are covered with forests of immense trees, stocked with wild animals—elephants, lions, leopards, and serpents. But the exuberance of the animal and vegetable life in the mountain-forests increases when we descend toward the coast. Sugar, cotton, indigo, pepper, and other spices, oranges, lemons, grapes, and other fruits abound, and in the animal kingdom cattle, antelopes, turtles, pheasants, and birds of beautiful plumage. But the land is very unhealthy, and its relations with the civilized world, though very famous (consisting as they formerly did mainly in the slave-trade), are comparatively small. It is divided into Upper and Lower Guinea. The former lies N., the latter E., of the Gulf of Guinea. Upper Guinea contains a great number of native states, among which are the kingdoms of Ashantee, Dahomey, and Benin (which see), and the principal European settlements, among which are Accra, Cape Coast Castle, Elmina, and Dixcove. It is divided, in commercial language, into the Grain Coast (*Liberia*), Ivory Coast, Gold Coast, Slave Coast, and Calabar Coast. The principal states of Lower Guinea are Loango, Congo, Angola, and Benguela, a Portuguese possession.

Guinea-Fowl, the *Numida meleagris*, a gallinaceous bird, a native of Africa, so completely naturalized in parts of tropical America as to have become wild. The birds are mostly of a blue-gray color, spotted with white. They are often kept as domestic fowls in the U. S. and Europe, and are thought to protect other poultry from the attacks of the hawks. Their eggs are very good, and so is their flesh when young. Their cry is harsh and disagreeable. There are other species of the genus, all African.

Guinea, Gulf of, a part of the Atlantic Ocean, washing the western coast of Africa between lat. 4° N. and 1° S.

Guinea Pig, the "restless cavy" (see Cavy), the *Cavia aperea* of Linnæus; or, more strictly, the domesticated variety of the same species, known to some systematists as *C. cobaya.* It is a rodent, and has no affinity with the pig, which it very faintly resembles in its grunting voice. Neither is it a native of Guinea, but is found wild only in South America, where its range is extensive. It is bred for its gentleness and for the pretty coloring of some examples. It is quite defenceless, and seems too stupid to fear anything, but its unpleasant odor may protect it to some slight degree, although its chief defence against extermination lies in its marvellous fecundity. The time of gestation is three weeks; there may be a dozen young at a birth, and in about six weeks the young may be fecundated. There is an incorrect belief that the guinea pig kills or drives away rats. Its flesh and fur are useless, and the principal use thus far found for guinea pigs is as subjects for vivisection; for this they are extensively used, being cheap and non-resistant; and it is probable that their sufferings under the knife are small, since during and after extensive mutilation they commonly give little evidence of pain.

Guinea-Worm (*Dracunculus*), the female of *Filaria medinensis*, a nematode entozoic worm inhabiting the flesh of men and other animals, as dogs and horses. It is from six inches to four feet in length, and about one-ninth of an inch in diameter. It is found to prevail in many parts of Africa, India, Sumatra, Persia, Arabia, and the island of Curaçoa. It is believed to enter the flesh through the skin, and there live till its young are matured, which takes from eight weeks to two years. Then it appears to approach the surface, causing a small ulcer, from which, if let alone, it will eject its young; after which it is quite easily drawn out. As many as fifty have been reported in a single person. In some cases they cause much pain and inconvenience, in others none. Death has sometimes resulted from them. The little tank-worm of East Indian fresh waters and of wet soils is believed to be the larval form of the Guinea-worm.

Guingamp, a very picturesque town of France, in the department of Côtes-du-Nord, on the Trieux. It has tanneries and manufactures of yarn. Pop. 7350.

Guipuz'coa, the smallest but one of the most densely peopled provinces of Spain, bordering on the Bay of Biscay, and traversed by several branches of the Pyrenees. It is one of the Basque provinces, is rich in minerals, and mining and fruit-culture are the chief pursuits of the inhabitants. Area, 891 square miles. Cap. San Sebastian. Pop. 180,743.

Guiscard (Robert), sixth son of Tancred of Hauteville, a Norman baron with twelve sons. Robert was b. about 1015; went about 1053 to the Norman county of Apulia in Italy, where several of his brothers had already attained distinction; captured Pope Leo IX. at Civitella 1053, and in 1057 succeeded his brother Humphrey as count. In 1059 his new title of duke of Apulia and Calabria was confirmed by Pope Nicholas II., who also appointed him gonfalonier of the Church, and gave him leave to become master of such parts of Italy as were in the hands of the Greeks and Saracens. He also assisted his younger brother Roger (1031–1101), afterwards grand count of Sicily, in his conquests. In 1074, Gregory VII. excommunicated him for trespassing upon the papal rights in Benevento, but in 1080 the pope was reconciled by Robert's submission. He next (1081–82) gained a series of victories in the Epirus over the Byzantines, but led the forces by which (1082–84) the pope resisted Henry IV., the emperor; delivered the pope from the castle of St. Angelo and sacked Rome 1084; carried the pope to Salerno 1084; defeated the combined Greek and Venetian fleet and raised the siege of Corfù 1084. D. at Cephalonia July 17, 1085. Robert and his brother Roger were the founders of the kingdoms of Naples and Sicily. Their most important part in history was their share in the expulsion of the Saracens from Italy. Scarcely less noteworthy is Robert's successful championship of the pope at one of the most important junctures of the long controversy between the popes and emperors.

Guise, a fortified town of the department of Aisne, France, on the river Oise, 23 miles N. of Laon. It has manufacturing interests. Pop. 5099.

Guise, Cardinals of, or **Cardinals of Lorraine.** The well-known devotion of the Guise family to the Roman Catholic religion caused the promotion of several of its members to the cardinalate. Prominent among them were Charles of Guise, b. at Joinville Feb. 17, 1524; became archbishop of Rheims in 1538, and cardinal in 1547; went to the Council of Trent in 1562; was learned, affable, and politic, but cowardly, hypocritical, and licentious. His great ambition was to become pope, and to make his brother, the second duke of Guise, king of France. He founded the University of Rheims, and d. at Avignon Dec. 26, 1574.—Jean of Guise, b. in 1498, was made cardinal in 1518, and d. May 18, 1550. He held three archbishoprics, six bishoprics, and many abbeys, and was famous for his large charities and his many amours; and when a beggar in those days received large alms, he would say to the giver, "Thou art either Christ or the cardinal."—Louis I., brother of Cardinal Charles (1524–74), was b. Oct. 21, 1527; d. at Paris Mar. 24, 1578. He became cardinal in 1553, and was chiefly noted for convivial habits; and the people called him "the bottle cardinal," but he possessed fine natural abilities.—Louis II., a brother of the third duke of Guise, b. at Dampierre July 6, 1555; became archbishop of Rheims in 1574 and cardinal in 1578. He was put to death by order of Henry III. (who feared his power) on the same day that the duke of Guise, his brother, was murdered, Dec. 24, 1588. The cardinal left a natural son, Louis de Guise, prince of Falzburg.—Louis III., brother of the fourth duke, was b. Jan. 22, 1575; became duke-archbishop of Rheims without consecration, and was made a cardinal in 1615; was fond of military pursuits, and once attempted to settle a difficulty about an investiture by a duel, but was arrested on the field, and sent for a time to the Bastile. He left five children by the countess of Romorantin, mistress of Henry IV. D. at Saintes June 21, 1621.

Guise, Dukes of, a cadet branch of the house of Lorraine. The first duke was Charles, duke of Aumale, b. Oct. 20, 1496; married Antoinette de Bourbon 1513; wounded at Marignano 1515; became count of Guise 1520

(the first count was Charles of Anjou, 1414); fought the Germans under Charles V. successfully, and became duke of Guise 1528; conquered Luxemburg in 1542, and d. at Joinville Apr. 14, 1550.—FRANCIS, second duke, b. Feb. 17, 1519, at Bar, an able general, rose by his own abilities and the aid of his niece Mary, afterwards queen of Scots, to a high place in public affairs; became lieutenant-general in 1552, and won renown by his defence of Metz 1552–53, and by his conduct at Renti 1554; unsuccessfully commanded in Italy 1557; served brilliantly in command against the English and Germans 1557–58, taking Calais, Guisnes, Ham, and Thionville; exercised the chief power under Francis II.; renewed the war with the Protestants by the massacre of Vassy, Mar. 1, 1562; defeated and captured Condé at Dreux Dec. 19, 1562; and was assassinated by a Huguenot named Poltrot de Méré, dying Feb. 24, 1563.—HENRY (*Le Balafré*), third duke and prince de Joinville, b. Dec. 31, 1550, gained great distinction in the service against the Turks and the Huguenots; was the leading spirit in the massacre of St. Bartholomew, and was afterwards "head and soul" of the League; was forbidden to come to Paris by Henry III., who well knew the ambition of Guise, but entered Paris in triumph, virtually imprisoned the king in the Louvre, and demanded of the states general the office of constable; but was assassinated by order of the king Dec. 23, 1588, and on the same day the cardinal Guise, brother of the duke, was also murdered by the king's command.—CHARLES, the fourth duke, prince de Joinville and duc de Joyeuse, b. Aug. 20, 1571, became governor of Provence, and was an able general; banished by Richelieu in 1631; d. at Cuna, near Siena, 1640.—HENRY, fifth duke, prince de Joinville and comte d'Eu, b. at Blois Apr. 4, 1614, became archbishop of Rheims when fifteen years old; entered upon a life of almost unexampled licentiousness; abandoned in 1640 the Church, and in 1641 was banished as a conspirator by Richelieu; married and became a soldier of fortune, distinguished for reckless valor. In 1647 he made himself generalissimo of Naples, but was given up to the Spaniards, and kept a prisoner four years; in 1655 he became grand chamberlain of France. D. at Paris June 2, 1664.—LOUIS JOSEPH, sixth duke, was b. Aug. 7, 1630, and d. July 30, 1671.—FRANCIS JOSEPH, seventh and last duke, prince de Joinville, duke of Guise, Alençon, Joyeuse, Angoulême, and count of Aleth, was b. Aug. 28, 1670, and d. Mar. 16, 1675. CHAS. W. GREENE.

Guitar′ [Gr. κιθάρα: Lat. *cithara;* Fr. *guitarre*], a stringed instrument in size between the violin and the violoncello, and in shape similar to them. Its construction is simple: a hollow body like a violin, but flat in floor and cover, the latter having in the centre a large round hole for resonance; a long wide neck, which serves as a keyboard; and six strings of wire and catgut, that are attached to a low wooden bridge below the sound-hole, are stretched along the instrument, and slackened or tightened by screws at the end of the keyboard. Across the neck, beneath the strings, are ridges of metal at unequal distances, pressure on which modulates the tone. The instrument is played with the fingers, the right hand touching the strings, the left making the modulations. As an instrument by itself, the guitar is not interesting, though finished performers execute difficult pieces on it; but as an accompaniment to the voice it has been, and still is, much used. In 1788 the duchess Amalia of Weimar introduced it in Germany as a new Italian instrument. The Italians had it from the Spaniards; the Spaniards had it from the Moors; and they brought it from the East, where it, or something very much like it, had been known from a great antiquity. Instrument-makers have attempted improvements on the guitar. A German artist in London invented a method of keys by which the instrument could be played more easily and be made to produce a fuller and steadier tone. Stauter of Vienna devised the guitarrencello and the guitarre d'amour; Birnbach tried to combine the guitar and violin by substituting a bow for the twanging of the strings. Other modifications have been suggested and applied, but none have met with favor, and the instrument remains essentially unchanged. As a distinct instrument it is now seldom used, and as an accompaniment to the voice it has been generally superseded by the pianoforte. O. B. FROTHINGHAM.

Guit′land, tp. of Marshall co., Kan. Pop. 707.

Guizot (ÉLISABETH CHARLOTTE PAULINE DE MEULAN), b. in Paris Nov. 2, 1773. Thrown upon her own resources by the death of her father, she developed considerable literary ability. She published in 1800 a popular novel entitled *The Contradictions*, and subsequently became editor of Suard's journal called *Le Publiciste*, and gained distinction as a critic and moralist. During a temporary illness she was relieved of her editorial duties by an anonymous substitute, who afterwards became known to her as the young M. Guizot. The acquaintance thus formed led to her marriage in 1812. She subsequently gave assistance to her husband in his historical labors, and published several works for the moral improvement of the young. Her book on domestic education won a prize from the Academy, and is esteemed her best work. D. Aug. 1, 1827. A. L. CHAPIN.

Guizot (FRANÇOIS PIERRE GUILLAUME), b. at Nîmes Oct. 4, 1787. His father, an eminent lawyer, fell a victim of the Revolution in 1794. His mother had him educated in the Protestant faith and classical learning at Geneva. He established himself at Paris in 1805, and commenced writing for the public in 1809. In 1812 he married Mlle. Pauline de Meulan, noted above, and the same year was appointed assistant professor of history at the Sorbonne. His political career began with the fall of Napoleon in 1814, when he was appointed secretary-general of the interior. The next year he was transferred to the department of justice, was made master of requests in 1816, and councillor of state in 1817. He belonged to the constitutional party, and in his writings represented the views of the Doctrinaires, so called. On the fall of the Decazes cabinet in 1820 he resigned the position of director-general of the communal and departmental administration, and having lost his seat in the council of state, resumed his historical lectures at the Sorbonne. In 1822 his lectures were suppressed on account of their liberal views. He then gave himself to literary work, and in 1828 established the *Revue Française*. The same year he married his second wife, a niece of the first, and also an authoress, by whom he had one son, who survived him. In that year also he was restored to his chair at the Sorbonne and to his seat in the council of state. His lectures during the next two years were received with great favor, and gained for him his highest distinction. In Jan., 1830, he became a member of the Chamber of Deputies, and favored the measures which led to the revolution of July. Louis Philippe called him into his first cabinet as minister of the interior, but he soon resigned and resumed his place in the Chamber. In 1832 he took the department of instruction in Marshal Soult's ministry, and for four years did much to organize the system of primary education. On the dissolution of that ministry in 1836 he retired, and except for a few months, when he again occupied his post in connection with the ministry of Molé, acted with the opposition party. In Feb., 1840, he was sent as ambassador to England, where he was received with marked attention on account of the favor with which in his lectures he had spoken of the English constitution. In October of the same year he entered the cabinet again as minister of foreign affairs, and for more than seven years was really the head of the government. In that position he maintained steadily and persistently the policy of resisting the revolutionary spirit prevalent in the country, and establishing on a secure basis a constitutional monarchy like that of England. His wise and able administration did much to form a healthy political sentiment in the nation, and to secure the largest liberty compatible with a stable government. But his policy favored peace with all other European states. This was interpreted by the opposition as involving a subordination to the influence of England and Russia, and the party which had inherited the ideas and spirit of the Great Revolution, restless and active, though comparatively small in numbers, used this plea effectively to make the ministry unpopular, especially in Paris. Yet M. Guizot had the full confidence of the king, and was sustained by the Chamber of Deputies to the end.

In the latter part of the year 1847 an earnest agitation for electoral reform created a feverish excitement throughout France; so-called reform-banquets were organized to discuss the proposed measures. In these the government was insulted and defied, and the city press fired the popular mind to intense excitement. Guizot proposed to the king that the cabinet should retire and open the way for a change of policy. But to this the king objected so long as the administration had the support of the Chamber of Deputies. The attempt subsequently made to suppress the banquets brought on the revolution of 1848, when Louis Philippe was dethroned and Guizot took refuge in England. After about a year's absence he returned, and as a candidate for the Chamber of Deputies was defeated. The remainder of his life was passed in retirement from direct concern with politics. He was, however, an interested observer of passing events, and occasionally gave public expression to his opinions. Thus, in 1861 he startled his Protestant friends by declaring himself in favor of continuing the pope's temporal power, and in 1870 he sustained the administration of Ollivier. During his later years his pen was continually busy, and he published many volumes on religious and historical subjects which embodied his mature judgments. He d. peacefully at his villa in Val-richer, near Lisieux, on Sept. 12, 1874, within three weeks of completing his eighty-seventh year.

As a statesman, M. Guizot must be ranked among the

great and good men of France. He was a consistent advocate of constitutional monarchy, but the nation, especially as represented by the population of the capital, was not prepared to adopt his views. His highest and most enduring reputation rests on his historical writings, in which he evinced accurate knowledge of facts, clear discernment of causes and governing principles, and great power for comprehensive and well-balanced generalization. The purity of his private life and the simplicity and strength of his Christian faith add a crown of solid worth and shining grace to his noble character. He was honored by membership in three of the five academies which make up the Institut de France. He was elected to the Academy of Moral and Political Science in 1832, to that of Inscriptions and Belles Lettres in 1833, and to the French Academy in 1836. In 1872 he received the chief prize of the Academy.

The following is a list of M. Guizot's most important published writings: *A Dictionary of French Synonyms* (1809); *Annals of Education* and *The State of the Fine Arts in France* (1810); an annotated translation of *Gibbon's Decline and Fall of the Roman Empire*, *Lives of the French Poets of the Age of Louis XIV.* (1813); an *Essay on Representative Government* (1816); *Conspiracies and Political Justice*, *Means of Government in France* (1821); *History of Representative Government* (lectures at the Sorbonne, 1822); *An Introduction to a Revised Translation of Shakspeare*, *Essays on the History of France from the Fifteenth to the Eighteenth Centuries*, *Notes to Memoirs respecting the English Revolution*, *Notes to Memoirs respecting the History of France down to the Thirteenth Century*; *History of the English Revolution* (1827); *General History of Civilization in Europe* (1828); *General History of Civilization in France* (1830); *Fall of the Republic and Restoration of Monarchy in England* (1850); *Corneille and his Times*, *Shakspeare and his Times* (1852); *History of the English Republic and the Protectorate of Cromwell* (1854); *History of the Protectorate of Richard Cromwell and the Restoration of the Stuarts* (1856); *Memoirs on the History of my Own Time* (1856–68); *The Church and Christian Society* (1861); *Meditations on the Essence of the Christian Religion* (1864); *Meditations on the Present State of the Christian Religion* (1865); *History of France, for my Grandchildren* (1870 *seq.*); *History of Four Great French Christians* (1873–4). His *Study of Washington*, written as a preface to the life and writings of Washington, is a charming monograph. Most of his works have been translated into English. A. L. CHAPIN.

Gules [from the Pers. *gul*, a "rose," or perhaps from the Late Lat. *gula*, the color of the mucous membrane of the mouth], in heraldry, red, the most honorable of the colors, ranking next to the metals, *or* and *argent*. In engravings and drawings it is shown by fine perpendicular lines upon the escutcheon.

Gulf, tp. of Chatham co., N. C. Pop. 1786.

Gulf Stream, The. The great current of the Atlantic Ocean known as the Gulf Stream issues from the Gulf of Mexico, through the narrow strait between the mainland of Florida and the Bahama Banks, and extends in a northerly and easterly course, parallel to the coast of the U. S., to the vicinity of Nantucket Shoals. Here its course changes still more to the eastward, extending quite across the North Atlantic in the direction of the British Islands, a portion of the stream penetrating far into the Arctic seas of Northern Europe. The edge of the stream next to the Atlantic coast is well defined, the separation of the warm waters of the stream from the cool waters of the counter-current from Baffin's Bay, which skirts the coast of North America, being well marked. The outer edge, on the other hand, is not so well defined, on account of the overflow or dispersion of the waters along the eastern limits. The width of the stream between Cape Florida and the island of Bimini is less than 40 miles, but its breadth gradually increases as it flows onward, being estimated at 300 to 400 miles on a line from the island of Bermuda to Halifax.

This great ocean-current forms but a part of the general system of circulation of the waters of the globe, although it is induced chiefly, without doubt, by the trade-winds of the equatorial regions of the Atlantic, which blow continually towards the shores of the continent of America. While, therefore, the rapidity of the current in the narrow Strait of Florida gives rise to the impression that this point is the origin of the stream, these local features of narrow breadth and great velocity are to a great extent accidental, and are due to the configuration of the coast and the outlying ranges of islands of the Caribbean Sea. The great circuit of motion given to the waters along the shores of the western continent would doubtless still exist were a barrier to be thrown across the Strait of Florida, although the stream would be greatly modified in its general characteristics. The waters which now are driven into the Caribbean Sea and Gulf of Mexico through the passages between the Windward Islands find an outlet mainly through the Strait of Florida, where, according to well-known laws of hydraulics, the channel being contracted, increased velocity is required to preserve continuity of flow.

The Gulf Stream, on account of its influences on the climates of the countries of the Old World, to the shores of which its warm waters find their way, and its effects on the meteorology of the North Atlantic, as well as on the commerce between the eastern and western continents, may be regarded as one of the most important phenomena connected with the physical geography of the globe. In this connection may be included what are known as its counter-currents, the most noted of which is that which comes from Baffin's Bay, and continues along the coast of America, depositing cooler water along the coast even as far S. as the Florida Strait. This cool water, skirting the coast, modifies in a remarkable degree the climates of the shores along which it passes. It is hardly possible to conceive the effects which would be produced along the temperate regions of the coast of the U. S. were the hot waters of the Gulf Stream to be thrown directly on our shores. They are now kept at a distance by the inner cool counter-current, which gives a well-defined inner wall or bank at a distance of 20 to 100 miles; and the influences of the Gulf Stream are felt more through the medium of the atmosphere than through direct contact of its waters.

Such being the general facts in regard to the Gulf Stream and its important influences, a brief history of exploration and discovery in connection with it may not be without some interest. Its influences were detected and observed along the coast of Europe many years before the discovery of America, and, according to some historians, it is apparently well authenticated that the discovery of objects from some unknown land cast ashore on the Azores, or floating in the sea to the westward, furnished evidence which was eagerly seized upon by Columbus as proof of his theory of the existence of a western continent; and while he was lingering in Spain, disappointed and almost discouraged in his efforts to obtain assistance in his great undertaking, the intelligence of this character that reached him from time to time served to renew his courage and strengthen his belief in the correctness of his views.

A venturous Portuguese pilot, Martin Vicenzo, who had sailed far out to sea, had seen floating upon the waves a piece of wood ingeniously carved with some rude instrument; another pilot, Pietro Correa, found a similar piece of carved wood on the island of Porto Santo. Stalks of cane, "each joint of which would hold several quarts," were found on the same shores; and some of the inhabitants of the islands reported that pine trees not belonging there had been driven ashore by the W. winds; at Cape de Verde two large canoes had been found which were supposed to have been forced to sea while going from one island to another; and finally the bodies of two men, differing in their features and color from the Christians, were cast upon the island of Flores.

These floating objects were supposed to have been driven about by the winds and waves until they were thrown by chance upon the coast of Europe; and this idea seems to have impressed Columbus with the belief that the new continent was much nearer to that of Europe than it is; and in his voyage he was obliged to conceal from his companions what surprised himself—the great distance which he found separating him from the Old World, without any signs of the New.

The continual discovery of trees, fruits, seeds, and other objects on the coasts of Norway, Ireland, and Scotland years after the continent of America had become known, led to the conjecture that these objects were brought from other lands by the more rapid agency of currents; and these conjectures have finally been confirmed by closer observations and by actual experiments upon the drifting of bodies thrown into the Gulf Stream. The molucca-beans found on the shores of the Hebrides, and regarded by the common people as curious productions of the sea, were pronounced by Sir George Mackenzie in the year 1675 to belong to a tropical climate, and he indulges in some speculations with regard to their having been brought through the North-west passage. In 1696 these beans were identified by another observer as belonging to the island of Jamaica, where he had seen and described them in a work on the natural history of that island. On the coast of Norway similar curiosities were found; and the fishermen of the western coast of Ireland and Scotland often discovered trees of cotton-wood and other unknown productions of the tropical forests. The exact route by which the seed or tree was carried was in a great degree conjectural until the general course of the Gulf Stream became known. Later evidences of the flow of this great current from the Gulf of Mexico to the coasts of Europe have been derived from

numerous observations on the drifting of bottles and pieces of wrecks, which have been carried in a few months from the western to the eastern continent: and also in the higher temperature of the western coast of Ireland, caused by the waters of the stream, which retain sufficient warmth to reproduce there some of the Algæ of the Florida coast.

In connection with the discovery of America, this agency of the Gulf Stream in transporting through several thousand miles of the ocean objects belonging to a new and unknown continent was the more important on account of the extravagant ideas which were then entertained of the sea beyond the visible horizon. It was generally regarded as a vast region of darkness, which the minds of the common people filled with imaginary horrors; even the more learned thought it impossible for a vessel to return after reaching the opposite point of the globe, on account of the tendency of the sea to the antipodes by the force of gravity. A mysterious dread pervaded the minds of seamen with regard to those unknown regions of the earth; an expedition which had secretly departed from Lisbon with the design of robbing Columbus of the glory of the discovery of the New World returned in dismay at the horrors with which their imaginations filled the expanse which seemed to stretch infinitely to the West. The simple incidents therefore of familiar objects borne quietly along from the vast unknown sea, while they were proofs of the existence of inhabited lands to the West, tended also to remove from the minds of the superstitious seamen the prevailing ideas of the intermediate ocean.

It is difficult to assign a precise date to the discovery of the Gulf Stream as a continuous current of the ocean. The early Spanish navigators did not fail to notice those currents of the Caribbean and Mexican seas in which the Gulf Stream current has its origin. In his last voyage Columbus sailed from the Canary Islands to Hispaniola in sixteen days "with prosperous wind, and by the swift fall of the ocean from the E. to the W.;" and in his voyage from Paria along the coast of South America towards Carthagena, it is stated that the "swift course of the water deceived both Johannes Sarranus, the chief pilot of the governor's ship, and all others, although they made their boast that they knew the nature thereof;" "for they affirm that in one night they were carried fifty leagues beyond their estimations." "The Strait of Florida was discovered in 1512 by Ponce de Leon. He first came upon the island of Bimini, and soon afterwards discovered the mainland, which he called Florida. To find a haven he kept sight of the shore, but his ships met with so strong a current that notwithstanding they were favored by a fresh gale of wind, yet they could not stem it, and one of the vessels was carried out to sea out of sight."

In 1519, Cortez, after having been three months in Mexico, sent messengers to inform the king of Spain of his conquests; he selected for their pilot Antonio Alaminos, who was already famous for the boldness of his navigation in the waters of the New World, and familiar with the coast of Florida and the adjacent islands. Alaminos resolved to sail through the Strait of Florida and take his course thence to Spain. He "took this resolution, concluding that those currents must lead somewhere," "and accordingly stood northward; and it proved well, for, being got safe out of the channel, he came into the open sea, and arrived safe at San Lucar in October, having sailed from Mexico on the 26th of July." Thus, Alaminos was the first navigator who followed the Gulf Stream to Europe; whether he recognized its influence throughout his entire voyage or not, it is impossible to determine.

Curious and interesting speculations on the currents of the Caribbean Sea and Gulf of Mexico, written by Peter Martyr, in his *Decades of the Ocean*, were translated into English, and published in Hakluyt's *Collection of Voyages*. It appears from these historical accounts that not only were the early Spanish navigators acquainted to some extent with the currents of the West Indian seas, but Sebastian Cabot discovered the counter-current which flows from the Arctic seas southward along the coast of America. From the accounts of these navigators, Peter Martyr concluded that the waters of the globe were "driven about by the incessant moving and impulsion of the heavens, and were not swallowed up and cast out again by the breathing of Demogorgon, as some imagined because they saw the seas increase and decrease, flow and reflow."

The first delineation of the Gulf Stream on a chart of the Atlantic of which we have any knowledge was made by Dr. Franklin in 1769-70, from the information communicated by Capt. Folger of Nantucket, commanding a whaling vessel from that port. In his account of this map he writes, "Vessels are sometimes retarded and sometimes forwarded in their voyages by currents at sea which are often not perceived." "About the year 1769-70 there was an application made by the board of customs at Boston to the lords of the treasury in London, complaining that the packets between Falmouth and New York were generally a fortnight longer in their passage than merchant-ships from London to Rhode Island, and proposing that instead of New York for the future they should be ordered to Newport. Being then concerned in the management of the American post-office, I happened to be consulted on the occasion; and it appearing strange to me that there should be such a difference between the places scarce a day's run asunder, especially when the merchant-ships are generally deeper laden and more weakly manned than the packets, and had from London the whole length of the river and channel to run before they left the land of England, while the packets had only to go from Falmouth, I could not but think the fact misunderstood or misrepresented. There happened then to be in London a Nantucket sea-captain of my acquaintance, to whom I communicated the affair. He told me he believed the fact to be true; but the difference was owing to this, that the Rhode Island captains were acquainted with the Gulf Stream, which those of the English packets were not. 'We are well acquainted with that stream,' said he, 'because in our pursuit of whales, which keep near the sides of it, but are not to be met with in it, we run down along the side; and frequently cross it to change our side; and in crossing it have sometimes met and spoke with those packets who were in the midst of it and stemming it. We have informed them that they were stemming a current that was against them to the value of three miles an hour, and advised them to cross it and get out of it, but they were too wise to be counselled by simple American fishermen. When the winds are light,' he added, 'they are carried back by the current more than they are forwarded by the wind; and if the wind be good, the subtraction of seventy miles a day from their course is of some importance.' I then observed that it was a pity that no notice was taken of this current upon the charts, and requested him to mark it out for me, which he readily complied with, adding directions for avoiding it in sailing from Europe to North America. I procured it to be engraved, by order from the general post-office, on the old chart of the Atlantic, at Mount and Page's, Town Hill, and copies were sent to Falmouth for the captains of the packets, who slighted it, however; but it has since been printed in France, of which edition I hereto annex a copy.

"This stream is probably generated by the great accumulation of water on the eastern coast of America, between the tropics, by the trade-winds which constantly blow there. It is known that a large stream of water ten miles broad, and generally only three feet deep, has, by a strong wind, had its water driven to one side and sustained, so as to become six feet deep while the windward side was laid dry. This may give some idea of the quantity heaped upon the American coast, and the reason of its running down in a strong current through the islands into the Bay of Mexico, and from thence issuing through the Gulf of Florida, and proceeding along the coasts to the Banks of Newfoundland, where it turns off towards and runs down through the Western Islands. Having since crossed the stream several times in passing between America and Europe, I have been attentive to sundry circumstances relating to it, by which to know when one is in it; and beside the gulf-weed with which it is interspersed, I find that it is always warmer than the sea each side of it, and that it does not sparkle in the night. I annex hereto the observations made in two voyages, and may possibly add a third. It will appear from them that the thermometer may be a useful instrument to the navigator, since currents coming from the northward into southern seas will probably be found colder than the water of those seas, as the currents from southern seas into northern are apt to be warmer."* The chart drawn by Franklin expresses exceedingly well the inner limits of the Gulf Stream as we now know them.

The second volume of the *American Philosophical Transactions* (old series, published in 1786) contains, besides a copy of the chart referred to, tables of the observations made during those voyages; the first is entitled "Observations of the warmth of sea-water, etc. by Fahrenheit's thermometer, in crossing the Gulf Stream, with other remarks, made on board the Pennsylvania packet, Capt. Osborne, bound from London to Philadelphia in April and May, 1775." The second table is entitled "Observations of the warmth of sea-water, etc. by Fahrenheit's thermometer, with other remarks, made on board the Reprisal, Capt. Wycks, bound from Philadelphia to France in October and November, 1776." And the third, "A journal of a voyage from the channel between France and England towards America, 1785." The temperatures observed were surface temperatures, and were noted daily, as well as the direction and course of the wind. On the last voyage an experi-

* *Am. Phil. Transactions*, vol. II, old series.

ment was made to obtain the temperature at moderate depths by bringing up water in a bottle and a cask with valves. The first attempt, with a bottle at twenty fathoms, was unsuccessful, the bottle coming up empty; in the second attempt, at thirty-five fathoms, the bottle came up full, and the water it contained was found to be six degrees colder than at the surface. On soundings off the Delaware, in eighteen fathoms, a cask, with a valve in the bottom opening inward and another in the top opening outward, was sunk to the bottom and then drawn to the surface, and the water it contained was found to be at 58°, which was twelve degrees colder than at the surface. In the first voyage Franklin sailed near the axis of the Gulf Stream, from lon. 60° 38′ and lat. 37° (the latitude of Cape Henry) to a point off the capes of the Delaware. In the second voyage his vessel seems to have kept S. of the axis, and finally crossed the stream in a direction nearly perpendicular to the coast at Cape May. The highest surface temperature recorded was 80°. On the voyage from Philadelphia to France the Reprisal struck the axis of the stream off the capes of the Delaware, and seems to have followed the middle of the stream nearly, the temperature of the water ranging for several days ten degrees above that of the air. The uncertainty with regard to the determinations of longitude in these voyages renders it difficult to trace the tracks of the vessels with accuracy.

The journal of Dr. Franklin on his last voyage was kept for him by Mr. Jonathan Williams, afterwards colonel and chief engineer of the U. S. A. The interest awakened in this subject by these experiments led Col. Williams to continue the investigations in subsequent voyages. Journals of four voyages between England and America, made by him, were published in the *Transactions of the American Philosophical Society* in 1790. Without defining the limits of the Gulf Stream, Col. Williams presented his observations as a foundation for a theory of thermometrical navigation, supposing that the temperature of sea-water, even at the surface, depended directly upon the depth, and that "the passage from deep to shoal water could be discovered by a regular use of the thermometer before a navigator could see the land," and that it would be "an easy thing to make a general survey of the coast under water, more particularly than could be done by sounding." In 1800 a paper was read before the Philosophical Society by Mr. William Strickland *On the Use of the Thermometer in Navigation*, giving the results of observations made by him during two voyages across the Atlantic. He kept a daily and sometimes hourly record of the temperature of the air and water, chiefly with a view of testing or confirming the theory of Col. Williams, which had come to his knowledge through the *Philosophical Transactions*. Mr. Strickland remarks that "in the outward voyage the subject appearing most worthy of attention is the probability of a branch striking off from the Gulf Stream in a northerly or northeasterly direction, flowing to the E. of and somewhat parallel to the Banks of Newfoundland;" and that "it is probably continued in about a N. E. direction, and extends entirely across the Atlantic till it ultimately strikes the coasts of Ireland and the Hebrides, after having lost in its long course in those northern latitudes much of its heat, and at last being reduced to the temperature of the sea through which it flows." He recommends the employment of a vessel especially to explore this northern branch of the Gulf Stream between lat. 47° and 60°, using the thermometer to detect its limits. The remaining part of the paper of Mr. Strickland is an attempt to prove the "accuracy of the thermometer in ascertaining a navigator's position at sea," in which he fell into the error of Col. Williams in taking the phenomena of the temperature of the Gulf Stream waters along the coast of America as general phenomena applicable to any part of the globe, and supposing that the thermometer might with safety be used by mariners to indicate the approach to dangerous coasts.

Tables of observations on the winds, the currents, the Gulf Stream, the comparative temperature of the air and water, etc., made in the North Atlantic during twenty-six voyages to and from Europe (principally between Philadelphia and Liverpool), between the years 1799 and 1817, inclusive, by John Hamilton, were published in the *American Philosophical Transactions* in 1825 (vol. ii. new series). In these tables the direction of the wind and the direction and velocity of the currents are given for the different months in the year, and also the temperature of the air and water near the axis of the stream. The average temperature of the water on soundings off the capes of the Delaware, St. George's Bank, and on the coast of Ireland for the different months of the year, were also given. The conclusions to which Capt. Hamilton arrived were, that it was impossible to define the limits of the current of the Gulf Stream, owing to the variable influence of the wind; that after it passes the tail of the Grand Bank of Newfoundland the main stream proceeds to the southward, while several ramifications, generally not very strong in their currents, branch off to the N. E., and from that to the E., with counter-currents in the intermediate spaces; that "on both sides of the Gulf Stream a counter-current running in the opposite direction is met with;" that "by the frequent use of the thermometer the navigator may always discern when he touches upon the Gulf Stream, and take advantage of its current or show its influence." Capt. Hamilton further remarks: "I was for a long time almost induced to conclude that some of these currents, particularly those which prevail between the coast of Newfoundland and Europe, were periodically running half the time in one direction and half the time in the other, and the foregoing tables seem to strengthen this conclusion, except the counter-currents near the edge of the Gulf Stream. In February and March the set seems to be southerly, with a single exception, from lat. 41° to 48°. In April, on the parallels between 48° and 50° and longitudes 13° and 26°, its direction was northerly, while at other times, from lat. 48° to 52°, lon. 14° and 29°, it set to the southward. In May, between lat. 49° and lon. 16° and 24° the set was invariably to the northward. In June always southerly, and always strong; in July, August, and September southerly. When the current from the northward prevailed to any great extent, a set in the opposite direction near the Bank of Newfoundland, and on the W. coast of Ireland," was always observed. "On the N. side of the Gulf Stream the temperature of the water is 10° higher than the surrounding ocean. On the S. side, 5°; the difference is greater in the winter than in summer. On the coast of Ireland the thermometer is of very little use in indicating soundings, the water seldom falling over 3°." The difference in the temperature of the water in the Gulf Stream and its counter-currents was considered to be very small, if there was any at all, and the breadth of the latter, particularly on the southern edge of the Gulf Stream, inconsiderable.

"The gulf-weed is no mark by which the stream can be distinguished, as it is met with in great quantities throughout the middle latitudes, to the westward of the Azores and N. of the Bermudas. It will be found uniformly the case that the water is much colder on banks than on soundings shelving gradually from the land. In summer the difference of temperature of the water on and off soundings on the coast of America is not so great as at other seasons of the year; and on the edge of soundings it will mostly be found to be colder than in shoaler water. The irregularity of the courses the Gulf Stream pursues, together with its undefined limits, all of which are considerably changed by the prevailing wind, renders it impossible for a person to know when he is in it unless the thermometer be used."

The publication of the chart of the Gulf Stream by Franklin in England led to numerous observations on its extent, velocity, and temperature by both public and private vessels of Great Britain; the results of which were collected and digested by Major James Rennell, F. R. S., and published after his death by his daughter, Lady Rodel, in 1832, in a work entitled *An Investigation of the Currents of the Atlantic Ocean, and of those which prevail between the Indian Ocean and the Atlantic*. This work is accompanied by an atlas containing elaborate charts of the currents of the North Atlantic, and representing the observations of different navigators, chiefly in the service of the British admiralty. Notwithstanding the great number of observations placed at his disposal, Major Rennell concludes that from a want of system in the observations, which form a collection for the most part of isolated and unconnected facts or statements, made by different observers at different seasons, and from errors in the determination of longitudes where the greater part of the stream from America to Europe lies E. and W., it was impossible in the state of knowledge at that time to say where the borders of the Gulf Stream were; and notwithstanding all attempts to arrange a line of passage from Europe to America, a ship might have the current against her during nearly half of her voyage. That part of the stream lying between the Strait of Florida and Cape Hatteras was better determined, but "no portion was less known, and which ought to have been better known, than that lying between Cape Hatteras and the Banks of New York and St. George." The observations discussed by Major Rennell were surface observations, and the apparent course and breadth of the stream were influenced by the winds and other causes prevailing at the time of observation. The central line or axis was wholly undetermined E. of Cape Hatteras, and the borders only approximately ascertained. Major Rennell suggested the method of bringing up water from different depths in determining the temperatures, for the purpose of ascertaining the thickness of the stratum of warm water; but the possibility of tracing the axis of the stream and its real course and breadth by cross-sections of deep temperatures does not

seem to have impressed him nor the various navigators from whom he derives his information. His work, however, was the most valuable collection of results that had yet been made, and his general conclusions and deductions, the result of many years' labor, and derived from a great mass and variety of observations, furnished the most reliable information we possessed of the Gulf Stream beyond the limits of our own coast. Accepting the explanation of Dr. Franklin with regard to the cause of the Gulf Stream, Major Rennell cites many instances to prove the effect of wind constantly blowing in one direction in producing a surface drift, which on meeting with the resistance of a coast causes a heaping up of the waters. The most noted instance is that of the Gulf of Guinea, where, according to frequent observations of Capt. Lawson, the water in the Bight of Benin is elevated five or six feet above its ordinary level by the S. W. winds. In support of this theory concerning the origin of the Gulf Stream, he states that there is an inset through every passage into the Caribbean Sea, caused by the trade-winds, except that between Cuba and Yucatan, where the current flows into the Gulf of Mexico. This current is divided—one, the main branch, flowing around the Gulf to the westward, and the other flowing directly to the outlet between Florida and the Bahamas.

The Gulf Stream is thus described by Major Rennell: "The Florida Gulf Stream is well known to issue from the Gulf of Mexico, whose waters, acquiring a higher level by accumulation, are discharged with great force and velocity through the channel between the southern cape of Florida and the island of Cuba, and being subsequently opposed in front by the Bahama Archipelago, and its banks and shoals, turns northward along the coast of North America, following it at no great distance, until it is again opposed by the banks of Nantucket and St. George, which advance far into the ocean from the shores of New York and New England. These turn it so decidedly from the coast that it never returns to it, but perseveres in its newly-acquired eastwardly course through the Atlantic, passing over or near the tail of the Great Bank of Newfoundland, and to a point several degrees beyond it, when the stream from the Hudson's and Davis's Straits appears to give it a cast to the southward. At this point, although it has made a course of more than 2000 miles, it still preserves a velocity of one mile and a quarter per hour, as also a temperature of seven to ten degrees of Fahrenheit's thermometer above the summer temperature of the surrounding ocean." The stream was supposed by Major Rennell, though from what he acknowledged to be insufficient data, to *follow the coast* between Cape Hatteras and Nantucket in the same manner that it does along the coast of Georgia and the Carolinas. The axis of the stream he supposed to lie towards the western side rather than in the middle. The velocity, according to his deductions, varies with the seasons, depending on the prevalence and strength of the trade-winds, and is greatest in the Strait of Florida in the months of July, August, and September, the maximum being 90 to 120 miles per day. The mean rate above the narrowest part of the strait is 44 miles per day; and between the narrowest part of the strait and the opening into the ocean the mean rate of motion in those months is 100 miles, and 82 miles per day for 180 miles northward; and at a distance of 1100 miles from the strait, or at a point where a line from Bermuda to Halifax crosses the stream, its velocity is commonly 48 miles per day. At its outlet from the Strait of Florida, the breadth of the stream is 40 miles; off the coast of Georgia, 60, and opposite Cape Hatteras, 75 miles; its inner edge at Cape Hatteras is reported to be 24 miles to the S. E. of the cape and in 60 fathoms depth of water. The mean velocity is understood to be from 2½ to 3 miles per hour from the straits to Cape Hatteras. "At Cape Hatteras the coast falls back suddenly from the N. E. to the W. of N., and the western border of the stream expands on that side, and takes a more northerly direction, whilst the main body continues its former course to a considerable distance, but, meeting the Nantucket and St. George's Bank, it is turned off to seaward, and never afterwards approaches any land."

When first turned from the coast the central part of the stream takes a direct eastwardly course, and finally to the southward of E., at the same time expanding to a vast breadth. After passing the Banks of Nantucket and St. George it continues through the Atlantic in an E. northerly course to the distance of 1,500 miles, or to lon. 45°–44′, lat. 41° 44′. From this point its course changes from E., northerly, to E. and S. E., and finally southward. This latter part of its course embraces about 570 miles, completing a course of 3060 miles from the Gulf of Mexico. No trace of the current S. of the Azores has been found, but the observations of Franklin and others show the existence at times of warm water which may be traced to the Gulf Stream. A part of the Gulf Stream 500 miles in extent, between 50° and 61° lon., is almost wholly unknown; neither its direction, velocity, nor temperature having been observed. The width of the stream at any point is variable; on a line from Bermuda to Halifax the variation is from 140 to 320 miles, according to numerous surface observations made by Mr. Napier and others in the passage along this line. These variations appear also to be sudden. Ten crossings of the stream between lon. 63° and 72° W. are reported by Major Rennell, in all of which except one the surface temperatures were recorded in detail. Five of these crossings were made by Mr. James Napier in H. M. ship Newcastle in the years 1820 and 1821, and by Mr. B—— during the same years nearly on the same meridian, giving good opportunities for determining the breadth of the warm water. The least breadth found on the line from Bermuda to Halifax was 140 miles, and the greatest 320—the northern limit changing generally less than the southern.

In crossing the stream in 1821, Mr. Napier noticed that after passing through Gulf water with a temperature of 70° for a distance of 36 miles, he came into water of 66° temperature, which continued 32 miles, where the temperature again rose to 70°. He observed that the water of the higher temperature was very much agitated, having every appearance of a current, but in the "cooler vein" the water was smooth. Three traverses of the stream were made in the month of May, 1821, along this line: viz. the above traverse of Mr. Napier and two by Mr. B——, all within 20 miles of longitude: the variation in breadth was 62 miles, and warm water was found in a higher latitude than at any other period. From these results Maj. Rennell estimates the extreme breadth of the stream at this point to be 390 miles. This extreme breadth is attributed to the overflowings of the stream, which are to be traced to the irregularities in velocity at the origin rather than to the seasons.

The general results of the inquiries of Maj. Rennell in regard to temperatures may be summed up as follows: The maximum temperature of the Gulf of Mexico is 86° at the entrance to the Strait of Florida, which is 8° higher than the ocean temperature in the same latitude. From this point to Cape Hatteras the mean velocity in summer is 77 miles per day. The difference in latitude is 11°, and the Gulf water loses in its passage 3° F. The ocean water is 6° F. lower at Cape Hatteras than in the latitude of Cape Florida. From Cape Hatteras to the point where a line from Bermuda to Halifax crosses the Gulf Stream, a distance of 600 miles, the loss of temperature is 2° F., and the difference of latitude 4°, the mean velocity being 50 miles per day. From the latter point to lat. 43½, lon. 43½, a distance of 950 miles, the velocity is about 40 miles per day, the increase in latitude 4°, and the loss of temperature 5½° F.; and finally to the neighborhood of the Azores, a distance of 570 miles, the temperature diminishes 3°, the velocity diminishes to 20 miles per day; the latitude in this last interval diminishes 2½°. Thus in running about 3000 miles, from the parallel of 24° to 43°, the temperature is diminished about 13½°, from 86° to 72½° F., and the time occupied is about 78 days. The data upon which the time is calculated are the mean velocities of the stream in summer between the different points. About five and a half months are required for the waters of the Gulf Stream to reach the coast of France.

The observations of the U. S. Coast Survey having furnished the means of calculating not only the volume of warm water which is carried by the Gulf Stream from the tropics to the North Atlantic and the Arctic regions, but also the amount of heat which is thereby transferred, Mr. James Croll estimates that 133,816,320,000,000 cubic feet of water are daily conveyed, and the quantity of heat in foot pounds transferred amounts *per day* to 154,959,300,000,000,000,000—a quantity of heat sufficient to melt daily a mass of cast iron as large as Mount Washington. This heat is distributed over Western Europe and a portion of the Arctic regions, producing the marked differences in climate and temperature which are there observed as compared with points of the same latitudes on the American continent.

Explorations of the Coast Survey.—From the preceding brief history of the progress of discovery with regard to the Gulf Stream, it will be perceived that even for the purposes of navigation it was but imperfectly known as late as 1842, especially that part lying along our coast from the Gulf of Mexico to Nantucket. It is this portion of the stream to which the name of *Gulf Stream* properly belongs; and having the swiftest current, and lying as it does in such a manner that all the commerce of our country must cross it or sail within its influence, a thorough knowledge of its limits and characteristics is of the first importance. When the explorations were commenced in 1844–45, this part of the Gulf Stream was imperfectly known, while the

interests of commerce, of science, and every consideration for the safety and welfare of navigators called for its thorough and systematic investigation. A report urging the lords of the admiralty to undertake the work was made by Admiral Sir Francis Beaufort in 1842, in which it was stated that to make a complete or even creditable exploration would require "very powerful means, considerable time, and conspicuous talents." The importance of an examination of the great rivers emptying into the Atlantic, to whose influence the Gulf Stream was attributed, was suggested, and a detailed plan given for the survey of the stream from the Gulf of Mexico to the shores of Europe. This plan proposed the employment of three steam vessels and one sailing vessel; one of the steamers to remain in the Gulf of Florida for the purpose of keeping a constant record of the velocity and temperature at that point, the sailing vessel to drift along the axis of the stream, and the other two steamers to operate from the centre to the edges in conjunction with the sailing vessel. The report suggested that, should their lordships be inclined to adopt the undertaking, they should invite the Royal Society and other learned bodies to suggest any inquiries which might seem to be connected with this great problem, and expresses the conviction that an enterprise of such magnitude and importance, if undertaken with less ample means, would end in disappointment and bootless expense. The work here suggested was undertaken along that portion of the stream adjacent to the coast of the U. S. by Prof. A. D. Bache on his accession to the control of the U. S. Coast Survey in 1844. To his conspicuous talents and untiring industry and perseverance we are indebted for the development of the most interesting characteristics of this part of the stream. The work extended over a period of nearly sixteen years, the explorations being conducted under his direction by officers of the U. S. navy, among whom may be mentioned, as distinguished in this as well as in other fields of duty, Bache, Davis, Sands, Berryman, Craven, Febiger, Murray, and Wainwright.

The plan of exploration of Prof. Bache was to run sections for soundings and deep-sea temperatures across the stream at various points, by which not only the limits of the warm waters of the stream would be defined at the surface and at various depths, but also the form of the bottom of the sea along its path. Numerous sections were run in this manner, which resulted in the discovery that the stream is divided from its initial point in the Strait of Florida, throughout its whole extent along the coast of the U. S., into alternating bands of warm and cool water; and further, that the bands of cool water are produced by the forcing to the surface of the cool underlying water of the ocean by submarine ranges of mountains running in lines generally parallel to the coast. The inner edge of the stream occurs where there is an abrupt descent of the bottom from soundings of moderate depths to the deep waters of the ocean, this feature being so marked as to be called the *cold wall*. The published reports of the Coast Survey give maps of the stream indicating the bands and the courses of these ranges of submarine elevations. It was found impracticable to determine the depths across the stream except near its origin, owing to the great depth and the velocity of the current; and it is a somewhat remarkable fact that the existence of the depressions and elevations at the bottom of the sea, determined in these explorations by the deep-sea thermometer, furnished the first evidence of the existence of such inequalities in advance of the sounding-line and plummet. These explorations of the Gulf Stream by Prof. Bache constitute one of the most important contributions to the physical geography of the sea of modern times. For the first time during these explorations specimens from the deep sea-bottom were procured and examined.

A notice of the Gulf Stream would be incomplete without some reference to its meteorological characteristics. The effect of the transfer of warm water in a continuous stream from the tropics to the poles makes its path a region of violent storms. It may indeed be said that there is an aërial band of cloud and mist continually overhanging the stream, in which the electric and other changes due to the changes of heat play a conspicuous part, making it a region of violent gales and heavy seas, from which ships seldom escape without damage, and in which many annually founder, while others are driven far from their courses. Its influences in modifying the climate of the western coast of Europe are in marked contrast with the effects on the N. E. coast of America of the cold current from the Arctic regions which flows from Baffin's Bay. W. P. TROWBRIDGE.

Gulf-weed (*Sargassum vulgare* and *bacciferum*), seaweeds found floating in great areas in various parts of the ocean, especially in what are called the Sargasso seas, of which the most extensive is near the Azores. It is also found floating in the Gulf Stream, whence the popular name.

Gu'lich, tp. of Clearfield co., Pa. Pop. 601.

Gull, a name given to many web-footed sea-birds of the family Laridæ and of the genera *Larus, Blasipus, Chroicocephalus, Rissa, Papophila, Lestris*, etc. The terns, too, are popularly known as gulls, which they resemble in habits and appearance. On the N. E. coasts of British America great numbers of young gulls are salted down for food. Their feathers and eggs also are extensively gathered. The species are very numerous. The *Larus canis* is the most common in Europe. The *L. marinus*, or great black-backed gull, is one of the very largest of the species. In the U. S. many gulls visit the lakes and rivers far inland, and often breed there.

Gull (Sir WILLIAM WITHEY), BART., M. D., D. C. L., F. R. S., b. in Thorpe-le-Soken, Essex, Eng., Dec. 31, 1816, passed M. B. in 1841 and M. D. in 1846 at the University of London; was professor of physiology at the Royal Institution 1847–49, and for many years was a lecturer at Guy's Hospital; won a baronetcy by his skill in attending the prince of Wales in a fever. Author of works on cholera, paralysis, hypochondriasis, and abscess of the brain.

Gul'ledges, tp. of Anson co., N. C. Pop. 1519.

Gul'liver (JOHN PUTNAM), D. D., b. in Boston, Mass., May 12, 1819; graduated at Yale in 1840; held a Congregational pastorate at Norwich, Conn., 1846–65; pastor of the New England church, Chicago, 1865–68; president of Knox College, Galesburg, Ill., 1868–72; became in 1872 pastor of the First Presbyterian church, Binghamton, N. Y.

Gum [Lat. *gummi*], a name somewhat vaguely applied to many concrete vegetable juices, chiefly to such as are neither oily nor resinous. The gums proper consist (according to Guérin) essentially of arabin ($C_{12}H_{22}O_{11}$, found in gums arabic and senegal), of cerasin (cherry, plum, and peach gum), of bassorin (the mucilaginous principle of Bassora gum and of tragacanth). *Arabin* has mildly acid properties; is soluble in hot or cold water, forming mucilage; is precipitated by alcohol or subacetate of lead; is coagulated by borax; and is believed to exist in gum arabic in combination with small proportions of alkalies and alkaline earths. It is isomeric with cane-sugar. *Bassorin* swells, but does not perfectly dissolve, in water, with which, however, it may be rubbed into a very adhesive paste, which cannot be called a solution. *Cerasin* much resembles it, but has somewhat different chemical reactions. The principal gums are the following: GUM ARABIC is mainly the product of *Acacia Verek*, but is in part the product of *A. Nilotica* and of other thorny trees and shrubs of the genus, found throughout a very large part of Africa and in portions of Asia. That from the Nile valley is the Turkey gum of commerce; Barbary gum comes mostly from Mogadore, and is of two kinds—one (identical with Turkey gum) grows in Morocco, etc., and the other is brought from the Soudan by caravans. GUM SENEGAL is closely allied in character to the above, is identical in its uses, and is the product of several trees of the genus *Acacia*, growing in Western Africa. *Galam gum* is a name given to some of the best varieties of gum senegal. Much of the gum arabic of commerce is really from Senegal. *India gum* is mostly produced in Africa and Arabia, and finds its way to Bombay in Arab vessels. *Cape gum* was formerly brought from South Africa, and Australia has supplied some of the gum of commerce. GUM MEZQUITE, from *Algarobia glandulosa*, a thorny leguminous shrub of the dry regions of Mexico and the adjacent parts of the U. S., is closely analogous to gum arabic, but its principle is not precipitated by borax. TRAGACANTH is the gummy exudation which appears spontaneously or upon the incised bark of *Astragalus verus* and other species of that genus, order Leguminosæ. (See TRAGACANTH.) BASSORA GUM, from Persia, combines the principles arabin and bassorin. The plant which produces it is not known, but is supposed to be an *Astragalus*. Besides the true gums, many other somewhat similar products are popularly known as gums. (See GUM-RESINS.)

Uses.—The true gums above enumerated are used in the arts as sources of MUCILAGE (which see); in medicine they are demulcent; they are employed in pharmacy in making troches and pills; in confectionery, for the basis of many pastes and confections; in calico-printing, in preparing inks, in making sizes, and other stiffening preparations, they have also an extended use; but DEXTRINE (which see), or British gum, has in part taken their place. Most experimenters have concluded that the gums are entirely innutritious, but this conclusion is perhaps open to some question. CHAS. W. GREENE.

Gumbin'nen, town of Prussia, in the province of East Prussia, on the Pissa. It was founded in 1732 by Frederick the Great, who received and settled here the Protestants from Salzburg who emigrated on account of religious persecutions. Pop. 9085.

Gum'bo (*Gomband, Okra*), the *Hibiscus esculentus*, a plant of the order Malvaceæ, native of the West Indies, and largely cultivated in the Southern States and in most warm countries for its mucilaginous pods, which are excellent in soup, and are often cooked and served up with butter or pickled. The *Gombo musqué* is the *Hibiscus moschatus*, cultivated in many warm countries, and prized for its reputed medical virtues. Its seed, known as ambrette, is employed by perfumers.

Gum-lac. See Lac, by Prof. C. F. Chandler, Ph. D., LL.D.

Gum Log, tp. of Pope co., Ark. Pop. 646.

Gum Neck, post-tp. of Tyrrell co., N. C. Pop. 1068.

Gum-Resins, a class of vegetable products long recognized in pharmacy, obtained by drying the milky juice which exudes from incisions made in the stems, branches, or roots of some plants. These juices consist chiefly of a resin and an essential oil, held in suspension in water, containing considerable quantities of gum or mucilage. The gum-resins are opaque, brittle solids, heavier than water, generally possessing a bitter taste and a strong smell, and more or less colored. The resinous portion is soluble in alcohol, the gum in water. They are principally used in medicine. The principal gum-resins are gamboge, frankincense, scammony, asafœtida, aloes, euphorbium, galbanum, myrrh, olibanum, opopanax, gum-ammoniac, sagapenum, and bdellium. The following analysis of asafœtida will sufficiently illustrate the character of this class of bodies:

Resin	18.5
Gum, with traces of saline matter	19.0
Bassorin	6.4
Volatile oil	4.5
Extractive, with saline matter	1.4
Sulphate and carbonate of lime	9.3
Alumina and oxide of iron	0.4
Sand and vegetable fibre	4.5
Water	6.
	100.

C. F. Chandler.

Gumri. See Alexandropol.

Gum'ti, a river of British India, an affluent of the Ganges, passes by the cities of Lucknow and Jounpoor.

Gum'town, post-v. of Lee co., Miss., on the Mobile and Ohio R. R., 35 miles S. of Corinth. Pop. 240.

Gum Tree, a name given in the U. S. to several trees: (1) The black or sour gum, pepperidge, or tupelo (*Nyssa multiflora*), a large tree growing in most of the States E. of the Mississippi, produces a firm, unwedgable timber, used for bowls, hat-blocks, windmill shafts, hubs, cart-lining boards, etc. It is grown in Europe. *Nyssa uniflora* and *aquatica*, the water-tupelos of the South, have soft light wood, and their roots have been recommended as substitutes for corks. The *Nyssa capitata* of the Gulf States bears a sour edible fruit, the Ogeechee lime. The above trees belong to the order Cornaceæ. (2) The sweet gum, bilsted, or liquidambar (*Liquidambar styraciflua*), of the order Hamamelaceæ, grows from New England to Mexico. It is a fine large tree, well known by its star-like leaves and furrowed bark. Its wood is soft, but firm and fine-grained, and used in making furniture. In the warmer latitudes it yields an abundant balsamic resin, called American storax. Its bark is very useful in the treatment of diarrhœa and dysentery. This tree grows well in Europe. *L. orientale* of the Levant yields styrax or storax, and so does *L. Altingia*, a very lofty tree of farther India, having a very hard, heavy, fragrant red timber. (3) Very different from either of the foregoing are the *Eucalyptus*, or gum trees of Australia (see Eucalyptus); (4) in different British colonies still other trees with gummy or viscid juice are called by this name.

Gun. See Artillery, by Gen. W. F. Barry, U. S. Army, and Small-Arms, by Gen. P. V. Hagner, U. S. Army.

Gun'boat, a war-vessel of relatively small dimensions, usually propelled by steam and carrying a small number of guns, often of heavy calibre. Gunboats are of especial service on rivers and for in-shore duty, such as blockading service and the like. They are of late constructed by nearly every naval power of any importance. (See Naval Architecture, by Com. T. D. Wilson, U. S. N.)

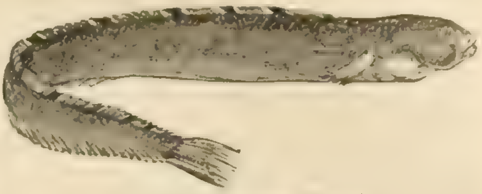
Gun-Cotton. See Explosives, by Gen. H. L. Abbott, U. S. Army. For chemical properties, see Pyroxylin.

Gunduck', a river of Hindostan, rises at the foot of the Dhwalagiri, and flows into the Ganges opposite Patna.

Gundwa'na, a former province of Central India, now mostly contained in the Nagpur or Nagpore district. It takes its name from the Gonds (which see), one of the most important of the native races. Their portion of this highland region is almost entirely a wild jungle. (See Nagpore.)

Gun-Making. See Ordnance, by Capt. R. P. Parrott.

Gun'nel, or **But'terfish,** a name given to certain small



The Spotted (European) Gunnel.

eel-like marine fishes of the blenny family, found often in tide-pools and under seaweed along the shore. Among the species are *Murænoides mucronatus* of the Atlantic coast of the U. S., and the *Murænoides Gunnellus* of Europe. They are covered with a surprising quantity of mucus, and are caught for fish-bait. They are very active in their movements.

Gun'nery, as a science, treats of the motion of projectiles from firearms. An eminent foreign writer divides the subject into interior and exterior ballistics, the former relating to the motion inside of the piece, the latter outside of it. This article refers to the latter division of the subject.

The line described by a projectile in motion is called its *trajectory*. The earliest idea of a trajectory was, that it was composed of two straight lines and an intermediate curve, supposed to be a circle. In 1537, Nicholas Tartaglia published in Venice a work called *Nova Scientia*, in which he claimed that no portion of a trajectory was a straight line. He invented the gunner's quadrant for measuring the angle of elevation of a firearm, and showed that the elevation corresponding to the greatest range is 45°. One hundred years later Galileo claimed from the law of falling bodies that a trajectory was a parabola. One hundred years after Galileo, Newton showed that when the resistance of the air was considered, a trajectory was far from being a parabola; that its two branches were dissimilar; and that the descending branch, if prolonged, would be a straight line. In 1742, Robins published his *New Principles of Gunnery*, and was the first person to place the subject on a scientific basis. He determined by actual experiment the density of gases in a firearm, and the pressure which they exert on a projectile. He invented the ballistic pendulum, and by means of it measured the velocity with which a projectile leaves its piece; and in this way showed the great disparity between a parabola and the real trajectory. He also showed by experiment that the revolution of a projectile around one of its points, combined with the resistance of the air, caused it to deviate from its true path; and finally, he pointed out the great advantage to be derived from using the rifle with oblong projectiles, thereby foreshadowing the great improvements of modern gunnery. Hutton and certain distinguished French artillerists improved the ballistic pendulum, and used it with the gun pendulum to develop a true knowledge of gunnery, particularly that relating to the laws governing that most important element, the resistance of the air.

The spiral grooves of the rifle, which contribute so much to increase the range and accuracy of projectiles by enabling us to use oblong projectiles, were first used in the sixteenth century, but it is only within the past thirty or forty years that their true value has been realized, and that they have been brought into general use for military purposes. At the present day the U. S. is the only nation of any military importance that employs smooth-bored cannon. The forces which act on a projectile to determine the form of its trajectory, are—the propelling force of the powder, which acts to move it in a straight line; the force of gravity, which draws it toward the earth; and the resistance of the air, which impedes its motion and diminishes its range. If the first and second of these forces only are considered, the trajectory *in vacuo*, from the well known laws of mechanics, is a parabola, and its equation is $y = x \tan \phi - \frac{g}{2} \cdot \frac{x^2}{V^2 \cos^2 \phi}$. In this equation y is the height of any point of the curve above a horizontal line drawn through the muzzle of the piece; x is the horizontal distance of the same point from a vertical line drawn through the muzzle; ϕ the angle which the axis of the bore makes with the horizon, or angle of fire; V the initial velocity; and g the force of gravity. When the resistance of the air is introduced into this equation, it becomes of such form that the ablest mathematicians have been unable to solve it perfectly. Capt. Didion, formerly professor of gunnery of the artillery school at Metz, gives the trajectory in air as follows—

viz.: $y = x \tan \phi - \frac{g}{2} \cdot \frac{x^2}{V^2 \cos^2 \phi} \cdot B$, which differs from the equation of a parabola by the quantity B, which is a function of the velocity of the projectile and the resistance of the air to it. Values of B for all resistances and velocities likely to arise in practice may be found in tabulated form in the course of ordnance and gunnery as taught at the U. S. Military Academy, and in Capt. Didion's work, *Traité Ballistique*, to which the student is referred for a full exposition of the subject.

The things to be considered in the movement of projectiles are the *initial velocity*, or velocity at the muzzle of the piece; the *remaining velocity*, or velocity at any point of flight; the *terminal velocity*, or velocity with which it strikes the object; the *final velocity*, or velocity which a projectile will finally have when allowed to drop freely in the air until the resistance of the air and the accelerating force of gravity become equal; the *range*, or distance passed over; the *angle of fire*, or angle which the axis of the piece makes with the horizon; and the *angle of fall*, or the angle which the tangent to the trajectory makes with the horizon at the point of fall. The following general deductions are made from the equation *in vacuo*, and to a certain extent are applicable to movements in air:

1st. *The greatest range is obtained with an angle of 45°; any other range can be obtained with two angles of fire; and variations in the angles of fire produce less variation in range as the former approaches 45°.*

2d. *With the same angle of fire the ranges are proportional to the squares of the velocities, and, reciprocally, the velocities are proportional to the square roots of the ranges.*

3d. *The velocity of a projectile varies in different points in its flight, depending on its height above the muzzle of the piece. It is least at the highest point or summit, and equal at any other two points cut by the same horizontal plane.*

4th. *The time of flight for an angle of fire of 45° is equal to the square root of the quotient of the range divided by one-half the force of gravity;* or for a practical rule, it may be said *to be equal to one-fourth of the square root of the range expressed in feet.*

5th. *The angle of fall is equal to the angle of fire measured in opposite directions.*

The *velocity* of a projectile is determined experimentally by ascertaining the time it takes for it to pass between two points a short distance apart, and dividing this distance by the ascertained time. The distance generally selected is 100 feet, and the time is measured by the rupture by the projectile of an electric current passing through each point and connecting with a delicate time-keeper. For this simple application of electricity the science of gunnery is indebted to Wheatstone. The delicacy of the numerous instruments using electricity now employed is so great that the velocity of the projectile at different points of its passage along the bore of a gun has been accurately measured. The following table of initial velocities has been obtained by this means for the various firearms in use in the U. S. service:

	Charge.		Initial velocity, feet in seconds.	
	Powder, grains.	Projectile, pounds.		
Army revolver	30 grs.	250 grs.	650 ft.	United States
Army carbine	55 grs.	405 grs.	1120 ft.	
Army musket	70 grs.	405 grs.	1350 ft.	
3-in. field-gun (rifle)	1 lb.	9 lbs.	1232 ft.	
4½-in. siege-gun (rifle)	3¼ lbs.	25¼ lbs.	1303 ft.	
15-in. Rodman gun (smooth)	100 lbs.	460 lbs.	1520 ft.	
12-in. rifle gun (Krupp)	130 lbs.	666 lbs.	1460 ft.	

It is found in practice that the initial velocity is affected by a change in the diameter and length of the bore, by the weight of the projectile and its windage, by the weight of the powder, and the size, form, and density of its grains, and the quality and proportion of the materials of which they are made. The form of the chamber and position of the vent are also found to have a certain effect on the velocity.

Everything else being equal, the initial velocities from two different charges of powder and weights of projectile will vary nearly in direct proportion to the square root of the weights of the powder, and indirectly in proportion to the square root of the weights of the projectiles. Knowing, therefore, the velocity for any particular charge of powder and weight of projectile, as in the foregoing table, the velocity for any other charge and projectile in the same gun may be determined by simple proportion. If the length of bore varies, it is found that the velocity will vary nearly directly as the fourth root of the length. These laws are empirical, and are only true within certain limits, which limits embrace most of the cases likely to arise in practice. More accurate but elaborate formulas for initial velocity may be found in special treatises on gunnery.

Resistance of the Air.—The resistance of the air varies with the form, size, and velocity of the projectile, and to a certain extent with the state of the atmosphere. Were air incompressible like water, it would offer a resistance to a projectile in proportion to the square of the velocity; being a compressible medium, it offers a resistance which increases in a ratio depending on both the square and cube of the velocity. The following formula, deduced by Piobert from the experiments of Hutton, has been found to give the resistance of the air with great accuracy—viz.: $\rho = A\pi R^2 \left(1 + \frac{v}{r}\right) v^2$; in which ρ is the resistance of the air in pounds; A is the resistance in pounds on a square foot of the cross-section of a projectile moving with a velocity of one foot; v is the velocity; and r is a linear quantity depending on the velocity, and for ordinary velocities is 1427 feet. For spherical projectiles $A = 0.000514$; for the ordinary oblong projectile with the ogival point, according to the careful experiments of Capt. Prince, U. S. ordnance department, $A = 0.0004192$. In other words, *the pressure of the air is about one-fourth greater on the spherical than on the pointed form of projectile.* The pressure of the air on a 15-inch shot moving with a velocity of 1500 feet is found by this formula to be 2865 pounds. The power of a projectile in motion to overcome the resistance of the air is directly in proportion to its weight, divided by the cross-section opposed to the air. Let $2c$ represent this power in any projectile; we have $2c = \frac{P}{A\pi R^2}$, in which P is the weight, and R the radius of the cross-section. The value of c is an important element in all equations of trajectories in air, and the study of it shows that large and dense projectiles will have a greater range than small and light ones, and that oblong projectiles will have a greater range than those of spherical form.

The expression for calculating the remaining velocity of a projectile after passing over a certain distance is $v = \frac{Vr}{(V + r)e^{\frac{x}{2c}} - V}$, in which v is the remaining velocity at the distance x; V the initial velocity; $e = 2.718$; and $r = 1427$, and c as before given. The loss of velocity in a 15-inch round shot and a 12-inch rifle shot will be as follows:

Distance.	15-inch round shot.	12-inch oblong shot.
500 yards.	185 feet.	46 feet.
1000 yards.	335 feet.	90 feet.
2000 yards.	571 feet.	172 feet.

The shape of the forward part of an oblong projectile exercises a certain influence in modifying the resistance of the air. The form found to experience the least resistance, and the one now generally employed for all rifle projectiles, is known as the ogival. In profile it is made up of the arcs of two circles tangent to the sides of the projectile and meeting in a point. The point may be very considerably rounded or flattened without materially increasing the resistance of the air. Oblong solid shot are now made about two and a half calibres or diameters long, and shells are about three calibres long.

That a projectile may not deviate from its true path, the resultant of the resistance of the air upon it must pass through its centre of inertia, and be constantly tangent to the trajectory throughout the flight. These conditions can only be fulfilled by a perfectly homogeneous spherical projectile that moves through the air without rotation, and are such as will seldom if ever occur in practice. This fact explains the general want of accuracy in the flight of round projectiles. The question is frequently asked, "Why do rifle projectiles have greater range and accuracy of flight than those from smooth-bored guns?" There are two reasons for this: (1) By means of the spiral or rifle grooves in the gun the projectile, if oblong, has a rapid rotary motion around its long axis, and is thus given the necessary stability to pass through the air in the direction of its least resistance from the air. (2) The rifle motion distributes the deviating forces symmetrically around the direction of flight, and thereby neutralizes their effects. A rifle musket bullet revolves at the start about 736 times per second, while a 12-inch rifle cannon projectile revolves about 30 times per second. The force expended in giving a projectile its rifle motion will be measured by the velocity of the centre of gyration. In the present .45-calibre service rifle the forces of translation and rotation are to each other as 1400 to 60. A round projectile from a smooth-bored gun rotates from two causes—viz. by bounding along the bore in consequence of windage, and by taking up motion around its centre of gravity when that centre does not coincide

with the centre of force. Having rotation, it is easy to see that the portions of the surface moving in the direction of flight impinge on the air with greater force than those on the opposite side, which are moving in an opposite direction, and that the projectile will be deviated from the side which moves the more rapidly. In the case of an eccentric spherical projectile the movement of the front surface will be towards the side on which the centre of gravity is situated, and the deviation will be in the same direction. In other words, the deviation of eccentric spherical projectiles will be in the direction of the position of the centre of gravity in the gun, and its amount will be in a certain proportion to the distance of the centre of gravity from the axis of the bore. If the centre of gravity is above the axis and in the plane of fire, the range will be increased; if below the axis, it will be shortened. This law of deviation has been confirmed by numerous experiments.

An oblong rifle projectile moves through the air with its long axis parallel to itself. The trajectory, however, being curved, the under surface of the projectile is brought in contact with the air in the descending branch, and there is an effort to raise the point and depress the base of the projectile, or, in other words, to rotate it around a short axis. The result of the efforts to rotate the projectile around the long and short axis at the same time will be to deviate the point to the right or left, as the rifle motion is with or contrary to the hands of a watch as seen by the person firing the gun. (On this subject see GYROSCOPE, by J. G. BARNARD.)

Guns both large and small are usually grooved to the right, or in the direction of the hands of a watch. The point of the projectile in these cases will move to the right, bringing the left side slightly oblique to the air, and consequently produce a deviation to the right. This peculiar deviation is called "drift," and increases in a greater ratio than the distance which distinguishes it from the deviation produced by an error in sighting a gun. Two rifles with opposite twists have been fired at the Springfield Armory at a distance of 500 yards in calm weather, and the shots carefully noted. The musket with a right-hand twist gave a mean drift to the right of 18 inches, while the one with a left hand twist gave a mean drift to the left of 19 inches. At 100 yards the drift of a musket projectile will not exceed 2 inches, while that at 1000 yards exceeds 16 feet.

The deviating effect of the wind is an important element to be considered in the movement of projectiles, more particularly on account of its varying and uncertain character. The effect will be the least on heavy projectiles moving with high velocities. A fresh wind blowing across the range of a rifle musket bullet will cause it to deviate from 1½ to 7 feet in a distance of 500 yards, and in a distance of 1000 yards from 14 to 28 feet. The rotation of the earth has the effect to make all projectiles fired in the northern hemisphere deviate to the right of the point aimed at, and those fired in the southern hemisphere to deviate to the left. This cause of deviation is only appreciable in very long ranges, and is never considered in practice.

To aim or point a firearm is to give it such elevation and direction that the projectile shall strike its object. The *line of sight* joins the front and rear sights of the piece and the object; the *line of fire* is the axis of the bore prolonged; the *angle of sight* is the angle included between the line of sight and the horizon; the *angle of fire* is the angle which the line of fire makes with the horizon; the *plane of sight* is the vertical plane containing the line of sight; the *plane of fire* is the vertical plane containing the line of fire. The most distant point where the lowest or fixed line of sight on a firearm intersects the trajectory is called the *natural point blank*, and the distance from the muzzle to this point is called the *natural point blank distance*. The English definition of point blank is that point where the projectile strikes the ground, the axis of the piece being laid horizontally and at the usual height above the ground. Having by means of the lines, etc. here described given the proper direction in aiming, it is necessary to give more or less elevation to the piece to strike the object. This information can be obtained from a *table of fire*, which gives the range, time of flight, etc. for each degree and part of a degree of the elevations likely to be required in service. These tables may be made from direct experiment, or be calculated by Didion's formulæ, which are found to answer well for the purpose.

Rapidity of fire depends on the size of the gun, the manner of loading, as at the muzzle or breech, the construction of the carriage, etc. A magazine small-arm can be fired, but without careful aim, about one shot per second for the number of cartridges contained in the magazine. A single breech loader can be fired about one shot in three seconds. The Gatling gun can be fired about 400 shots per minute. Field guns can be discharged from two to four times per minute; heavy sea-coast guns require from one to two minutes for each discharge.

All artillery firing is divided into *horizontal* fire and *vertical* fire, the former being at low and the latter at high angles of elevation. A fire is said to be *direct* when it hits its object at the first impact; it is a *ricochet* fire when it strikes the object after one or more rebounds on land or water. A *rolling* fire is a particular case of ricochet fire when the axis of the piece is placed nearly parallel to the ground; and a *plunging* fire when the object is situated much below the level of the piece. A direct fire is important when great penetration is required, as against armorclad vessels, and in cases where the nature of the intermediate surface does not ensure a regular rebound. The greatest angle under which a round projectile will ricochet depends upon the penetrability of the surface struck. On ordinary ground this angle will not exceed 15°, and on smooth water it will not much exceed 8°. If the water be rough, very little dependence can be placed on the regularity of the rebound. Artillerists divide ricochet firing into the *flattened*, when the angle of fall is between 2° and 4°, and *curvated*, when it is between 6° and 15°.

The projectile which has the flattest trajectory and least deviation from the true trajectory has the greatest chance of hitting its object if the piece be properly aimed. The mean deviation of the service rifle bullet at distances of 500 and 1000 yards is about one and three feet respectively. Rifle cannon projectiles preserve their accuracy at greater distances, increasing with their size and velocity. Accuracy of fire is properly determined by firing a certain number of shots with an unvarying aim at a target placed at the given distance. The mean distance of the shot-holes from the centre of the group is termed the *mean deviation* for that distance. For sporting rifles, however, accuracy of fire is generally measured by the *string* or sum of the distances of each shot-hole from the point aimed at. In military small-arm firing accuracy of fire is measured by the number of shots which strike in certain portions of the target; for instance, a certain space around the centre point of the target is called the "*bull's eye*," and each shot that hits in this space counts 4 points; a certain space around the bull's eye is called the "*centre*," and each shot that strikes in it counts 3 points; the remaining portion of the target is called the "*outer*," and each shot-hole made in it counts 2 points. A shot missing the target counts 0. The maximum number of points is when all are in the bull's eye.

Before a firearm can be properly aimed at a distant object its distance must be approximately known. Various instruments, known as "telemètres," plane tables, etc., have been devised for measuring distances for the military service, some of them very simple and accurate in their operation. The most reliable plan, however, is to cultivate the judgment through the eye.

Military projectiles are either *solid shot*, *shells*, or *case shot*. Solid shot are now but little employed in warfare, except in large smooth-bored cannon, when they are invariably of spherical form. Shells contain more or less powder as a bursting charge. When employed against armor-plates they are made of cast steel or chilled cast iron, and have very thick sides. As the heat generated on striking the object is sufficient to ignite the bursting charge, these projectiles have no fuze, and are known as "blind shells." A "live shell," not being intended to penetrate very resisting objects, is longer than a blind shell, and has thin sides, which give it capacity for a large bursting charge, which is ignited by a time or percussion fuze. *Shrapnel* are a species of case shot, or thin shells, containing a small bursting charge and a large number of small round projectiles made of iron or lead. By means of a properly regulated time-fuze the shrapnel is made to burst in front of and near its object. The contained projectiles, being but slightly dispersed by the bursting charge, are carried forward against the object with a velocity which the shrapnel had when it burst. *Canister* and *grape* shot are species of case shot which begin to disperse at the muzzle of the piece. They are effective at short distances only, while shrapnel are effective at nearly all distances. (Consult DIDION, *Traité de Balistique*; HÉLIE, *Traité de Balistique*; BENTON, *Ordnance and Gunnery*.)

J. G. BENTON.

Gun'ny [Bengalee] **Bag,** a sack made of jute, and used for covering cotton bales and as bags for wheat, rice, coffee, pepper, saltpetre, and many other commodities. Gunny cloth is manufactured chiefly in South eastern Bengal. But little machinery is used in the business, which employs vast numbers of people during their leisure from other employments. The work is very largely domestic in character. Immense quantities are exported to all parts of the globe. When worn out, the material makes a good stock for wrapping paper.

Gunplain', tp. of Allegan co., Mich. Pop. 2238.

Gun'powder is an explosive substance formed by the intimate mechanical mixture of nitre, sulphur, and charcoal. It is principally used in firearms and for mining; for the latter purpose, however, it has of late years been superseded to a considerable extent by gun-cotton, dynamite, and other substances of very great explosive power. The knowledge of the combustible nature of a mixture of nitre, sulphur, and charcoal is of very great antiquity; some writers place it antecedent to the Christian era. Gunpowder is known to have been employed in China in the ninth century to propel rockets; and in the early part of the fourteenth century it was first employed in firearms. The idea of employing gunpowder as a propelling power for projectiles is popularly ascribed to an accident which occurred to Berthold Schwartz, a monk of Fribourg, in 1330, but it was not until the sixteenth century that it came into general use in warfare. The earliest known proportion of the ingredients of gunpowder corresponds nearly to those of the best powders of the present day, as well as those called for by the theory of combining equivalents—viz.:

By atomic theory	74.64 nitre,	13.51 charcoal,	11.85 sulphur.
For U. S. military service	76. "	14. "	10. "
For sporting	78. "	12. "	10. "
For blasting	62. "	18. "	20. "

In blasting powder the proportion of nitre is reduced, to make it cheap; the residuum from the incomplete combustion that follows a variation of the proportions from those called for by the atomic theory being not so objectionable in mining as in firearms. A very strong and cheap powder can be made by substituting nitrate of soda for nitrate of potassa or nitre, but as it has a strong affinity for moisture, it will not retain its strength for a length of time.

The most important ingredient in powder is the *nitre*, or *saltpetre*, a substance composed of nitric acid and potassa. The principal source of the supply of this mineral is the East Indies, where it occurs as an efflorescence on the surface of the ground. In the condition in which it is imported it is called *rough saltpetre*, and contains a considerable quantity of the chlorides of potassium and sodium or common salt. These are separated at the powder-mills by the process of refining. Nations whose supplies of nitre are cut off during war are mainly dependent on artificial *nitre-beds*, as was the case during the French Revolution and in the Confederacy during the late war in this country. These beds are formed of a collection of earth, calcareous matter, mortar from stables, and animal products, such as blood, urine, etc. It may also be made from the nitrate of soda, an extensive natural product of this continent, and the chloride of potassium.

Charcoal for gunpowder is obtained by distilling the lighter kinds of wood in iron retorts. The woods most in use in this country are *willow* and *poplar;* in Europe the *common* and *black alder*, with the exception of Russia, where the *white birch* is the principal wood. The sticks should be of small size, about one inch in thickness for military powder, while still smaller sticks or twigs are employed in sporting powders. The wood should be cut in the spring when filled with sap, that the bark may be peeled off easily, and it should be well seasoned before charring. The quality of charcoal for powder depends on the heat of distillation. If it be about 1800° F., or sufficient to drive off all the volatile matters in six hours, the result is *black* charcoal. If the heat be about 500° F., or only sufficient to drive off the volatile matters in twelve hours, the result is a *brown* charcoal. Brown charcoal makes a stronger and more inflammable powder than black charcoal, but it is a powder more liable to absorb moisture, and cannot be so well preserved. Black charcoal is generally employed for military powders in Europe, and brown in this country.

Sulphur is mostly obtained from Sicily, where it occurs as a volcanic product. It is imported in a crude state, containing some 6 or 8 per cent. of earthy matter. It may be obtained, but not so cheaply, in this country from metallic ores. For powder, crude sulphur is purified by distillation and afterwards pulverized in a mill. The flowers of sulphur produced by sublimation contain more or less sulphurous and sulphuric acids, and are consequently not suited to the manufacture of powder. The tests for sulphur as a suitable ingredient for gunpowder are—1st, burning a small quantity on porcelain, when the amount of residuum should not exceed 0.25 per cent.; 2d, boiling with water and testing with blue litmus-paper, which it should only very feebly redden. Prof. Bloxam states "that sulphur is valuable as an ingredient in gunpowder on account of the low temperature (560° F.) at which it inflames, thus facilitating the ignition of the powder. Its oxidation by saltpetre appears also to be attended with the production of a higher temperature than is obtained with charcoal, which would have the effect of accelerating the combustion, and of increasing by expansion the volume of gas evolved."

The necessary operations in making gunpowder are—(1) *Refining* and *pulverizing* the ingredients. The charcoal and sulphur are first broken up in mills of peculiar construction. The nitre is generally sufficiently pulverized as it comes from the refinery. The charcoal is pulverized by rolling it in cast-iron barrels with zinc balls. The same method is pursued with sulphur, except that the barrel is made of leather stretched over a wooden frame.

(2) The second operation is *incorporation*, the object of which is to bring each particle of ingredient into close contact with the others. The process consists of two parts—mixing the pulverized materials in a rolling barrel, and then grinding them under heavy cast-iron wheels, following each other in a circular cast-iron trough. Each wheel weighs from four to eight tons, and both are joined to a vertical shaft by a horizontal axle around which they turn. The amount of mixture varies with the size of the wheel and duration of the operation. In England the charge is 50 pounds, in this country about 150 pounds; and the time varies from three to four hours. In the case of certain fine sporting powders the operation is continued as long as twelve hours. This operation is one of the most important in the making of powder, as the more thoroughly the ingredients are mixed the more complete will be their combustion.

(3) *Compressing*, to give the necessary density to the mass and strength to resist the shocks of transportation. The fragments of cake as they come from the wheel-mill are broken down under rollers, and then spread out into layers about four inches thick, and separated by brass plates. These are brought under a powerful hydraulic press, which compresses the layers to a thickness of one inch.

(4) *Graining* is the operation of breaking up the pressed cake into small fragments or grains for the purpose of increasing and regulating the combustion. It is performed by passing the cake between fluted rollers, and separating the fragments thus produced by sieves.

(5) *Glazing* is done by rolling the grains in a barrel for a certain length of time. The attrition of the grains on each other and against the sides of the barrel wears away the sharp corners and hardens the surfaces, thereby preventing the formation of dust in transportation. A high polish is sometimes given to powder by adding powdered blacklead to the charge, but this is objectionable.

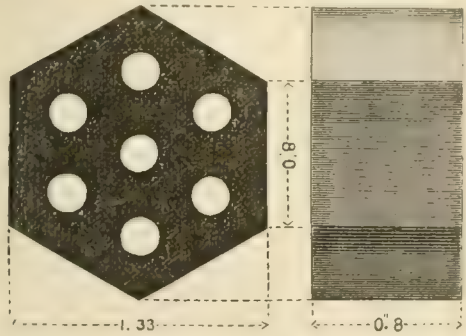
(6) *Drying* has for its object to remove the moisture that is purposely introduced in the several stages of manufacture. It is done by spreading out the powder on shelves in a room heated by steam to a temperature of 140° to 180° F.

(7) *Dusting* has for its object to remove the dust and fine grains which would otherwise fill up the interstices and retard inflammation. It is done by means of fine sieves and bolting-cloths.

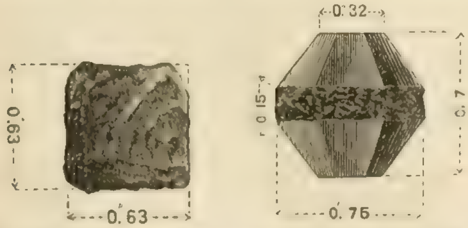
The *explosion* of a charge of powder may be divided into three distinct parts—viz. *ignition*, *inflammation*, and *combustion*. Ignition is the setting on fire of a particular grain; inflammation is the spread of ignition from one grain to another; and combustion is the burning up of the body of each grain. The heat required to ignite gunpowder is about 572° F. The friction and percussion of metals against each other or against wood will ignite powder, and so will the electric spark. The velocity with which the inflamed gases from gunpowder move in a resisting tube like a gun-barrel was determined by Robbins to be about 7000 feet per second. When forced to pass through the interstices of a charge of powder, Piobert concludes that their velocity is reduced to some 33 feet, depending on the size and form of the grains, which regulate the size of the interstices. The rate of inflammation is found to be greater for large than small charges, and for light than for heavy powders. Too much compression or ramming of a charge of powder retards the inflammation. If compression be carried to the extent of reducing the charge to a single mass, the inflammation will be entirely destroyed, and the case becomes one of simple combustion. When the inflammation has spread to all of the grains of a charge of powder, each grain burns progressively from its surface to its centre. The rate with which the burning surface approaches the centre is called the *velocity of combustion*, and is the same for the same composition and manufacture of powder, whatever may be the shape of the grain and the surrounding pressure. For English and American military powders the velocity of combustion is about 0.4 inch per second. The nature and condition of the ingredients, together with their proportions and the trituration which they undergo in manufacture, will cause the velocity of combustion to vary. The density of the grains has also an important influence on it. *The Handbook of the Manufacture and Proof of Gunpowder at the Royal Powder-Mills at Waltham Abbey* states that a difference of 0.05 in density of the powder may affect the initial velocity of a 12-pound shot, fired with a 1-pound

charge, to the extent of 50 feet per second. Probert shows by experiment and calculation that each grain of a charge of powder of the size of American mortar powder will be entirely consumed in 0.1 of a second, and that by far the largest portion will be consumed in the first $\frac{1}{50}$th part of a second. The force which accompanies this evolution of gas is exerted on the projectile before it has sensibly moved from its seat in the gun, and a corresponding strain is brought to bear on that part of the gun which surrounds the charge. In the case of large projectiles, and especially rifle projectiles, this strain is so great that it is necessary to moderate it to save the piece from rupture; and this is done by diminishing the surface of combustion of the grains which compose the charge, so that less gas shall be given off in the first instants. The total surface of combustion of a given charge of powder may be diminished by increasing the size of the grains which compose it.

Gen. Rodman, late of the U. S. ordnance department, was the first person to suggest the idea that the most suitable powder for any firearm would be one in which the grain burned from the centre to the surface, developing gas in increasing amount with the space behind the projectile as it moved along the bore. It being impracticable to carry out this idea fully with ordinary grains, he proposed instead cakes with holes running through them, for the spread of the flame. That the cakes might fit each other in the charge without loss of space, he proposed to make them of hexagonal form. This idea has been tested



by experiment in this country, and has been very generally adopted by the continental nations of Europe for making powder for heavy rifle cannon. Prism powder, as the foregoing is now called, was first made on a large scale in Russia, and in the form and dimensions given in the accompanying figure. Each cake is 0''.8 thick, and has seven holes, each 0''.2 diameter, extending through it in the direction of its axis. The powder now used in England for heavy guns, is known as "pebble powder." Its normal shape is that of a cube about 0''.63 on the side. In breaking down the cake to form the grains the edges of the cube are left in a more or less broken condition, as shown in the accompanying figure. The large grain powder heretofore employed in this country for heavy guns is known as mammoth powder, the grains of which are of irregular size and shape, varying from 0''.6 to 0''.9. Lately, a very great improvement has been made in mammoth powder by making



the grains of uniform size. In shape they are composed of the frusta of two hexagonal pyramids, separated at their bases by a prismatic space 0''.15 in height. (See accompanying figure.) The figures represent the full size of the grain in each case.

To obtain uniform results from charges of powder of the same weight, it is essential that they occupy the same space in the gun; hence it is important that the grains be of the same size, and of such shape that their volume shall not vary in handling or ramming the cartridge. It is principally for this reason that uniform results are obtained with the three kinds of powders just described for heavy guns.

Gunpowder when fired in a confined space exerts a pressure which bears a certain relationship to the density of the charge; which density is equal to the weight of the charge divided by the space occupied by the gases evolved. This relation, as determined by the experiments of Rumford, is $p = 1.841\ (1000d)^{1+0.0004d}$, in which p is the pressure in atmospheres, and d the density of the gases. The pressures of charges, the densities of which are $\frac{1}{20}$, $\frac{1}{10}$, and $\frac{1}{2}$, are 1290, 2900, and 3700 pounds per square inch respectively. The results given by the formula of Rumford are considered reliable up to a density of $\frac{1}{10}$, which includes all the densities likely to occur in practice. The absolute force of fired gunpowder, or the force which it exerts when it exactly fills the space in which it is confined, has never been satisfactorily ascertained. It has been variously estimated, however, at from 1000 to 100,000 atmospheres. The later experiments of Gen. Rodman show that it is *at least* 200,000 pounds per square inch.

Rules for the inspection and proof of powder for the military service require that the grains should be rounded and of uniform size; that they should be hard, have a certain density, and be free from dust. The size of the grains is determined by passing a certain quantity through the holes of sieves made of a certain diameter. The density is ascertained by the "densimeter," an instrument for determining specific gravity by means of mercury. The strength of powder is best determined by firing service charges in guns in which the powder is intended to be used in service, and determining the initial velocity by one of the many reliable velocimeters now used for such purposes. The strain on the gun, if of large calibre, is important, and is determined by a pressure gauge which may be inserted with the charge or affixed to the gun. The sizes of the holes of inspecting sieves are as follows, viz.: mammoth powder, 0''.9 and 0''.6; cannon, 0''.31 and 0''.27; mortar, 0''.1 and 0''.07; musket, 0''.06 and 0''.035.

The following table gives the standard initial velocities and pressures for military powders:

Powder.	Gun.	Weight of charge	Initial velocity, feet per second	Pressure pounds per sq. inch
Mammoth....	8 in. Rodman	10 lbs.	Not less than 1050	Not more than [illegible]
Cannon....	8 in. Rodman	10 lbs.	" 1,225	" 40,000
Mortar....	3 in. rifle....	1 lb.	" 1000	" 50,000
Musket....	Rifle	70 grs.	" 1300	

The new hexagonal powder has lately given in the 15-inch Rodman gun pressures as low as 18,000 pounds, with initial velocity of 1600 feet, with a service charge of 100 pounds, and a shot weighing 450 pounds.

Sporting powders and blasting powders in this country and in England are designated by a name indicative of use or peculiar quality or manufacture, as "mining powder," "duck shooting powder," "electric powder," etc. Each particular kind is again subdivided according to the size of the grain, as No. 1, No. 2, No. 3, etc., or as F, FF, FFF, and C, CC, CCC, etc. J. G. Benton.

Gunpowder Plot, a conspiracy entered upon in 1604 by several Roman Catholics to blow up King James I. of Great Britain, the ministers, and the Houses of Parliament by gunpowder, which was stored by them in the vaults under the Parliament House. The plot was to be executed Nov. 5, 1605, but was detected on the preceding day by means which are not now well understood. It is probable that some one of the conspirators revealed the plot. The famous Guy Fawkes was to be the immediate agent of the conspirators. The 5th of November is celebrated in many English, and in some New England, towns by the burning in effigy of Fawkes.

Güns, town of Western Hungary, on the Güns, famous for the persistent and successful defence of its fortifications against the Turks in 1532. Pop. 6915.

Gun'shot Wounds, wounds produced by balls or other projectiles propelled by the force of an explosive, such as gunpowder, gun-cotton, or the like. They differ in some essential points from other wounds; they are generally accompanied by shock, and complicated by the presence of foreign bodies in the wound, such as the ball or projectile itself and pieces of clothing or accoutrements which the ball has carried with it and before it. Another element of their danger consists in the fact that they generally occur in large numbers, as in war, when the accumulation of a large number of suppurating wounds gives rise to dangerous complications, such as erysipelas, pyæmia, and hospital gangrene; add to that, that in protracted wars the constitution of the men has already suffered by camp life, bad diet, and exposure, producing typhus, dysentery, scurvy, etc. When, after the discovery of gunpowder, gunshot wounds first became known, surgery being then in its infancy, these wounds were looked upon as the result of some supernatural and maleficent agency, and were therefore often treated by incantations and the like, or they were looked upon as poisoned either by the powder or the ball, and were treated with a view to destroy the poison—for

instance, by pouring boiling oil into the wound. At the present day the treatment of gunshot wounds has become more simple and rational; even the extraction of the ball is no longer looked upon as of such absolute necessity as formerly. Still, some erroneous notions have prevailed till very recently. Thus, it was maintained that the wound of exit of the ball was always larger than that of entrance—a question which might be of importance in a legal point of view. Recent investigations have shown that the above is not true, and that the wound of entrance is often larger than that of exit. Another mistaken idea has prevailed with regard to what was called the "wind of the ball." A round shot will not unfrequently crush the parts under the skin without wounding the skin; this was ascribed by some writers to the compression of the air, by others to the vacuum which the ball leaves behind it in its passage, and again by others to electricity, thought to be acquired by the ball by friction through the gun and its rapid passage through the air. Recent investigations have done away with these erroneous notions, and have proved that a spent round shot may roll over a part of the body when it touches at an obtuse angle like a wheel, crushing everything beneath the skin, without breaking or wounding the skin itself.

Taking a statistical view of gunshot wounds and their fatality on a large scale, we find that on an average the number of those killed outright on the field of battle to those wounded is about in the proportion of 1 to 5, and that of the wounded about 14 to 15 per cent. will die of their wounds. Thus, the number of killed in battle in the U. S. army during the civil war was 59,850. The number of gunshot wounds from May 1, 1861, to June 30, 1865, was 235,585; of the latter, 33,653, or 14.2 per cent., died of their wounds. The Confederate army lost 57,425 killed in battle, and had 227,871 wounded. In spite of these formidable numbers of killed and wounded, it must not be overlooked that in protracted wars internal diseases incidental to, and as yet unavoidable in warfare carry off a by far larger number of men than all the hostile engines of death. WM. DETMOLD.

Gun'ter (EDMUND), b. in 1581 in Herts, England; was educated at Westminster and Christ Church, Oxford, where he passed M. A. in 1606; in the same year invented the sector; took orders in the Church, and in 1619 became professor of astronomy in Gresham College, London; made use of a logarithmic scale before 1624, and d. in London Dec. 10, 1626. His works best known are *Canon triangulorum* (1620); *Of the Sector, Cross staff*, etc. (1624); *Description of His Majesty's Dial* (1624). Is best known by the chain, scale, line, and quadrant which bear his name.

Gun'ter's Chain, the invention of Edmund Gunter, is 66 feet in length, and is used in land-measuring. It is composed of 100 links; consequently, 10 square chains, or 100,000 square links, are contained in an acre.

Gunter's Scale. See GUNTER (E.).

Gun'tersville, post-v., the county-seat of Marshall co., Ala., on the S. bank of the Tennessee River, at its southernmost point. It has 1 weekly newspaper. Pop. 244.

Gün'ther (ALBERT CHARLES LEWIS GOTTHILF), M. D., F. R. S., b. at Esslingen, Würtemberg, Oct. 3, 1830; was educated at Tübingen, Berlin, and Bonn, and in 1858 became connected with the zoological department of the British Museum. Author of several valuable works on fishes, reptiles, and batrachians, of which the most important is the noble catalogue of the fishes in the British Museum (8 vols. 8vo, 1859–70), and edited (1864–70) the *Record of Zoological Literature.*

Guntoor', district of the presidency of Madras, British India, bordering N. on the Kistna and S. on the Bay of Bengal. The coast is so low that it cannot be seen at a small distance. It is consequently dangerous and little visited. Area, 4960 square miles, with 570,089 inhabitants.

Guntoor, the capital of the Kistna collectorate, presidency of Madras, British India, is in the Guntoor district, 252 miles N. of Madras and 40 miles W. of the Bay of Bengal. Pop. 26,000.

Gu'ra Spring, tp. of Etowah co., Ala. Pop. 722.

Gurhwal', an independent dominion of India, under the protection of the British. It is situated on the southwestern slope of the Himalayas, and consists of mountains, some of which rise to the height of 23,000 feet. It contains the sources of the Ganges, for which reason it is yearly visited by thousands of pilgrims. Area, 4500 square miles. Cap. Serinagur. Pop. 309,947.

Guriev', town of Russia, on a delta-island of the river Ural, near its mouth; peopled by Cossacks, who maintain considerable trade and some manufactures. It is 188 miles E. N. E. of Astrakhan. Pop. 16,162.

Gur'ley (JOHN A.), b. at East Hartford, Conn., Dec. 9, 1813; was a Universalist minister of Methuen, Mass., 1834–37, and for fifteen years edited the *Star of the West* in Cincinnati, O. He was a member of Congress from Ohio 1858–62, and was the first governor of Arizona (1862–63). D. at Cincinnati, O., Aug. 19, 1863.

Gurley (RALPH RANDOLPH), b. at Lebanon, Conn., May 26, 1797; graduated at Yale 1818; removed to Washington, D. C., and became a licensed preacher (Presbyterian); was (1822–72) agent of the American Colonization Society, and one of the founders of Liberia. Author of *Lives* of J. Ashmun and S. Larned, and of a narrative of his *Mission to England* in behalf of colonization; was long editor of the *African Repository.* D. at Washington, D. C., July 30, 1872.

Gur'nard, a name given to some marine fishes of the family Triglidæ and of the genera *Trigla*, DACTYLOPTERUS (which see), *Peristethus*, *Prionotus*, etc. The number of genera in the family is about thirty. Several species, called grunters, sea-robins, sea-swallows, cuckoos, etc., are found in American waters. These fishes have the head, or in some genera the whole body, covered with hard plates. They often have numerous sharp spines and fantastic-looking appendages, which give them a singular appearance, but their flesh is generally very good. The red gurnard, found on both sides of the Atlantic (*Trigla enculus*), and the sapphirine gurnard of Europe (*T. hirundo*), are among the most important species.

Gur'ney (Sir GOLDSWORTHY), KNT., b. in England in 1793; educated for the medical profession, he became early absorbed in the study of practical chemistry, and in 1822 delivered a course of lectures on chemical science at the Surrey Institution, which were published in 1823; was the inventor of the "lime light," the "magnesium light," the Bude and the oil-gas lights; also of the high-pressure steam-jet and the tubular boiler; and in 1829 drove a steam carriage from London to Bath over the turnpike road at a speed of 14 miles per hour. By means of his high-pressure steam-jet, first applied to locomotives Oct., 1830, the rate of speed was increased from 12 to 30 miles an hour; it was subsequently successfully used to ventilate and extinguish fires in coal-mines; it was further applied in 1849 to the exhaustion and consumption of the poisonous gases from the sewers of London. In 1852 he was appointed to assume charge of lighting and ventilating the new houses of Parliament, which he accomplished by a method of his own. In his early lectures he claimed to have been the first to observe the deflection of the magnetic needle, the basis of the electric telegraph; knighted in 1863. D. Mar., 1875.

Gurney (JOSEPH JOHN), b. at Earlham, near Norwich, England, Aug. 2, 1788; was educated at Oxford without formally entering the university, and in 1818 became a preacher of the Society of Friends. He was distinguished for labors in behalf of prisoners, which he carried on in conjunction with his sister, Mrs. Fry, and was also an active friend of the abolition of slavery. His ample wealth was freely used in benevolent causes. He travelled extensively in the U. S., the West Indies, continental Europe, etc. while prosecuting his charitable enterprises. D. at Earlham Jan. 4, 1847. His biography was written by Bernard Barton (*Memorial*, etc., 1847) and by J. B. Braithwaite (2 vols., 1854). Among his quite numerous works are *Notes on Prison Discipline* (1819), *On the Religious Peculiarities of the Society of Friends* (1824), *Portable Evidences of Christianity* (1827), *Sabbatical Verses* (1837), *A Winter in the West Indies*, and other books of much value. Mr. Gurney's doctrinal views called forth some opposition in the U. S., and the resulting controversy led to the separation of the party called Wilburites from the main body of Orthodox Friends in 1843.

Gurow'ski, de (ADAM), COUNT, b. at Kalisz Sept. 10, 1805. In youth his ardent and expressed sympathy with the Polish cause resulted in his expulsion from school, and in 1820 he went to Germany, where he pursued his studies for the next five years. Returning to Poland, he was on several occasions imprisoned for his active sympathy with the opponents of Russia. He was a prominent instigator of the revolution of 1830, and acted agent of the republicans in France, where he remained in exile after the insurrection was suppressed. In 1835 he published a work (*La vérité sur la Russie*) advocating Panslavism, and was in consequence recalled to Russia and employed in the service of the emperor. Here he remained till 1844, when he secretly left Russia on account of troubles at court, and went to Berlin; here and at Heidelberg he pursued his studies, delivering lectures in the mean time at the University of Berne, Switzerland, on political economy. In 1849 he came to the U. S., and was for a time professor of languages; from 1861 to 1863 he was a translator in the department of state at Washington. He was the author of numerous works in various languages. Among his published works in this

country are *Russia as it Is*; *America and Europe*; and *My Diary*. D. at Washington, D. C., May 1, 1866.

Guspi′ni, town of Sardinia, in the province of Cagliari. In its neighborhood are the ruins of Neapolis, an ancient and important town mentioned by Ptolemy, which was destroyed by the Saracens. Other antiquities exist in the vicinity, among them several *nuraghi*, or round towers of a peculiar construction, the origin and purpose of which are doubtful. Pop. in 1872, 5716.

Gusta′vus, post-tp. of Trumbull co., O. Pop. 928.

Gusta′vus I. Va′sa, king of Sweden, the son of Eric, duke of Gripsholm, was b. at Lindholm May 12, 1496, and was descended lineally from the old Swedish kings; educated at Upsala, he entered the public service (1511) at a time of general discontent with the Danish domination, a large party having openly pronounced for independence. Vasa was one of the hostages sent in 1518 to warrant the safety of the Danish king, and was treacherously sent in irons to Denmark; escaped in 1519; listened to Luther's preaching, and became his correspondent; returned to Sweden, where his father was killed in 1520; headed an insurrection of Dalecarlians in 1521, whom his eloquence aroused from apathy to patriotic fervor; gained the battle of Westeraas (1521); was made administrator of Sweden, of which he became king in 1523; openly professed Lutheranism in 1527; and in 1528 made it the state religion. His reign was disturbed by domestic wars with the peasants and with the reactionary party, and by contests with Russia. D. at Stockholm Sept. 29, 1560. Though a man of noble moral qualities and excellent ability, Vasa was a somewhat arbitrary ruler, but his reign was a great blessing to Sweden.

Gusta′vus II. Adol′phus, grandson of Gustavus Vasa, was b. at Stockholm Dec. 9, 1594 (old style); succeeded Charles IX., his father, Nov. 8, 1611; found the nation at war with Denmark, Poland, and Russia, the king of Poland, Sigismund, his cousin and the lawful heir of the Swedish crown, having been set aside for being a Roman Catholic; detached Denmark from the alliance by a treaty in 1613; gained great advantages over Russia, and forced the czar to a disadvantageous peace in 1617; overran Polish Prussia, and was wounded at Dantzic; and though the Poles were sustained by the emperor Ferdinand, who put Gustavus under the ban and let loose Wallenstein upon him, he made an advantageous truce of six years; landed again at Usedom in 1630, and joined issue with the emperor in the great Thirty Years' War (which see); and the last two years of Gustavus's life were the most glorious of all. The great battle of Leipsic, Sept. 7, 1631, Tilly's first defeat, established the fame of Gustavus; the victories of Würzburg and the Lech (Apr. 10, 1632), where Tilly received his death-wound, added to that fame. The generalship of Wallenstein drew him into Saxony, and the foes met at Lützen Nov. 16, 1632, where Wallenstein was defeated and Gustavus fell covered with wounds. The first tactician and the first disciplinarian of his age, a man of large ambition for military glory, his most marked trait was nevertheless his profoundly religious spirit. As a ruler he showed what he might have been by the improvements introduced in the industrial, commercial, and mining interests of Sweden, and by the valuable changes he made in the internal economy of his government. Few names are held in more reverent esteem by the entire Protestant world than that of Gustavus Adolphus.

Gustavus III. of Sweden, b. at Stockholm Jan. 24, 1746, succeeded his father, Adolphus Frederick, in 1771. His reign was much disturbed by conspiracies, the machinations of the Hat and Cap factions, and wars with Denmark and Russia. Gustavus was a man of ability and ambition, but his vacillating and perhaps treacherous disposition, and his disregard of the constitutional limits of his power, bred much discontent, and he was shot by Ankarstroem at a masked ball, and d. of the wound Mar. 29, 1792.—His son, Gustavus IV., b. Nov. 1, 1778, succeeded to the crown in 1792; was robbed of Pomerania by Napoleon, and of Finland by the czar Alexander; was forced to abdicate in 1809, was succeeded by Bernardotte (Charles XIV.), and d. at St. Gall Feb. 7, 1837. He was a vain, incompetent, and tyrannical man.

Gustavus Adolphus Society, a society of German Protestants, organized in 1832 in consequence of resolutions adopted on the two hundredth anniversary of the death of Gustavus Adolphus (which occurred Nov. 16, 1632, new style). This society is very popular in Germany, and also in the Netherlands and Sweden. Its object is the assistance of weak congregations of evangelical Protestants in all parts of the world. Its annual receipts are now about $150,000, which are distributed among more than 900 congregations.

Güs′trow, town of Mecklenburg-Schwerin, on the left bank of the Nebel. It has a fine cathedral and considerable breweries and distilleries. Pop. 10,575.

Gu′tenberg (Henne or Johann), b. at Mainz, Germany, about 1400, was the son of one Gänsfleisch, and probably took his mother's name; removed in 1420 to Strasburg, where in 1436 he took several partners for the practice of wonderful secret arts by him invented. Of these arts, that of printing with movable types was the most important. Books printed before this time are all of the class called block-books, printed from engraved plates of wood or metal. It is certain that Gutenberg and his associates had a printing-press, with other essential apparatus for practising the new art, as early as 1438, but it is not known that any books were printed until after the formation of his partnership with Faust and Schöffer at Mainz in 1450. (See Faust.) In 1465, Gutenberg, who had for some years been carrying on printing by himself, left the business and entered the court of the elector of Nassau. D. at Mainz Feb. 24, 1468.

Guth′rie, county of S. W. Central Iowa. Area, 576 sq. m. It is a fertile prairie region. Grain and wool are staple products. Cap. Panora. Pop. 7061.

Guthrie, tp. of Lawrence co., Ind. Pop. 1292.

Guthrie, post-v. of Guthrie co., Ia., on the Chicago Rock Island and Pacific R. R., 90 miles E. of Omaha.

Guthrie, tp. of Faribault co., Minn. Pop. 550.

Guthrie (James), LL.D., b. near Bardstown, Ky., Dec. 5, 1792, of Scotch origin. He acquired an education at the academy at Bardstown, and at once commenced the study of law; admitted to the bar in Louisville, Ky., where he soon built up a lucrative practice; represented Louisville several times in the legislature with marked ability; chosen presiding officer of the convention which formed the new constitution of Kentucky 1850; appointed secretary of the treasury by Pres. Pierce 1853–57; elected to the U. S. Senate (1865), but resigned on account of ill-health. D. at Louisville, Ky., Mar. 13, 1869.

Guthrie (Thomas), D. D., son of a banker, was b. at Brechin, Forfarshire, Scotland, July 12, 1803; graduated at the University of Edinburgh; studied medicine in Paris; was settled at Arbirlot, in his native county, in 1830; in 1837 removed to Old Grey Friars church in Edinburgh, and in 1840 to St. John's, a new church built for him in the same city; in 1843 took a prominent part in the establishment of the Free Church; encouraged the building of manses; inaugurated in 1847 the Ragged School system; was moderator of the General Assembly in 1862; was compelled to give up public speaking in 1864, when he began to edit the *Sunday Magazine*; and d. at St. Leonard's, Fifeshire, Feb. 24, 1873. He was an ardent Christian, an earnest philanthropist and social reformer, and a very brilliant orator. Among his humanitarian publications may be named *A Plea for Ragged Schools* (1847), *A Plea for Drunkards* (1856), *The City, its Sins and Sorrows* (1857). He published also *The Gospel in Ezekiel* (1855), *Christ and the Inheritance of the Saints* (1858), and *The Way to Life* (1862). His sons issued his *Autobiography and Memoir* in 1874. R. D. Hitchcock.

Guthrie Centre, post-v. of Guthrie co., Ia., 50 miles W. of Des Moines. It has a newspaper, 2 churches, 2 schoolhouses, 1 hotel, 1 mill. Principal business, farming.
Hess & Kautzman, Eds. "Journal."

Gut Manufacture. See Catgut, Goldbeaters' Skin.

Guts-Muths (Johann Christoph Friedrich), b. at Quedlinburg, Germany, Aug. 9, 1759; was educated at Halle; studied divinity, and in 1786 became overseer in gymnastics at Schnepfenthal, where he d. May 21, 1839. He was one of the founders of modern German gymnastics; published a series of textbooks on gymnastics and other athletic exercises, and some school geographies and other educational books.

Gut′ta Per′cha is the hardened milky juice of the *Isonandra Percha* or *I. Gutta*, a large tree, which grows in Malacca, Borneo, and other islands of the Indian Archipelago, and also, according to Bleekrode, procured from *Sapota Mulleri*. The milky juice exudes from incisions in the bark made after the tree is cut down, and is inspissated by boiling. Crude gutta percha is purified either by rasping in water to remove soluble impurities, and then heating to 230° F. to reduce to a compact mass; or by dissolving in bisulphide of carbon and evaporating the filtered solution. The purified gutta percha has a brownish-red color, and a specific gravity of 0.979. It becomes electrical by friction, and is a very poor conductor of electricity; hence it is used for forming insulating supports for electrical apparatus and for covering telegraph wires which are to be immersed in water. At about 115° F. it softens and becomes pasty, without losing its tenacity. At

104° F. it may be easily spread out in sheets, drawn into tubes, applied to any surface, or worked into any desired form. It will take the finest impressions from a mould. It is used for water-pipes, mouldings, and, mixed with linseed oil, for the moulds employed in making electrotypes. It is insoluble in water, and but slightly soluble in alcohol and ether. Boiling olive oil dissolves a little of it, but deposits it again on cooling. It is readily soluble in bisulphide of carbon, benzol, chloroform, and oil of turpentine, especially when heat is applied. Alkalies and hydrofluoric acid have no action upon it. Bottles and other vessels for the latter acid are made from it. Oil of vitriol carbonizes it, and strong nitric acid converts it into a yellow resin. It yields volatile oils by dry distillation. Gutta percha consists of—

1. Pure gutta..........	$C_{10}H_{16}$	75 to 82 per cent.
2. Fluanil..............	$(C_{10}H_{16})2O$	6 " 4 "
3. Alban	$C_{10}H_{16}O$	19 " 14 "

The fluanil and alban are products of the oxidation of the gutta. The fluanil is a yellow resinous body, soluble in cold alcohol; the alban, a crystalline substance, insoluble in cold, but soluble in boiling alcohol. The gutta is insoluble even in boiling alcohol. Pure gutta is obtained by exhausting gutta percha with water and hydrochloric acid, dissolving in boiling ether, pressing the substance which separates on cooling, repeating the operation as long as anything is taken up by the ether. The pure gutta is perfectly white, cakes together at 212° F., begins to melt at 300° F. Gutta percha is strongly attacked by ozonized oxygen and by strong hydrochloric acid. It rapidly deteriorates by oxidation when exposed to the air, especially in warm climates. It loses its flexibility, tenacity, and extensibility, and becomes very brittle and entirely useless for industrial purposes. Mixed with sulphur or certain sulphides, and heated to 260° or 300° F., the gutta percha undergoes a change similar to that which occurs during the vulcanizing of caoutchouc. (See INDIA-RUBBER.) Gutta percha is chiefly employed for coating submarine telegraph-wires. For this purpose it will probably be replaced by *kerite*, a preparation of India-rubber which is not affected by the air. (For further details see URE'S *Dict.*, MUSPRATT'S *Chemistry*, and articles by T. M. BLOSSOM, E. M., in the *American Chemist*, vol. ii., 1871, p. 81 *seq.*) C. F. CHANDLER.

Gut'ta Ro'sea ("rosy drop"), a name somewhat vaguely applied to skin diseases in which some of the sebaceous glands of the nose and face become the seat of inflammatory action, often of a very obstinate kind. The name includes often those cases of *acne* so common among young persons of either sex just as they are coming to years of maturity. The whelks or tubercles which appear upon the faces of hard drinkers come under the same general name. Regulation of the habits in any case is the most essential condition of cure. Mild lead lotions, with iron, are useful.

Gut'ta Sere'na [Lat. "the clear drop," so called in distinction from *gutta opaca*, or cataract; it being the belief of the ancients that drops of some humor of untoward quality fell into the eye and quenched the sight], an old synonym for AMAUROSIS (which see); the "drop serene" of Milton.

Gut'tenberg, post-v. of Clayton co., Ia., on the W. bank of the Mississippi, 40 miles above Dubuque. It has mines of lead, and is in a beautiful locality. Pop. 1040.

Guttif'eræ, a synonym for the Clusiaceæ, a natural order of exogenous trees and shrubs, all tropical or subtropical, and sometimes epiphytic. Many of them have resinous and balsamic juices, and the fruits of some species are prized as food. The timber of some of these trees is of great value. Gamboge and tacamahac are products of the order, which has one representative species in Florida.

Gutzkow (KARL FERDINAND), b. in Berlin, Germany, Mar. 17, 1811; studied philosophy and theology; became an acknowledged head of the "Young Germany" party. His *Wally die Zweiflerin* (a novel, 1835) caused his imprisonment for three months, its tendency being considered atheistical and destructive to social order; and this opinion was confirmed by his *Nero* (1835), a dramatic piece. He afterwards attained very great popularity as a novelist, dramatist, and journalist, but has been subject to occasional attacks of insanity. He has lived in various German capitals, and since 1870 at Berlin. Noteworthy among his works are *Zur Philosophie der Geschichte* (1836, written against Hegel); *Blasedow*, a satirical tale (1838–39); *Zopf und Schwerdt* (1844) and *Urbild des Tartufe* (1847), comedies; *Uriel Acosta* (a tragedy, 1847); *Die Ritter vom Geiste* (1850–52); *Der Zauberer von Rom* (1859–61); *Fritz Ellrodt* (1872), and many other novels. Notwithstanding the popularity of his works, his influence is regarded as deplorable by many thoughtful critics. D. Dec. 16, 1878.

Gütz'laff (KARL FRIEDRICH AUGUST), b. near Stettin July 8, 1803; went in 1823 as a missionary of the Dutch Church to Singapore, and showed wonderful proficiency in the acquisition of languages; went to Java in 1826, to Siam in 1828, and to China in 1831; became in 1834 interpreter and secretary of the British legation; sustained himself without connection with any missionary society, and was beloved by the Chinese, among whom he practised medicine with great success. D. at Hong-Kong Aug. 9, 1851. Among his works are *Journal* (1834); *Chinese History* (in English, 1834; in German, 1847); *China Opened* (1838); *Life of Tao-Kwang* (1852); and numerous papers on the geography, social life, and religion of the Chinese, into whose language he translated the New Testament.

Guy (THOMAS), founder of Guy's Hospital, Southwark, London, b. at Horseleydown in 1644; carried on business first as a bookseller, importing English Bibles from Holland; then as a financier, buying the prize-tickets of seamen at a large discount and investing the money in stocks. By this means he amassed a fortune of nearly £500,000, which, at his death in 1724, he bequeathed to charitable purposes. He founded the Stationers' Company, and different charitable institutions at Tamworth, his mother's birthplace, received large grants.

Guy'an, tp. of Gallia co., O. Pop. 1279.

Guyandotte, tp. and post-v. of Cabell co., West W., on the Ohio, at the mouth of the Guyandotte River, and on the Chesapeake and Ohio R. R., 4 miles above Huntingdon. It has 1 weekly newspaper. Pop. 427; of tp. 2095.

Guyon (Mme. JEANNE MARIE BOUVIER DE LA MOTHE), b. at Montargis, France, Apr. 13, 1648, and in 1664 married the wealthy but uncongenial M. Guyon, a tyrannical and irreligious man, who late in life was converted to her own religious views. He d. in 1676, leaving his wife free to foster that state of spiritual exaltation to which from infancy she had been inclined. Severe penances, untiring labors for the spiritual good of others, the abandonment of her property for the use of her children, the guardianship of whom she surrendered, led her to a state in which she believed herself to be the bride of Christ, united in soul with God, having daily and hourly communication with Heaven, being invested with what she termed the apostolical state, in which she could discern the spiritual state of those whom she met. She was much with one Lacombe, a Barnabite of mystical views, a devout man who was long her confessor, and who d. insane; and Mme. Guyon's enemies spread many scandalous rumors regarding this relationship, but no one who knew her ever believed any of these reports. She was (1688–89) confined as a Quietist in the Visitation convent of Paris, her brother, a monk, being the chief instigator of her imprisonment, for the pope in 1687 had condemned Quietism, and most of the French bishops now condemned Mme. Guyon's books; and Fénelon, for defending her, was involved in the persecutions which fell upon her. She was liberated through the agency of Madame de Maintenon, and for a time lived at the French court. She was (1695–1700) confined at Vincennes and in the Bastile, where she suffered many indignities. When released she retired to her daughter's house at Blois, where the rest of her life was spent in works of charity; and there she d. June 9, 1717, in full fellowship with the Roman Catholic Church, which she had never forsaken. But the leading divines of that Church suspected her of heresies, and her most appreciative admirers have been Protestants. John Wesley especially, while disapproving strongly of some of her teachings, cannot withhold from her his hearty praise. She left a considerable number of volumes containing hymns, letters upon spiritual questions, and devotional treatises, some of them of a highly mystical character. The best *Life* is that by Upham (2 vols., 1848–50). The so-called autobiography is probably not altogether her own.

Guyon (RICHARD DEBAUFRE), a general in the Hungarian army during the revolution of 1848–49, was of English descent, b. at Wolcott, near Bath, in England, Mar. 3, 1813. In 1832 he entered the Austrian service, but after marrying the countess Splényi in 1838, he lived as a private citizen on his estates near Comorn. As soon as the revolution broke out he offered his services to the national government, and accompanied Görgei as a brigadier-general on his victorious march to Buda and on his unfortunate retreat to Temeswar. On many occasions Guyon distinguished himself by his audacity and inexhaustible energy. After the battle of Temeswar (Aug. 9, 1849) he escaped to Turkey, and entered the service of the sultan. Under the name of Kourshid Pasha he was governor of Damascus, and during the Crimean war he organized the army of Anatolia. D. at Constantinople 1856.

Guyot (ARNOLD HENRY), PH. D., LL.D., M. N. A. S., b. near Neuchâtel, Switzerland, Sept. 28, 1807; was educated at Neuchâtel, Stuttgart, Carlsruhe, and the University of Berlin, where he graduated Ph. D. in 1835; continued his studies in Paris 1835–39. Though at first a student of theology, he gave especial attention to the natural and physical sciences. With Agassiz, his early associate, he accepted 1839 a professorship in the Academy of Neuchâtel, just founded, to carry on a post-graduate course of higher studies, and filled the chair of universal history and physical geography from 1839 to 1848. During these ten years he studied the structure and physics of the modern and the extent of the ancient glaciers of the Alps. He discovered the laminated character of the ice of glaciers, and the fact that the movement of the glacier is due to molecular displacement, mainly under the action of gravity, explaining thereby the principal laws of glacier motion which he had found and pointed out. He then investigated the subject of the transportation of Alpine boulders around the Central Alps, determined for the first time the real limits of each erratic region in Switzerland, Savoy, and Lombardy, as well as the vertical limits of the phenomenon, and demonstrated the identity of the laws of the distribution of erratic débris with those of moraines of glaciers. His observations were to have been published in full in the *Système Glaciaire* of Agassiz, Guyot, and Desor (Paris, 1848), of which, however, only the first volume was printed; but the most important results are found in the *Bulletin of the Society of Natural Sciences* of Neuchâtel, and in *Archives d'Histoire de la Géologie*, vol. ii., Paris, 1848. He removed in 1848 to the U. S.; delivered (1849) the lectures in French, translated by Pres. Felton of Harvard College, and published as the *Earth and Man* (1849). These lectures inaugurated the movement of reform in geographical teaching which has been since going on, and to foster which he was employed for six years by the Massachusetts board of education as a lecturer on physical geography. He organized for the Smithsonian Institution a system of meteorological observations, superintended the construction of the improved instruments now in use; published *Directions for Meteorological Observations* (1850), and a volume of *Meteorological and Physical Tables* (1851–59); travelled extensively in the U. S., and made numerous and important hypsometrical observations, especially in the Appalachian Mountain system, from Maine to Georgia, partly published in a paper on the *Physical Structure of the Appalachian Mountains* in *Silliman's Journal of Science* (1861); became in 1855 professor of geology and physical geography in the College of New Jersey, Princeton; is author of the treatise on physical geography in *Johnson's Family Atlas of the World*, and of a series of school geographies (1866–75); has also published a series of wall-maps for schools. In 1873 his geographical works received the medal of progress at the Vienna Exposition; has also written numerous scientific lectures and papers. He received the honorary degree of LL.D. from Union College; was one of the original members of the National Academy of Sciences created by Congress; is associate member of the Royal Academy of Turin; honorary correspondent of the Royal Geographical Society of London, and of the Geographical Society of Paris; member of the American Academy of Boston, American Philosophical Society of Philadelphia, and other learned societies.

Guys'borough, the north-easternmost county of the mainland of Nova Scotia. Its surface is partly rough and broken. It abounds in mineral wealth, especially in gold. Its coast line is broken by many bays and harbors. Cap. Guysborough. Pop. 16,555.

Guysborough, port of entry and cap. of Guysborough co., N. S., on the W. side of Milford Haven. It was settled in 1783. Its harbor is commodious. Fishing and gold mining are important industries. Guysborough is the seat of a large academy. Pop. about 1000.

Guy's Hospital, a great charitable institution of Southwark, London, named from its founder, Thomas Guy, who began its erection in 1722, and at his death most liberally endowed it. In 1829 it received large benefactions from a Mr. Hunt. It was first opened in 1725.

Guyton-Morveau (LOUIS BERNARD) was b. at Dijon Jan. 4, 1737. He studied first law, and had become an attorney when he determined to devote himself exclusively to the study of natural science, especially chemistry. At his instigation chairs of chemistry, mineralogy, and medicine were erected at the Academy of Dijon, and he filled the first-mentioned one till 1790. During the Revolution he was active as a politician, and voted for the immediate execution of Louis XVI. He contributed much to the erection of l'École polytechnique in Paris, at which he became a professor. From 1800 to 1814 he was director of the mint. D. in Paris Jan. 2, 1816. His chief merits as a chemist are his discovery of the disinfecting qualities of chlorine, made in 1773, and since that time extensively utilized, and his establishment of a new and simpler chemical terminology, the idea of which he conceived in 1783, and in the execution of which he was aided by Lavoisier. But his experiments and researches have also been of great influence in the manufacture of saltpetre, gunpowder, prussian blue, etc., in the employment of cement for building under water, and in many other instances of practical application of chemical science. His principal works are *Dictionnaire de Chimie* (1786), *Méthode d'une Nomenclature chimique* (1787), *Traité des moyens de désinfecter l'air* (1801), *Rapport sur la restauration d'un tableau de Raphael* (1802).

Gu'zerat, an old province of Hindostan, consisting of the peninsula of Kattywar, projecting into the Arabian Sea between the Gulfs of Cutch and Cambay, and an irregularly shaped territory on the mainland between Baroda, Gwalior, and British India, between which powers Guzerat, containing 40,000 square miles, with about 6,000,000 inhabitants, is now divided, parts of it forming the northern districts of the presidency of Bombay, and part belonging to the Guicowar.

Gwa'lior, a region of Central Hindostan, formerly belonging to the family of Scindia, but now governed by a maharajah who is tributary to the British government. Its northern part is low, occupying the basin of the Jumna; the middle part is hilly, and the southern covered with branches of the Vindhyan and Santpoora mountains. Area, 33,119 square miles. Pop. 3,228,000.

Gwalior, capital of the state of Gwalior, on the Subanrika, an affluent of the Jumna, but with very little water in the dry season. In the midst of the city rises a rock, perpendicular, 300 feet high, 1½ miles long, and 300 yards broad. This rock has been used as a fortress for more than 1000 years; but leaving the natural advantages of the position out of sight, the fortifications are picturesque, and nothing more. At the foot of the rock stretches the city, built in the ancient Hindoo style, hot, squalid, uninviting. Pop. 30,000.

Gwin (WILLIAM MCKENDRY), b. in Sumner co., Tenn., Oct. 9, 1805; was educated at Transylvania University; studied medicine, and removed to Vicksburg, Miss.; became U. S. marshal 1833; was in Congress 1841–43; as commissioner of public buildings supervised the construction of the New Orleans custom-house 1847; went in 1848 to California; was in the constitutional convention 1849; U. S. Senator 1850–61; was imprisoned for disloyalty 1861–63; took part in a scheme for colonizing Sonora with people of Southern birth 1864–65; and, according to a report (officially denied by the imperial representative), was appointed prefect of Northern Mexico under the short-lived empire of Maximilian.

Gwin'iad [Welsh, "white fish"], or fresh-water herring, a lake fish of Northern Europe, the *Coregonus fera*, of the salmon family, closely resembling the white-fish of the American lakes, though greatly inferior to it as food. It is caught in England and Wales in large quantities, and salted, and sold to the poor at very cheap rates.

Gwin'nett, county in the N. of Georgia. Area, 550 square miles. It is hilly, but fertile. Granite, gold, antimony, and iron have been found here. Grain, tobacco, cotton, and wool are produced. It is traversed by the Atlanta and Richmond Air-line R. R. Cap. Laurenceville. Pop. 12,431.

Gwinnett (BUTTON), b. in England about 1732; emigrated to Charleston, S. C., in 1770, and became engaged in agriculture (1772). He took an active part in the political questions of the time during the Revolution, was elected by the general assembly of the province a representative to the general Congress, and was a signer of the Declaration of Independence. He was killed in a duel by Gen. McIntosh May 27, 1777.

Gwynn (NELL) was b. about 1650 in London, in the most abject poverty. Nor was her career upward to the top of society very enviable. She sold oranges in the taverns, and sang and danced for money, and became the mistress of the actors Hart and Lacy. In her sixteenth year she went upon the stage, and made a great hit in humorous and lascivious rôles, after which she became the mistress of Lord Buckhurst. In 1669, Lord Buckhurst sold her to the king, and in 1675 she was appointed a lady of the privy chamber to Queen Catharine, and received the name of Madam Ellen. But once raised to this station, her behavior made her rather popular. She was coarse, but kind, generous, witty, and pleasant. She helped her old friends among the actors and poets with great liberality, and did harm to none. She gave the first idea of the erection of Chelsea Hospital for disabled soldiers, and she was generally believed to exert herself in support of the Protestant

cause at court. She bore two sons to the king, of whom the one died early, and the other was created duke of St. Albans. After the death of Charles II. she lived in retirement, and when she died (about 1690) her funeral sermon was preached by Dr. Tenison, afterwards archbishop of Canterbury. Two memoirs have been published of her—one by John Seymour in 1752, and another by Peter Cunningham in 1850.

Gwyn'edd, post-tp. of Montgomery co., Pa. Pop. 2094.

Gyarmat-Balassa. See BALASSA-GYARMAT.

Gy'aros [Γύαρος], one of the Cyclades, now uninhabited and employed as a sheep-pasture. It lies S. W. of Andros; was anciently proverbial for the poverty of its people; and was a place of banishment for the Romans. It is very small and rocky.

Gy'ges, the founder of the dynasty of the Mermnadæ in the kingdom of Lydia, was the favorite of King Candaules, and in possession of a ring by means of which he could make himself invisible. Urged by the king, who boasted of the beauty of his wife, Gyges concealed himself in the bed-chamber of the queen in order to see her naked, but was discovered. The queen, indignant at the affront offered her, gave him the choice of being put to death himself or of killing her husband. He chose the last, and became king about 716 B. C. D. 678 B. C. The Delphic oracle confirmed him in his new position, and he acquired great wealth. The story of the ring is told by Plato, and the ring of Gyges was with the ancient Greeks a symbol of extraordinary good luck, like the lamp of Aladdin with the Arabs.

Gylip'pus [Γυλιππος], son of the exiled Spartan general Cleandridas; commanded two Spartan galleys for the relief of Syracuse, then (414 B. C.) besieged by the Athenians; took command of the Sicilian land forces, by the aid of which (413) the siege was broken up. In 412 he returned to Sparta; for the Syracusans, notwithstanding his brilliant and successful efforts in their behalf, seem to have despised him and treated him with open insult. (PLUTARCH, *Nicias*, 19, 21, 28.) He was afterwards banished from Sparta for having stolen a part of the treasure sent from Athens by Lysander, and probably d. in exile. Ælian states that he was a *Mothax*—that is, a man of Helot birth, brought up as a Spartan, and allowed a part of a citizen's privileges, but there is reason to doubt the truth of the statement.

Gymna'sium [Gr. γυμνάσιον, from γυμνός, "naked"] properly designates a place for athletic exercise, but in ancient Greece the great gymnastic schools became also places for lounging, for conversation, for study, and for oral instruction. Thus, the gymnasium finally became a school. But except in Germany and some other European countries the name has reverted to its original sense. (See GYMNASTICS.) In Germany, the gymnasia are the schools where young men are fitted for the universities. Latterly, most of the instruction in practical studies, mathematics, foreign languages, and the like, for those who do not intend to enter the universities, are taught in the REALSCHULEN (which see).

Gymnas'tics [Gr. ἡ γυμναστική (τέχνη), from γυμνός, "naked"], the systematic exercise of the muscles for the preservation or restoration of health and the development of the physical powers. Hardly any other nation ever put the gymnastic art so thoroughly in practice as did the ancient Greeks. They knew that much of the enjoyment of life depends upon the possession of a vigorous physical constitution. All free-born youths were exercised systematically in the gymnasium; in the Doric states even young women took part in the exercises. The Greek physicians often prescribed gymnastics as a means for the recovery of health. To the thorough physical culture of the Greeks we must undoubtedly give much of the credit for their intellectual and artistic successes. Gracefulness and strength in movement and sanity of mind and body were national characteristics, for which the Greeks owed much to the gymnasium. Rome borrowed the Grecian physical culture, but only in her later days. In the Middle Ages knightly and rustic pastimes, tourneys, and feats of arms on the one part, and wrestling, boxing, archery, and other exercises of strength on the other, took, to some extent, the place of the old physical culture; and it was not till a comparatively late time that interest in these things began to die out. Modern gymnastics originated early in the nineteenth century in Prussia. Germany, Scandinavia, and France adopted them for schools and for the soldiery, and in all these countries private enthusiasm did much for the cause. Basedow, Jahn, Guts-Muths, and Salzmann were the great promoters of this reform. Great Britain's upper and middle classes, always fond of manly exercises, have given an important but not a prominent place to gymnastics. In the U. S., chiefly through the influence of the colleges, the Caledonian societies, and of the German Turners, there has been of late an awakening of interest in the subject.

Gymne'trus, a remarkable genus of fishes of the family *Trachypteridæ*. They inhabit deep parts of the sea, and are

Hawken's Gymnetrus.

seldom seen. *G.* or *Regalecus Banksii* and *G. Hawkenii* are found in the Atlantic waters. They are board-like in form, very much compressed, and from six to twenty feet in length. Their ventral fins are reduced to the form of oar-like filaments. These fishes are very delicate and fragile, and when found some of their parts are usually wanting.

Gymnoc'ladus [γυμνος, "naked," and κλαδος, a "branch," referring to the absence of small boughs], a genus of the order Leguminosæ, of a single species, the *G. Canadensis*, called coffee tree, stump tree, and chicot. It is a handsome tree, with peculiar and very compound leaves, but in winter it appears as if dead, from the absence of small branches. Its wood is valuable to the joiner and furniture-maker, and the very hard seeds have been used for coffee.

Gymnodon'tes [from γυμνός, "naked," and ὀδούς, "tooth"] are a sub-order of Plectognath fishes, distinguished by a complete union of the bones of the upper jaw and the consolidation of their dental armature, as well as that of the lower jaw, in exposed, beak-like masses, with or without median sutures; the scapular arch is also characterized by the atrophy of one of its bones (the hypercoracoid). The various species are distinguishable by a greater or less eccentricity of form and deviation from the fish-like type, some having sac-like bodies, with the belly more or less distensible, and others by a truncation of the body behind, and a consequent absence of the caudal peduncle and true fin. Three families belong to this group—viz. Orthagoriscidæ, Tetrodontidæ, and Triodontidæ, whose representatives are known popularly as salt-water sun-fishes, swell-fishes, porcupine-fishes, etc. THEODORE GILL.

Gym'nogens, a synonym for GYMNOSPERMÆ (which see).

Gymnono'ti [from γυμνός, "naked," and νῶτος, "back"] are a sub-order of Teleocephalous fishes, distinguished by the brain-case of the skull produced forward; symplectic bones present; pterotic normal; opercular all present; branchiæ normal; four anterior vertebræ, much modified and united in a single mass, with which are connected the ossicula auditus; air-bladder connected by a duct with the intestinal canal; and an anus far in front and in advance of the scapular arch, or even behind the symphysis of the lower jaw of a prolonged snout; the body is elongated and finless on the back, but with a long anal continued far forward. To this sub-order belong two families of South American fishes: (1) Gymnonotidæ, which includes a number of genera and species, and (2) Electrophoridæ, of which the only well-determined representative is the famous electrical eel. THEODORE GILL.

Gymnoso'mata [Gr. plu. for "naked-bodied"], a name applied to those pteropod mollusks which are naked, having neither mantle nor shell (except sometimes a rudimentary one); the head distinct; fins upon the sides of the neck, and the gill not often distinctly developed. They constitute one family, the Cliidæ, which some divide into three or more. The number of known species is small. All are marine, and the right whale feeds largely upon some of the species, engulfing great numbers in its open mouth, and straining them from the water by means of its baleen.

Gymnos'ophists [Gr. γυμνοσοφισταί, "naked philosophers"], a name given by the Greeks of Alexander's time to the Fakirs of India. (See FAKIR.)

Gymnosper'mæ [from the Gr. γυμνός, "naked," and σπέρμα, "seed"], a sub-class of exogenous plants, including the Coniferæ, the Cycadaceæ, and the Gnetaceæ or joint-firs. They have either no pistil or an open leaf or scale serving as a pistil, the seeds and ovules being therefore naked (that is, destitute of a pericarp), the ovules being fertilized by the direct contact of the pollen. They have been called polycotyledonous plants, because there are sometimes (not always) more than two cotyledons to the embryo.

Gymnotus Electricus. See ELECTRICAL FISHES.

Gyo'ma, town of Hungary, on the Körös, is celebrated for its excellent wine. Pop. 8587.

Gyöngyös', a well-built and beautifully situated town of Central Hungary. It has a considerable trade in corn, fruit, wine, cattle, and horses. Pop. 15,850.

Gyp'sies. *First Appearance in Europe.*—It is generally assumed, on the authority of M. H. M. G. Grellman (*De Zigeuner*, Leipsic, 1783), that the gypsies first appeared near the North Sea in 1417, and that this must have been shortly after their migration from their fatherland, India; but more recent research indicates that small bands of them had long before this date been found in Europe, and that great numbers of them had been living in Greece and those countries where Greek is spoken, in all probability as early as the eleventh century. Little now, however, is known with regard to their presence in Eastern Europe previous to the year 1417, except that, although held as serfs, they were inveterate vagabonds, and in all respects, as to appearance and manners, the same as those of every country in the world at present. In 1417 they suddenly appeared in Germany in hordes of hundreds, which in a few years swelled to thousands. In that year, says Herman Korner, "a strange multitude of Oriental vagabonds came into Germany, . . . appearing at first by the sea, beginning at Lunenburg, whence, coming into Prussia, they went through Hamburg, Lubeck, and other cities. They went afoot, camped by night afield, being thieves and fearing arrest in cities. They were about 300 in number, ugly, black as Tartars, and called themselves *Seccani*. They had leaders, a duke and count, whose judgments they obeyed. They were great thieves, especially the women: many of them were in many places arrested and slain. They bore letters of commendation from princes, especially from the Roman emperor Sigismund, through which they were admitted to cities, princes, castles, towns, bishops, and prelates, by whom they were kindly treated. Some of them rode." Another contemporary writer shrewdly observes that those who rode changed their horses very frequently. "They said that the cause of their wanderings and pilgrimage was a penance for having relapsed to Paganism after being converted to Christianity, and this penance of wandering had been enjoined on them by their bishops for seven years." Rufus, a Low German writer between 1400 and 1430, observed them very closely, and states that they were called Tartars by the common people, but *Ciani* in Italy. He utterly disbelieved their story of the penitential pilgrimage by which his contemporaries were deceived, declaring it to be his conviction that they were born vagabonds and thieves, "*nullam agnoscentes patriam*"—knowing no country. They care for no religion, he adds, and live but for the day. "A wonderful rabble (*vollunties hominum*), skilled in all languages, but dire for the rustics." Another writer of that period says they appeared as "baptized heathens" in Switzerland, at Bâle, Zurich, and other places. They appear to have been the same party seen at Hamburg with the duke and count, "who wore silver girdles and rode," bearing the imperial letter. In 1422 they appeared in Bologna, headed by a "duke of Egypt," named Duke Andrew. Inspired by the success of the (probably forged) letter from the emperor Sigismund in Germany, they added to the old story of their being renegades and penitents by declaring that Hungary was their original country, the king of which having conquered them in battle, had sent them on a seven years' penitential pilgrimage, and had granted them a decree which they showed, "authorizing them to rob and steal without being amenable to justice." They remained in Bologna fifteen days, stealing freely. It would appear that faith and respect attached to their "license," since the authorities did not arrest them, but decreed that any one whom they had robbed might steal to an equal amount from them; and the Bolognese availed themselves of this to such an extent that the gypsies were glad to escape to Rome. They were "*la più brutta genia*"—"the most beastly people ever seen in those parts. Black and lean, they ate like pigs. The women went in chemises." From a description of their hair, color, and ornaments they were evidently low caste Hindoos.

Name and Origin.—The first gypsies did not profess to come from Egypt, but the name Egyptian having been applied to them, it was soon corrupted to gypsies. That some of them came *through* Egypt is likely from several Coptic words, and in Egypt to-day Copts call themselves *Gypti*. But from the beginning they were universally called Cingari or Chingani, varied in Italy to Zingari, in Spain to Zincali, in Germany to Zigeuner. An immense amount of learning and research has been devoted to the origin of this word. But as it is given among the gypsies of Persia to a large class among themselves, the saddle-makers, or Zingari, which has given its name in turn to the Zinganeh, a Kurd tribe, supposed to be of gypsy origin, this is possibly the true root. Among themselves they never say gypsy, but always *Rommany*. There exist in India several kinds of wandering pariahs or outcasts, which are identical in all respects with gypsies, the latter, however, uniting in one the peculiarities which in India attach to different bodies. Prominent among them are the Doms, whose name, it is probable, is identical with that of *Rom*, by which gypsies distinguish themselves all the world over. The Hindoo *d* generally changes to *r* in the Rommany or gypsy language (*e. g.* *doi*, a "spoon," into *roi*); and as the words Dom, Domni, and Domnipana mean in Hindoo, a Dom, a female Dom, and "the being a Dom," so Rom, Romni, and Romnipen have precisely the same signification, and in common use as applied to a gypsy, his wife, and gypsydom. The antiquity of the Doms is indisputable, as they are mentioned in the Shasters, where they are called Sopuckh, or "dog eaters." At the present day in India they roam about, living in tents, eat swine which have died a natural death, carry out corpses, etc., and flay animals; all of which are habits or pursuits peculiar to gypsies, or were so when they first appeared in Europe. The Doms of India, like gypsies, make baskets and mats, which they sell while roaming about. Their women sing, play on musical instruments, and frequent weddings, as did the gypsy-women of Italy and Spain. Unlike all other Hindoos, the Doms are madly addicted to intoxication, being "so fond of drinking that they spend nearly the whole of their earnings on spirits." Even in Germany the excessive fondness of gypsies for spirits was observed in early times. The name Dom was probably the first type of that of Rom, but other causes may have helped to form it. In Hindoo, as well as English, a similar word signifies roaming. Many gypsies passed through Egypt on their way westward, and in Coptic—which was more generally spoken in the eleventh century than at present—*Romi* means, as in gypsy, a "man;" and it is also probable that from their long sojourn in Roumania and among Greeks, who are generally called Rūmi in the East, being confounded at an early period with *Romans*, they spoke of themselves as Romani when they first appeared in Hungary. There is, however, in India another body of outcasts which probably contributed largely to the gypsies, but at a *later* period, the first immigrants being Doms. These are the Nāts, which all European residents in India call simply gypsies, so identical are they with them. The Nāts "are noted thieves, wander about, are addicted to conjuring, legerdemain, and theatrical pursuits." It may here be remarked that there is probably *not one* theatre or circus in England or America in which there are not one or more performers of more or less mixed gypsy blood. The Nāts tell fortunes by chiromancy, and live, like English gypsies, in tents of dark blanket-stuff. Many of the men are skilful blacksmiths. Their women sell love-potions and charms against the evil eye, just as in Europe. The personal appearance of these tribes is peculiar, and so identical with that of gypsies that any one who is familiar with the one cannot fail to recognize the other. This is especially seen in a very singular and characteristic glitter of the eye, and an expression not to be seen in any other kind of Easterns, excepting perhaps Persians, who often resemble gypsies. Like North American Indians, the gypsies all walk with the feet *straight*; so that, as a gypsy once informed the writer, he could tell the track of one of his own people among a hundred *gorgios* (or non-gypsies). There are in India two or three other roaming castes which have strongly marked gypsy traits. The use of a secret language among most of these wanderers, and especially by the Nāts, also identifies them with gypsies. Nothing is as yet known which explains the fact why at one period there was apparently a vast and sudden migration of them from India. The pariahs or outcasts of that country have in their ranks many men of genius, and it is to the writings of members of the Poorachchameyyan and Valloovan sects of pariahs and similar heretics that India owes its best literature in a literal sense. It is probable that the first leaders of the gypsies into Europe, who are described as men of rank and knowledge, were of this class, and that, owing to the free thought which sprang from Booddhism, the ranks of the intellectual pariahs were at one time largely augmented, the result being an effort to deliver themselves by emigration from the extreme tyranny to which they were subjected. The only history of their early migration is contained in their language. We shall speak more in detail of one group of European gypsies.

English and Scotch Gypsies.—Their dialect contains Greek, Slavonian, Magyar, and German words. To these Miklosich adds French, but the 10 "French" words given by five different writers are not all French, and the rest are either not gypsy or are doubtful. The immense number of Indian and Persian words collected among English gypsies by the writer, and not as yet found on the Conti-

nent, renders it possible that the English branch are of a separate migration; which seems the more likely from the fact that many of these so called Greek, etc. words are also of Indian origin. The first Gypsies slipped over into England very quietly. An anonymous writer in 1612 states that they first began to gather to a head in the south of England about 1512. They had a king named Giles Hather, and a queen, "Calot." They roamed about in some state, cheating poor country-girls of everything, and stealing. The vagabond element seems to have been developed and perfected in England by gypsies, and the *old* Cant, or early thieves' slang, was founded on Rommany. In 1522 they were described as an outlandish people calling themselves Egyptians, exercising no craft but palmistry and robbery, etc. In 15[illegible] they were included in a search made through Sussex for all "vagabonds, gypsies, conspirators, prophesiers, players, and such like." From some cause it would appear that gypsies during the reign of Henry VIII. were imported into England. A fine of £40—a large sum for those days—was imposed in consequence on every gypsy entering England; and at one time a great number were reshipped to France. Yet in 1563 there were fully 10,000 of them in England. At this time they taught their language freely to recruits. Acts for their suppression being useless, it was made felony without benefit of clergy for any person above fourteen years of age to keep company with them; and Judge Hale remarks that at one assize a few years before the Restoration 13 gypsies were executed—*i. e.* simply for being gypsies. It should be remembered that the outrages and evils committed by them were incredible, and even at the present day the *Rommany* is the life of the entire vagabond population of the roads in England, it being almost impossible to find a tinker or petty hawker who is not part gypsy. There are now but a few hundred full-blooded *tent*-gypsy persons in England (1874), but of *kairengroes*, or house-dwellers, who keep their gypsy blood a secret, and of half breeds (*churedi* or *posh an posh*), or of those affiliated by blood—all of whom possess the great secret of the Rommany language to a greater or less degree—there are perhaps 20,000. As the tinkers in England are all gypsies, and as they were probably the same in the time of Shakspeare, since he speaks of "their own language," it is thought by some that John Bunyan was of gypsy origin, as his father was a tinker, and as he himself speaks of being of the most despised *race* in the land. The old class of gypsies in England occasionally speak Rommany very purely, and mourn for the dead, as in Germany, by abstaining from some peculiar food for years, or from some pursuit or pleasure. They also refrain from mentioning the name of the dead, and otherwise manifest great respect for them. Gypsydom in England received its first blow at the period of the American Revolution, when great numbers were forced into the fleets and armies serving in America. Most of these deserted, finding America a congenial home. Another great blow to English gypsyism was the railroads, and of late years the Enclosure Act, which by enclosing all commons and wastelands has deprived them of places to camp. At present (1874) they are being driven with great severity from all their old camping-grounds. In an outskirt of London called the Potteries about 1000 live in small houses, especially during the winter. Dr. R. Bright in 1818 first gave the world some account of the English gypsy language, followed by John Hoyland in 1816. Hoyland was an English Quaker who married a gypsy girl. The gypsies of the present day are by no means so dishonest as is generally supposed, though, like all childish, ignorant, and very poor people, they yield to temptation. When implicitly trusted they are very honorable, and are grateful for *kindness*. They are all strong of body, are good rough-riders, and box well. They are very quarrelsome, continually fighting, and even murdering, among themselves, but very seldom trouble *gorgios*. When one is arrested for crime, his friends make incredible efforts to obtain his release. Of late years the works of George Borrow have attracted much attention towards them. They burn the clothes of their dead, and sometimes other valuables. The writer knows of a young gypsy who recently (1874), because he had been jilted and disgraced by his bride's not coming to the wedding, broke his watch to pieces and burned his wagon. Their favorite food is the hedgehog, stewed or roasted. It should be known that gypsies among themselves ridicule fortune-telling as being mere *hockerben* or lying, as the writer has learned from frequent conversations with them on the subject.

Tradition asserts that gypsies were in Scotland in 1460. In 1506 James IV. granted them a letter of favor, deluded by the old story of their being penitents. For many years their true character was not suspected. When it was intimated to the gypsy king that it was time for him to leave the kingdom and end his pilgrimage, "commanded by the pope," he declared that he had been robbed by some of his subjects, and obtained the aid of government. It is said that James V., while travelling in disguise, was cruelly treated by two gypsies of a band of three, in consequence of which he made a law that whenever three tinkers or gypsies were found together, two should be hanged and the third set at liberty. This order was in force only one year, and with this exception the gypsies were unmolested. They multiplied prodigiously, and married well among the natives, their thieving habits, as Simson (himself a Scotchman) asserts, proving no bar to such connections, "as the Scottish people were accustomed to thieving of all kinds." After a period of peace was established severe edicts against the gypsies appeared in 1592, 1600, 1603, 1609, etc. But though to be a gypsy was a capital crime, and they were hunted down with excessive severity, they remained in great numbers; and it was only after the persecution ceased that they rapidly diminished. Until a very recent period the Scottish gypsies were generally robbers and villains of the worst kind, availing themselves of the popular weakness for romance and boldness to outrage law, as they appear, according to Simson, to have always been popular. Until within fifty years, Scotch gypsies divorced themselves by killing a horse with several Hindoo ceremonies; and the writer has found English gypsies who preserved the tradition of such a custom. In Scotland gypsies call themselves *Nawken*. A small town (Kirkyetholm) was at one time peopled by them, in consequence of a gypsy, by his bravery at the siege of Namur, having obtained a grant authorizing his descendants to dwell there. At present very few remain in it, great numbers of Scotch gypsies having gone to America, where they generally become at once house-dwellers, and are lost to view. At one time, English gypsies buried their dead in remote places, but at present they are careful to secure Christian burial. Their ordinary weddings generally consist of nothing but an announcement and a feast, but of late years the better class obtain the aid of a clergyman. They have several Hindoo superstitions not known to the English, such as the evil eye and a belief that the blind-worm sees for half the year out of his right eye, and half with his left. Like the Hindoos, they send cooked food for three days to the family of a deceased person, and call it by nearly the same words (*kair habben*; in Hindoo, *kaná khana*). Their children are very beautiful, and the old people are distinguished by a peculiarity which is also observed among their ancestors, the doms of India. Their hair seldom turns gray, even in advanced age, unless there be "white" blood in their veins. During the summer the gypsies frequent races, where they set up cocoanuts or toys to be thrown at at a halfpenny a throw, or keep "Aunt Sallies" (a similar game), while their women beg and tell fortunes. They also frequent fairs, where they sell horses, and haunt pic-nics with their games or music. In the autumn, during a period of three days, hundreds of them may be seen in London crowding one or two favorite shops (of which Belrose's is the chief), and buying baskets, brooms, clothes-lines, etc.; after which they wander all over England, selling them. Formerly, they made their baskets, but of late years they purchase the French, on which they make a profit of over 200 per cent. As winter advances the men begin to manufacture clothes-pins and butchers' skewers, by which they earn two shillings a day. Chair mending with split rattan is in England exclusively followed by quarter-blood gypsies or those more remotely allied to them; no one can walk far in London without seeing one or more seated on the curbstone hard at work. This class speak very little Rommany. Gypsies are in England industrious; the women, however, earn more than the men. On the whole, they earn twice as much as farm-laborers, and lead much happier lives. They are very fond of tea and beer, and always live well. The men greatly prize a coat or other garment from a gentleman, particularly from a patron, far above its value. This is also characteristic of Hindoos. There are nearly 100 English gypsy family-names, most of which are represented in America.

It has been asserted that there are no gypsies in America, but there are in reality more than in Great Britain, and in fact those of other countries are here in great numbers. Mr. Simson says (in his *History of the Gypsies*, London, 1865) that he met in America with French, Hungarian, German, and English gypsies, and speaks of a village in Pennsylvania and of one in New England originally established by gypsies, and in which Rommany is still secretly spoken. Many peddlers in America are gypsies, and many of the smaller tin, crockery, and basket "stores" in New York are kept by half or quarter blood gypsies. The tinware which they sell is of a plain, coarse kind, so that a gypsy tin-store is easily known. A very large proportion of the itinerant cutlers and tinkers in American cities are German, Hungarian, or French gypsies. Hungarian gypsies are sometimes to be found in negro-minstrel and other

bands. There are a number of gypsy musicians in Baltimore. Many of the fortune-telling women in our cities are half-blood gypsies. Within a few years the number of wandering tent gypsies has largely increased in America, many of them roam from Canada to Texas; the writer is well acquainted with one who did this. They are, like all gypsies, very reticent as to their language. Yet very few among the wanderers possess a large vocabulary or speak Rommany well, and the reader who will devote a very few weeks to either Dr. B. Smart's vocabulary, to G. Borrow's *Romano Lavo Lil*, or C. G. Leland's *English Gypsies* (London, 1872), can in a few weeks speak the language better than most gypsies. (See ROMMANY LANGUAGE.) CHARLES G. LELAND.

Gyp'sum [from the Greek γύψος]. Gypsum is a mineral, the natural bihydrated calcium sulphate, $CaSO_4 + 2H_2O$, crystallizing in the monoclinic system. The translucent crystalline varieties are known as selenite (from selene, the "moon," in allusion to the characteristic soft lustre); the ordinary massive forms and opaque crystals as gypsum; the finer granular sub-translucent massive kinds, as alabaster, and fibrous varieties, as satin spar. In hardness gypsum varies from 1.5 to 2.0, and the specific gravity of pure crystals is from 2.314 to 2.328. Heated, this mineral gives off its contained water, and becoming opaque falls to a powder, which has the power, if moistened, of rapidly "setting" or assuming again the solid form. Upon this property depends the most extensive application of this mineral in the arts, as plaster of Paris is made from it by heating and subsequently grinding it to a fine powder. It is also used as a fertilizer and in the manufacture of glass and porcelain. Alabaster, being of great beauty and easily carved on account of its softness, is extensively used for ornamental purposes. Extensive deposits of gypsum are worked in England, France, and other countries of Europe, and also in the U. S. and Nova Scotia. The latter occur in the Palæozoic series of rocks, but this mineral occurs most abundantly in the Mesozoic or Secondary formations, especially in association with deposits of rock-salt. Gypsum is also found generally in volcanic regions. In the U. S. gypsum is recorded from a great number of localities, more or less extensive beds having been met with in Virginia, Tennessee, Michigan, etc., and in imitative forms of scrolls, vines, flowers, shrubbery, etc., it constitutes one of the wonders of the Mammoth Cave, Ky. Perhaps the most celebrated gypsum-beds in the world are those of Montmartre, near Paris, which have given rise to the name "plaster of Paris," and which are rich in the remains of Tertiary mammals. These quarries are classical ground in science, as they furnished to the great Cuvier the materials upon which he based his observations on the philosophic history of life on the earth. EDWARD C. H. DAY.

Gypsum Creek, post tp. McPherson co., Kan. P. 117.

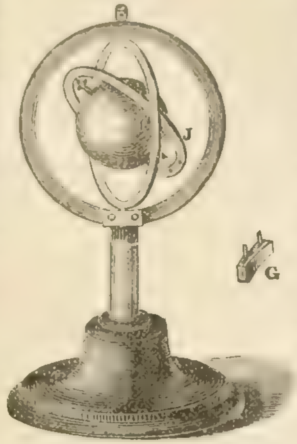
Gyrenceph'ala [from γυρόω, to "bend" or "wind," and ἐγκέφαλος, "brain"] are those mammals in which the superficies of the cerebrum is folded into gyri or convolutions (as implied by the name), and the cerebrum itself extends over more or less of the cerebellum, and generally over the olfactory lobes: they were considered by Owen as a "sub-class," and in the group were included the quadrumanous Primates, Carnivores, Ungulates, Proboscideans, Toxodonts, Sirenians, and Cetaceans. Man was excluded, through a peculiar interpretation of certain characters, as the sole representative of a corresponding group called Archencephala. This sub-class has not received the approbation of original investigators, although it has found considerable currency in popular and semi-popular works. The Gyrencephala and Archencephala had been combined long previously in a group named (by Bonaparte) Educabilia, for more valid reasons. THEODORE GILL.

Gyr'falcon, the *Falco gyrfalco* of Iceland, Scandinavia, Asia, and North America, one of the most highly esteemed of the noble falcons used in hawking, was trained with great difficulty, and commanded a very high price. It is about two feet long, and has mostly white plumage, especially when full grown. Some writers distinguish a second species of gyrfalcon, *Falco candicans*. The name is also spelled *gerfalcon* and *jerfalcon*.

Gyro-Pigeon. See PIGEON, GYRO.

Gy'roscope [Gr. γῦρος, a "ring" or "circle," and σκοπεῖν, to "view"], a word first applied, as is believed, by Foucault to that form of the instrument designed by him to show ocularly the rotation of the earth; it became thereafter the received name for the curious instrument sometimes known as the "mechanical paradox." It illustrates "a particular case of the rotational motion of ponderable bodies," viz. that case in which such a body is a rapidly rotating solid of revolution, held by, but free to move about, a fixed point in its axis of figure and rotation. Poisson (*Méc. Analytique* and *Journal de l'École Polytechnique*, cah. 16), at the conclusion of his analytical investigation of this "particular case," remarks: "There is to be seen in many philosophical cabinets a machine of Bohnenberger which exhibits with fidelity all the circumstances of this rotational motion, just as Atwood's machine gives ocular illustration of all the circumstances of the motion of falling bodies." This (Bohnenberger) machine (Fig. 1) was first described in the *Tübingen Blätter für Naturwissenschaft*, etc., 1817, and also in Gilbert's *Annalen*, vol. lx., p. 60, and is the oldest, the prototype, of gyroscopic instruments. Designed, probably, to illustrate the precession of the equinoxes, and consisting merely of a spherical or spheroidal body so balanced in gimbals that its axis is free to take any direction, it is well fitted to illustrate, *first*, the *stability of direction* of the axis of rotation of a solid of revolution possessing high rotary velocity (this may be done by placing the instrument on the revolving disk of a centrifugal machine; the axis of the rotating sphere will continue invariable, or nearly so, in direction); *second*, by attaching the small weight G to the inner ring J near one of the extremities of the axis of the rotating spheroid, a preponderance is established *tending* to tilt or pull down that extremity, but *actually* causing a slow horizontal gyration or *precessional* motion.

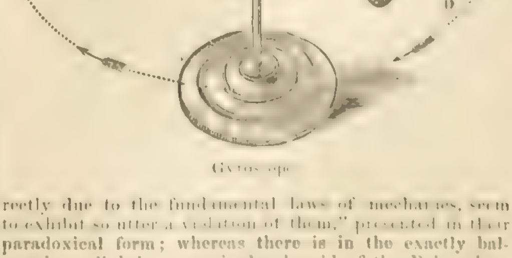
FIG. 1.



Bohnenberger Machine.

In 1831 (see *Am. Jour. Sci.*, vol. xxi., 1832), Prof. Walter R. Johnson of the University of Pennsylvania invented a machine to which he gave the name of "rotascope," and which, possessing all the qualities comprised within the narrow scope of the Bohnenberger machine, afforded the means for curiously illustrative experiments in which it has not really been equalled in any subsequent invention. It is not within the compass of this paper to enumerate these experiments, or even minutely to describe the instrument. Reference must be made to the volume just cited, and to an interesting lecture by Prof. Snell printed in the *Annual Report of the Regents of the Smithsonian Institution* for 1855. It is sufficient to remark that with the combined wheel and inner ring, disconnected from the other parts, all the characteristic experiments of the *common* and popularly known "gyroscope" were exhibited by Prof. Johnson.* By this latter instrument (Fig. 2) we have the phenomena which, "though so directly due to the fundamental laws of mechanics, seem to exhibit so utter a violation of them," presented in their paradoxical form; whereas there is in the exactly balanced or slightly overpoised spheroid of the Bohnenberger machine nothing of this *apparent* violation of fundamental laws—nothing which so perplexes, and, even to scientific observers, seems at first sight to invoke "some

FIG. 2.



Gyroscope.

* At a later date the instrument in the more familiar form was brought out by Mr. J. H. Lane, now of the U. S. Coast Survey, and named by Prof. Olmstead the "Mechanical Paradox."

new and hitherto unknown mechanical principle, or some modification of those already admitted." The rotascope of Prof. Johnson seems to have remained for many years as little known as had been the Bohnenberger machine: something was needed to make it an object of general attention, which seems to have been found in the novel and startling applications, by Foucault, of the Bohnenberger machine and the pendulum, to the ocular exhibition of the diurnal rotation of the earth. Neither Poisson, who, in his solution, already referred to, of "a particular case of rotational motion, etc.," prepared the way to a complete analysis of the gyroscope, and who in reference to the pendulum investigated the motions of bodies near the surface of the rotating earth, nor Laplace, who, in the remarkable words, "Though the rotation of the earth is now established with all the certainty that belongs to the physical sciences, nevertheless a *direct proof* of the phenomena could not fail to be highly interesting to geometricians and astronomers," seemed to desiderate some ocular demonstration—neither of these great analysts caught the clue which their own researches offer to the invention of such an ocular exhibition. It was reserved for the greatest genius in this sphere of invention of modern times, the late Léon Foucault, to furnish to the eye the "direct proof" desiderated by Laplace, by means of the "freely suspended" pendulum, and again, and independently, by means of the gyroscope.

Nearly contemporaneous with these inventions of Foucault was the invention of oblong projectiles for rifled arms, by aid of which the rifled weapon, whether of small-arms or of cannon, speedily superseded the smooth-bore; and the phenomena of "deviation" which these rapidly rotating projectiles exhibited gave rise to the invention of Prof. Magnus of Berlin (*Poggendorf Annalen*, vol. xc. pp. 175 and 371, and vol. lxxxviii. p. 18) of a gyroscopic instrument ("rotations-apparate") designed to illustrate his theoretical deduction that this "deviation" had a common origin with that of the already familiar gyroscopic phenomena.

The gyroscope in its common form, and the phenomena which it exhibits (Fig. 2), are now so familiar to every one as to need but few descriptive words. The wheel or circular disk A of the instrument having, by well-known means, been put in motion with very great velocity, the bearing-point C of the ring in which the disk and axis are mounted is placed on the point of an upright support B. Not only does the rotating disk (with its ring) *not* fall, as would happen were there no rotation, but, preserving the angular elevation of its axis, it takes up a slow horizontal angular motion (gyration) in the reverse direction to that in which, by rotating, the upper periphery of the disk is moving—*e. g.* the disk in the figure revolves as marked by the arrow near its top; its *gyration* is as the arrows along the indicated horizontal circle D. If the direction of disk-rotation be reversed, so will be that of the gyration. It will be found also that the *rate of gyration* is the same for all elevations of the axle, and that the greater the rotating velocity of A the *slower* will be the gyration—that as (by friction and the resistance of the air) rotatory velocity is lost, the *gyratory* velocity increases simultaneously, with a gradual dropping of the outer extremity of the axis, which, with continually accelerated gyratory velocity, falls in a descending spiral (or helix), until finally the bearing C, if not prevented, escapes (slips off) from its point of support. Still more puzzling, still more paradoxical, is that phase presented by placing the wheel (rotating with *very* great velocity) on the point of support with axis considerably elevated. Instead of falling as it gyrates, the axis will *rise*.

A full analytical exposition of these phenomena cannot be attempted here. Every student of mechanics (and the analysis which follows will be intelligible to none other) is familiar with the principle of *moments* or "areas," by virtue of the latter of which the sum of the areas described by the radius vector of bodies acted on by central forces remains constant. Expressed in terms of "moments of the quantity of motion," it affirms, among other things, that the sum of these moments with respect to any axis cannot be altered by forces acting *parallel to that axis.* For the purpose of analysis, we must suppose an imaginary gyroscope in which (Fig. 2) the rotating wheel or disk A alone *has mass*, the axis (the ring excluded) being an immaterial rigid line resting and held at a fixed point at O. Let C be the "moment of inertia" of the solid referred to its axis of rotation, and A the common value of that moment with respect to all other "principal" axes though the *point of support*.

M = the mass.

γ = the distance from the centre of gravity to the point of support.

ψ = the *azimuth* angle (counted positively in the reverse direction to that in which the disk by its rotation n would roll as a wheel) made by the axis with any arbitrarily chosen horizontal line of direction through the point of support.

θ = the *vertical* angle made by the axis at any instant, with the *inferior* vertical drawn through the point of support.

α = the *initial* value of the same vertical angle.

n = the *angular velocity* of rotation of the disk.

g = the force of gravity.

The wheel being put in rotation with the velocity n, Cn will represent the moment of the quantity of motion about its axis *of figure*; and Cn multiplied by $\cos\alpha$ the moment of that same quantity of motion referred to the inferior vertical. If, by the action of gravity, the disk is pulled down to any angle of elevation denoted by θ, Cn multiplied by $\cos\theta$ will then be the expression, and hence an increment in the sum of "moments" $Cn(\cos\alpha - \cos\theta)$ will have resulted.

Suppose that, in falling, *the axis of figure*, motionless at first, has *acquired* azimuthal angular motion $\frac{d\psi}{dt}$; this implies rotation, about, as an instantaneous axis, a principal axis of A in the same vertical plane, of angular velocity $\sin\theta\frac{d\psi}{dt}$, and the sum of the moments with respect to this axis will be $A\sin\theta\frac{d\psi}{dt}$. This sum, referred to the inferior vertical as an axis, becomes $A\sin^2\theta\frac{d\psi}{dt}$.

But since these effects are due to a force (gravity) acting parallel to the axis about which they are measured, the "principle" of moments (or of "areas") demands that these acquisitions neutralize each other, or that $A \sin^2\theta\frac{d\psi}{dt} + Cn(\cos\alpha - \cos\theta) = 0$;

which may be put in the form

$$(1)\qquad \sin^2\theta\frac{d\psi}{dt} = \frac{Cn}{A}(\cos\theta - \cos\alpha).$$

If λ be the length of the simple pendulum which would swing at the same angular velocity as the disk (considered as suspended at O), the *total* angular velocity acquired must be that due to the action of gravity *through the total fall*, which will be $\lambda(\cos\theta - \cos\alpha)$. We have attributed already a horizontal angular component $\sin\theta\frac{d\psi}{dt}$; let there be also a vertical one, $\frac{d\theta}{dt}$. These two components make up a resultant angular velocity, the square of which is $\sin^2\theta\frac{d\psi^2}{dt^2} + \frac{d\theta^2}{dt^2}$, and *by the law of living forces* (as it exhibits itself in the case of the pendulum) we have,

$$\lambda^2\left(\sin^2\theta\frac{d\psi^2}{dt^2} + \frac{d\theta^2}{dt^2}\right) = 2g\lambda(\cos\theta - \cos\alpha).$$

But $\lambda = \frac{A}{M\gamma}$, and the foregoing becomes,

$$(2)^*\qquad \sin^2\theta\frac{d\psi^2}{dt^2} + \frac{d\theta^2}{dt^2} = \frac{2Mg\gamma}{A}(\cos\theta - \cos\alpha).$$

If we eliminate $\frac{d\psi}{dt}$ between the equations (1) and (2), and abbreviate by putting λ for $\frac{A}{M\gamma}$, and β for $\frac{Cn}{2A}\sqrt{\frac{\lambda}{g}}$, we shall get

$$(3)\quad \sin^2\theta\frac{d\theta^2}{dt^2} = \frac{2g}{\lambda}\left[\sin^2\theta - 2\beta^2(\cos\theta - \cos\alpha)\right](\cos\theta - \cos\alpha).$$

The equation (3) expresses a relation between the angle θ and the angular velocity $\frac{d\theta}{dt}$. When that angle is *maximum* or *minimum*—that is, when, in its motions, the axis of the disk reaches its *greatest* or *least* inclination—the differential coefficient $\frac{d\theta}{dt}$ (*or* the vertical angular velocity) is zero. This will be the case when either of the factors of the second member of (3) becomes zero; that is, when $\cos\theta = \cos\alpha$, *or*

$$(4)\qquad \cos\theta = \beta^2 \pm \sqrt{1 - 2\beta^2\cos\alpha + \beta^4}.$$

The first value corresponds to a *maximum*, and shows that the axis *never rises higher than its initial position.*

The second of the above equations gives the *minimum* value of θ; and this minimum cannot be zero (that is, $\cos\theta$ cannot $= +1$) so long as β is not zero; that is, so long as n, the rotary velocity, is not zero. Make n zero (that is, deprive the disk of rotation) and equation (3) becomes that of the simple pendulum of length λ, and the motion is accordingly such. But if n be *not* zero—*i. e.* if there be ro-

* These equations (1) and (2) are usually derived from the general Eulerian equations for rotary motion; as they are in the writer's work on *The Gyroscope*. This *direct* derivation from certain fundamental mechanical principles is here preferred.

tation, however slow, this motion is modified *in this*, that the axis in swinging cannot pass *through* the interior vertical, as does the pendulum.

The self-sustaining power of the gyroscope when very great velocities are given *is but an extreme case of this law*. For if β be *very great*, the small quantity $1 - \cos^2\alpha$ may be subtracted from the quantity under the radical without sensibly altering its value, and therefore the equation is equivalent to $\cos\theta = \cos\alpha$ (*nearly*). Hence in this case the minimum of the angle θ differs very minutely from the maximum α.

Here, then, is the result, analytically found, which so surprises the observer, and for which an explanation has been so much sought and so variously given. The revolving body, though solicited by gravity, *does not sensibly fall*.

Knowing this fact, we may, assuming that the impressed velocity n is very great, introduce a new variable u (equal to $\alpha - \theta$), which will always be minute; and deducing the values of $d\theta$ and (by development) of $\sin^2\theta$ and $\cos\theta$ in terms of u (neglecting its higher powers), and substituting in (1) and (3) (as abbreviated), they become (omitting, as relatively small, $\cos\alpha$ in the factor $\cos\alpha + 4\beta^2$),

$$(5)\qquad \sqrt{\frac{g}{\lambda}}\,dt = \frac{du}{\sqrt{2u\sin\alpha - 4\beta^2u^2}},$$

$$(6)\qquad \frac{d\psi}{dt} = 2\beta\left(\frac{g}{\lambda}\right)^{\frac{1}{2}}\frac{u}{\sin\alpha}.$$

Equation (5) gives by integration and putting $\beta\left(\frac{g}{\lambda}\right)^{\frac{1}{2}} = k$,

$$(7)\qquad u = \frac{1}{2\beta^2}\sin\alpha\sin^2 kt,$$

which substituted in (6) gives

$$(8)\qquad \frac{d\psi}{dt} = \frac{1}{\beta^2}k\sin^2 kt,$$

$$(9)\qquad \psi = \frac{1}{2\beta^2}kt - \frac{1}{4\beta^2}\sin 2kt.$$

If we make $\alpha = 90°$, $\sin\alpha = 1$, in equation (6), deduce the value of dt, and substitute in (5) we get

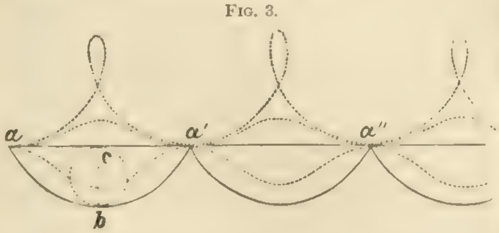
$$(10)\qquad d\psi = \frac{u\,du}{\sqrt{\frac{1}{2\beta^2}u - u^2}},$$

the differential equation of the cycloid, generated by a circle of which the diameter is $\frac{1}{2\beta^2}$, and having a chord $\frac{\pi}{2\beta^2}$.

If the value of α is not 90°, the diameter of this circle will be $\frac{1}{2\beta^2}\sin\alpha$; but the quantity $\frac{\pi}{2\beta^2}$ then measures an angle of an arc of a small circle having a radius $= \sin\alpha$; and the chord of the curve is reduced in the same proportion as its sagitta, and the curve is still a cycloid.

The *theoretical* character of the motion of a point of the axis would therefore be represented by the cycloid (Fig. 3, *full line*) generated by the rolling of the circle of which the diameter cb (exceedingly minute) is $\frac{\sin\alpha}{2\beta^2}$.

FIG. 3.

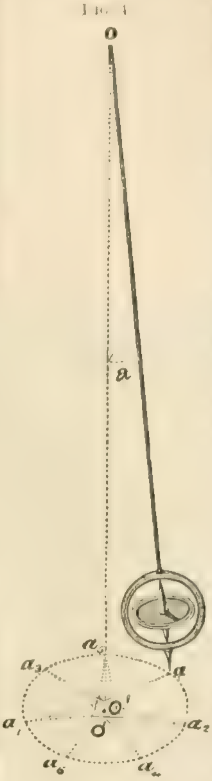


The above demonstration of the intrinsic character of the gyroscopic motion was first given (as is believed) by the writer of this in the *Am. Jour. of Science* in 1857, and in *Barnard's Am. Jour. of Ed.*, No. 9, of same year.*

In the foregoing it is assumed that at the instant of starting the rotary disk has *no other* motion than its rotation. If there be given, at that instant, an *initial* gyration, such as may be imparted by a push or shock, the resulting cycloid will be (cf. works above cited) according to its intensity of the species known as *prolate* (Fig. 3, *broken line*) or *curtate* (Fig. 3, *dotted line*).

The "gyroscopic pendulum" (Fig. 4) is one of which the pendulum-bob is a rotating gyroscope. It offers a particular case of the problem, in which the initial angle α is very small, and β (owing to the length of the pendulum arm, and hence great value of γ) much less than for the ordinary gyroscope. If the pendulum starts from a position of rest at a, and O O′ is a vertical dropped from the point of suspension, the foot of the pendulum will not swing through O′ but, passing near it, be deviated in a curve $a\,a_1$ convex towards O′, till it attains a departure at a equal to the initial angle α, where, coming to rest, it commences (making a *cusp* at a_1) another swing to a_2; and so on. If propelled from a state of rest *in* O′, the curves of vibration will all pass *through* the centre O′, and the extremities a_1, a_2, a_3, etc. will be loops instead of cusps. The special analysis of the motion is identically the same as that of the "freely suspended pendulum," which reveals by the progressive azimuthal displacement of its plane of vibration the rotation of the earth; though in the case in hand this azimuthal motion is far more rapid. (See *Smithsonian Contributions*, vol. xix., "Problems of Rotary Motion," by the writer.)

FIG. 4.



In the foregoing we have given in a very condensed form the *mathematical theory* of the gyroscope. But to the unmathematical reader the "why" of the phenomena will be still unanswered; and even the student who has mastered the analysis will yet ask for some other rationale than the ineloquent logic of "operations" upon abstract symbols. Verbal explanation is difficult, *mainly* in consequence of the imperfection of ordinary language for the conveying of ideas on such subjects; hence circumlocutions, in themselves confusing, and perplexities of terms where clearness is the first requisite. Let the inquirer take in his hands the combined wheel and ring of the common gyroscope (Fig. 2); the wheel having been put in rapid motion by the usual means. Holding the extremities C and C′ by the thumb and forefinger of the two hands, let him give a rapid angular motion (*i. e.* change of direction) to the axle C C′. He will become sensible that *a force* which he did not anticipate is, through this motion, exerted. It does not directly *oppose* the motion; it is *lateral* (sideways) to it.† In scientific language it is a force acting "normal to the plane of the angular motion of the axis." It is this force, addressing without symbols or words the very *senses* of the inquirer, which is the unknown cause—the *deus ex machinâ*—of the gyroscopic phenomena. But *why* is this force developed? The answer in its simplest form is, "In giving *angular* motion to the axis of a rotating body, *change of direction of the motion* of every material point of the body is compelled." Now, it is fundamental to mechanics, and obvious to the senses, that a moving body cannot be deviated from its direction without the exertion of *force* normal *to that direction*. Bodies describing curved paths undergo a continual diversion of *direction*, and *hence* require the incessant action of normal forces. The familiarly known "centrifugal force" is but an expression for the force necessarily applied to constrain to curvature of path.

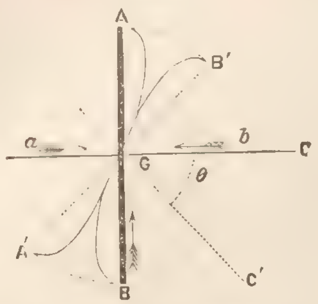
For the purpose of showing the connection of this law with the case in hand, conceive the mass of the revolving disk concentrated in a single ring of matter, and, for simplicity, suppose the angular motion of the axis to take place around the centre of figure and gravity G. "Let A

* Poisson terminates his analysis with eq. (5), (6), (7), and deduces no other results than this, that "when the rotary velocity is very great the axis preserves a nearly constant inclination, at the same time taking a nearly uniform but very slow azimuthal motion, the rate of which will be independent of the initial angle α, etc., etc." Jullien (*Problèmes de Mécanique rationnelle*, Paris, 1855) does indeed deduce the *circular* motion, relatively to the "instantaneous axis" of the axis of figure, but he fails to show that a *common* cycloidal path results, and indeed makes the blunder of confounding this minute nutation with the astronomical "nutation" of the earth's axis due to the inclination to the ecliptic of the moon's orbit.

† "The use of a fly-wheel to regulate the motion of machinery in a steamboat was formerly very common, and some of our boats still retain it. In describing a curve, as in rounding to near a wharf, [illegible] inspection of the wheel will show that a powerful effort is made by it to [illegible] and elevate the other of its [illegible] and that a corresponding [illegible] the [illegible] is produced."—[illegible] *Am. Jour. Sci.*, Jan., 1852.

B be the projection of such a ring revolving about its axis of figure G C, while the axis turns in the plane of the

FIG. 5.



paper about a point G to the position G C′. Let the rotary velocity *n* be such that the visible portion of the disk moves upward through the semi-circumference from B to A, while the axis moves downward through the angle θ to the position G C′. The point B, by its axial rotation *alone*, would be carried to A, but the plane of the disk, by the simultaneous angular movement of the axis, is carried to the position A′ B′, and the point B arrives at B′ instead of A, through the curve projected in B G B′. The equation of the projection, in circular functions, is easily made: but its general character is readily perceived, and it is sufficient to say that it passes through the point G; that its tangents at B and B′ are perpendicular to A B and A′ B′; and that its concavity, throughout its whole length, turned to *the right*. The point A descends on the other or remote side of the disk, and makes an exactly similar curve A G A′ with its concavity reversed."

Thus, instead of describing circles in the plane of rotation A B (in which the centrifugal forces exactly balance each other), all the particles are diverted in their motion by the angular motion imparted to the axis, describing in front curves projected with concavities *to the right*—in rear of the plane of the axis, curves projected with reverse concavity. Hence, the opposite (in direction) forces necessary to *compel* this curvature, and hence the force tending to turn the axis normally to the plane of its *imparted* angular motion; hence, in short, the strange *force* felt by the hands under the circumstances mentioned.

This force (consult works already cited) has been computed,* and shown to be precisely that which, necessarily attending, is *required* to produce the phenomena of the gyroscope. That it does not directly *oppose* the falling of the axis at the first instant can be proved by any arrangement which will *prevent* azimuthal motion. Thus, if the extremity of the axis of rotation were confined in a vertical circular groove in which it could move without friction, or if (Fig. 8) the spindle J be clamped, and gyration thus prevented, the gyroscope falls just as if (in both cases) no rotation existed.

Let us see now how such a force can produce the theoretical effects. The rotation-axis being assumed, *ab initio*, motionless, it is self-evident that the first *tendency*, the first *effect* of gravity, is to cause it to *fall*, generating *vertical angular velocity*. But with this angular velocity the *deflecting* force proportional to its rate and normal to its direction is generated, which pushes aside the descending axis from its vertical path. But as the direction of motion changes, so with it does the direction of this force. It finally acquires an upward component of intensity equal to that of gravity; but the *acquired* downward velocity still exists, and the axis *still* descends, at the same time acquiring a constantly increasing horizontal component, and with it a still increasing upward deflecting force. At length the descending component of velocity is entirely destroyed—the path of the axis is horizontal; the deflecting force due to it acts directly contrary to gravity, which it exceeds in intensity, and hence causes the axis to commence rising. This is the state of things at the point *b* (Fig. 3). The axis has described the curve *a b*, and has acquired a velocity due to its actual height of fall *c b*; but this velocity has been deflected to *a horizontal direction*. The *ascent* of the branch *b a′* is precisely the converse of its descent. The acquired horizontal velocity impels the axis horizontally, while the deflecting force due to it (now at its maximum) causes it to commence ascending. As the curve bends upward, the normal direction of this force opposes itself more and more to the horizontal, while gravity is equally counteracting the vertical, velocity. As the horizontal velocity at *b* was due to a fall through the height *a d*, so, through the medium of this deflecting force, it is just as capable of restoring the *work* gravity had expended, and *lifting* the axis back to its original elevation at *a′*, and the cycloidal undulation is completed, to be again and again repeated, and the axis of our *theoretical* gyroscope, performing these rapid and minute undulations, moves slowly around its point of support.†

But, as already intimated, the phenomena of the gyroscope, as actually constructed, are not apparently in complete harmony with these theoretical results. No appearance of the minute cycloidal motion can be detected in the common gyroscope:‡ moreover, as already stated, the common gyroscope not only does not sensibly fall, but under certain circumstances, in actual violation of the foregoing theory, *rises*. The violation is only *apparent*, however. The actual gyroscope is *loaded* with the heavy ring by which its axle finds points of support, and there is always *friction* at these points, which (together with the resistance of the air) gradually destroys the rotary velocity, or converts it into azimuthal motion *of the whole mass*. On the other hand, owing to loss of rotary velocity in the disk, the deflecting force which depends on it is gradually impaired, and cannot, even for a single cycloidal arc, bring back the axis to the level *a′* (Fig. 3) from which it started; hence, instead of the cycloid *a a′ a″*, etc., we would have a curve shown by the full line *a b b′* (Fig. 6), which would speedily lose all undulatory character; the axis moving horizontally with such an *angular velocity as will generate an upward deflecting force adequate to oppose gravity and prevent sensible falling.*

FIG. 6.

Let, now, the rotary velocity be *very* great, and the axis be placed, at the commencement, with considerable *upward* inclination; the friction of the axle extremities on the sustaining ring tends to impart rotation to the ring, and this tendency will be converted (through the impossibility of the ring turning about any other than the *vertical* standard on which it rests) into azimuthal motion of the whole mass about that standard—that is, the *gyratory* velocity is thereby accelerated—and the resulting upward deflecting force becomes thereby *greater* than gravity, and the axis rises.

The phenomenon may be best illustrated in the following manner: Let the outer extremity of the common gyroscope, having its axis inclined *above* the horizontal, be held by a thread attached to some fixed point vertically above the point of the standard. Here gravity is eliminated, and the axes of our theoretical solid of revolution would remain perfectly motionless; but the gyroscope *starts off, of itself*, to gyrate in *the same direction* that it would were its extremity *free*. This gyration increases (if the rotary velocity be great) until the deflecting force due to it lifts the outer extremity from its support on the thread, and causes it indefinitely to rise. Try the same experiment with the axis *below* the horizontal. The gyration will commence spontaneously as before, but in the *reverse direction*;§ it will increase until the *inner extremity is lifted from the point of support on the standard* (the action of the deflecting force being here reversed), the instrument supporting itself *on the thread alone*. If the experiment is tried with the axis perfectly horizontal, *no gyration takes place*, for the component of rotation about the standard produced in the ring by friction is, in this position, zero.

The TOP (which, childish toy as we usually regard it, is called by Sir John Herschel in his *Treatise on Astronomy* a "philosophical instrument") is but a gyroscope of which a point of its rotary axis rests not on a fixed point, but on a horizontal plane. The theory is analogous. As in the gyroscope, a *deflecting force* is generated by any angular motion of the axis of the rotating top: and it is this

* The "couple" developed or *moment* of this force is $\frac{W}{g} k^2 n r$ in which *W* is the weight of the ring, *k* its "radius of gyration," and *r* the *angular velocity* given to its axis *G C*. (See *Van Nostrand Mag.*, Apr., 1875.)

† By means of the apparatus of Dr. Franz Heinen of Brunswick, Germany, nutate cycloids can be manifested.

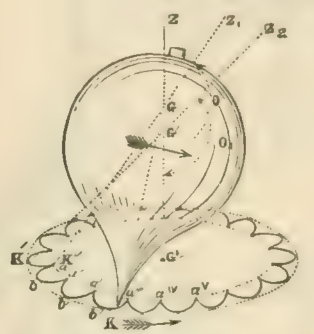
‡ I have thus, with the precision of mathematical analysis developed, and with detail described, this theoretic motion to show, *first*, the inaccuracy of speech, and even violation of *fundamental mechanical principles*, by which in even scientific explanations by composition of rotations pure horizontal gyration is affirmed to result *directly* from the action of gravity (as if gravity could produce motion *at all*, unaccompanied with that of *falling*); *second*, that the modifying causes of the *observed phenomena* may be better understood; and, finally, because in the astronomic phenomena (precession, etc.) the theory (the earth's crust considered rigid) absolutely applies, though even they have been subjected to the same objectionable reasoning.

§ Were it not for the thread support the *natural* gyration would be *in the same* direction; clearly showing that the gyration *now* observed is due to friction of the axle on its point of support in the ring.

force which supports it. Did the axles of the top terminate in a mathematical point, and were the horizontal surface on which it spins a true plane, and *perfectly* hard and smooth, the centre of gravity of the top would be ever in the same vertical line, and its point would *gyrate*, describing on the surface an epicycloid; that is, the minute cycloidal arcs of Fig. 3 would be superposed externally on the periphery of a circle described round the projection G″ on the surface, of the centre of gravity. This is never the

Fig. 7.

2.

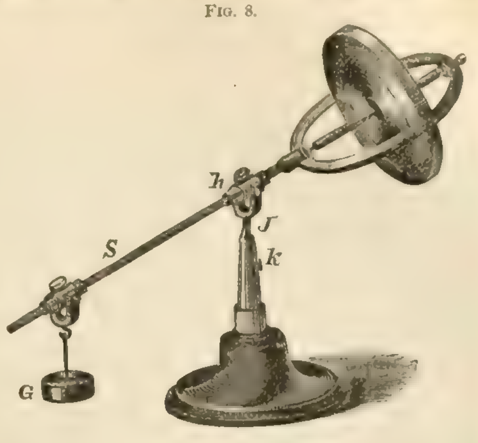


case of reality. It will be found, however, that the more perfectly pointed the top is, and the harder and smoother the surface, the less will be the tendency to *rise*. This rising is due to the (more or less) *rounded* point rolling (with friction) on the surface, and thus increasing the angular motion of the axle, by which the upward *deflecting force* is made greater than the downward force of gravity, and the top gradually rises to a motionless spinning in a vertical position.

From the minute motions of this child's toy, or of the *gyroscope*, to the grand phenomena exhibited in the heavens—the "precession of the equinoxes"—there seems an *incommensurable* stride; yet as mechanical phenomena they are essentially identical. The earth is a rotating solid of revolution. It is *oblate*—that is, flattened—at the poles, and protuberant around the equator. The ring of protuberant matter is more strongly attracted on the side nearest the sun or moon than on the more remote side; hence, the tendency of solar or lunar attraction to *tilt* or pull down the equator into the plane of the sun's (or moon's) orbit. The result is, just as in the case of the gyroscope, *gyration* around the direction of the disturbing force. But these directions are, owing to the orbital motions of the sun and moon, constantly changing, and hence, also, the direction of the resulting gyrations. Regarding the earth as a solid of revolution rotating about its axis, the fixed point of which is the centre of inertia, and acted upon by the disturbing or tilting action of the sun or moon, and integrating the elementary gyrations for each momentary direction of the tilting force (*Smithsonian Contributions*, vol. xix.), I obtain the known formulæ for "precession" and "nutation." The latter term (as understood in astronomy) is the "nodding" or undulatory motion of the "precession" produced by the moon, and is due to the slight obliquity of the moon's orbit to the plane of the ecliptic, to the revolution of the nodes of which its "period" ($18\frac{2}{3}$ years) corresponds. In this connection it is interesting to remark that if there were a solid ring having the mean radius of the moon's orbit, and having the same inclination to the ecliptic (about 5°) as the actual orbit, and did this ring revolve about the earth (at its centre) with the mean velocity of the moon's orbital motion, the attraction of the sun would cause *gyration* of the plane of the ring, or, in other words, regressive motion of its nodes. Calculated in this way, the period would be about $17\frac{1}{3}$ years. It is actually (as just stated) $18\frac{2}{3}$ years. Nevertheless, the actual and the hypothetical phenomena are not identical in their *rationale*—a remark the more necessary since a gyroscopic ring has been invented to illustrate and explain mechanically the regression of the moon's nodes; and on the other hand a solid "girdle of moons" "clasping" the earth has been invoked (*Cyclo. of Phys. Science*) to explain the earth's precession.

Before closing this article a brief allusion will be made to some of the forms and applications of gyroscopic instruments. The original Bohnenberger machine (Fig. 1) has been already depicted, and mention made of the more complex instrument called the rotascope invented by Prof. Johnson. Another form (Fig. 8) is the apparatus introduced by Fessel (*Pogg. Ann.*, vol. xc., pp. 175 and 361). The prolonged stem S, and the movable counterweight G (with both of which we are familiar in our common instruments), serve only to vary the experiments. If the counterweight

Fig. 8.



is placed so near the fulcrum that the weight of the disk and ring preponderate, gyration will ensue, as in the case of Fig. 2; but slower, since the weight of the latter is partly counterbalanced. If the weight is so far removed as to preponderate, gyration in the reverse direction will ensue, since, through the preponderating counterweight, gravity tends to *lift* (instead of to pull down) the rotating disk. Let, now, the weight be placed so as exactly to balance the disk and ring; no gyration will be observed. The weight and a portion of the prolonged stem S can be removed, and then we have *essentially* the gyroscope of Fig. 2; with this difference, however, that instead of a mere pointed end to the standard B, there is introduced the fork J (Fig. 8), the vertical stem of which turns freely in the standard, while the prongs hold the trunnions of the band or socket *h* through which the stem S is introduced and clamped. By this arrangement free angular motion is permitted, while at the same time the disk and ring are always firmly connected with the standard, and cannot "fly off," as they often, and damagingly to surrounding objects, do, from the common gyroscope. The machine illustrates (as already mentioned) another property, which has been announced as a discovery of experiment, but which theoretical investigation without experiment affirmed—viz. that by simply *preventing gyration* (by means of the clamp screw *k* which fixes the axle J) the disk and ring *fall* "as if no rotary motion existed." An improvement on this instrument—a much more complicated and elaborate apparatus—is that of Dr. Franz Heinen of Brunswick (1857). As, however, all the essential properties are sufficiently exemplified by the instruments mentioned, the description and diagram are omitted. As before remarked, this instrument illustrates the exhibition under certain conditions of the *curtate* cycloid of Fig. 3.

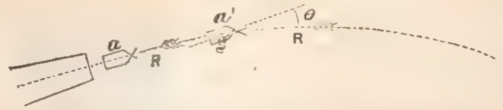
Another form of gyroscope is that designed by Dr. Magnus of Berlin to illustrate the causes of the "deviation" of oblong rifle projectiles.* It is a familiar fact that the rotation given to the projectile by the rifling or grooves of the barrel is indispensable to the maintenance of axial direction in the projectile; without it the oblong shot *tumbles* and flies wildly. But it has also been shown that this stability against disturbing forces is not absolute, but is necessarily accompanied with a slow gyratory motion. The elongated projectile is discharged from the piece with its axis coinciding with its trajectory, but, through the action of gravity, the trajectory deflects from its original direction and from that of the axis. In consequence of this, the resistance of the air acts obliquely to the axis, and, with the ordinary forms of elongated projectiles, its resultant passes above the centre of inertia, tending to raise the point; and from this results the angular motion of the axis to the right if the rotation is to the right—to the *left* in the contrary case.

The machine of Dr. Magnus is merely a Bohnenberger with a solid of revolution, in the general form of a rifle projectile, substituted for the spheroid. By directing upon it, obliquely to the direction of the axis of rotating body, a current of air, a pressure results, the resultant of which will not in general pass through the centre of gravity. Instead of the tilting which would ensue were there no

*Dr. Magnus also designed what he called a "polytrope," having two rotating disks. [illegible] to the gyroscope is illustrated by instruments described, and as in the case of the [illegible] of Prof. Johnson, particular description is here out of place.

rotation, a slow horizontal gyration will be observed. In the real projectile (Fig. 9) we have, likewise, the essential

Fig. 9.



conditions of gyration—viz. a solid of revolution revolving rapidly about its axis, and a dynamic "couple" (*i. e.* the inertia of the projectile's motion of translation acting through its centre of gravity, and the resistance of the air acting through a point of the axis more or less distant from g), tending to turn the projectile upward about a horizontal axis through g; and this produces instead an elementary gyration about a line through g, parallel to R (the atmospheric resistance). If this line retained an invariable direction, the integral effect of these elementary gyrations would be to revolve *down* the axis of the projectile, and we should ultimately find it assuming horizontal and even sub-horizontal directions. But such cannot be the case; the direction of the axis is no sooner deviated, *laterally*, from its original direction than a (nearly) corresponding change takes place in the direction of the resistance R (since from the elongated form of the projectile the direction of its motion follows pretty nearly that of its axis), and in that of the line (parallel to R) about which gyration takes place. The integral of such a series of elementary gyrations is angular motion about a line perpendicular to the plane in which that line shifts direction—that is, about a vertical. Hence, the vertical direction (or "elevation") of the axis of the projectile remains constant, or nearly so, while its horizontal direction undergoes a small progressive azimuthal motion.

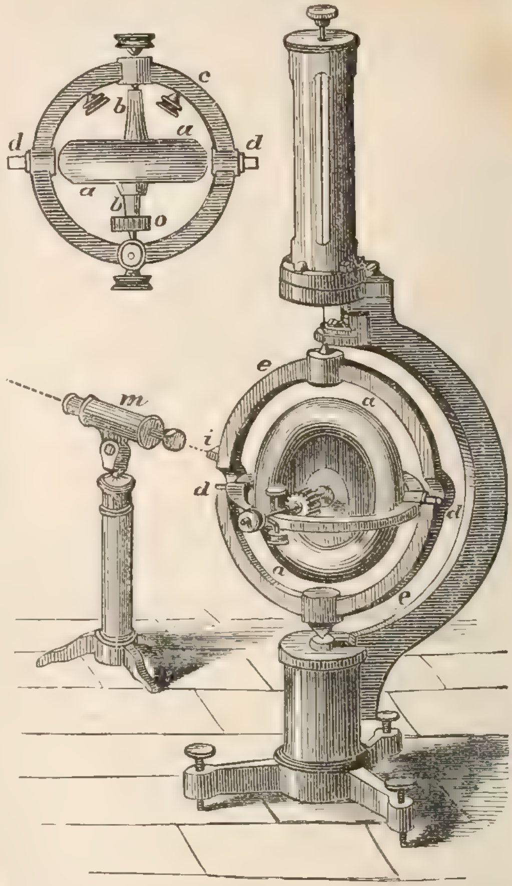
Friction of the air is sometimes assigned as the cause of deviation. It has influence, doubtless; but "deviation" sometimes is the contrary of what would be produced by it; *e. g.* Dr. Magnus states that a cylindrical projectile is found to deviate *to the left*, when, the twist being to the right, the deviation due to friction *should* be to the right. In the want of accurate observation, and in the diversity with which the problem presents itself with different forms of projectile,* no precise statement of actual results can be ventured upon. Dr. Magnus asserts that the axis of the projectile is generally found to be in direction of the tangent to the trajectory. Proof is wanting,† and, however deviated from original direction, it is little probable that the dictum is precisely exact. Possibly, the downward gyration may sometimes be more rapid than the horizontal shifting of the line of direction, and greater or less depression may ensue. The material fact is, that, by Dr. Magnus's apparatus and by theory, deviation *is accounted for*. His paper (translated by Rieffel, Paris, 1863) amounts to little more than this. The theory herein given is believed to be a nearly true expression of the main features of the phenomena.

A more interesting—the *most* interesting—application of the gyroscope is that into which the Bohnenberger machine was modified by the late M. Foucault, and (in allusion to its functions) named the Gyroscope. It depends on the principle that the plane of a rapidly-rotating disk, perfectly free to take any position about its centre of inertia, will retain uniformity of direction however that *centre* may move or be moved; that the otherwise sensible effects of slight disturbing forces (friction, etc.) will be transformed into comparatively insensible *gyration*, and thus minimized.

"The tall figure shows the gyroscope in supposed action, the frame *e e* being suspended at the top by a simple thread passing through the upright cylinder, and resting at its bottom on a very fine point placed in an agate cup. Within the frame *e* the detached frame *c c* may be laid at any time, so that the knife-edges *d d* rest on hard plates; the rotation-disk *a a* may be put into rapid rotation by a separate machine, and placed in that state of rapid motion within *e e*, where, by the suspension, and by the knife-edge bearings, it will have perfect freedom of motion."

"Suppose, now, that a graduated slip on the edge of the apparatus is examined through the telescope *m*; it is clear that if the earth be at rest, the same graduated line will continue under the spectator's eye at the telescope. But if the earth is rotating, and carrying the gyroscope along with it, the revolving ring cannot remain in its original relation to the telescope, just because its displacement by the

Fig. 10.



earth would, if it did so, *change the direction of the plane in space in which the ring revolves*. The graduated slip will therefore move in the telescope; and the observer will discern the different lines of graduation passing regularly under his eye, exactly as a star moves across the field of view of a transit instrument."

The same ingenious inventor had previously applied the pendulum to the same effect—*i. e.* the ocular exhibition of the earth's rotation. Widely different as these two experiments seem to be, their radical identity has been demonstrated by the writer in vol. xix. *Smithsonian Contributions* ("The Pendulum and Gyroscope as exhibiting the Rotation of the Earth"). By these experiments the "direct proof" desiderated by Laplace has been furnished, and the earth's rotation, long since taken from the category of "admirable hypotheses," has become not only an established, but an *observed* fact.

Of *practical* applications, other than to these illustrative experiments, the gyroscope as yet has none; unless indeed the successful application of rotation to elongated projectiles, which has been the means of the greatest stride of advance in the effectiveness of modern firearms, be considered such. An attempt to utilize it to giving steadiness to the telescope in observing the eclipses of Jupiter's satellites was made in 1855 by Prof. C. Piazzi Smyth (astronomer-royal of Scotland); and the Russian government has made some researches in this way, with no successful result. It is as a beautiful illustration of the truth (just where it *seems* to our senses to be contradicted) of the received law of mechanics, that the gyroscope asserts its claim to consideration; and it would require a useless array of words to explain why more "practical" uses need not be anticipated.‡ J. G. Barnard.

Gyula, town of Hungary, on the White Körös, which divides it into German and Magyar parts. It is a handsome old town, with considerable trade in cattle. Pop. 18,495.

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*Col. Benton, U. S. ordnance corps, observed with a Magnus instrument that when the air impinged with less than about 10° obliquity (rotation being right-handed) the deviation was to the right—greater than 10° to the left; the reason being that the different presentations of the model to the current caused a shifting of the resultant resistance from *above* to *below* the centre of gravity. Similar *apparent* anomalies may present themselves with actual projectiles. (*See next note.*)

†The theory of Thiroux assumes the axis of the ball is depressed below the trajectory; that of Panot, that the direction is unchanged.

‡Concerning an "invention" of Mr. Bessemer (and the proposed modifications) of a gyroscopic machine to regulate the controlling valves of his "suspended saloon," see *Engineering*, Oct. 9 and 30, 1874, and *Van Nostrand's Eng. Mag.*, Apr., 1875.

H.

H, a consonant, the eighth in order of the letters of our alphabet. Ordinarily, it is a simple aspiration or rough breathing in our language. In some words it is quite silent. With *t* it forms two digraphs, *th* soft and hard. With *c* it forms three such digraphs, and with *g* one; *gh* being, however, in English ordinarily a *g* pronounced as if hard, when from position, without the *h*, it would be soft. H in chemistry stands for hydrogen.

H, in German music, is used as the designation of B natural. H dur, when indicating a key, is the major key of B natural; and H moll is B natural minor.

Haar'lem, city of the Netherlands, in the province of North Holland, on the Spaarne. It is a well built and extremely neat city, with several interesting buildings, as, for instance, St. Bavon's Kerk, with its world famous organ. It has many collections of consequence to science and art, good educational institutions, and considerable manufactures of velvet, silk, linen, carpet, and lace. It is the centre of the trade in flowers, bulbs, and flower-seeds, which is a great specialty of Dutch enterprise, and which here has assumed astonishing dimensions. Close by is the beautiful Haarlem-Hout, with the royal palace, Welgeleque, which is a much frequented summer resort for people from Haarlem and Amsterdam. It has a Roman Catholic and a Jansenist bishop. Pop. 32,156.

Haarlem Lake, Holland (no longer existing), was contiguous to the city of that name. A map of the date of 1531 shows within the area afterwards covered by it, which was traversed by two highways, four small lakes and three flourishing villages; the combined area of the lakes was about 6000 hectares (15,000 acres). In 1591 one of these villages had disappeared, and so in 1647 had the other two, and the four lakes had united into one, to which the name which had belonged to that one nearest the city of Haarlem attached, and which thus gained its ultimate fame. But its dimensions continued to increase by encroachment on the bordering land, particularly towards the N. and E., and in the early part of the century had acquired an area of 18,000 hectares (45,000 acres). All this process seems to have been due to want of adequate means of artificial drainage, the surface, as is that of so much of Holland, being lower than the sea level. With such an area, and a perimeter of more than 30 miles, every tempest caused new encroachments, and the danger to some of the adjacent regions became very great. Long before, projects of drainage had been proposed and discussed. The realization grew more and more urgent, and in 1839 the Dutch government inaugurated the great work, finally completed in 1852, the history of which forms one of the most interesting narratives of engineering works of that kind. It has been described in various professional works. Reference may be made to *Civil Engineer and Architect's Journal* (1851–52); *Journal des Ponts et Chaussées* (1842, 1846, 1863); more especially to the work of M. Gevers d'Endegeest, *Du Dessèchement du Lac de Haarlem.*

J. G. Barnard.

Hab'akkuk [Heb., "loving embrace" or "embracer"], the eighth of the twelve minor prophets of the Old Testament. Apparently (iii. 19), he was a Levite, and he is thought to have prophesied during the reign of Josiah (639–609 B. C.), Delitzsch supposes about the year 630 or 629 B. C. As Nahum denounces the Assyrians, who had already crushed the kingdom of Israel, so Habakkuk denounces the Chaldeans, who are about to crush the kingdom of Judah. The third chapter, which has been called a "Pindaric ode," is one of the sublimest compositions ever penned. *The History of Bel and the Dragon*, an apocryphal addition to the book of Daniel, is, in the Septuagint, ascribed to "Habakkuk, the son of Joshua, of the tribe of Levi," thought by some to be identical with the prophet.

R. D. Hitchcock.

Habeas Corpus [Lat. "You may have the body"], in law, a writ issuing out of a court of justice, or awarded by a judge in vacation, with the view of bringing a person before the court or judge to be dealt with according to law. There are several writs passing by this name with words added, more specifically to denote their application, such as: (1) *Habeas corpus ad faciendum et recipiendum*; (2) *ad prosequendum*; (3) *ad respondendum*; (4) *ad satisfaciendum*; (5) *ad subjiciendum*; (6) *ad testificandum*. The office of the first of these is to remove, on the application of a defendant, a cause from an inferior to a superior court; of the second, to remove a prisoner to be tried within the jurisdiction where an alleged act was committed; of the third, on the part of a suitor, to remove a cause of action to a higher court; of the fourth, after judgment, to charge a person in a superior court, with process of execution; of the fifth, to bring up a person detained by another, with a view of inquiring into the cause of detention; and of the sixth, to bring a witness who is in custody at the time of a trial into court. Of these the last two are much the most important. The fifth, as above enumerated, is the great writ of *habeas corpus*, of so much importance to the liberty of the individual both in England and in this country. The residue of this article will be confined to this writ, with the exception of a few words as to the *habeas corpus ad testificandum*.

The writ of habeas corpus is called in the English law a "writ of right." By this is meant that the party in confinement, on making a proper case, is entitled to it. It is, accordingly, only issued on a proper foundation of proof. It is necessary that there should be an affidavit and motion for an allowance of the writ. When these steps are taken, the right of the prisoner is fixed. The writ is said by some jurists to be based on the well-known clause in Magna Charta that "no freeman is to be deprived of his life, liberty, and property except by the judgment of his peers and the law of the land." The subject will be treated under the following principal divisions: I. History of the writ and of the statutes affecting it; II. Its general effect; III. Procedure; IV. Relation of the States to the U. S. courts; V. Power of U. S. courts to issue the writ.

I. At the common law the writ issued from the court of king's (or queen's) bench, not only while the court was in session (or in "term time"), but also in the vacation, by an order from one of the justices. In the latter case it was made returnable either before the judge who issued it or before the full court. The other great common-law courts (viz. the common pleas and exchequer) did not originally have general power to issue the writ, but only in special cases. It was supposed at one time that the lord chancellor had no power to grant the writ in vacation, though the law is now settled to the contrary. A serious controversy arose in England in the reign of Charles I. upon the point whether a return to a writ of *habeas corpus* by the warden of the Fleet prison was legally sufficient, which set forth that the prisoners were detained by a warrant from the privy council, setting forth no particular cause of imprisonment, but that they were committed by the special command of the king. The counsel for the prisoners insisted that the council was bound as much as any petty magistrate to assign a sufficient cause for commitment. The decision of the judges was in favor of the legality of the warrant. The effect of this decision was that every statute from the time of Magna Charta designed to protect personal liberty was practically nullified, since it was only necessary, in order to avoid their effect, to insert in the warrant the words "by the special mandate of the king." This servile action of the bench so aroused the nation that an act affecting the subject was passed in the same reign, the famous "petition of right," 16 Charles I. ch. 10, sec. 8. This statute, among other things, provided that where a person was committed by the king or his privy council, he should have a writ of *habeas corpus* upon demand or motion made to the *court* of king's bench or common pleas. A close construction was put upon this statute by the judges, who declined to award the writ (*ad subjiciendum*) in vacation. At a later day, for the purpose of furnishing a more complete remedy, the famous *habeas corpus* act was passed (31 Car. II. c. 2). This act is frequently termed "Lord Shaftesbury's act," its enactment having been due largely to the exertions of that distinguished statesman. It is said to have been carried through the House of Lords by a mere artifice. Bishop Burnet gives the following account of it in his *History of his Own Times*: "Lords Gray and Norreys were named to be the tellers. Lord Norreys, being a man subject to vapors, was not at all times attentive to what he was doing; so, a very fat lord coming in, Lord Gray counted him for ten, as a jest at first; but seeing Lord Norreys had not observed it, he went on with this misreckoning of ten, so it was reported to the house, and declared that they who were for the bill were the majority, though it indeed went on the other side." (Vol. ii. p. 256, Oxford ed., 1833.) This story is corroborated by a note by Speaker

Onslow and adopted by Lord Mahon in his *History of England* (ed. 1858, Murray, Lond., vol. iv. p. 125. See also Cooke's *Life of Shaftesbury*, 220, ed. 1836). The last-named work adds that when the numbers were reported from the wool-sack, the ministry, who knew their strength, were surprised; and whilst they were whispering to one another, Lord Shaftesbury, who found there was a mistake and guessed their intentions, immediately started up and spoke upon the first thing that occurred to him almost an hour. Whilst he was speaking several lords went out and others came in, so that it was impracticable to retell the house, and by this means the bill was carried. This great act was an important contribution to English constitutional law, as it tended to render more effectual rights whose existence had long been recognized, but which had hitherto been imperfectly vindicated. This statute has had much influence upon American legislation, and the substance of it will be briefly stated. It is applicable to persons committed and charged with *crime*, and therefore does not embrace all the cases in which there may be an unlawful detention. The act provides that, with certain exceptions, when any person is charged with crime, a judge, in vacation, on viewing a copy of the warrant, shall award the writ, returnable either before himself or any other of the judges, and if the case is bailable shall discharge the prisoner on proper security being given. The prisoner is required to be brought up within a limited time, not exceeding twenty days. Heavy fines are imposed upon the judge for refusing to award the writ upon a proper case being made, as well as upon the officer or keeper of the prisoner neglecting to make return or evading the mandate of the judge; similar provisions are made for punishment of one causing, after discharge, a recommitment of the prisoner for the same offence. The writ was made to run into all counties palatine and privileged places. There are also clauses providing for the prisoner's discharge unless he is speedily indicted and tried after indictment. There is also a heavy penalty imposed upon any one sending a person as a prisoner out of England, unless in cases of transportation for crime, etc. The *habeas corpus* act of Charles II. was seriously defective in one respect: it only applied to persons arrested on *criminal* charge. In the year 1757 an instance occurred of a gentleman being by some mistake pressed as a foot-soldier, whereupon his friends, on applying for the writ, found that the case did not come within the act. This led to the introduction of a bill into Parliament extending the act to other cases of confinement besides those resulting from a charge of crime. Though the bill passed the House of Commons, it was defeated in the House of Lords under the lead of the great Lord Hardwicke, and it was not until the year 1816 (56 Geo. III. c. 108) that this obvious defect in the law was supplied and the writ in other respects made more effective.

Legislation in general in the U. S., while following the spirit of the English act, is not confined to commitments on criminal charges, but is more comprehensive in its character, and extends beneficial provisions to all arrests and detentions on any grounds or pretexts whatsoever. There is a clause in the U. S. Constitution and in State constitutions to the effect that "the privilege of the writ of *habeas corpus* shall not be suspended unless when, in cases of rebellion or invasion, the public safety may require it." The effect of this clause was much discussed in the late civil war, the President of the U. S. having on the 27th of Apr., 1861, addressed to Lieutenant-General Scott an order authorizing him, under certain contingencies, to suspend the writ. Other orders of a similar nature were issued. One Merryman having been arrested on May 25, 1867, charged with various acts of treason, the general having him in charge refused to comply with the writ, as well as to yield to an attachment issued for its enforcement, on the ground of its suspension by the President. Chief-justice Taney; who had issued the writ, filed an opinion denying the President's authority, and insisting that the power of suspension was vested solely in Congress. (9 Am. Law Register, N. S., 527.) This view is supported by the opinion of Deady in the case of *McCall* v. *McDowell*, 1 Abb. U. S. 112, and of Smalley in *Ex parte Field*, 5 Blatchford 63. These views of the judges referred to have been distinctly controverted by able jurists in pamphlets and professional opinions. Among these may be mentioned the venerable Horace Binney of Philadelphia, Reverdy Johnson, Prof. Theophilus Parsons, etc. Congress passed an act upon this subject Mar. 3, 1863, authorizing the President to suspend the writ. (12 U. S. Statutes at Large, 282. See also ch. 22 Laws of 1871, sec. 4; 17 U. S. Stat. 15.) A proclamation by the President, issued Oct. 17, 1871, under the last-named act, will be found in 17 U. S. Stat. Appendix No. 4, and another in Appendix No. 7, issued Nov. 10, 1871. It would seem that the current of judicial and professional opinion is in favor of the view that the power of suspension under this constitutional provision is vested in Congress rather than in the President.

II. The general scope and office of the writ is to bring before a court or judge the question whether the person in whose behalf it is issued is lawfully detained. The cases coming before the court, etc. will be divisible into two principal classes, one where the person is simply detained without any legal process, and the other where he is in custody under such process. The first class of cases is illustrated by that of a contest between a father and a mother as to the custody of a child. There being no legal process in such a case, there must be an inquiry embracing the merits of the whole controversy for the sake of determining to whom the custody of the child shall be awarded. Wholly different considerations occur when the detention is upon legal process. The point then may be whether the legal proceedings were not wholly void because the court instituting them had no jurisdiction, or whether, assuming that the tribunal had jurisdiction, it was proceeding irregularly, or if all the proceedings were regular whether the merits of the controversy can be considered. There will thus be three principal points to be examined: (1) The right upon a writ of habeas corpus to relieve from detention where the process is issued by a court or magistrate having no jurisdiction; (2) where jurisdiction exists, but the proceedings are irregular; and (3) cases where there is an entire regularity of proceeding and the claim is made that the merits of the case shall be considered.

(1) Where the court or magistrate has no jurisdiction over the subject matter or the person, the prisoner may be relieved by this writ even though there may have been a final judgment, and though the court may have been one of high jurisdiction. So, if it had no power to dispose of the particular question in the mode that it pursued, its judgment is a mere nullity. In the eye of reason there has been no decision and no judgment, no matter though legal forms may have been pursued. Thus, if a court had only power to sentence to imprisonment, and it rendered judgment of death, a writ of *habeas corpus* might be resorted to. It may be said that this is a dangerous doctrine. While this is readily conceded, its soundness cannot be denied. Judicial as well as administrative power has its limits. If these are exceeded by a court, its pretended decision is no judgment; it is but waste paper, and may be disregarded. Great caution should be observed in reaching a conclusion that the judgment is a nullity. If, however, it be clear that jurisdiction is exceeded, there is no more reason why a prisoner held under such a void judgment should be detained than that property seized under a similar void proceeding should be sacrificed. The writ of *habeas corpus* is a legitimate mode of showing the nullity of the judgment and of relieving from the false imprisonment. This subject has recently been extensively considered by the Supreme Court of the U. S. in the case of *Ex parte Lange*, 18 Wallace's Reports, 163.

(2) In the second class of cases (where the court has jurisdiction over the subject in the way that it is presented for its action, but it is proceeding in an irregular manner), it will not necessarily follow that a prisoner will be discharged by the writ. If the proceedings be of a summary nature, and it appears upon the face of them that some essential step or form has been omitted, they will be void and the prisoner will be discharged. Thus, if a fugitive from justice were demanded by way of extradition (see EXTRADITION), the regularity of the proceedings might be tested by means of a writ of *habeas corpus*. It has, however, been maintained by some jurists that if the warrant or other process is sufficient to protect the officer who executes it from an action of false imprisonment, a discharge will not be made. In many cases where a court has jurisdiction over the subject-matter and of the person, the only mode of taking advantage of an irregularity in the proceedings is by a motion addressed to the court itself in the very proceeding complained of. In other words, the writ of *habeas corpus*, an independent method of review, is not to be resorted to, but the mode of correcting the irregularity is to be found in addressing the very tribunal before which it takes place, and asking it so to mould and correct its own procedure as to make it conform to the rules of law; and if such correction is refused, resort may perhaps be had to an appellate court.

(3) Where the case is regularly before a court, the writ under consideration cannot be used to determine the merits of the controversy. This point will only be considered in detail in connection with the administration of criminal law. When a prisoner is charged with crime, the common practice is to bring him before a magistrate, *e.g.*, a justice of the peace, and to make an inquiry into the circumstances which are supposed to establish his guilt. This is not a trial, but a preliminary proceeding devised for the purpose of securing his attendance at the trial. The testimony of

witnesses is taken down in writing by the magistrate; on this he proceeds in making his commitment. The writ of *habeas corpus* may be resorted to with the view of testing its validity, and the court may, in connection with a *certiorari*, consider whether the testimony, as shown in the depositions, supplied a sufficient basis for the action of the magistrate, as well as whether the commitment itself is sufficient in point of legal form. No inquiry can be had even at this stage as to the guilt or innocence of the prisoner. To do that would be to examine the case on its merits. Let it now be assumed that an indictment (see INDICTMENT) has been found. The writ of *habeas corpus* cannot be used to inquire into the depositions before the committing magistrate. These are shut out of view by the indictment; the prisoner is now held upon that. The only question that can be examined is, whether the indictment itself is sufficient in point of form. If that be regular, the court or judge will not go beyond the indictment to inquire into the merits; if it would, trial by jury might be practically abolished. The writ of *habeas corpus* accomplishes its beneficent purposes by securing the prisoner so far that he is not to be held without *apparent* cause. Whether he is in fact guilty or innocent can only be determined by a regular course of trial. The prisoner may be allowed, in certain cases, to go at large on bail, notwithstanding that the proceedings are valid. The statutes of the respective States must be consulted upon this point. (See BAIL.)

III. *Procedure.*—Application for the writ must be made by petition signed by the party or some one in his behalf. In the well-known case of *Ashby* v. *White*, in Parliament, it was resolved "that every Englishman who is imprisoned by any authority whatsoever has an undoubted right, by his agents or *friends*, to apply for and obtain a writ of *habeas corpus* in order to procure his liberty by due course of law." A father claiming the custody of an infant child may himself apply for the writ. Statutory provisions in some States lead to the view that if the petition is properly drawn, the writ must be granted, even though there is good reason to believe that it would be without practical effect; in other words, it must be granted where there is but slight apparent ground for asking for it. The form of petition is also in some States prescribed by statute. It may be directed to any one who has the prisoner in custody or who has participated in the illegal detention. The writ is made returnable at a specified time and place, either before the officer who issues it, at chambers (see CHAMBERS), or to the court as such. The person to whom the writ is directed is expected at the appointed time to make a "return," or a statement of the grounds on which the detention is made. This must be distinct and unequivocal. It would not be enough, for example, to state that the prisoner is not in the defendant's *custody*, but it must be made to appear that he is not under his control, so that he could respond to the requirements of the writ. If the return be evasive or otherwise imperfect, an amendment of it may be allowed. Formerly, the prisoner could make no denial of the truth of the matters alleged in the return. If that furnished a sufficient excuse for the imprisonment, though it were wholly unfounded in point of fact, the prisoner must be remanded. The only remedy of the prisoner was to bring an action for damages for any injury sustained by him for the false return. In some cases criminal proceedings might be instituted. This serious defect in the administration of justice has been remedied by modern statutes, and the prisoner has been allowed to deny the statements of his custodian, or, in legal phrase, to "traverse the return," and also to set up any facts arising subsequently which may make in his favor. The judge or court disposing of the writ may thus have to consider both questions of fact and of law, the matters of fact being presented by way of affidavit or affirmation. If the return is not made or is evasive, the party to whom it is addressed may be regarded as having committed a contempt of court, and will be liable to be placed in close custody until he obeys the writ. On the hearing of the case, the prisoner, if the circumstances require it, may be discharged, or may be remanded to the original custody. The decision does not, as it would seem, necessarily prevent the hearing of the matter again upon a new writ, particularly where the circumstances of the case have changed. Thus, if the custody of a child were awarded to one of its parents at a given time, the facts might be so changed as to make it proper that, on a new application, it should be awarded to the other. Severe penalties are imposed by law upon a ministerial officer who knowingly recommits a prisoner for the same cause as that on account of which he was discharged. Allusion may be made in this connection to another writ existing at common law in favor of personal liberty, *de homine replegiando* (replevying a man). This raises a question to be tried by a jury; while the proceedings in a *habeas corpus* take place before a judge or court. The former writ has become practically obsolete.

IV. Conflicts of jurisdiction have arisen frequently in executing writs of *habeas corpus* between the State and the Federal courts. The principles that should apply to the subject have recently been expounded by the final interpreter of the U. S. Constitution, the supreme court (*Tarble's Case*, 13 Wallace Reports, 397). It is there said that no State judge has a right to issue a writ of *habeas corpus* for the discharge of a person held under the authority of the Federal government. If it do not appear, upon application for such a writ, that the person is so held, the State judge may inquire into the circumstances of the case as to how the prisoner is held, and the marshal in whose custody the party is should give the requisite information. These principles were applied to a case in which the commissioner of a State court issued a warrant to a recruiting officer of the U. S. to discharge a minor who had enlisted in the service of the U. S. It was decided that the commissioner had no jurisdiction, the prisoner being detained under the authority of the Federal government. The proper course in such a case is that the U. S. officer upon whom the writ is served should produce the body of the prisoner before the State court and set forth in what manner he holds him under the authority of the U. S. The State court or judge should go no farther. By this decision the relations of the two governments as to this writ must be regarded as authoritatively settled.

V. The power of the U. S. courts to issue the writ is more limited than that of the State courts, being confined to the exercise of such authority as is either expressly or by implication conferred by the U. S. Constitution and the laws made under its provisions. The courts and judges of the U. S. are authorized to issue the writ in cases coming within Federal jurisdiction. The *circuit* court may inquire into the cause of a commitment, and except when the privilege of the writ is suspended may determine the question whether the prisoner is entitled to be discharged. Thus, this court may by this means, where the circumstances of the case require it, discharge a prisoner held under a warrant of extradition (see EXTRADITION) issued by the governor of a State. The writ, however, cannot be issued to bring up any person *confined in jail* unless held under or by color of the authority of the U. S., or unless such person is required to testify in a cause depending in a court of the U. S. Neither a court of the U. S., nor any judge thereof, under these rules can issue the writ to bring up a prisoner in custody under a sentence or execution of a State court for any other purpose than to be used as a witness. When a prisoner is taken by an order of a U. S. court from a State court to be used as a witness, its authority continues so as to send him back, after his testimony is taken, to the place from which he was brought. In cases coming within the purview of the U. S. Constitution and the laws of Congress it has been said that relief may be granted not only to those held under legal process, but also to such as are confined without any formal appearance of authority; as, for example, where the prisoner and the defendant are citizens of different States, or where a master, before the abolition of slavery, demanded the return of slaves taken from him by force. The *Supreme* Court of the U. S. has not the same power to issue the writ in question as the circuit court. It can only exercise the power in an appellate form, as its original jurisdiction is limited to specific cases. (See JURISDICTION.) It may accordingly issue the writ, where the circumstances of the case require it, when a person is imprisoned under the order or warrant of a court of the U. S. It does not by this means review decisions made at chambers (see CHAMBERS) by a justice of the court.

Further information upon the general subject of the writ will be found in Hurd's treatise on *Habeas Corpus*, and in an elaborate note written by the late Nicholas Hill of Albany and published in vol. iii. of his *Reports*, pp. 617–676; also in Blackstone's, Kent's *Commentaries*, Story, Rawle, Paschal, and Pomeroy on the *U. S. Constitution*, and in the digests and decisions of the Federal and State courts. (See also Hallam's *Constitutional History* for historical information.)

A word is added as to the writ *ad testificandum*. This is resorted to for the purpose of bringing up a person who is in custody to testify in some cause or other matter pending judicially. When his testimony is given in, he is returned to the custody from which he is taken. The writ is obtained upon motion based upon an affidavit setting forth the facts upon which the application is founded. A legislative body, *e. g.*, the House of Representatives, desiring the attendance of a witness at the time in custody, simply executes its will by the warrant of its Speaker, giving authority to its sergeant at arms to produce the prisoner. The writ of *habeas corpus ad testificandum* cannot in such a case be resorted to.

T. W. DWIGHT.

Haber'geon, a coat of chain-mail without sleeves, or in later times a suit of plate armor worn over the hauberk.

Hab'ersham, county in the N. E. of Georgia, bordering on South Carolina. Area, 450 square miles. It is mountainous and well watered. Gold and iron are found abundantly, and rubies, diamonds, and other precious stones have been found. The scenery is generally fine. The staple products are corn and tobacco. Cap. Clarkesville. Pop. 6322.

Habersham (Col. JOSEPH), b. at Savannah, Ga., July 28, 1751; was eminent throughout the Revolutionary war, and at its close held the rank of lieutenant-colonel. He became Speaker of the assembly in 1785, and again in 1790. He was appointed postmaster-general by Washington in 1795. D. at Savannah, Ga., Nov. 17, 1815.

Habersham (JOSEPH CLAY), M. D., was b. in Savannah, Ga., Nov. 18, 1790; d. there Nov. 2, 1855. He took his literary diploma at Princeton, N. J., and his professional from the University of Pennsylvania in 1814. Commencing the practice of medicine in Savannah in 1815, he continued to the date of his death in active business. He was at one time health officer of Savannah, president of the Medical Society of Georgia, and well known for his benevolence and love of science. PAUL F. EVE.

Habersham (RICHARD W.), b. in Savannah, Ga., in 1786; graduated at Princeton, N. J., in 1805; rose to distinction at the bar in his native city; occupied many positions of high official trust in the State; was member of Congress 1839–43; was greatly lauded for resigning the office of U. S. district attorney in 1825, when there was a threatened collision between the Federal administration of John Quincy Adams and the State administration of George M. Troup. D. in Habersham co., Ga., Dec. 2, 1846. A. H. STEPHENS.

Hab'ington (WILLIAM), b. at Hindlip, Worcestershire, England, Nov. 5, 1605, of an old Roman Catholic family; was educated at St. Omer in France; married Lucy Herbert ("Castara"), the daughter of Lord Powis, and lived chiefly on his ancestral estate at Hindlip, where he d. Nov. 13, 1645. He is chiefly remembered for his *Castara* (1634), a collection of poems addressed mostly to his wife, and remarkable for their pure and elevated sentiment and for their occasional quaint and far-fetched conceits. The *History of Edward IV.* is believed to have been his father's work. He wrote also the *Queene of Aragon,* a play.

Hab'it [Lat. *habitus,* a "condition;" Gr. ἕξις], a constitution or state of mind or body which disposes one to certain acts or conditions, mental or physical. A habit is of more fixed character than a *disposition,* but is generically the same. There are habits intellectual and moral, acquired and inherited, active and passive. Habits are originally the results of voluntary acts, but the control of them may become impossible to the will. A wise and skilful formation of habits may be of the greatest moral and intellectual advantage, whilst habits injudiciously formed may be destructive of mind, character, body, and estate. The question of habit is intimately connected with that of the ASSOCIATION OF IDEAS (which see).

Hack'berry, Sugar-berry, or **Nettle Tree,** the *Celtis occidentalis,* a North American tree of considerable height and much beauty, but singularly variable in its mode of growth. Its wood is quite tough, but is not much used in the arts. It makes good charcoal, and when young is used for barrel hoops, and sometimes called hoop-ash. The genus (*Celtis,* order Ulmaceæ) contains several foreign trees of considerable importance.

Hackberry, tp. of Labette co., Kan. Pop. 637.

Häck'el, or **Haeckel** (ERNST HEINRICH), M. D., b. at Potsdam, Germany, Feb. 16, 1834; studied medicine and botany; was the pupil of Kölliker, Leydig, Virchow, and Johannes Müller; became a medical practitioner of Berlin 1858; devoted much attention to biological questions; became zoological professor extraordinary at Jena 1862, and in 1865 received the regular professorship of zoology there, which he has since retained, his lectures having rendered that university a very famous school for biological science. Häckel was one of the first German savants to recognize and accept Darwinism, a theory towards which his own researches had long been leading him. He has published many remarkable monographs. Among his principal works are *Generelle Morphologie der Organismen* (2 vols., 1866); *Natürliche Schöpfungsgeschichte* (1868); *Biologische Studien* (1870); and *Die Kalkschwämme* (3 vols., 1872). He has propounded many novel and suggestive biological theories, and the general drift of his recent writings is toward the confirmation of Darwinism, in support of which theory he has brought forward many interesting facts.

Hack'ensack, post-v. and tp., cap. of Bergen co., N. J., on the Hackensack River, the Erie R. R., and the New Jersey Midland R. R., 13 miles from New York and 6 miles from Paterson. It has several churches, 3 newspapers, public and private schools, 2 banks, gas and water companies, and a number of small factories. Pop. of tp. 8038. H. D. WINTON, ED. "THE BERGEN CO. DEMOCRAT."

Hackensack River rises in Haverstraw, Rockland co., N. Y., and flows S. through Bergen and Hudson cos., N. J., falling into Newark Bay, and draining a beautiful and fertile region.

Hack'ett (HORATIO BALCH), D. D., LL.D., b. at Salisbury, Mass., Dec. 27, 1808; graduated from Amherst College in 1830; studied theology at the Andover Seminary until 1834, and afterwards at Halle and Berlin in Germany; was professor of Latin in Brown University four years, also a tutor in Amherst College; was elected to the chair of biblical literature in the Newton Theological Institution (Baptist) in 1839; became professor of New Testament Greek in Rochester Theological Seminary 1870. Published Plutarch's *De Sera Numinis Vindicta,* with notes (1844); translated and enlarged Winer's Chaldee grammar (1845); published a Hebrew grammar and reader (1847); *Commentary on Acts* (1851); *Illustrations of Scripture* (1855); *Philemon,* newly translated, with notes (1860); *Christian Men in the War* (1864); translated (for Lange's *Commentary*) Van Oosterzee on Philemon (1868), and Braum on Philippians (1870); was one of the editors of the enlarged American edition of Smith's *Dictionary of the Bible;* edited also Rawlinson's *Historical Illustrations of the Old Testament* (American reprint, 1873). D. at Rochester, N. Y., Nov. 2, 1875.

Hackett (JAMES HENRY), b. in New York Mar. 15, 1800; d. at Jamaica, L. I., Dec. 28, 1871; studied a year at Columbia College; applied himself a little while to the study of law; tried business without success, and in 1826 attempted the stage, appearing first at the Park Theatre. For twenty-five years he was popular in England and the U. S. In 1849 he was joint manager with William Niblo of the Astor Place Opera-house, and in 1854 took part in the management of the Grisi and Mario opera troupe in their visit to America. Mr. Hackett was a comedian of much versatility. He introduced Yankee characters with great effect, but his highest excellence was shown in the humorous characters of Shakspeare, especially in Falstaff, which he made his own. His talent, however, was not for comic parts exclusively, as his admirable performance of King Lear proved. In his later years Mr. Hackett seldom appeared before the public. O. B. FROTHINGHAM.

Hack'ettstown, post-v. and tp. of Warren co., N. J., on the Musconetcong River, half a mile from the highest point in New Jersey. The Morris Canal and the Morris and Essex and Delaware Lackawanna and Western R. Rs. pass through it. It is liberally supplied with water by an aqueduct, and the streets are lighted at night with kerosene. It contains 4 churches, 3 academies, the Newark M. E. Conference Seminary, 2 weekly newspapers (one run by steam-power), 1 bank, 2 steam saw and planing mills, 1 car manufactory, 2 foundries, 4 harness manufactories, 30 stores of various kinds, 2 lumber and 3 coal yards, 3 grist-mills, and 9 carriage-factories, the latter being the leading industry. Pop. 2202. E. W. OSMUN, ED. "HACKETTSTOWN GAZETTE."

Hack'länder, von (FRIEDRICH WILHELM), was b. at Bertscheid, near Aix-la-Chapelle, Nov. 1, 1816. He learned the dry-goods business in Elberfeld; entered the Prussian artillery; returned again to his commercial occupations, and succeeded at last in 1841 in making for himself a literary name by the publication of his *Bildern aus dem Soldatenleben* in a Stuttgart paper, and shortly after of his *Wachtstubenabenteuer.* He then accompanied Baron von Taubenheim on a trip to Arabia to buy horses, and published in 1842 *Daguerreotypes taken in the Orient,* which also was well received, and which recommended him to the crown prince of Würtemberg, whom he accompanied on a journey through Italy, France, and Russia. New travelling sketches and small humorous tales followed, and the king of Würtemberg gave the author an office and a pension. In 1850 he published a large novel or romance, *Handel und Wandel* (2 vols.), and in 1854 another, *Europäisches Sklavenleben* (4 vols.), both of which made some sensation. But his quick observation, his talent of humorous sketching, his easy-flowing style, which are sufficient to entertain in a travelling sketch or small tale, are utterly insufficient in a large composition. Of his dramas, *Der geheime Agent,* a comedy in five acts, and two or three one-act pieces, *Schuldiz, Unten im Haupe,* etc., have been played with success in all the German theatres; they are a sort of mosaics, dexterously put together and pleasant to look at. In 1857 he founded, in connection with Zoller, *Ueber Land und Meer,* an illustrated paper, which was deservedly very popular. D. July 5, 1877.

Hack'le, Hat'chel, or **Hetchel,** the comb with long steel teeth by means of which the tow is removed from flax, hemp, or jute, and the fibres fitted for spinning or other

uses by straightening and laying them parallel to each other. The long, tapering, polished teeth are affixed to a wooden or metallic block, and are arranged in two, or more frequently in many, rows. Their adjustment for effective use requires considerable skill.

Hack'leman (PLEASANT ADAM), b. in Franklin co., Ind., about 1817; studied law, and attained prominence in his profession in his State. About 1840 he assumed the editorship of the Rushville *Republican*, which he retained till the outbreak of the civil war in 1861; was elected to the State legislature in 1841; member of the Republican national convention 1860, and of the Peace Conference at Washington in 1861; appointed colonel 16th Indiana Vols. in 1861, he served with distinction under Gen. Banks in Virginia; was promoted to be brigadier-general of volunteers Apr., 1862, and ordered to the army of the South-west, under Gen. Grant, being engaged in the battle of Iuka, Miss., Sept. 19–20, 1862, and at Corinth, where he was killed, Oct. 4, 1862. G. C. SIMMONS.

Hack'ley (CHARLES E.), A. M., M. D., b. at Unadilla, N. Y., Feb. 22, 1836; graduated at the University of Pennsylvania; A. B. in 1856, M. D. in 1860; surgeon 2d U. S. Cavalry 1861–64; surgeon-in-chief to the 3d cavalry division Army of the Potomac; appointed physician to New York Hospital 1867; surgeon to New York Eye and Ear Infirmary; clinical professor of diseases of eye and ear Woman's Medical College, New York, etc. Translator of Stellwag on the eye and Billroth's *Surgical Pathology*; one of the translators of Niemeyer's *Practical Medicine*, etc.

Hackley (CHARLES W.), b. in Herkimer co., N. Y., Mar. 9, 1809; graduated from the U. S. Military Academy in 1829; appointed second lieutenant of artillery; retained at the Academy as assistant professor of mathematics until 1833, when he resigned from the army. Was ordained in 1839 in the Protestant Episcopal Church. Professor of mathematics at the University of New York from 1833 to 1839, when he was appointed president of Jefferson College, Miss.; subsequently professor of mathematics in Columbia College 1843–57, and of astronomy from the latter date to his death in New York City Jan. 10, 1861. He published *A Treatise on Algebra*, *Elementary Course of Geometry*, *Elements of Trigonometry*, etc., and was a frequent contributor to the scientific and literary journals of the day.
G. C. SIMMONS.

Hack'matack, Tam'arack, or **American Larch** (*Larix Americana*), a forest tree of the U. S., growing frequently in wet places, and attaining a noble size, except in the far north, where it is a stunted shrub. It is our only native coniferous tree whose leaves fall off in winter. Its wood is of excellent quality. It is prized in the West for poles and rafters: in shipbuilding it is used for ship's knees, top-timbers, and spars; and if fastened with square iron is far better than oak for such uses.

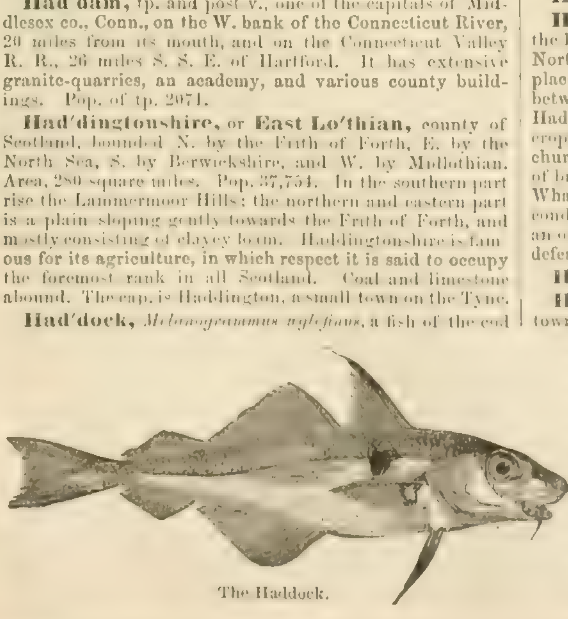
Hack'ney, a N. E. suburban district of London, in the county of Middlesex, Eng. Pop. 124,951; of the sub-district of Hackney (inclusive of the workhouse, lunatic asylum, and hospital), 50,087.

Hackney, tp. of Tallapoosa co., Ala. Pop. 1755.

Had'dam, tp. and post-v., one of the capitals of Middlesex co., Conn., on the W. bank of the Connecticut River, 20 miles from its mouth, and on the Connecticut Valley R. R., 26 miles S. S. E. of Hartford. It has extensive granite-quarries, an academy, and various county buildings. Pop. of tp. 2071.

Had'dingtonshire, or **East Lo'thian,** county of Scotland, bounded N. by the Frith of Forth, E. by the North Sea, S. by Berwickshire, and W. by Midlothian. Area, 280 square miles. Pop. 37,754. In the southern part rise the Lammermoor Hills; the northern and eastern part is a plain sloping gently towards the Frith of Forth, and mostly consisting of clayey loam. Haddingtonshire is famous for its agriculture, in which respect it is said to occupy the foremost rank in all Scotland. Coal and limestone abound. The cap. is Haddington, a small town on the Tyne.

Had'dock, *Melanogrammus æglefinus*, a fish of the cod family, captured in large quantities on both sides of the Atlantic for food. It is generally eaten fresh, but is sometimes smoked or salted and dried. It resembles the cod, but is easily distinguished by the black line along its side, that of the cod being white.



The Haddock.

Haddock (CHARLES BRICKETT), D. D., b. at Franklin, N. H., June 20, 1796; graduated from Dartmouth College in 1816, and from Andover Seminary in 1819. Held the chair of rhetoric and belles-lettres at Dartmouth College from 1819–38, also that of intellectual philosophy and political economy at same college 1838–54. Was *chargé d'affaires* to Portugal 1851–55; was a member of the legislature in his native State for four years, where he introduced and carried through the present common-school system of the State; was the originator of the railroad system in New Hampshire. He was well versed in public law, etc. Author of several addresses, essays, etc. D. at West Lebanon, N. H., Jan. 15, 1861.

Had'don, tp. of Sullivan co., Ind. Pop. 2750.

Haddon, tp. of Camden co., N. J. Pop. 1926.

Had'donfield, post-v. in Haddon tp., Camden co., N. J., on the Camden and Atlantic R. R., 7 miles S. E. of Philadelphia. It has a public library and several churches. Pop. 1075.

Had'ersleben [Dan. *Haderslev*], town of Prussia, in the duchy of Sleswick, with a good harbor on the Haderslev Fjord, an inlet of the Little Belt. Pop. 8259.

Ha'des [Gr. Ἀιδης, ᾅδης], in the Homeric writings (as in *Il.* xv. 188), is used as the name of the god of the lower or invisible world, and is the equivalent of Pluto. In later Greek writings it is used to designate the place of departed spirits. The corresponding Hebrew word is *Sheol*, which in our English version is sometimes rendered "grave," sometimes "pit," and sometimes "hell." *Hades* is almost always employed by the LXX. in translating *Sheol*. It occurs eleven times in the New Testament, and in our English version is rendered "hell," except in 1 Cor. xv. 55, where it is rendered "grave." R. D. HITCHCOCK.

Hadház, one of the Haiduk towns of Hungary, in the county of Szabolcs. Pop. 7024.

Hadj [Arab., "pilgrimage"], the pilgrimage to Mecca which every Mohammedan is under obligation to perform at least once, unless poverty or sickness forbid. The hadji or pilgrims from distant lands often perform a great part of the journey by ship; other persons travel in great caravans, of which there are four regular ones—one from Cairo, consisting largely of Berbers; one of Turks from Damascus; one of Persians from Babylon; and a fourth of Indians, Arabs, and others from Zibith. Strict discipline is maintained. Arrived at Mecca, a routine of ceremonies is performed. These ceremonies, and the pilgrimage itself, were adopted by Mohammed from the old Arabian heathenish customs, which had become thoroughly established ages before his time. These he adopted, partly to gain the sanction of rites so immemorial and so sacredly esteemed, and partly because their rejection would have endangered the success of his own system.

Had'ley, tp. of Pike co., Ill. Pop. 1309.

Hadley, tp. and post-v. of Hampshire co., Mass., on the E. side of the Connecticut River, which separates it from Northampton and Hatfield. The village is a beautiful place, embowered in ancient trees. Mount Holyoke lies between this town and South Hadley. The greater part of Hadley is a very fertile alluvial plain, producing luxuriant crops of tobacco, broom corn, hay, and grain. There are 3 churches, an academy, a public library, and manufactures of brooms. Hadley was long the place of refuge of Goffe, Whalley, and Dixwell, three of the regicide judges who condemned Charles I. Here on Sept. 1, 1675, according to an old tradition now discredited, the colonists, led by Goffe, defeated the Indians after a sharp encounter. Pop. 2301.

Hadley, tp. and post-v. of Lapeer co., Mich. P. 1461.

Hadley, tp. and post-v. of Saratoga co., N. Y. The township lies on the Hudson River. It is mountainous, and has manufactures of leather, lumber, etc. There is abundant water power, and gneiss is extensively quarried. Large quantities of this stone have been used in the construction of the new State capitol at Albany. The town has 4 churches, and is on the Adirondack R. R., 22 miles N. of Saratoga. P. 1039.

Hadley (JAMES), LL.D., was b. at Fairfield, Herkimer co., N. Y., Mar. 30, 1821. His father was professor of chemistry in a medical institution established there. Entering the junior class in Yale College, he graduated in 1842. From 1843 to 1845 he was a theological student in New Haven, serving as tutor in Middlebury College meanwhile (from Sept., 1844, to Apr., 1845); was tutor at Yale from

1845 to 1848, when he was appointed associate professor of Greek; succeeded Dr. Woolsey as full professor in 1851; and d. Nov. 14, 1872. At first he gave great promise of distinction in mathematics, but circumstances turned his genius and industry in a different direction. Few men in either hemisphere have made such attainments. In addition to his mastery of the Greek language, he was well versed in Hebrew, Arabic, Armenian, Sanscrit, Welsh, Gaelic, Irish, and the principal modern languages, including Swedish. Keen as a Damascus blade, he had the gentleness of a child and a simple, steady Christian faith. His *Greek Grammar*, based on that of Curtius, was published in 1860. In 1873 a posthumous volume of twelve lectures on *Roman Law* was edited by Ex-President Woolsey; and in the same year another volume of twenty *Philological and Critical Essays* was edited by Prof. Whitney. (See President PORTER's art. in the *New Englander*, Jan., 1873.) His brother, HENRY HAMILTON HADLEY, who graduated at Yale in 1847, at Andover in 1851, was appointed teacher of Hebrew in Union Theological Seminary, N. Y., in 1862, and d. at Washington, D. C., in the service of the Sanitary Commission, Aug. 1, 1864, at the age of thirty-eight, was a scholar of kindred spirit. R. D. HITCHCOCK.

Had'lyme, post-v. of Lyme tp., Middlesex co., Conn., 30 miles S. S. E. from Hartford.

Hadramaut' [the *Adramitæ* of Strabo], in a narrow sense designates the S. W. portion of Arabia Felix, but in a large sense it includes nearly all that part of Arabia S. and S. E. of the central desert of the peninsula. The coastland is low, the interior dry, and broken with ranges of mountains and hills. In the valleys there are some torrents, which are often dry. Its people are of many tribes, subject to various local sultans. As a rule, they are not nomadic. The country affords fine horses, camels, wool, dates, gums, and grain. Copper, coal, and bitumen exist. Chief seaport, Makallah.

Ha'drian, or **A'drian** (PUBLIUS ÆLIUS HADRIANUS), the fourteenth Roman emperor, b. at Rome Jan. 24, 76 A. D., the son of a senator, a kinsman of Trajan (afterwards emperor), who became his guardian in youth. Young Hadrian was a zealous student of Greek letters; entered the army in Spain when fifteen years old; became a military tribune in Mœsia 95 A. D.; was made quæstor in 101; married Trajan's grand-niece; tribune of the people 105; prætor 107; prætorian legate in Lower Pannonia 108, where his military renown, already great, was much increased; was consul suffectus 109; archon at Athens 112; legate in the Parthian war 114–117; was chosen consul 117; was proclaimed emperor after Trajan's death 117; gave up the country E. of the Euphrates to the Parthians, and made Armenia independent; appeased the discontent of the people consequent upon the bloody suppression of a formidable conspiracy by the remission of all arrears in taxes and debts due the state, and by large gifts of money to the people; passed a large part of his reign in travels throughout the empire, redressing wrongs, confirming disputed privileges, inspecting the troops and the fortifications. During one of these famous progresses the wall of Hadrian from the Tyne to the Solway was constructed (119 A. D.). In 132 the bloody revolt of the Jews broke out, which lasted for several years, and was not ended till Palestine was almost depopulated. Athens was a favorite residence of the emperor. He rebuilt Jerusalem (134), returned finally to Rome in 135, spending a great part of his declining years in his splendid villa near Tibur. He d. at Baiæ July 10, 138 A. D. Hadrian's name is one of the most illustrious in the imperial annals. He was the first emperor, almost the first Roman, who cared for any part of the empire except Italy. He fostered peace and promoted the welfare of his people. He reformed the system of jurisprudence, and punished severely injustice and crime. But his private character was not free from stains, and late in his reign he was guilty of many acts of tyranny. He affected to be a poet, architect, painter, philosopher, orator, and musician. Six Latin and six Greek epigrams, and some quotations from his history of his own life, are all that remain to us of his written works. He was succeeded by Antoninus Pius.

Hadrosau'rus [Gr. ἁδρός, "thick," "stout," and σαῦρος, a "lizard"], a genus of fossil reptiles from the American Cretaceous, belonging to the order Dinosauria. This order included animals now extinct, mostly of very large size, some of them being the largest of land animals, and, although true reptiles, they possessed also many characters of birds and mammals. Their affinities with the birds, as Huxley has shown, are especially seen in the large medullary cavities of the long bones, and in the structure of the pelvic arch and hind limbs. Thus, the sacrum consists of four to six vertebræ; the ilium extends far in advance of the acetabulum, and furnishes only a widely arched roof for that cavity; the ischium is greatly elongated, and often presents the obturator process characteristic of birds; and the *os pubis*, in many genera at least, is slender and elongated, and directed downward and backward. The femur has, usually, a strong inner trochanter, and its distal end is particularly bird-like in the presence of a strong ridge between the tibia and fibula. The tibia closely resembles that of a bird, and in many genera the astragalus is ankylosed with its distal end. The latter bone is very similar to that of a bird, and has a stout ascending process. The metatarsals are elongate and closely fitted together; the inner and outer digits are short or rudimentary; and the third digit is the longest, as in the birds. The hind legs were usually much larger than the fore legs, and ordinarily supported the body in walking. The so-called "bird tracks" in the Connecticut River sandstone were probably all made by Dinosaurs. The cervical vertebræ, as in many mammals, were convex in front and concave behind—a character possessed also by the dorsals, but in a less degree posteriorly. The teeth in the herbivorous genera present broad grinding surfaces, and the articulation of the jaw admitted of lateral motion, as in herbivorous mammals. Other genera were, however, carnivorous, and furnished with sharp, recurved, serrated teeth. The latter are implanted in various ways, but never ankylosed with the jaws. In their manner of life Dinosaurs seem to have resembled ordinary terrestrial mammals. Their remains are found throughout the Mesozoic or Reptilian Age, at the close of which they appear to have become entirely extinct. The present genus (*Hadrosaurus*) is the principal American representative of the herbivorous group of this order. Its existence was first made known in 1858 by Dr. Leidy, who described portions of a skeleton found at Haddonfield, N. J., under the name of *Hadrosaurus Foulkii*. It is closely related to the *Iguanodon* from the Wealden and Cretaceous of Europe. The teeth of *Hadrosaurus* are small, set in alveolar grooves separated by narrow intervening ridges, and present the same general characters as those of *Iguanodon*. They appear to have been crowded together, both those in actual use and the successional teeth, in a quincuncial arrangement. In the upper teeth the layer of enamel seems to have been upon the outer side, so that the series of teeth at the border of the jaw, as worn down by use, formed a continuous pavement sloping inward and downward, and presenting triturating points and facets of various sizes and patterns, according to the portion of the tooth that had reached the grinding surface. In the lower teeth the inner side of the crown only is covered with enamel, and forms a lozenge-shaped surface, divided by a prominent median keel. The upper angle or apex of each tooth is rounded, the lower angle notched. This structure and disposition of teeth indicate a vegetable feeder that masticated its food like the herbivorous mammals. The skull is little known. The cervical vertebræ are convex in front, concave behind. The caudals are biconcave. The humerus resembles that of *Iguanodon*. It is twenty-two and a half inches long, and has a large medullary cavity. The bones of the fore arm are similar to those of the living iguana. Their interior is occupied by a coarse, spongy substance. The bones of the hind limbs are of very large size in comparison with those of the fore limbs—larger than in *Iguanodon*. The femur is four and a half feet in length. It has a quadrilateral shaft, with the head and trochanter on the same line as the condyles. The medullary cavity is large in this bone, as well as in the tibia, which is slender, twisted, and about three feet long. The entire length of this animal is estimated at more than twenty-five feet. It moved usually upon its hind legs, and used its large tail as an additional support while it browsed upon the vegetation growing near the ocean where it lived. Two smaller species of *Hadrosaurus* have since been found, also in the Cretaceous—*H. minor* from New Jersey, and *H. agilis* from Kansas.
O. C. MARSH.

Hæm'atine [Gr. αἷμα, "blood"], a substance ($C_{96}H_{102}N_{12}Fe_3O_{18}$) which may be obtained from blood long extravasated. It was long supposed to be the coloring-matter of the blood, and to be essential to health. It was believed to be associated with globulin in the red blood-corpuscles, but at present most chemists recognize but one definite compound, hæmoglobin, instead of two associated compounds.

Hæm'atite, or **Specular Iron Ore,** one of the most common ores of iron, distinguished by its color into red and brown hæmatite. It does not attract the magnet. These ores are composed chiefly of peroxide of iron, and are very important sources of metallic iron. They occur largely in metamorphic strata, and are found sometimes crystallized in various forms. (See IRON, ORES OF.)

Hæmatox'ylin, a crystalline yellow principle obtained by digesting the aqueous extract of logwood (*Hæmatoxylon Campeachianum*) in ether or alcohol, and carefully evapo-

rating it; then adding a little water and allowing the hæmatoxylin to form crystals. When pure, it is sweet to the taste. Its formula is $C_{16}H_{14}O_6 \cdot 6Aq$. It does not have the power of dyeing cloths, but with alkaline bases fine reds, blues, and purples are produced. It exists already formed in the logwood.

Hæmatozo'a [Gr. αἷμα, "blood," and ζῶον, an "animal"] are those Entozoa or intestinal worms which are found in the blood-vessels of other animals. This habit is not confined to any one natural group, but is manifested in representatives of several widely separated types, some belonging to the order of Nematoids, some to the Trematodes, and others to the Gregarinidæ or Protozoa. One or more species occur under certain conditions in the several species of mammals, birds, reptiles, and fishes, as well as in some invertebrates. They are of course small, and generally of microscopic size, but a few reach comparatively large dimensions. They are generally (when in the blood-vessels) in an undeveloped stage—*i. e.* without generative organs—but in the larger forms these organs are sometimes found developed. The only examples of this group which it is necessary to specifically name are a "fluke" found in the abdominal venous system of man (called *Distoma hæmatobium*), and a thread worm found in the vascular system of man lately discovered (*Filaria sanguinis hominis*). These are generally confined to the specific portions mentioned, but in other animals the species infesting them may be met with in other specific parts of the vascular system, the several species always, however, being limited to certain parts thereof. The source of these animals is not yet definitely known. It has been supposed that they may be transmitted in mammals through the vessels of the placenta from generation to generation, but the researches of several naturalists have militated against this view. The parasites do not generally cause much inconvenience to their hosts, but occasionally they seem to be the origin of grave disorders, and even derangements of the nervous system have been attributed to them. The occasional occurrence in the blood-vessels of man of the common liver-fluke (*Distoma hepaticum*) has been verified by several observers, who have found individuals in the veins of different parts of the body (neck, feet, and abdominal veins), and in each case the presence of the parasite was indicated externally by a tumor. In these several cases death was apparently caused or hastened by the parasite. The *Filaria sanguinis hominis* has recently (1874) been claimed to be associated with chyluria and the elephantoid condition of the tissues in man in India, and has been made the subject of special investigation by Dr. T. R. Lewis. THEODORE GILL.

Hæmoglo'bin, Hæm'ato-glob'ulin, or **Hæm'atocrys'tallin,** a substance which forms the principal part of the red corpuscles of the blood of vertebrates. It was formerly supposed to consist of hæmatin, intimately associated with globulin. Its composition is given as 54.2 parts of carbon, 7.2 of hydrogen, .42 of iron, .16 of nitrogen, 21.5 of oxygen, and .7 of sulphur. From the blood of certain animals it can be obtained in the form of crystals, which vary in character according to the animal whence they are obtained.

Hæmop'tysis [Gr. αἷμα, "blood," and πτύσις, "spitting"], the expectoration of blood from the vessels of the lungs or from the mucous membrane of the thoracic air-passages. Hæmoptysis occurs in pulmonary consumption, in heart disease, etc. It is sometimes vicarious in cases of suppressed menses. The significance of hæmoptysis in any case can only be estimated by the trained diagnostician. A distinction is to be observed between hæmoptysis from the congested mucous membrane of the air-passages (the blood issuing from many points in the congested surface, which is not lacerated), and the far more formidable *pneumorrhagia*, when the flow is from a vessel opened in the course of pulmonary disease. It is believed by some good observers that cases of consumption which are characterized by a decided tendency to hæmoptysis are as a rule slower in progress and less rapidly fatal than other cases are. The remedies usually administered for hæmoptysis are dilute sulphuric acid, ergot, gallic acid, lead-acetate, opium, turpentine, common salt, and other hæmostatics. Perfect quiet of mind and body is to be sought. Sometimes obstinate hæmorrhage is stayed by the free opening of a vein in the arm, which seems marvellously to divert the flow from its former course. Ice to the chest and the swallowing of lumps of ice is often effective.

REVISED BY WILLARD PARKER.

Hæmorrhage. See BLEEDING.

Hæmorrhoids. See PILES.

Hæ'res [Lat., "an heir"], in Roman law one who is the universal successor to all the property and all the rights of a person deceased, and who is bound to acquit all the charges and burdens of the said property. The term *hæres* in civil law has a much more comprehensive signification than the word *heir* in English law. For the *hæres* succeeds immediately to all the property of the deceased, and not merely to some specific portion, as the real estate; and even though devises or legacies have been made to third persons, these cannot be obtained by the donees except at the hands of the *hæres*, who is charged with the fulfilment of the trust which the gift imposes. Moreover, a person was called *hæres* even when appointed by will and having no natural claim to the inheritance. The *hæres* therefore corresponded partly with the heir or devisee, and partly with the executor or trustee under the common-law system. Sometimes *hæredes* received the property entirely for their own personal benefit, and then they occupied simply the position of heirs or donees, but more commonly duties of a fiduciary character were devolved upon them to carry out the intentions of the deceased; and the discharge of trusts thus created might constitute their entire functions, so that they would act merely as executors. There were two kinds of *hæredes*—those who were appointed by a testament, who were called testamentary *hæredes;* and those to whom the law gave the inheritance on account of their connection by blood with the deceased, who were therefore called *hæredes* at law. All persons might act in this capacity except persons not Roman citizens, slaves of such persons, persons not in being at the death of the testator, corporations unless specially privileged, and a few less important classes. If a person appointed *hæres* was a slave of the testator, or was under the testator's authority at his death, he was obliged to accept the position, but in other cases acceptance was discretionary.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Háfiz (SHEMS UD DÍN MOHAMMED), better known by his *takhallus* or poetical *nom de plume* of HÁFIZ—*i. e.* "one who know the Kor'án by heart"—was b. at Sheeraz in the beginning of the fourteenth century. Like many other great poets, the historical notices of his life are very scanty; indeed, one or two unimportant incidents are all that have come down to us. One of the most authentic of these is that one of the kings of the Deccan, admiring Háfiz's genius, endeavored to tempt him by splendid presents to his court. Háfiz set out from Sheeraz, and reached Ormuzd in safety, but no sooner had he embarked on board ship there than a storm arose which forced the ship to return to port. The poet was so dreadfully seasick that he refused to trust himself again on the ocean, and sent an ode to his royal friend as an apology for not coming in person. Another incident related by the Persian historians is the following: When the Teimur Lang (Tamerlane) had subjugated the province of Fars, he is said to have sent for the poet, and called him to account for having made free with his (the conqueror's) dominions in a well-known verse which says, "For the black mole on thy cheek I would give Samarcand and Bokhara." Háfiz replied, "Yes, sire, and it is such reckless extravagance that has made me poor as I am." Tamerlane was so pleased with his ready wit that he bestowed on him a magnificent mark of his favor. Unfortunately for the truth of the story, Tamerlane did not take Sheeraz till at least four years after the poet's death. Here and there a few records of his life and times may be extracted from various passages in his works; as, for instance, the tragical end of Abu Isḥák, the usurping prince of Sheeraz; but his personal biography is little better than a blank. Háfiz d. in 1389, and was buried in a garden near Sheeraz; a white marble monument was erected over the tomb, which is still an object of veneration to numerous pilgrims who visit the spot. The anacreontic and free-thinking expressions which abound in Háfiz's poems appear to have brought him into disfavor with the clerical party, who hesitated about according him Muslem burial. A *fál* or omen was, however, taken from his poems, after the fashion of the *Sortes Virgilianæ*, and the following verse being indicated,

> "Shun not Háfiz's bier, for, though sunk in sin, he will yet go straight to heaven,"

the coincidence was considered sufficiently remarkable to overcome the scruples of the mollahs. The works of Háfiz are frequently used for a similar superstitious purpose at the present day. The poems of Háfiz consist for the most part of *ghazals*—that is to say, of short odes consisting of from five to fifteen verses each, with the same rhyme throughout. They were not published in a collected form until after his death. Such a collection of poems, arranged in alphabetical order of the rhymes, is called a *díván*, and the *Díván i Háfiz* is the name under which his works are generally known. Háfiz is justly esteemed the greatest lyrical poet which Persia has ever produced. His language is singularly idiomatic and beautiful; his verse is exquisitely smooth and flowing; and his thoughts and allusions are eminently national. European writers have

for the most part disputed whether the odes of Háfiz are to be considered anacreontic and erotic, as they at first sight appear, or whether they are mystical and religious, as native readers and critics deem them. The fact is, that both views are correct. Háfiz, in common with nearly all his compatriot poets, belonged to the religious order of dervishes called Súfis. This sect profess doctrines which may be fairly called the esoteric creed of Islam; steering a middle course between the pantheism of India on the one hand, and the monotheism of the Koran on the other, the Súfis' cult is a religion of beauty, where heavenly perfection is considered under the imperfect type of earthly loveliness. He aims at elevating mankind by the contemplation of spiritual things through the medium of the most impressionable feelings. The charms of visible objects are enthusiastically described by him, but as he refers all love and beauty to the Deity, it is easy to extract an allegorical meaning from the most passionate of his utterances. This is the real secret of understanding Háfiz's poetry; his utterances are fresh and natural, and, as he was no ascetic, it is probable that many of the passages in which he describes the pleasures of love and wine are actual records of his own experience. But the sorrows and yearnings to which he gives expression may also have been real; but, for all that, they may be read—nay more, may have been written—in an allegorical sense. As a true poet, Háfiz poured his soul into his verse; as a true mystic, he saw God reflected in the human soul. To a person who desires to study the thoughts, manners, or language of Persia, Háfiz is the best guide. The native editions of his *Diván* are so numerous that it would be difficult to make a selection, but for general use an edition lithographed at Lucknow by Munshí Nowel Kishore, proprietor of the *Audh Akhbár* newspaper, may be recommended. It is easily obtainable through the munshi's agents, Messrs. Trübner & Co. of London, and is furnished with a concise and useful commentary in Persian. Of European editions, etc., there are *Die Lieder des Hafiz, Persisch mit dem Commentar des Sudi*, v. H. BROCKHAUS, Leipsic, 1857–59; *Der Diwan des grossen Lyrischen Dichters Hafiz, in Persischen Original herausgegeben ins Deutsch metrisch übersetzt, und mit Anmerkungen versehen*, v. VINCENZ RITTER VON ROSENSVEIG-SCHVANNAN, Wien, 1858; *Der Diwan v. Mohammed Schems eddin Hafis aus den Persischen zum erstenmal ganz übersetzt*, v. J. V. HAMMER, Stuttgart and Tübingen, 1813; *A Specimen of Persian Poetry*, or *Odes of Hafiz*, with an English translation and notes by J. RICHARDSON, London, 1774; do. second ed., by ROUSSEAU, London, 1802; *Persian Lyrics, or Scattered Poems from the Diwan Hafiz*, with paraphrases in verse and prose, by J. HADDON HINDLEY, London, 1800; *Select Odes from the Persian Poet Hafiz*, translated into English verse, with notes critical and explanatory, by J. NOTT, London, 1787; *The Persian Poet Hafiz*, by PROF. COWELL, *Macmillan's Magazine* for Aug., 1874, No. 177, p. 251; *A Translation into English Verse of the Principal Poems in the Collection*, by Mr. BIKNEL of London, is also in the press. E. H. PALMER.

Hag, a very low form of cyclostome fishes, including the *Myxine glutinosa* of European seas and the *Myxine limosa* of the American Atlantic waters, found abundantly about Grand Manan Island. They were formerly classed as worms, which they much resemble. The former is believed to live sometimes within the stomachs of other fishes. They have a remarkable power of secreting slime. There are no eyes, and the ears are but little superior to the molluscan type. The six pairs of gill-sacs receive water from the gullet, and discharge it from an opening upon the ventral aspect of the fish. There are no bones, and the dorsal chord is of embryonic type. There is a portal heart. The mouth is a sucking organ, and is surrounded with barbules.

Ha'gar, post-tp. of Berrien co., Mich., on Lake Michigan. Pop. 834.

Ha'geman's Mills, post-v. of Amsterdam tp., Montgomery co., N. Y. It has manufactures of woollen goods. Pop. 250.

Ha'gen, town of Westphalia, Prussia, on the river Volme and the Dortmund-Düsseldorf Railway, has extensive manufactures of metallic wares, steel, cloth, papers, etc. Pop. 13,445.

Hagen (HERMANN AUGUST), M. D., PH. D., was b. in Königsberg, Prussia, May 30, 1817; graduated at Königsberg 1836; received the degree of M. D. in 1840, and practised medicine and surgery from 1843 to 1867. Since then he has been assistant in the entomological department of the Cambridge Museum at Harvard University, Mass., and has published many articles, chiefly on entomology, in French, English, Danish, Russian, and North American scientific periodicals.

Ha'genbach (KARL RUDOLPH), D. D., the son of a professor in the University of Bâle, was b. May 4, 1801; studied at Bâle, Bonn, and Berlin; in 1823 became adjunct professor of theology, and in 1828 full professor, at Bâle; and d. there June 7 1874. He was a firm Protestant, but a man of catholic temper. Of the long list of his publications, the most important are *Encyklopädie und Methodologie der theologischen Wissenschaften* (1833; 8th ed. 1869); *Lehrbuch der Dogmengeschichte* (1841; 5th ed. 1867), translated by BUCH (Edinburgh, 1846; 3d ed. 1858), revised and enlarged by PROF. HENRY B. SMITH (New York, 1861–62); and *Vorlesungen über die Kirchengeschichte von der ältesten Zeit bis zum 19 Jahrhundert* (thoroughly revised, 1868–72). The first part of this last work was published in 1853. *German Rationalism* is a translation by GAGE and STUCKENBURG (Edinburgh, 1865).—His father and his two brothers, JOHANN JAKOB and EDUARD, were distinguished naturalists. R. D. HITCHCOCK.

Ha'genau, town of the German empire, in the province of Lower Alsace, on the Moder. It was founded by Frederick Barbarossa in 1164, and was formerly a fortress which played a conspicuous part in the wars between France and Austria. It is now chiefly a town of manufacturing interest. Pop. 11,331.

Ha'gerstown, post-v. of Jefferson tp., Wayne co., Ind., at the junction of the White Water Valley R. R. with the Pittsburg Cincinnati and St. Louis R. R. It has 1 weekly newspaper. Pop. 830.

Hagerstown, city and tp., cap. of Washington co., Md., 20 miles N. W. of Harper's Ferry and 6 miles N. of the Potomac River. It has 2 daily and 3 weekly newspapers, 3 banks, 2 savings institutions, and 3 machine-shops. There are 8 turnpikes leading into the city, and 3 railroads passing through. Pop. of city, 5779; of tp. 6471.
BELL & HEIKES, EDS. "HAGERSTOWN MAIL."

Hag'gada [Heb. "narration"], a name applied to the great body of Hebrew and Chaldee legends, often poetical, and designed to be expository of the Scriptures or of human duty. The Haggadoth are not regarded as authoritative in their teachings. Their total amount is very great, and they have never been entirely printed.

Hag'gai [Heb. *Chaggai*, "the festal one," from *chag*, "festival"], in the Apocrypha and Vulgate AGGEUS, the tenth of the twelve minor prophets of the Old Testament, and the first after the Babylonian captivity. Chronologically, he follows Jeremiah, Ezekiel, and Daniel. The rebuilding of the temple, which began under Zerubbabel in 535 B. C., had been arrested by the hostility of the Samaritans. In 520 B. C., the second year of Darius Hystaspis (521–486 B. C.), Haggai roused his disheartened and sluggish countrymen to a resumption of the work. His three messages were delivered in the sixth, seventh, and ninth months (Sept., Oct., and Dec.) of that year. His third message contains a striking Messianic prediction, which is referred to in Heb. xii. 26. Haggai is supposed by some critics to have written also a part of the book of Ezra. In the Roman martyrology Hosea and Haggai are reckoned among the saints, and commemorated (see ACTA SANCTORUM) on the 4th of July. R. D. HITCHCOCK.

Hag'gerty (JOHN), b. in Prince George co., Md., in 1747. He joined the Methodists about 1771, and was distinguished in the early history of his denomination; as a local preacher labored extensively under the Methodist founders Strawbridge, Rankin, and King till 1779, when he joined the conference and became a regular and most effective itinerant. In 1792 he settled in Baltimore, where he continued to preach successfully down to his death in 1823. He was one of the original elders or presbyters of his Church, ordained by Bishop Coke at its organization. He preached in German as well as in English. A. STEVENS.

Hagiographa. See BIBLE, by PROF. W. G. SUMNER, A. B.

Hag'ner (PETER), b. at Philadelphia Oct. 1, 1772; d. at Washington July 16, 1850. Appointed a clerk in the treasury by Gen. Washington in 1793, and third auditor by Mr. Monroe upon the creation of that office in 1817, he served under every administration for fifty-six years, with high approbation and esteem, resigning his office to Gen. Taylor in 1849. Congress repeatedly devolved on him the settlement of large and important claims, and twice, by direct votes, expressed their appreciation of his valuable services. The office of third auditor, before the institution of the present court of claims, became at one time so prominent, from the calls made upon its chief by Congress, that John Randolph of Roanoke, once pausing in debate for an apt phrase to express his sense of the influence of the emperor Nicholas in the affairs of Europe, styled him "the great *third auditor of nations*." In the *Union* of Oct. 24, 1849, its editor, the late Thomas Ritchie, commenting upon the

retirement of Mr. Hagner, said: "No government could ever boast of a more able, honest, and efficient officer. He has been the model of what a public servant should be; no higher compliment can be paid to a public officer than to say of him, 'He is as virtuous as Peter Hagner.'"

G. C. SIMMONS.

Hagner (PETER V.), b. Aug., 1815, at Washington, D. C.; graduated at the Military Academy in 1836, and was assigned to 1st Artillery. He served in the Florida war during Gen. Jesup's campaign of 1836–37 with a field-battery and on ordnance duty, and on the Niagara frontier until July, 1838, when he was transferred to the ordnance corps. In the war with Mexico he was attached to the "siege-train company of ordnance" of Gen. Scott's army; was brevetted captain Apr. 18, 1847, "battle of Cerro Gordo," and major Sept. 13, 1847, "assault and capture of the city of Mexico." Visited European arsenals and laboratories, under orders of the secretary of war, in 1848–49 (report published with Ex. Doc., 1850); member of the ordnance board from 1854 to 1860; in May, 1861, was assigned to the duty of ordering, inspecting, and purchasing arms and ordnance stores; and in Mar., 1862, was appointed by Secretary Stanton member of commission on ordnance and ordnance stores. He was inspector of all factories making small-arms for the government under contract from July, 1862, to Dec., 1863; since which time he has been in command of Watervliet Arsenal. Member of ordnance boards in 1863, 1868, and 1870, of board for the trial of breech-loading small-arms in 1866, and of the board for selecting a breech system for muskets and carbines 1872–73. Was promoted colonel of ordnance Mar. 7, 1867, having received brevets of colonel and brigadier-general Mar. 13, 1865.

G. C. SIMMONS.

Hague, or **The Hague** [Dutch, *s'Gravenshage*], city of the Netherlands, the capital of the province of South Holland, and the residence of the king and seat of the states-general, in lat. 52° 4′ N. and lon. 4° 18′ E. It is a very handsome city, but, as it has no trade and no manufactures of any consequence, it is somewhat dull. Many of its streets are intersected by canals, with rows of linden trees planted on both sides, and spanned by elegant bridges. Among its most notable buildings are the church of St. James, built in 1308, and famous for its hexagonal tower with a chime of thirty-eight bells; the national museum and the palace of the prince of Orange, containing large collections of the most excellent works of the Dutch school of painting: the Gevangenpoort, the Binnenhof, and the Buitenhof, old places of striking architecture, and interesting on account of their connection with the history of the country. A short distance from the city lies, to the N., the Huis in 't Bosch, a royal summer-palace, containing some of the finest frescoes and paintings by Rubens, and to the S., the castle of Ryswick, where the treaty was signed in 1697. Pop. 92,785.

Hague, a mountainous tp. and post-v. of Warren co., N. Y., on Lake George. It is a place of summer resort. Iron ore has been mined in this township. Pop. 637.

Hague (WILLIAM), D. D., b. in New York about 1805; graduated from Hamilton College, N. Y., in 1826 with high honors; studied theology, became a Baptist minister, and has preached in New York, Boston, Mass., Providence, R. I., etc.; now settled at Orange, N. J. Published *The Baptist Church Transplanted from the Old World* (1846), *Home Life* (1855), *Christianity and Statesmanship* (1855), etc.

Hahn (MICHAEL), b. in Bavaria, Germany, Nov., 1830; obtained his education at New Orleans; he studied law, was M. C. 1862–64, and governor of Louisiana 1864–68. The degree of LL.B. was conferred upon him by the University of Louisiana.

Hah'naman, tp. of Whitesides co., Ill. Pop. 621.

Hah'nemann (SAMUEL CHRISTIAN FREDERICK), M. D., b. at Meissen, in Saxony, Apr. 10, 1755. His father, a painter of porcelain in the royal manufactory, discouraged the eager desire of the son for a high education. The schoolmaster of the parish, however, gave the young man such efficient instruction as enabled him to enter the University of Leipsic at twenty years of age. After reaching Leipsic with what was left of twenty thalers, his sole patrimony, he supported himself by teaching English, French, and Italian, and by making translations from those languages. The following year he went to Vienna, where he obtained more lucrative employment, and was able to prosecute his studies with fewer privations. Afterwards he received the appointment of librarian to the governor of Transylvania, a position which enabled him to graduate as doctor of medicine at Erlangen in 1779. He returned to Saxony and settled as a physician, first at the little village of Hettstadt, and afterwards at Dessau, but finding little employment in either place, he was forced to accept a government appointment as "district physician" at Gommern, where, as he himself admits, "no physician had ever been before, nor did the people have any desire for one." He remained three years at Gommern, where the lack of professional employment left him abundant leisure to cultivate the sciences. At length he removed to Dresden, where his genius and learning were appreciated, and where his already numerous contributions to scientific literature were recognized. He served for a year as physician to the hospital, and soon attained a liberal patronage. He assiduously continued, however, his investigations in general science, especially in chemistry and toxicology, upon both of which he wrote several works of acknowledged value. One, on arsenical poisoning, is still referred to as authority. From Dresden he removed to Leipsic for the better prosecution of his studies.

Among the English works which he was at this time engaged in translating was Cullen's *Materia Medica.* The ingenious but unsatisfactory explanation proposed by that author of the therapeutic action of Peruvian bark in certain fevers, then a subject of much controversy, induced Hahnemann to undertake a series of experiments with that drug upon himself and others, with the hope of ascertaining the true principle of its operation. The result of these trials, a full record of which he published, was the confirmation of an opinion which previous observations had already led him to entertain of the existence of a general law of drug-action, which, if established, would give a scientific basis for therapeutics. This principle, which he afterwards expanded into a system which he called Homœopathy, is aptly expressed by the maxim, *Similia similibus curantur* (or similars are cured by similars), and constitutes, as is well known, the fundamental doctrine of the Homœopathic method. Similar experiments to those above referred to with Peruvian bark were made with various other substances, and records of medical experience were searched for whatever evidence they might yield upon the same point. No public declaration was made by Hahnemann of his new views until three or four years later, the interval being occupied with his investigations. In 1792 he was appointed physician to a hospital for the insane at Görgenthal in the Thuringian Forest, where he was afforded an opportunity of making a partial application of his principles. The complete and unexpected recovery of the Hanoverian minister, who was in the institution, made him the object of no little congratulation, while his courageous inauguration of an entire reform in the physical management of his patients deserves to be mentioned with that of Pinel, who in the very same year removed the chains from the unhappy lunatics in the Bicêtre. In 1796 he published in *Hufeland's Journal* the first partial exposition of his doctrine, in an essay "On a New Principle for ascertaining the Remedial Powers of Medicinal Substances." This was followed by other contributions to the same journal. The extraordinary nature of these opinions attracted no little hostile criticism and ridicule from the profession. Several physicians of character and repute, however, adopted his views, and afterwards greatly assisted him in his further experiments and by collecting the results of Homœopathic clinical experience. The controversy aroused by the publications of Hahnemann and his friends was carried on with earnestness on both sides, but gradually new accessions were made to the number of his professional and non-professional adherents. In 1810, Hahnemann published an elaborate exposition of his system (*Organon of Homœopathic Medicine*), of which numerous editions in various languages have since appeared. The following year he put forth the first volume of the *Materia Medica Pura,* containing the collated results of his observations and experiences. Additional volumes of the same work were published in the course of the next few years.

A singular feature in the history of Hahnemann was the persistent opposition he experienced from the apothecaries, on the ground that his habit of preparing his medicines himself was an infringement of their prerogative. As the law was found to be in their favor, and as he could not yield a point that he considered of vital importance, he was several times forced to escape their prosecutions by removal. In 1821 he was relieved from further annoyances of this kind by accepting the protection of the duke of Anhalt-Cœthen, who made him state councillor and court physician. By this time his reputation had extended throughout Germany, and great numbers of patients from different parts of Europe sought his advice and treatment. In 1835, when eighty years of age, he married his second wife, a French lady, Mademoiselle d'Hervilly, who had gone to Cœthen to consult him regarding her health. By her persuasion he was induced to remove to Paris. In that capital he met with great success, and for eight years continued with great activity the exercise of his profession. He d. July 2, 1843. He lived to see the system he had founded adopted by considerable numbers of physicians in

most countries of Europe and America. He was a prolific and forcible writer on medical and other scientific subjects, and most of his later works have been translated into several languages. (For a more particular account of his system, see HOMŒOPATHY.) H. D. PAINE.

Hahn-Hahn (IDA MARIA LOUISA FREDERIKA GUSTAVA), COUNTESS, b. at Tressow, Mecklenburg-Schwerin, June 22, 1805 (the daughter of the count von Hahn, a devotée to the drama); was married in 1826 to another count von Hahn, and divorced in 1829. Author of numerous volumes of poetry, fiction, and travels. Became an ardent Roman Catholic, and since 1851 has published a number of religious works.

Hahn'ville, post-v. of St. Charles parish, La., 28 miles above New Orleans, on the W. bank of the Mississippi River. It has a church, a public school, several stores, a newspaper, a concert-hall, a machine-shop, and several minor manufactories. It is about half a mile from the parish court-house, and is the centre of a sugar, rice, and orange-producing country.
HORACE VALLAS, ED. "ST. CHARLES HERALD."

Hai'duk, Hajduk, or **Hayduk,** the Magyar inhabitants of the district of Hajdu Kerület in Eastern Hungary. They are Calvinists, and descendants of Bockskay's soldiers. From 1605 to about 1700 they were free from taxation and had the privileges of nobles. They are chiefly agriculturists, and are estimated to number 70,000. The name signifies "shepherds;" sometimes designates the militia of the country; and not unfrequently is incorrectly applied to menial attendants at German courts.

Haight (Rev. BENJAMIN I.), S. T. D., LL.D., b. in the city of New York Oct. 16, 1809; graduated at Columbia College 1828, and at the General Theological Seminary 1831; ordained same year, and became first rector of St. Peter's church in New York; from 1834 to 1837 was rector of St. Paul's church, Cincinnati; in 1837 accepted the rectorship of All Saints' church, New York, which he retained for nearly nine years; from 1837 to 1855 acted as professor of pastoral theology and pulpit eloquence in the General Theological Seminary. His connection with Trinity parish commenced in 1855, and in 1874 he was elected assistant rector. He was appointed a delegate from the diocese of New York to the General Conventions of 1868, 1871, and 1874. In 1873 he was elected bishop of the diocese of Massachusetts, but was obliged, from failing health, to decline that high honor. He was secretary of the diocese of New York for twenty years, and for more than ten years a member of the standing committee of that diocese. He held the office of trustee of Columbia College from 1843. D. in New York City Feb. 21, 1879.

Haight (HENRY HUNTLEY), governor of California 1867–71, b. at Rochester, Monroe co., N. Y., May 20, 1825; graduated from Yale College in 1844; studied law; was admitted to the bar in St. Louis Oct., 1846, where he began practice, and afterward settled in San Francisco, Cal., 1850. D. Sept. 2, 1878.

Hail. The precipitation of the vapor in the atmosphere, when it occurs at a low temperature, takes place in a solid form, and assumes the shape of snow, sleet, or hail. No very precise distinction is drawn between the terms hail and sleet, other than that the latter word is applied to the smallest hailstones, comparable in size to drops of water, and generally falling at the close of a rain or snow storm. While snow descends in crystalline flakes whose weight is at the most but a few grains, hail, on the contrary, frequently occurs weighing an ounce, and in exceptional cases one or two pounds. Such hailstones are formed of crystalline and amorphous masses of ice, the latter generally of lenticular or spherical shape. Their structure, as revealed by the microscope (see FLOGEL in *Pogg. Ann.*, 1871, Band 146, seite 482) and by the polariscope (see MULLER in *Pogg. Ann.*, 1871, Band 144, seite 333), suggests that they have been formed by a process of rapid crystallization and accretion at temperatures a little below the freezing-point—a process precisely similar to the formation of crystals from ordinary liquid solutions. We are indeed warranted in the general statement that as snowflakes are smallest when formed slowly at very low temperatures, and largest when formed rapidly at temperatures near the freezing-point, so hailstones are largest when formed most rapidly, and have in general as their origin large snowflakes or snowballs; these latter being carried upward by the violent ascending currents attending summer thunderstorms (and to whose mechanical cooling the precipitation is originally due), begin their fall, in the course of which the snowball is converted into a semi-crystalline mass of ice enclosing many air-bubbles, and, rotating rapidly, grow by the addition of such particles of vapor as lie near their path. In large lenticular-shaped hailstones this additional formation was found by Abich (see MORITZ, *Klimatologie der Kaukasus*) on the equatorial portions of the central mass, and in the shape of more or less definite crystals imbedded slightly in the surface of the spheroid. In the case, however, of conical hailstones, Flogel found the accretionary ice confined to the base of the cone, and composed of closely packed crystals, that would have been indistinguishable from each other except for the fact that their respective optical axes were inclined to each other at all possible angles; within each crystal he also found cavities, each of which contained liquid water and a minute bubble of air. It has also been by Reinsch shown that these bubbles of air are confined under a pressure of many atmospheres. (See *Pogg. Ann.*, 1871; Band 144.)

The origin of the cold necessary to the formation of hail in the midst of warm weather was first properly explained by Espy (1835) as the result of the mechanical cooling of ascending expanding currents of air. The development of this principle by William Thomson (*Memoirs of Manchester Lit. and Phil. Soc.*, 1862), Hirn (*Introduction à la Météorologie de l'Alsace*), Reye (*Die Wirbelstürme*, 1872), Peslin (*Bull. Hebd.*, 1868), Hann (*Zeitschrift für Meteorologie*, 1874), offers a complete explanation of the fact that hail falls usually on the advancing side of a thunderstorm or tornado, and of its dependence upon local topography. These vertical currents can, in fact, rarely occur except when the surface of the ground has been heated by the sun so rapidly that, so far as temperature is concerned, the upper and lower portions of the atmosphere are in a condition of unstable equilibrium. As a consequence, the upper colder layers descend, pushing the warmer ones up; and although in its descent the air is warmed at the rate of 0.99° C. for every 100 mètres descent, it still reaches the earth as cool air compared with that which it displaces; the latter in its ascent cools at a rate from 0.99° C. to 0.0° C., varying with its humidity. In accordance with these principles, it is found that hailstorms are usually of small dimensions, and confined to the central portions of more extensive rainstorms; they deposit their hail in narrow bands, sensibly parallel to the general track of the storm; they are usually preceded by a notable rise in the temperature, and occur especially in the springtime or early summer, and during the hottest portions of the day; the duration of the fall rarely exceeds a few minutes, within which period, however, enormous quantities sometimes fall over quite limited areas, resembling in this respect the floods of water or cloud-bursts that occur in some localities. Although hailstorms are usually accompanied by intense lightning, yet there is no reason to believe that electricity is essential to the formation of hail, at least not in any such way as was suggested by Volta; on the other hand, it is plausible that the electrification of minute particles of vapor or ice may hinder the process of accretion, and that the formation of large crystals may take place rapidly immediately after a discharge of lightning. The geographical distribution of hailstorms is in complete accordance with the previous explanations; thus, Prettner has shown that in Carinthia hailstorms occur most frequently in broad, open valleys, and least frequently in those that are closely shut in by mountains. Humboldt first called attention to the fact that in the tropics hail never occurs with any severity above 5000 feet, and rarely occurs near the level of the sea. France and portions of Northern Germany are visited with more frequent, severe, and destructive hailstorms than are recorded in any other country except India, and in these portions of Europe the statistics relating thereto are made the basis of numerous flourishing hail-insurance companies. CLEVELAND ABBE.

Hailes (Sir DAVID **Dalrymple**), LORD, b. at Edinburgh Oct. 28, 1726, grandson of Viscount Stair; was educated at Eton, Edinburgh, and Leyden; became a Scottish advocate 1748; a judge of the court of session 1766, and as such assumed the title of Lord Hailes, but was never a peer; became a lord of justiciary 1776. D. Nov. 29, 1792. Author of many highly valued works, among which are *Canons of the Scottish Church* (1769); *Annals of Scotland* (1776–79); *Remains of Christian Antiquity* (1776–80).

Hailes (JOHN) **of Eton.** See HALES (JOHN).

Hailesborough, post-v. of Fowler tp., St. Lawrence co., N. Y., on the Oswegatchie River. Pop. 177.

Haimu'ra, a large and excellent food-fish of the upper parts of the rivers of Guiana. It is the *Erythrinus macrodon*, of the family Erythrinidæ. Its bite is very severe.

Hainan, island of China, belonging to the province of Quang-Tong, in the China Sea, just outside the Gulf of Tonquin, between lat. 18° and 20° N., and between lon. 108° and 111° E. Its area is estimated at 12,000 square miles, its population at 1,500,000 Chinese, besides wild tribes in the interior. The western coast is low and surrounded by shoals and banks, but fertile and productive of rice, sugar, and indigo. The interior is mountainous, mostly covered with extensive forests, from which much

timber is exported. The southern coast is rocky, but has good harbors. Here is situated Kiang-Choo, the capital and the southernmost Chinese port open to foreigners. It is a very populous town, said to have 200,000 inhabitants.

Hainaut (formerly **Hainault**), province of Belgium, bounded W. and S. by France, E. and N. by the provinces of Brabant and Flanders. Area, 1430 square miles. Pop. 896,285. The southern and eastern parts are hilly, occupied by the Ardennes; the northern and western parts are flat, but exceedingly fertile. The region around Mons contains very extensive coal-fields, and coal, together with porcelain, flax, hemp, tobacco, and linen, forms the main export. The old province of Hainault comprised also a territory which in 1678 was ceded to France, and now forms the department of Nord.

Hain'burg, town of Austria, in the province of Lower Austria, on the Danube, 27 miles S. E. of Vienna, contains many interesting remains of antiquity, among which are a Roman aqueduct which still provides the town-market with water, and the so-called Roman tower with the statue of Attila; and has an imperial manufactory of tobacco, the largest in the country, employing 1300 men, and a needle-factory, which annually produces more than 60,000,000 needles. Pop. 4325.

Haines, tp. of Centre co., Pa. Pop. 1354.

Hainesville, post v. of Clinton co., Mo. Pop. 218.

Hair. See KERATINE and HISTOLOGY.

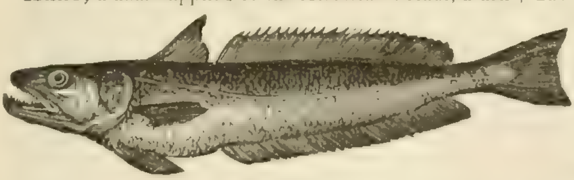
Hair-Spring, in a watch, the delicate spiral steel spring, the outer extremity of which is attached to the frame of the watch, the inner to the "verge" (or axle) of the balance-wheel, supplying the force for resisting the successive impulses given by the teeth of the escapement-wheel, and converting them into isochronous vibrations. The perfect manufacture (*tempering* included) of these (slighter than hair) springs (the combined weight of 4000 being required to make an ounce) is one of the essentials to producing correct timepieces, and is now successfully performed by American watchmakers. (See WATCHMAKING.)

Hair'tail (*Trichiurus*), a genus of fishes of the family Cepolidæ. The silvery hairtail, *T. lepturus* (ribbon-fish, sword-fish), is from two to four feet long, of a shining, silvery color, and is caught along the Atlantic shores of the U. S.

Hair-worm. See GORDIUS.

Hajji. See HADJ.

Hake, a name applied to the *Merlucius albidus*, a fish



Hake.

of the cod family, caught along the North American Atlantic coast, and the *M. vulgaris*, a similar fish of Europe. They are both coarse and poor. The name *hake* is also given in the U. S. to species of forked hake, or FORK-BEARD (which see).

Ha'kim Ben-Al'lah, or **Ben-Hash'em,** an Arabian impostor of the eighth century, is also known under the name of MOKANNA ("the veiled") and SAZENDE MAH (the "moon maker"). The former of these surnames he received from his habit of wearing a veil before his face in order to hide his ugliness, or, as he said himself, in order to conceal the radiance of his eyes; the latter from a trick of legerdemain he once performed, causing a moon to issue from a deep well and remain visible for a whole week. He succeeded in gathering a number of adherents, with whom he seized several strong places near Nekshib and Kish. The caliph Mahadi marched against him, and soon all his strongholds were taken. Shut up in the last of his fortresses, he poisoned his soldiers by wine at a banquet, and burned himself up, in order to make people believe that he had ascended bodily to heaven. Moore has used the story of his life for the episode of "The Veiled Prophet of Khorassan" in *Lalla Rookh*.

Hak'luyt (RICHARD), b. in London in 1553; studied at Oxford. He was master of arts and professor of divinity when in 1584 he accompanied the English ambassador to Paris, and here he published in 1587 an account of a voyage to Florida by Laudonnière, which he found in the library, and also Peter Martyr's work, *De Novo Orbe*. But the greater part of his reputation he owes to his *Principal Navigations, Voyages, Traffiques, and Discoveries of the English Nation* (3 vols., 1598–1600), in which are found accounts of 220 voyages, accompanied with many curious documents. D. in London in 1616, a prebendary of Bristol and Westminster. The Hakluyt Society was established in London in 1846 for the purpose of preserving and editing accounts of geographical or historical interest.

Hakoda'di, town of Japan, on the island of Jesso, at the foot of the southernmost promontory Tzagar, in lat. 41° 40′ N. and lon. 141° 15′ E. It is not a large place, but it has a good harbor, and has become important as one of the Japanese ports opened to foreigners. Hakodadi is much visited by whalers. Pop. 50,000.

Hal'acha [Heb., the "rule"], the Hebrew oral and traditional law, handed down, as Jews conceive, from Moses and the other eminent teachers of antiquity, and first reduced to writing in the early centuries of the Christian era. The general code is called MISHNA (which see), but the Halacha is much more extensive.

Halas, town of Hungary, about 80 miles S. E. of Pesth. It has a considerable trade in wine. Pop. 13,339.

Hal'berd [originally *helmbart*, "helmet axe," that is, an axe to split helmets with], a form of the battle axe, combining the hooked blade of the bill or gisarme with the head of the lance. It was once borne by bodies of troops called halberdiers and by various non-commissioned officers. Its use is now limited to ceremonial occasions. In Great Britain the partisan, one form of the halberd, is borne by the Yeomen of the Guard.

Hal'berstadt, town of Prussia, in the province of Saxony, on the Holzemme. It is an old town; many of its houses are ornamented with curious wood carvings. Its cathedral, built in the thirteenth century, is in the finest Gothic style; the church of Our Lady, built in the eleventh century, is in the Byzantine style. Halberstadt has considerable manufactures of soap, oil, leather, gloves, etc. Pop. 25,419.

Hal'bert, tp. of Martin co., Ind. Pop. 1336.

Hal'cott, mountainous tp. of Greene co., N. Y., containing extensive forests. Pop. 426.

Halcyon. See KINGFISHER.

Hal'dane, tp. of Ogle co., Ill. Pop. 1265.

Hal'dane (JAMES ALEXANDER), brother of Robert, b. at Dundee, Scotland, July 14, 1768; became a mariner, and master in 1793 of the Melville Castle, an East India Company's ship; retired in 1794 from business with a considerable estate; was for more than fifty years minister of the Tabernacle, a Baptist chapel, Leith Walk, Edinburgh; travelled extensively in Scotland, and engaged in religious labors. D. at Edinburgh Feb. 8, 1851. Author of *The Social Worship of the First Christians* (1805), *Man's Responsibility and the Atonement* (1842), *Exposition of Galatians* (1848), *Inspiration of the Scriptures* (1845), and controversial tracts.

Haldane (ROBERT), b. of Scottish parents in London Feb. 28, 1764; served 1780–83 in the royal navy; was converted to Christianity, of the divine origin of which he had entertained doubts, and devoted his life and large fortune thenceforth to missionary-work. Forbidden to labor in India, his field preaching aroused great religious feeling in Scotland, but in 1800 the General Assembly interfered with his work, and Haldane in consequence left the National Church, and after a time joined the Baptists. He built many "tabernacles" or places of worship, did much for the African and French missions, and for the Bible and continental societies. D. Dec. 12, 1842. Among his works are *Evidence and Authority of Revelation* (2 vols., 1816), *Exposition of Romans* (2 vols., 1835), *Verbal Inspiration* (1830), etc. (See *Memoirs of R. and J. A. Haldane*, by ALEX. HALDANE, 1852.)

Hal'deman (SAMUEL STEHMAN), A. M., LL.D., b. near Columbia, Pa., in 1812, pursued his studies at Dickinson Coll. until 1830; was chosen assistant in the New Jersey geological survey (1836), and held the same office the ensuing year in the Pennsylvania geological survey. While engaged in this capacity there he discovered the oldest fossil known at that time—viz. *Scolithus linearis*; occupied the chair of natural history in the University of Pennsylvania (1851–55); took the corresponding professorship in Delaware College 1855, and in the same year became professor of geology and chemistry at the Agricultural College of Pennsylvania; is now professor of comparative philology in the University of Pennsylvania. Author of numerous articles on conchology, entomology, and palæontology, published in various scientific magazines. His work entitled *Analytic Orthography*, which consists of investigations into the philosophy of language, obtained for him in England the highest Trevelyan prize over 18 competitors (1858).

Hal'dimand, fertile county of Ontario, Canada, on the N. shore of Lake Erie. Cap. Cayuga. Pop. 20,091.

Hale, county in the W. of Alabama. Area, 520 square miles. It has an undulating surface and an excellent soil. Cotton, corn, tobacco, and wool are staple products. The Black Warrior River is its western boundary. Cap. Greensborough. Pop. 21,792.

Hale, tp. of Warren co., Ill. Pop. 1212.

Hale, tp. of Jones co., Ia. Pop. 997.

Hale, post-tp. of McLeod co., Minn. Pop. 399.

Hale, tp. of Hardin co., O. Pop. 1254.

Hale, post-tp. of Trempealeau co., Wis. Pop. 616.

Hale (BENJAMIN), D. D., b. at Newbury, Mass., Nov. 23, 1797; graduated from Bowdoin College (1818) with high honors, and was selected at once as principal of the Saco Academy; studied theology at Andover Seminary, and began preaching in 1822; was elected tutor at Bowdoin College 1823, and principal of the Gardiner Lyceum 1822–27; in 1827 became professor of chemistry and mineralogy at Dartmouth College, Hanover, N. H., in which office he remained until it was abolished by the trustees in 1835; took orders in the Protestant Episcopal Church; was chosen president of Geneva (now Hobart Free) College in 1837. Author of *Scriptural Illustrations of the Liturgy* and other works. D. July 15, 1863, at Newbury, Mass.

Hale (CHARLES), brother of E. E. Hale, was b. at Boston, Mass., June 7, 1831; graduated at Harvard 1850; has been editorially connected with *To-day*, a journal, and with the Boston *Advertiser*, of which his father, Nathan Hale, was long responsible editor; U. S. consul in Egypt 1864–70. Author of pamphlets, review articles, etc.

Hale (DAVID), b. at Lisbon, Conn., Apr. 25, 1791; went to Boston in 1809, and engaged in mercantile business in 1815; in 1827 became associate editor of the New York *Journal of Commerce*, and in 1828 became associated with Gerard Hallock as proprietor of that journal, long thereafter one of the most influential in the U. S. He was a prominent Democratic politician, and a most liberal benefactor of the religious enterprises sustained by the Congregational denomination, of which he was an active member. D. at Fredericksburg, Va., Jan. 20, 1849. (See his *Memoir* by J. P. THOMPSON, 1845.)

Hale (EDWARD EVERETT), D. D., b. in Boston, Mass., Apr. 3, 1822; was educated at the Boston Latin School and at Harvard College; studied divinity in private; entered the ministry of the Unitarian sect; was settled at Worcester, Mass., in 1846; became minister of the South Congregational church of Boston in 1856. In his profession Mr. Hale is eminent for his interest in social and philanthropic movements, for pastoral activity, denominational zeal, and power of organization. To the general public he is best known through his writings—*The Rosary, Margaret Percival in America, Sketches of Christian History, Kansas and Nebraska, Letters on Irish Emigration, Ninety Days' Worth of Europe, If, Yes, and Perhaps, Ingham Papers, Sybaris and other Homes, How to Do it, Ten Times One is Ten, Reformation, Level Best and other Stories, Ups and Downs, Christmas Eve and Christmas Day, In His Name, Our New Crusade, Workingmen's Homes.* In addition to these volumes he edited the Boston edition of Lingard's *History of England*, was editor of the *Christian Examiner*, the organ of the Unitarian body, and founded in 1869 *Old and New*, a monthly magazine semi-theological in its character, whereof he has been the sole editor. Mr. Hale has contributed largely to the papers, is a popular lecturer, a man of extensive information, of extraordinary energy, and large influence. O. B. FROTHINGHAM.

Hale (EDWIN M.), M. D., b. at Newport, N. H., Feb. 2, 1826; became a printer and *littérateur* of Newark, O.; graduated at the Cleveland Homœopathic Medical College; practised twelve years at Jonesville, Mich.; became in 1864 professor of materia medica in the Hahnemann Medical College, Chicago; in 1870 professor of medical botany and pharmacology; and in 1871 became also special lecturer on diseases of the heart in the same institution. Has long been editorially connected with professional journals. Author of many monographs, etc., and of a treatise on *New Remedies* (1862; 3d ed. 1867); *On Sterility* (1868); *Pocket Manual of Domestic Practice* (1870); *Lectures on Diseases of the Heart* (1871); *Treatise on Cerebro-Spinal Meningitis* (1875), and other professional works.

Hale (ENOCH), M. D., b. at Westhampton, Mass., Jan. 19, 1790; took his medical degree at Harvard University 1813; practised until 1816 at Gardiner, Me.; then removed to Boston, where he was long a very prominent physician and public-spirited citizen. Author of many professional dissertations of value. D. at Boston Nov. 12, 1848.

Hale (EUGENE), b. at Turner, Me., June 9, 1836; was admitted to the bar in 1857; was for nine years attorney for Hancock co., Me.; was in the legislature 1867–68; was elected to Congress 1868, and has been thrice re-elected; has taken a prominent part in national affairs, and in 1874 declined the postmaster-generalship. Resides at Ellsworth, Me.

Hale (JOHN PARKER), b. at Rochester, N. H., Mar. 31, 1806; graduated from Bowdoin College, Me., 1827; studied law, and was admitted to the bar in 1830; became a member of the New Hampshire legislature 1832; M. C. 1843–45; occupied the chair of U. S. Senator 1847–53 and 1855–65, and was U. S. minister to Spain 1865–69. Candidate of the Free-Soil party for President in 1852, receiving 157,680 votes. D. at Dover, N. H., Nov. 19, 1873.

Hale (Sir MATTHEW), b. at Alderley, Gloucestershire, England, Nov. 1, 1609; was bred a Puritan, but while at Oxford University (1626–29) fell into wild habits, which he soon abandoned; read law 1629–36, and was called to the bar at Lincoln's Inn; entered Parliament 1654, and was 1654–58 a judge of common pleas under Cromwell; was in the Convention Parliament 1660; was knighted and made chief baron of the exchequer 1660; was chief-justice of the king's bench 1671–76. D. at Alderley Dec. 25, 1676. Among his legal works are the *History of the Pleas of the Crown* (1678), *History of the Common Law* (1713), *Analysis of the Law* (1739); among his religious works, *An Abstract of the Christian Religion, A Discourse of Religion, Contemplations* (1676), *The Knowledge of Christ*, and some minor works. He was the last English judge who condemned persons accused of witchcraft. He was nevertheless a man of justice, moderation, wisdom, and wide and thorough learning, as well as of devout religious character.

Hale (NATHAN), b. in Coventry, Conn., June 6, 1755; graduated at Yale College 1773; intended for the ministry, he yet devoted a time to teaching at East Haddam and at New London; after the battle of Lexington he joined the army as lieutenant, and was soon after appointed captain. Among his exploits the capture of a British sloop, in Sept., 1776, loaded with provisions, from under the guns of a frigate in New York harbor, is worthy of record. After the defeat of our army on Long Island and its subsequent retreat therefrom, Washington was extremely anxious to obtain information of the strength, plans, and situation of the enemy, and Hale volunteered to undertake the perilous task. He crossed safely, and possessed himself of full knowledge of the situation, but on returning was discovered by the enemy, with his notes upon his person, and being recognized, was hanged as a spy, by order of Sir William Howe, on the morning of Sept. 22, 1776. His last words were, "I only regret that I have but one life to lose for my country." His virtues have been extolled in verse and prose by Dwight. His *Life* was published by Stuart in 1856. G. C. SIMMONS.

Hale (NATHAN), b. at Westhampton, Mass., Aug. 16, 1784; graduated at Williams College 1804; began the study of law, but devoted two years as instructor in the academy at Exeter, N. H., when he removed to Boston, and in 1810 was admitted to the bar; after practising his profession four years, during which time he was also an editor of the *Weekly Messenger*, he purchased (Mar., 1814) the Boston *Daily Advertiser*, the pioneer daily in New England; Federal in politics at first, it subsequently became an advocate of the Whig and Republican parties, Mr. Hale remaining at the editorial helm during his life. During the discussion of the Missouri (1820) and Nebraska (1854) bills the journal took a decided and influential stand in opposition, but was the first to advocate the free colonization of Kansas. Actively interested in internal and local improvements, he was the first president of the Boston and Worcester R. R., which position he held nineteen years; was influential in promoting the introduction of water into the city of Boston, and at the head of the commission for that object; was one of the founders of the *North American Review*, also of the *Christian Examiner;* at various times elected to the Massachusetts legislature; member of the Academy of Arts and Sciences, Massachusetts Historical Society, etc. Mr. Hale was a nephew of the Revolutionary patriot who was executed as a spy in 1776, and father of the Rev. E. E. Hale. G. C. SIMMONS.

Hale (SALMA), b. at Alstead, N. H., Mar. 7, 1787; studied law, and held the office of clerk of the superior and county courts of Cheshire for twenty-two years; was M. C. in 1817–19, and a member of the legislature 1823–25. Author of several works, as *History of the U. S.* (1825), *Annals of Keene*, etc. D. at Keene, N. H., Nov. 19, 1866.

Hale (SARAH JOSEPHA BUELL), b. at Newport, N. H., Oct. 24, 1790. She issued in 1823 her first work, *Genius of Oblivion, and Other Original Poems.* She became editress of the *Ladies' Magazine* (1828), which was united with *Godey's Lady's Book* in 1837. She also published *Traits of*

American Life (1852), *Dictionary of Poetical Quotations* (1852), *Woman's Record, or Biographical Sketches of all Distinguished Women from the Creation to the Present Time* (1853), *New Household Receipt Book* (1853), *Letters of Lady Mary Wortley Montagu* (1856), etc. D. Apr. 30, 1879.

Hales (ALEXANDER OF), surnamed *Doctor Irrefragabilis*, was b. probably (date not known) at Hales, in Gloucestershire, England. Hence his name, Alexander *Halensis*. He cannot have belonged to the famous abbey there, which, according to Tanner, was not founded till the year after his death. After studying a while at Oxford, he went to Paris in 1222, and joined the Franciscans. In 1230 he was made professor in the university, and d. Aug. 27, 1245. Bonaventura, and perhaps Aquinas, were among his pupils. He was the first of the Schoolmen to make a thorough use of Aristotle. Only the *Organon*, translated by Boethius, had previously been in the hands of Occidental theologians. After the fall of Constantinople (in 1204) all the Greek originals, with the Arabian commentaries, were accessible. Very shortly Aristotle supplanted Plato. Alexander of Hales commented on Aristotle, as also on the Psalms and the Apocalypse. But his great work was the *Summa Universæ Theologiæ*, in four books (God, Creation, Redemption, Sacraments), based on the *Sententiæ* of Lombard. The arguments on each side were arranged in a syllogistic form. He first developed the doctrine of a *Thesaurus Meritorum*. The earliest edition of his *Summa* was that of Venice (1475; again, and improved, 1576). Other editions are those of Nuremberg (1482) and Cologne (1622). R. D. HITCHCOCK.

Hales (JOHN), M. A., "the ever-memorable," b. at Bath, England, Apr., 1584; was entered of Corpus Christi College, Oxford, 1597; became a fellow of Merton 1606, of Eton 1613; professor of Greek at Oxford 1612; went to the Synod of Dort 1618, and was then converted to Arminianism; canon of Windsor 1639; was an irenic or latitudinarian, and one of the oldest of what is now called the Broad Church school, hence denounced in his own time as a trimmer; chiefly remembered for his *Golden Remains*, written in a quaint and vigorous style, but hardly worthy of his great fame for learning and ability. D. in great poverty at Eton May 19, 1656.

Hales (WILLIAM), D. D., an Irish divine who became fellow of Trinity, Dublin, in 1769; professor of Oriental languages 1782; rector of Killeshandra 1787, and d. Jan. 30, 1831. Among his scientific works are *Sonorum doctrina rationalis* (1778), *Analysis æquationum* (1784), *Analysis fluxionum* (1800), *New Analysis of Chronology* (1809–14). Among his other writings are *Prophecies regarding our Lord* (1708), *The Holy Trinity*, *Primitive British Church* (1819), etc.

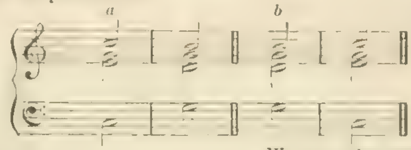
Hale's Location, an unincorporated tract in the White Mountain region of New Hampshire, is in Carroll co. It contains much romantic scenery. Pop. 4.

Halévy (JACQUES FRANÇOIS ÉLIE FROMENTAL), b. in Paris May 27, 1799; d. at Nice Mar. 17, 1862. He was of Jewish parentage; studied successfully at the Conservatoire, and was a favorite pupil of Cherubini; was enabled to spend two years in Italy, having won a first prize for composition. There his opera *Pygmalion* was written; this was followed by others, *Phidias*, *The Artisan*, which had a local reputation. The opera *La Juive* was the foundation of his fame; it was first produced in 1835. Other well known works are *The Queen of Cyprus*, *Charles VI.*, *The Queen's Musketeers*, *The Wandering Jew*, *The Tempest*, *Valentine d'Aubigné*, and *The Sorceress*. He produced some thirty operas in all, tragic and comic. He was a talented and cultivated composer, painstaking and scholarly, but without the gift of genius. He was a writer besides on musical topics. Except in Paris, Halévy is little known, though once he was highly honored. Louis Philippe and his family conferred distinction on him; he was made "professeur de haute composition" at the Conservatoire, member and perpetual secretary of the Academy of Fine Arts, officer of the Legion of Honor.
O. B. FROTHINGHAM.

Halévy (LÉON), son of Jacques Fromental Halévy, b. in Paris Jan. 14, 1802, author of many works on literature, philosophy, history, foreign languages, etc. One of these works appeared with the remarkable epigraph: "The golden age, which a blindfold tradition has placed behind us, is in front of us." His principal books are—*Literary, Philosophical, and Industrial Opinions*, *The Barcelona Plague*, *Summary of the History of the Hebrews*, *Summary of the History of French Literature*. He gave also many plays to different Paris theatres: *The Spy*, *Czar Demetrius*, *Indiana*, *Beaumarchais at Madrid*, *The Golden Broomstick*, *Electra*, etc. FÉLIX AUCAIGNE.

Halévy (LUDOVIC), son of Jacques Fromental Halévy, b. in Paris in 1834. He is one of the most popular authors of light plays or vaudevilles of the French stage. He has also written nearly all the librettos of the opéra bouffe composer, Offenbach. Among the works of Halévy the following are the best known: *Ba-ta-Clan*, *Orphée aux Enfers*, *Metella's Key*, *The Brazilian*, *La Belle Hélène*, *Blue Beard*, *La Vie Parisienne*, *La Grande Duchesse de Gérolstein*, *King Lear*, *The Brigands*, *Frou-frou*. In many of his plays he had the collaboration of H. Meilhac. FÉLIX AUCAIGNE.

Half Cadence, in music, the name sometimes applied to a cadence on the dominant, otherwise called the "imperfect" cadence, as contradistinguished from the perfect on the tonic. In the example see the half (or imperfect) cadence at *a*, and the perfect at *b*:



WILLIAM STAUNTON.

Half Moon, post-tp. of Saratoga co., N. Y., extending from the Hudson to the Mohawk River. Many thousand tons of moulding-sand are annually shipped from this town, which is traversed by the Erie Canal and the Rensselaer and Saratoga R. R. Pop. 3093.

Half Moon, post-tp. of Centre co., Pa. Pop. 698.

Half Moon Bay, post-tp. of San Mateo co., Cal. Pop. 1665.

Half Note, a term popularly, though incorrectly, used for half *tone* or semitone, such as the progression from B to C, or from F to F sharp; also, the designation of a minim, as having half the duration of a semibreve, the latter being regarded, in modern music, as the standard of time, and hence called a *whole* note.

Hal'ford (Sir HENRY), BART., M. D., b. at Leicester, England, Oct. 2, 1766 (named VAUGHAN in youth); was educated at Rugby and Oxford; M. A. 1778, M. D. 1791; settled in London 1794; was made a baronet 1809; took the name HALFORD with an inherited estate 1815; was a court-physician throughout nearly all his professional career, and one of the most popular physicians in London; was made knight commander of the order of Guelphs 1825. D. in London Mar. 9, 1844. Among his works are *Essays and Orations* (1831), *The Death of Some Eminent Persons* (1835), *Nugæ Metricæ* (1842).

Half-pay [Fr. *demi solde*], the money-allowance made to officers of armies and navies when not engaged in active professional duties. Half-pay is unknown in the U. S. In the British navy half-pay is the regular stipend of every officer except when afloat or performing certain specified duties. In the British army half-pay is ordinarily given to officers temporarily thrown out of employment by sickness or by the reduction in size of the corps to which they belong. There are also some officers *retired* upon half-pay, but as a rule retired officers have full pay. Half-pay was first granted by William III. in 1698.

Hal'iburton (THOMAS CHANDLER), D. C. L., b. at Windsor, Hants co., Nova Scotia, in 1797; was educated at King's College, Windsor, and after studying law was called to the bar in 1820; practised for a number of years in Nova Scotia, and became subsequently judge of the court of common pleas. He issued 1837 his work entitled *The Clockmaker, or Sayings and Doings of Samuel Slick of Slickville*, which became very popular in the U. S. and England; also published *Traits of American Humor* (1852) and other works. D. at Isleworth, England, Aug. 27, 1865.

Hal'ibut, the *Hippoglossus vulgaris*, a large fish of the family Pleuronectidæ, sometimes found to weigh more than

Halibut.

600 pounds. It is caught on both sides of the Atlantic, and especially on the Banks of Newfoundland in the winter

season. Its flesh is justly prized. Its upper side is dark, its lower white, the eyes being both upon the upper side, as in the other Pleuronectidæ.

Halicarnas'sus (Ἁλικαρνασσός, now *Boudroum*), a Greek city of Caria, on the Ceramian Gulf, was colonized from Trœzene, and once belonged to the Dorian Hexapolis, but afterwards became the great centre of Persian influence, and fell under the power of a line of Carian princes, vassals of the Persians, of whom Mausolus was the most celebrated. Though Greek in language and culture, it was Persian in politics. Alexander was unable to take its citadel, Salmacis, but destroyed the rest of the town. It never afterwards regained its greatness. The village of *Boudroum* occupies its site, and recent excavations have revealed abundant relics of its former splendor. Boudroum has an outer and an inner harbor; lat. 37° 2′ 21″ N., lon. 27° 25′ 18″ E.

Hal'ifax, town of England, in the county of York, on the Hebble. It is a flourishing and rapidly growing town of very large manufacturing interests. Its carpet-works are the largest in the world, and its manufactures of woollen and worsted rank next to those of Leeds and Bradford. Pop. 65,124.

Halifax, county of Nova Scotia, bounded on the S. E. by the Atlantic. Its surface is broken, and in part not very productive. Its coast is broken by deep bays and harbors, and is sheltered by numerous small islands. Ores of gold and lead are among the minerals found. Shipbuilding, commerce, and the fisheries are important industries. It is intersected by the Intercolonial Railway. Cap. Halifax. Pop. 56,963.

Halifax, the metropolis of Nova Scotia, and the principal naval station and arsenal held by England in British America, was founded by Gov. Cornwallis in 1749. It is beautifully situated on the W. side of Chebucto Bay, one of the best harbors in the world. Commanded by a hill on which is a strong fort, the town is protected seaward by many batteries armed with guns of the newest pattern and heaviest calibre. The garrison consists at present of two regiments of foot, several companies of artillery and engineers, while the local forces are in a very efficient state. The principal streets are laid out parallel with the water, crossed by others at right angles; they are wide and commodious, with sidewalks having heavy granite curbings and crossings. As usual with all towns on the seaboard of British North America, the houses were constructed of wood, though, in consequence of repeated and disastrous fires, these have been in a great measure replaced by really beautiful buildings of stone or brick. Many of the stores and public edifices may vie in external appearance with any on this continent. The salubrity of the air—devoid in summer of the relaxing effects of extreme heat, tempered by bracing winds from the ocean; the beautiful drives into the surrounding country; the well-known hospitality of its citizens; its easy accessibility by means of the Intercolonial Railway, render it one of the most desirable of watering-places; and there are several hotels which, without much pretension, are really comfortable, not to say luxurious. Halifax is supplied with pure water from two beautiful lakes a few miles distant, brought in pipes twenty inches in diameter, ample for a population of 100,000. The fire department is in a most efficient state, served by three steam and several hand engines, and the pressure from the lakes is such that, by means of hose, the water can be thrown in heavy streams to a considerable height in any part of the city. There are 26 places of worship, 4 convents, a Presbyterian theological school, 2 public libraries, 1 university and 2 colleges, 1 grammar school, 17 public schools, and many private seminaries, attended by nearly 7000 pupils; the public schools are free to all, and compare very favorably with similar establishments elsewhere. There are three orphans' homes, an asylum for the poor, one for the blind, and one for the deaf and dumb, all of which are in successful working order and are generously sustained. The 6 daily and 4 weekly papers have a large circulation. Four breweries, 2 steam-bakeries, a carriage and skate factory,

New Provincial Building.

foundries, establishments for machinery, for canning lobsters and fish, tobacco, piano, and furniture manufactories, and an extensive gasworks have been for some years in active operation, and command extensive business, while 7 banks possess ample capital. Halifax carries on an increasing trade, particularly with the West Indies. The exports are fish and lumber in very large quantities. The return cargoes consist of sugar, molasses, rum, and other West Indian produce, while from England and the U. S. are imported all kinds of manufactured goods. Imports for the year ending Dec. 31, 1873, $9,116,798; exports, $4,120,155; duties collected, $1,044,470. Pop. 29,582. It has an Anglican bishop and a Roman Catholic archbishop. Lat. 44° 39′ 42″ N., lon. 63° 35′ 30″ W. J. R. WILLIS.

Halifax, county in the N. N. E. of North Carolina. Area, 680 square miles. The Roanoke River is its N. E. boundary. It is intersected by the Wilmington and Weldon R. R. The chief products are cotton, corn, and swine. Cap. Halifax. Pop. 20,408.

Halifax, county of Virginia, bounded S. by North Carolina. Area, 960 square miles. It is bounded N. E. by the Roanoke River, and is traversed by the Richmond and Danville R. R. It has a fertile soil, producing grain and large amounts of tobacco. Plumbago is found. Cap. Halifax Court-house. Pop. 27,828.

Halifax, post-tp. of Plymouth co., Mass., on the Old Colony R. R., 28 miles S. E. of Boston. Pop. 619.

Halifax, post-v., county-seat of Halifax co., N. C., on the Wilmington and Weldon R. R., 8 miles S. of Weldon, and on the W. bank of the navigable Roanoke River. It is finely situated, and has a good trade. Pop. 429.

Halifax, tp. and post-v. of Dauphin co., Pa., on the Northern Central R. R., 20 miles N. of Harrisburg, and on the E. bank of the Susquehanna. Pop. 568; of tp. 1905.

Halifax, post-tp. of Windham co., Vt., on the Massachusetts line, and 15 miles W. of Brattleborough. It has manufactures of lumber, maple-sugar, leather, chair-stuff, and other articles. Pop. 1029.

Halifax (CHARLES **Montague**), EARL OF, b. Apr. 16, 1661, at Horton, Northamptonshire, and educated at Cambridge. He entered the House of Commons as member for Malden during the Convention Parliament, and was appointed a commissioner of the treasury in 1692, and first lord of the treasury in 1698. His two most famous measures were the foundation of the English national debt in 1694 and the establishment of the Bank of England in 1695, both of which plans were devised with great insight and carried out with immense success. In 1699 he was made Baron Halifax, but in 1701, and again in 1703, he was impeached by the House of Commons, and escaped only by the protection of the House of Lords. During the reign of Queen Anne he was without office, but he took part very actively in the negotiations for the union between Scotland and England and for the succession of the House of Brunswick. On the accession of George I. he was made premier, earl of Halifax, knight of the Garter, etc., but d. soon after (May 19, 1715). His personal character was mean and probably dishonest, a mixture of baseness and arrogance, but his talents and his taste were superior. In his youth he had dabbled a little in literature, and when he came into power he patronized authors and artists.

Halifax (GEORGE **Saville**), MARQUIS OF, b. in 1630; d. in 1695. During three reigns he held the highest offices and played a most conspicuous part in politics. In 1668 he was made Baron Saville and Viscount Halifax for his participation in the Restoration, and in 1680 it was due to his eloquence that the House of Lords rejected the bill excluding the duke of York from the succession. Nevertheless, it was he who presented the crown to William and Mary on their accession, and he was for several years their prime minister; when he retired he entered into negotiations with the Jacobites. His party was contemptuously called the *Trimmers*, which name, however, he adopted and defended. He wrote *Character of a Trimmer*, *Anatomy of an Equivalent*, *Maxims of State*, etc.

Halifax Court-house, post-v., cap. of Halifax co., Va., on the Banister River, 6 miles from S. Boston. It has 3 churches, 1 newspaper, a good water-power, grist and flouring-mills, and some stores. Tobacco is the chief crop of the surrounding country. Pop. about 600.

P. H. CARPENTER, ED. "THE HALIFAX RECORD."

Halifax River, in Volusia co., Fla., is a salt-water tidal channel, running N. 30 miles. It is 1 mile wide throughout, and communicates with the sea through Mosquito Inlet. It is sometimes called Mosquito North Lagoon. It is continuous southward with Hillsborough River. It is navigable, and abounds in fish and oysters. Its W. bank is a mass of oyster-shells.

Halite. See ROCK-SALT.

Hall, at the English universities of Oxford and Cambridge, an institution differing from a college chiefly in being unendowed, or nearly so, and in having no corporate existence. In former times the halls were very numerous, Oxford alone having had at one time over 300, according to Anthony à Wood. At present they are few at either university; and in 1874, Magdalen Hall, Oxford, was absorbed by (the restored) Hertford College. It is, however, allowable for any M. A. to open a new hall, but the few that have been recently instituted on this plan have been, on the whole, unsuccessful.

Hall, town of Austria, in the province of Tyrol, 10 miles from Innspruck, and on the Inn, has many good educational and benevolent institutions, and large manufactures of salt and chemicals. Pop. 5022.

Hall, town of Würtemberg, on both sides of the Kocher. It is a picturesquely situated town, with large salt-works and sugar-refineries. Pop. 7793.

Hall, county in the N. E. of Georgia. Area, 540 square miles. It has rich mineral wealth, gold, silver, and lead, and several diamonds, rubies, and other rare precious stones have been found. Corn and tobacco are staple products. The county is traversed by the Atlanta and Richmond R. R. Cap. Gainesville. Pop. 9607.

Hall, county of E. Central Nebraska, bounded S. by the Platte River, and intersected by the Union Pacific R. R. Area, 414 square miles. The interval-lands are very productive; the higher lands need irrigation, but afford good pasturage. Cap. Grand Island. Pop. 1057.

Hall, tp. of Bureau co., Ill. Pop. 1059.

Hall, tp. of Dubois co., Ind. Pop. 2046.

Hall, tp. of Gates co., N. C. Pop. 778.

Hall, tp. of Anderson co., S. C. Pop. 1240.

Hall (BASIL), F. R. S., F. R. S. E., b. in Edinburgh, Scotland, 1788; entered the royal navy 1802; become post-captain 1817; d. in the insane hospital at Haslar, near Gosport, Sept. 11, 1844. His principal works are *A Voyage to the West Coast of Corea and the Great Loo-Choo Island* (1818); *Extracts from a Journal* (written on the Pacific coast of America, pub. in *Constable's Miscellany*); *Travels in North America* (3 vols., 1829, a work which excited no small indignation in the U. S.); *Fragments of Voyages* (9 vols., 1831–40, his best work), and several other volumes of travels.

Hall (CHARLES FRANCIS) was b. in 1821 at Rochester, N. H.; became a blacksmith, but removed to Cincinnati, where he was a stationer and journalist. He for a time paid great attention to the subject of caloric engines. He afterwards became deeply interested in the fate of Sir John Franklin, and in 1860 sailed from New London in the ship George Henry, Capt. James Buddington, the expedition being fitted out chiefly at the expense of Henry Grinnell of New York. Hall remained two years with the Esquimaux, and in 1862 returned. He published his *Arctic Researches* in 1864, and soon sailed again for the N. in the Monticello, Capt. James Buddington, again at the expense of Mr. Grinnell. He remained in the polar regions until 1869, when he returned, bringing many undoubted relics of the Franklin party. In 1871 he sailed on his third expedition in the steamer Polaris, fitted up by the U. S. government for polar exploration. Capt. Hall d. Oct. 10, 1871, in Greenland, and after great privations and many dangers the Polaris was abandoned, a portion of her crew under Capt. Tyson having drifted away on floating ice, from which they were rescued by the steamer Tigress Apr. 30, 1873, after floating 195 days. The remainder of the crew constructed boats, put to sea, and were picked up June 23, 1873, by a whaler, and carried to Dundee, Scotland.

Hall (REV. CHARLES H.), b. in North Carolina Apr. 18, 1831; d. in Virginia Aug. 22, 1872. He graduated with high distinction at Randolph-Macon College, and joined the Virginia conference of the Methodist Episcopal Church, South in 1853. He was rarely gifted as a preacher, and occupied high positions in Virginia, and for three years was pastor of Trinity church, Baltimore. T. O. SUMMERS.

Hall (CHARLES HENRY), D. D., b. at Augusta, Ga., Nov. 5, 1820; studied at Phillips Academy, Andover, Mass., and graduated at Yale in 1842; entered the Protestant Episcopal ministry. Author of *Commentaries on the Gospels* (2 vols.), *Protestant Ritualism*, *Spina Christi*. Received the degree of D. D. from Hobart and Columbia colleges.

Hall (DOMINICK AUGUSTINE), b. in South Carolina in 1765; became U. S. judge of the State of Louisiana after its admission into the Union in 1812; is prominent as being interested with Gen. Jackson in a violent controversy 1815. D. at New Orleans, La., Dec. 19, 1820.

Hall (FREDERICK), M. D., LL.D., b. at Grafton, Vt., 1780; graduated at Dartmouth 1803; was a tutor there 1804–05; tutor in Middlebury College 1805–06; professor of natural philosophy and mathematics 1806–24; held the chemical professorship in Trinity College, Conn., and Columbian College, D. C., and the presidency of Mt. Hope College, Md. D. at Peru, Ill., July 27, 1843.

Hall (GORDON), one of the first missionaries of the A. B. C. F. M., was b. in Tolland, Hampden co., Mass., Apr. 8, 1784, and graduated at Williams College in 1808 with the first honors. He studied theology at Andover; was ordained, and set apart to the foreign missionary work with his brethren and colleagues, Messrs. Nott, Rice, Judson, and Newell, Feb. 6, 1812, at Salem, and in the same month sailed on his mission to India. He reached Calcutta in August of the same year, but the East India Co. refused to allow him and his fellow-missionaries to remain. After having been subjected to the greatest embarrassments through the arbitrary measures of the government, during all of which he never lost his self-possession and dignity, he succeeded in getting a foothold in Bombay, where he labored for thirteen years with absorbing devotion and great success. D. of cholera Mar. 20, 1826. He published several tracts and volumes on the missionary work, and revised the Mahratta New Testament.

Hall (GORDON), D. D., b. at Bombay, India, Nov. 4, 1823; graduated at Yale College in 1843, and at Yale Divinity School in 1847; was a tutor in Yale College 1846–48; was ordained at Wilton, Conn., in 1848, and in 1852 became pastor of the Edwards church (Congregational) in Northampton, Mass.

Hall (HILAND), LL.D., was b. at Bennington, Vt., July 20, 1795, the son of a farmer. He was admitted to the bar in 1819; served in the Vermont legislature, and became State's attorney; was a member of Congress 1833–43; a judge of the supreme court of Vermont four years; second comptroller of the U. S. treasury 1850; land commissioner of California 1851–54; governor of Vermont 1858–60. Published *History of Vermont* (1868), and has held various prominent offices.

Hall (JAMES), b. at Philadelphia Aug. 19, 1793; served 1812–18 in the army on duty on the northern frontier, and in the expedition of Decatur against Algiers; became in 1820 a lawyer and editor at Shawneetown, Ill.; was four years public prosecutor, and three years judge of a State circuit court; removed to Vandalia; was four years State treasurer, and was also a successful lawyer and editor there; went in 1833 to Cincinnati, where he edited the *Western Monthly Magazine* 1833–37; was a bank president 1853–65. D. at Cincinnati July 5, 1868. Author of *Letters from the West* (1829), *Legends of the West* (1832), *The Soldier's Bride*, etc. (1832), *The Harpe's Head* (1833), *Tales of the Border* (1835), *Statistics of the West* (1836), *Life of W. H. Harrison* (1836), *History of the Indian Tribes* (3 folio vols., 1838, written jointly with T. L. McKenny; original price $120), *Notes on the Western States* (1839), *The Wilderness and the Warpath* (1846), *Life of Thomas Posey* (1846), *Romance of Western History* (1857), *Works* (4 vols., 1853–56).

Hall (JAMES), LL.D., b. at Hingham, Mass., Sept. 12, 1811; studied under Amos Eaton in the Polytechnic Institute of Troy, N. Y., 1831–36; became in 1837 one of the State geologists of New York, and in 1843 was appointed State palæontologist, a position which he holds in 1875; has long been professor of geology in the Polytechnic Institute of Troy, N. Y. Among his published works are annual reports (1838–41) upon the State geological survey; a volume (1843) of the *Natural History of New York*, published by the State; five large volumes (1847–75) upon the *Palæontology of New York* (to be finished in 7 vols.), besides many papers, reports, etc. upon geology (dynamical and descriptive) and palæontology. He was appointed in 1855 State geologist of Iowa, and afterwards served upon the State survey of Wisconsin, and has done much work upon the U. S. surveys in the far West. Is a member of many learned societies at home and abroad.

Hall (JAMES CROWHILL), M. D., was b. in Alexandria, Va., Jan. 10, 1805; graduated M. D. in the University of Pennsylvania 1827, and opened an office next year in Washington, D. C. In 1832 he was elected professor of surgery in the Columbian Medical College. He has not written much professionally, but has long held connection with the charitable institutions of the district, of which he is one of the leading practitioners. PAUL F. EVE.

Hall (JOHN), D.D., of Scottish descent, b. in the county of Armagh, Ireland, July 31, 1829; entered Belfast College at the age of thirteen; repeatedly won the Hebrew prize; was licensed to preach in 1849, going as a missionary into the W. of Ireland; in 1852 became pastor of the First Presbyterian church in Armagh, and in 1858 was called to the church of St. Mary's Abbey, now Rutland Square, in Dublin. By royal appointment he was commissioner of education for Ireland. In 1867 he came as a delegate from the Presbyterian Church in Ireland to the Presbyterian churches in the U. S., and soon after returning to his native land was summoned by cable telegram to take charge of the Fifth Avenue (19th street) Presbyterian church in New York, over which he was installed Nov. 3, 1867. In 1875 a splendid church edifice was erected for him on the corner of Fifth Avenue and 55th street. As a clergyman he magnifies his office and emphasizes the great facts and doctrines of the gospel. His habit is carefully to write his sermon, and then leave the manuscript behind him. He has published *Family Prayers for Four Weeks* (1868), *Papers for Home Reading* (1871), *Questions of the Day* (1873), and *God's Word through Preaching* (1875). This last volume comprises the lectures on the Lyman Beecher foundation delivered before the students in the theological department of Yale College. R. D. HITCHCOCK.

Hall (JOHN E.), brother of James (1793–1868), b. 1783; was educated at Princeton, N. J.; became in 1805 a lawyer of Baltimore, and soon was made professor of rhetoric, etc. in the University of Maryland; was a Federalist; edited the *Am. Law Journal* 1808–17; the *Portfolio*, Philadelphia, 1816–27; the *Philadelphia Souvenir* 1827. Author of *Memoirs of Anacreon*, *Memoirs of Eminent Persons* (1827), *Practice and Jurisdiction of the Court of Admiralty* (1809), etc. D. June 11, 1829.

Hall (JOSEPH), D. D., "the Christian Seneca," b. at Ashby-de-la-Zouch, Leicestershire, July 1, 1574; became a fellow of Emmanuel College, Cambridge, 1595; dean of Worcester 1617; went in 1618 to the Synod of Dort; was consecrated bishop of Exeter 1627; translated to Norwich 1641; was imprisoned for six months in the Tower by the Puritans 1642; and d. at Heighham, Norfolk, Sept. 8, 1656. He was a man of great wisdom, piety, and moderation. His principal works are *Mundus alter et idem* (1607), *Contemplations* (1612–15, on the Old and New Testaments), *Virgidemiarum Liber* (1597–98, a collection of satires), *Epistles* (1608–11), *Explication of Hard Texts* (1633–34), *Christian Meditations* (1640), one of his best works; also an autobiography and other writings.

Hall (DR. LYMAN), a signer of the Declaration of Independence, b. in Connecticut 1725, graduated at Yale College 1747; settled near Sunbury, Ga., in 1752; was elected a delegate, and then a member, to Congress from Georgia 1775–79, and in 1783 made governor of that State. He was in person tall and well-proportioned, with easy manners and dignified deportment, and by nature was of a warm and enthusiastic disposition. D. in Burke co., Ga., Oct. 19, 1790. PAUL F. EVE.

Hall (MARSHALL), M. D., b. at Basford, Notts, in 1790; passed M. D. at Edinburgh in 1812; studied on the Continent; settled at Nottingham in 1815, and attained a large practice, and removed in 1826 to London. D. at Brighton Aug. 11, 1857. Dr. Hall's observations in clinical medicine and the physiology of the nervous system, and his well-known method for the restoration of asphyxiated patients, placed him in the front rank of the medical men of the present century. Author of *Diagnosis* (1817); *Medical Essays* (1824); *The Circulation of the Blood* (1831); *The Nervous System* (1836); *Theory and Practice of Medicine* (1837); *Theory of Convulsive Diseases* (1848); and various scientific and other papers.

Hall (NATHANIEL), b. in Medford, Mass., Aug. 13, 1805; was destined for a business-life; entered a store in Boston at the age of sixteen, then an insurance office as secretary; at twenty-four devoted two years to preparation for the study of divinity; entered the school at Cambridge 1831; graduated in 1834 and was ordained Unitarian minister of the First parish in Dorchester 1835. Mr. Hall was the author of about thirty published discourses. He was an earnest abolitionist, a warm philanthropist, a broad thinker, and a devoted pastor. He received from Harvard College the honorary degree of A. M. D. Oct. 19, 1875.

O. B. FROTHINGHAM.

Hall (NATHAN K.) was b. at Marcellus, Onondaga co., N. Y., Mar. 28, 1810; studied law with Millard Fillmore, and in 1832 became his partner at Buffalo, N. Y.; held various important State offices; was a member of Congress 1847–49; U. S. postmaster-general 1850–54; and a judge of the U. S. district court for Western New York. D. Mar. 2, 1874.

Hall (REV. NEWMAN), LL.B., b. in 1816; graduated B. A. and LL.B. at the University of London, winning a law-scholarship; was 1842–54 a Congregational pastor in Hull, and in 1854 became minister of Surrey chapel, Blackfriars' road, London; after the war of 1861–65 visited the

U. S. for the purpose of allaying the popular bitterness towards Great Britain: author of *Homeward Bound, Notes of a Journey from Liverpool to St. Louis, Pilgrim Songs,* and other works.

Hall (ROBERT), M. A., b. at Arnsby, Leicestershire, England, May 2, 1764, the son of a Baptist preacher, was distinguished in childhood for precocity of intellect; was educated at the Bristol College and at King's College, Aberdeen, where he passed M. A. with first honors 1781. He served as a tutor in the Bristol Academy, and was also assistant pastor of the Broadmead Baptist chapel; took a pastorate at Cambridge 1791; was several times between 1804 and 1807 temporarily insane by reason of his severe sufferings, for he had a large renal calculus; was pastor of a church in Leicester 1807–26; and then again pastor of the Broadmead chapel, Bristol, until his death, Feb. 21, 1831. Mr. Hall was one of the first of English preachers, a man of thorough sincerity, broad and generous principles, and active charity. He published political tracts of liberal tendencies; opposed Socinianism and the so-called close communion; and published many sermons, reviews, lectures, etc. His *Works*, with a memoir by OLINTHUS GREGORY, were published in 6 vols., 1831–33.

Hall (SAMUEL CARTER), b. at Topsham, Devonshire, in 1800; studied law and entered upon his literary career as a parliamentary reporter for the London *Times*. In 1824 he established the *Amulet*, an illustrated annual, and has since edited many illustrated books; as, for instance, *Book of Gems, British Ballads, Baronial Halls, Ireland*, etc. He has been the editor of the London *Art Journal* since 1839. His *Trials of Sir Jasper* (1873), a temperance poem, proved very popular.—In 1824 he married ANNA MARIA FIELDING, b. at Dublin in 1805, who, besides assisting him in many of his literary undertakings, has achieved a literary name of her own by her *Sketches of Irish Character* (1828), *Lights and Shadows of Irish Character* (1838), *Stories of Irish Peasantry* (1840), *The Buccaneer* (1832), *Uncle Horace* (1838), etc. She has also written two dramas—*The French Refugee* and *The Groves of Blarney*.

Hall (SAMUEL READ) was b. at Croydon, N. H., Oct. 27, 1795; began in 1814 to teach at Rumford, Me., and in 1822 at Fitchburg, Mass. From 1823 to 1830, at Concord, Vt., where he was a Congregational missionary, he conducted a school for teachers, founded by himself, the first school of the kind in the U. S. In 1827 he assisted in organizing the American Institute of Instruction. In 1830 he became principal of the English department of Phillips Academy, Andover; taught in a teachers' seminary at Plymouth, N. H., 1837–40; at Craftsbury, Vt., 1840–46; and afterwards removed to Bennington, Vt. He has published several works, chiefly educational.

Hall (WILLARD) was b. at Westford, Mass., Dec. 24, 1780, and graduated at Harvard in 1799. In 1803 he was admitted to the New Hampshire bar, but soon removed to Dover, Del.; was secretary of state for Delaware 1811–14, and again in 1821; was a member of Congress 1817–21; and in 1823 became U. S. district judge for Delaware. He also held other prominent public offices. In 1829 he published the revised statutes of the State. D. May 10, 1875.

Hall (WILLIAM W.), M. D., b. at Paris, Ky., in 1810; graduated at Centre College 1830, and took his medical degree at Transylvania University 1836; practised medicine fifteen years in the South; removed to New York; began in 1854 to publish *Hall's Journal of Health*, which has had a wide circulation. Author of *Health by Good Living* and other works on hygiene; *Cholera, Bronchitis, and Kindred Diseases* (1855), etc. D. May 10, 1876.

Hall (WILLIS), b. at Granville, N. Y., Apr. 1, 1801; graduated at Yale 1824; studied law in New York and at Litchfield, Conn.; was admitted to the bar 1827; practised in Mobile, Ala., 1827–31, in New York 1831–38; was in the assembly 1837 and 1842; attorney-general of New York 1838; was for a time lecturer in the Saratoga Law School; resumed practice in New York; retired in 1848 from professional and political life. D. July 14, 1868.

Hal'lam (ARTHUR HENRY), son of the historian Hallam, b. in London Feb. 1, 1811; was educated at Eton and Trinity, Cambridge, where he passed B. A. in 1832; studied law in the Inner Temple in 1832; went to Germany for his health, and d. at Vienna Sept. 15, 1833. He is memorable as the subject of Tennyson's *In Memoriam*. A volume of his writings in prose and verse appeared in 1862.

Hallam (HENRY), LL.D., D. C. L., F. R. S., b. at Windsor, Eng., in 1777; was educated at Eton and Oxford, and studied law. His early contributions to the *Edinburgh Review* (1802 seq.) gave him a wide fame as a liberal thinker and able writer. His principal works are *Europe during the Middle Ages* (1818); *Constitutional History of England* (1827); *Introduction to the Literature of Europe* (1837–39); *Literary Essays and Characters* (1852). D. at Penshurst Jan. 21, 1859.

Hal'le, town of Prussia, in the province of Saxony, on the Saale. It has some manufactures of hardware, woollens, and starch, and very extensive salt-works. The vicinity is rich in salt-springs, and the inhabitants around these springs (the so-called Halloren), who are employed in the manufacture of salt, form a peculiar race in features, character, and customs; they are supposed to be of Wendish or Celtic origin. Händel, the composer, was b. in Halle in 1685. The university (founded in 1694), with which that of Wittenberg (founded in 1502) was united in 1817, has ranked high, especially in theology. Gesenius was one of its professors from 1810 to 1842. In his time there were 1300 students, subsequently less than 600; and now again (1875) more than 1000. Pop. 52,639.

Hal'leck (FITZGREENE), an American poet, was b. at Guilford, Conn., July 8, 1790. His mother was a descendant of the missionary John Eliot. He studied in the academy of his native town, and in 1811 became, and long remained, a clerk in the house of Jacob Barker of New York. Was afterwards (1824–49) employed by J. J. Astor, who named him a trustee of the Astor Library. In 1849 returned to Guilford, Conn., where he d. Nov. 19, 1867. He was never married, and in the latter part of his life was a Roman Catholic. The best known of his poems are *Twilight*, first printed in 1818 in the New York *Evening Post*; that on the death of his friend, J. R. Drake, which appeared in 1820; *Fanny* (1819; enlarged 1821), his longest production; *Alnwick Castle, Marco Bozzaris,* and *Burns* (1827). His *Young America* appeared in 1864. The *Croaker Papers* (1819), by himself and his friend Drake, were first published in a complete edition in 1860. (See his *Life* by J. G. WILSON, 1869.)

Halleck (HENRY WAGER), LL.D., b. at Waterville, Oneida co., N. Y., Jan. 16, 1815; graduated at West Point Military Academy July 1, 1839, entered the army as second lieutenant of engineers, being retained at West Point as assistant professor of engineering till June, 1840, and for a year subsequently was assistant to a board of engineers at Washington, D. C., during which time he prepared a work on *Bitumen, its Varieties, Properties, and Uses.* From Washington he was transferred as assistant in charge of the construction of fortifications in New York harbor, where he remained till 1846, except while absent in 1845 on a tour of examination of public works in Europe. On his return he delivered a course of twelve lectures on the science of war before the Lowell Institute at Boston, which were published in 1846 under the title of *Elements of Military Art and Science*, a second edition of which, with large additions, including notes on the Mexican and Crimean wars, was issued in 1861, and largely used as a manual during the civil war. Early in the Mexican war he was sent to the Pacific coast, where he bore an influential part in military operations and in the civil government there up to the time that California was admitted as a State of the Union. Becoming deeply interested in the fortunes of that new State, he left the army by resignation in Aug., 1854, and devoted himself to the practice of law, continuing as director-general of the New Almaden quicksilver-mine, which position he had held since 1850. Early in 1861, at the solicitation of Lieut.-Gen. Scott, Gen. Halleck was appointed major-general of the regular army, and assigned to the command of the department of the Missouri, embracing the States of Missouri, Iowa, Minnesota, Wisconsin, Illinois, Arkansas, and Western Kentucky. On assuming this command he immediately applied his military knowledge and administrative powers to the organization of the chaotic masses in his department and to the reform of existing abuses. In Mar., 1862, the departments of Kansas and Ohio were added to Halleck's command, the whole constituting the department of the Mississippi, including the territory between the Alleghany and the Rocky Mountains. After the battle of Shiloh, Halleck took the field, and after reorganizing and recruiting his forces moved on Corinth by slow and regular approaches, so that it was not until May 27 that his army appeared before that fortified city, to which stronghold the army of Gen. Beauregard had fallen back. Active preparations were made by Halleck on the 28th and 29th for an attack, but on the morning of the 30th it was found that Beauregard had evacuated this stronghold during the previous night, and Corinth was occupied without resistance. After the campaign of Corinth, Halleck was called to Washington as general-in-chief, and exercised that command until the grade of lieutenant-general was revived. He then continued under assignment as chief of staff of the army until transferred to the command of the military division of the James in Apr., 1865. Upon the termination of the war, Halleck was ordered to the military division of the Pacific, assuming command

Aug., 1865, and Mar., 1869, was transferred to that of the South, which he retained till his death, which occurred at Louisville, Ky., Jan. 9, 1872. Degrees of A. M. and LL.D. conferred by Union College, N. Y. Among the more important of Gen. Halleck's published works may be mentioned his great treatise on *International Law, or Rules Regulating the Intercourse of States in Peace and War*, and a translation of Jomini's *Vie Politique et Militaire de Napoléon*.

G. C. Simmons.

Hallelu'jah [Heb., "Praise ye the Lord!"], also written *Alleluia* (from the Gr. Ἀλληλούια), an ancient formula of praise, universally adopted by the Christian churches as a doxology.

Hal'ler, von (Albrecht), M. D., F. R. S., the father of the science of physiology, was b. at Berne Oct. 18, 1708; studied divinity at Tübingen, medicine under Boerhaave at Leyden, and mathematics with the Bernoulli family at Bâle; made a botanical exploration of the Alps with Gesner; practised medicine with great applause at Berne 1729–36; held important professorships at Göttingen 1736–53, declining calls to several of the most renowned universities of Europe; became physician to the king of England 1729; retired to private life in Berne 1753. D. Dec. 12, 1774. He was a voluminous writer on physiology, anatomy, botany, surgery, and practical medicine; author of several romances and poems, and of an almost incredible number of reviews and scientific papers. His hypotheses were often short-lived and inadequate, but admirable for their scientific spirit, and for the great stimulus which they gave to physiological study throughout Europe.

Hal'lettsville, post-v., cap. of Lavaca co., Tex. It has 1 weekly newspaper. Pop. 431.

Hal'ley (Edmund), LL.D., F. R. S., an eminent astronomer, b. at Haggerston, near London, Nov. 8, 1656; was educated at Queen's College, Oxford, where he chiefly studied mathematics, physics, and astronomy; published in 1675 a method for finding aphelia and planetary eccentricities; was in St. Helena 1676–78, cataloguing the southern stars; discovered in 1680 the great comet which bears his name while travelling on the Continent; became a captain in the royal navy 1699, and conducted expeditions to observe the variations of the magnetic needle; became Savilian professor at Oxford 1703, a position which had previously been refused him on account of his alleged infidelity; was made secretary of the Royal Society 1713, and astronomer-royal 1720. Halley was a friend and collaborator of the great Newton, and a member of many learned societies, and one of the ablest physicists of his time. D. near Greenwich Jan. 25, 1742.

Halley's Comet. See Comet.

Hal'liwell (James Orchard), F. R. S., b. at Chelsea, England, June 21, 1820; studied for a time in Cambridge, and in 1839 began his great work of the editing and publication of old English authors and MS. texts. He has produced an incredible number of works, many of them original. Among these are *Shakspeariana* (1841); *A History of Freemasonry* (1842); *Dictionary of Provincial and Archaic Words* (1844–45); and many volumes of Shakspearian literature, including a *Life of Shakspeare* (1845).

Hal'lock, post-tp. of Peoria co., Ill. Pop. 1094.

Hallock (Gerard), a son of Rev. Moses Hallock, was b. at Plainfield, Mass., Mar. 18, 1800, and graduated in 1819 at Williams College. He was for a time a teacher of German and Hebrew. In 1824 he founded the Boston *Telegraph*; in 1827 became one of the proprietors of the New York *Observer*; and from 1828 to 1861 was one of the owners and editors of the New York *Journal of Commerce*. This paper in 1828 stationed a vessel off Sandy Hook so as to get the earliest European news from inward-bound vessels, and in 1828 its proprietors established a horse-express from Philadelphia, which enabled them to give the Congressional news a day sooner than any other New York newspaper. Mr. Hallock was liberal in the support of religious and benevolent institutions, was strongly conservative in politics, and was one of the founders of the Southern Aid Society, a home-missionary organization.

Hallock (Moses), b. at Brookhaven, L. I., Feb. 16, 1760; graduated at Yale in 1788. He was in 1792 settled over a Congregational church in Plainfield, Mass., where he remained till his death. He was a man of nobly pure character, and was distinguished as an instructor of young men for the ministry. One of his students was the afterwards famous John Brown of Ossawatomie. D. July 17, 1837. (See his *Life* by W. A. Hallock, D. D.)—His brother, Jeremiah Hallock (b. Mar. 13, 1738; d. June 23, 1826), was a famous minister of West Simsbury, Conn. His *Life*, by Cyrus Yale, was published in 1838.

Hallock (William Allen), D. D., b. in 1794 at Plainfield, Mass., a son of Rev. Moses Hallock. He graduated at Williams College in 1819 with the highest honors, and studied theology at Andover. In 1822 he became agent for the New England Tract Society, and in 1825, when the American Tract Society of New York was organized, he became its corresponding secretary. His life-work has been that of the society itself, thousands of whose publications he has carried through the press, a work of peculiarly arduous character from the varied theological opinions of the supporters of the society. In addition, besides his laborious work as secretary, he has published *Lives* of Harlan Page, Justin Edwards, and Moses Hallock; also the *Mountain Miller* and other well-known tracts and sketches.—Mrs. M. A. Hallock, wife of the preceding, was b. in 1810 at Rowe, Mass., and early removed with her father, a Mr. Ray, to Norwich, N. Y. Her first husband, a Mr. Lathrop, d. in 1854, and she afterwards commenced authorship to obtain means for the support of her children. Her writings for the young are highly esteemed. They are published by the American Tract Society, of whose secretary she subsequently became the wife.

Halloween', or **All Hal'lows' Eve,** the night of Oct. 31—*i. e.* the *eve* of All Saints' or All Hallows' Day, which is the first day of November. The word *hallow* is the Anglo-Saxon *halig* and the German *heilige* ("holy," "sacred," etc.), nearly equivalent to the Latin *sanctus*, from whence comes our word *saint*. All Saints' (All Hallows' or All Hallow Tide) Day takes its origin from the conversion in the seventh century of the Pantheon at Rome into a Christian place of worship, and its dedication to the Virgin and all the martyrs. First celebrated on the 1st of May, the date was subsequently changed to November 1st, and under the designation of "Feast of All Saints" set apart as a general commemoration in their honor, and as such retained by the Anglican and American Episcopal churches, the collect for which supplicates for "grace so to follow Thy blessed *saints* in all virtuous and godly living," etc. On that day it is a custom of Roman Catholic countries (still practised in Louisiana) to visit the cemeteries for devotions or for laying floral tributes on the graves of relatives. But the "Halloween" has nothing churchly about it, and seems to be a relic of pagan times, or perhaps of mediæval superstitions, which regard it as the time of all others when supernatural influences prevail, and which set apart the night for a universal walking abroad of spirits both of the visible and invisible world; for on this mystic evening it was believed that even the human spirit might detach itself from the body and wander abroad. Halloween seems clearly allied to the "Walpurgis Night" of the Germans, the witch-festival or assembling of evil spirits on the summit of the Brocken in the Hartz Mountains on the eve of the 1st of May—the day, as already noticed, dedicated to the Christian martyrs or saints. The Walpurgis legend being almost coeval and early associated with the latter day, it is probable that in England the transference of the festival-day to the 1st of November carried with it the superstitions attributed to its preceding night. Practically, so far as it is recognized at all, as it is still in Great Britain and in some of our own States where church usages and traditions survive (*e. g.* Maryland and Virginia), it is devoted to sports and practical jokes. Nuts and apples are in requisition, the former giving the name "Nutcrack Night" to Halloween in the S. of England. They are not only cracked and eaten, but are made the means of vaticination in love-affairs.

> "The old guidwife's well-hoordit nits
> Are round and round divided,
> And mony lads' and lassies' fates
> Are there that night decided." (Burns: *Halloween*.)

But the grand sport is that of "ducking" or "bobbing" for apples set afloat in a tub of water. It is believed to be yet practised in Maryland, and perhaps elsewhere in the U. S.

J. G. Barnard.

Hal'lowell, city of Kennebec co., Me., beautifully situated on the W. bank of the navigable Kennebec River, 2 miles below Augusta, and on the Kennebec and Portland R. R., 58 miles from Portland. It has 3 national and 1 savings bank, 6 churches, and manufactures of cotton goods, oil-cloth, soap, candles, carriages, etc. It was formerly distinguished for its shipbuilding, which has now declined. It has of late an active trade in granite of superior quality, which is here extensively quarried. Except in winter, it has a line of steamers running to Boston and the ports on the Kennebec. Pop. 3007.

Halls, tp. of Sampson co., N. C. Pop. 1010.

Hall's Cross-Roads, tp. of Harford co., Md. It includes the village of Havre de Grace. Pop. 3805.

Halls'ville, post-tp. of Duplin co., N. C. Pop. 381.

Hallsville, tp. of Chester co., S. C. Pop. 1416.

Halluc, a small river of Northern France, which enters

the Somme from the right above Amiens, is noticeable on account of the battle which took place here Dec. 23, 1870, between the German general Von Manteuffel and the French general Faidherbe. The latter came from Lille with the purpose of advancing on the besieging army around Paris, and rested on the Hallue, Dec. 20; the former proceeded from Rouen with the purpose of arresting his advance. The French took up a position along the river, the 22d corps, under Gen. Lecointe, occupying the ground from Daours to Beaucourt, and the 23d, under Gen. Paulze d'Yvoy, Corbie, its vicinity, and the villages to the S. W. of Albert; they numbered 40,000 men with 78 guns. On the 23d, Manteuffel attacked with 20,000 men, chiefly consisting of the 8th army corps under Gen. von Goeben. The German attack was directed from Amiens against the French front, but as the judiciously selected position made it impossible to get into the rear of the wings of the enemy, the attack was very difficult. From the right bank the French were soon driven back, but in their main position on the left bank they continued the resistance with great stubbornness. The battle was chiefly concentrated around Daours on the German right wing, and around Pont Noyelles in the centre; on the left German wing, however, a sally was made against Fréchencourt. The French succeeded in taking these places, but a further success was not achieved. At 4 P. M., when it began to darken, the situation of the battle was this: the Germans held the right bank, and on the left bank all places in the valley; the French, the heights on the left bank. In the dusk Faidherbe tried to take the offensive, but without success. After some fighting, during which several villages changed occupants, yet finally remained in the hands of the Germans, both armies occupied their respective positions and awaited the next day. No contest, however, took place on the 24th; in the afternoon Faidherbe drew off towards Arras and Douay. He lost 141 dead, 905 wounded, several hundred prisoners, and 1000 missing; the German army lost 38 officers, 834 men, dead and wounded, and 93 missing.

A. NIEMANN.

Hallucination. See INSANITY, by PROF. W. A. HAMMOND.

Hall'ville, a station of the Union Pacific R. R., in Sweetwater co., Wy., 225 miles by rail W. of Laramie. It has mines of good lignitic coal. It is on Bitter Creek.

Halm (FRIEDRICH) is a pseudonym under which ELIGIUS FRANZ JOSEPH, Baron von Münch-Bellinghausen, wrote his dramas, and under which he is best known and most often spoken of in German literature. He was b. at Cracow Apr. 2, 1806; studied law, and held different government offices in Vienna at the imperial library, the Burg theatre, etc. In 1834 his first drama, *Griseldis*, was performed at the Burg theatre, and had a great success. Then followed in 1836 *The Adept*, in 1837 *Camoens*, in 1838 *Imelda Lambertazzi*, in 1843 *Der Sohn der Wildniss* ("Ingomar"), in 1844 *Sampiero*, in 1847 *Maria de Molina*, in 1854 *The Gladiator from Ravenna*, etc. The last mentioned is his best work; his subsequent ones are rather weak. As a dramatist, Friedrich Halm belongs to the school of Schiller. He starts from an idea which he finds represented in some historical event, and in the development of this idea through strong contrasts he is often very successful; as, for instance, in the *Gladiator* and *Ingomar*. But outside of these contrasts there is no picture in his dramas either of history or character; and as his words generally are bigger than his thoughts, and his situations much more powerful than his passion, it often causes a sad disappointment to read his dramas after seeing them well performed. He has also written some lyrical poems, but of inferior quality. His collected works were published at Vienna in 8 vols. (1857–64). CLEMENS PETERSEN.

Halma (NICOLAS), ABBÉ, b. Dec. 31, 1755, at Sedan; studied theology, languages, mathematics, and geography at the colleges of Lemoine and Sainte Barbe in Paris; took holy orders, and was in 1791 appointed director of the College of Sedan. In 1794 he was made secretary at the École Polytechnique and teacher in the engineering school in Paris, but as he refused to accept the title of captain he was discharged. He served for a time as an army surgeon. Later he held different offices, such as professor of geography at the military school of Fontainebleau, as librarian of Sainte Geneviève in Paris, etc. D. in Paris June 4, 1828. He was a very prolific writer, and published a great number of handbooks and essays on mathematics, geography, education, archæology, chronology, and other subjects, but his principal work is his translation of Ptolemy's *Almagest*. He worked for more than ten years on this translation, but when finished it was found admirable both in linguistic and astronomical respects. Halma was an excellent linguist, and a man of marvellous knowledge and exceedingly varied accomplishments.

Ha'lo, the popular term applied to bright circles and attendant optical phenomena seen when the sun or moon shines through or upon fog, haze, or cloud. For the purposes of scientific description in meteorology, halos are classified as greater or lesser halos; the former are the halos proper, while under the lesser halos are included the small rings, aureolæ, or glories known as coronæ and anthelia. Huygens and Sir Isaac Newton explained the process of the formation of the ordinary rainbows and halos; the principal steps in the further elucidation of the subject are due to Fraunhofer (*Théorie des Halos*, 1824), Brandes (art. "Hof" in Gehler's *Wörterbuch*, 1829), Kämtz (*Meteorology*, vol. iii., 1836), Galle (*Ueber Höfe*, etc., *Pogg. Ann.*, 1840, bd. 49). For a careful investigation of a remarkable halo see Clausen (Dorpat, 1849), and for a general description see Loomis' *Meteorology*, New York, 1870. According to the numerous physicists who have contributed to the explanation of the phenomena in question, these are all the result of certain modifications which light undergoes by reflection, refraction, dispersion, diffraction, and interference when it falls upon the crystals of ice, the raindrops, or the minute particles that constitute fog and clouds. The phenomena and their explanations may be considered under the following heads:

(1) A *corona* is a simple ring or concentric rings of light surrounding the sun or other luminary. These rings are generally tinged with colors, the inner being blue or purple, and the outer red; several series of such rings, separated by white spaces, are included within a distance of from one to five degrees from the sun. Fraunhofer first explained the origin of these rings as being the result of the diffraction of the rays of light in passing between the particles of a cloud or fog; by careful experiments upon coronæ artificially produced he rendered his explanation perfectly acceptable; and the undulatory theory of light enables us to conclude the average diameter of the drops of vapor from the measured diameter of the colored rings. The results of this investigation have been carefully collated by Kämtz, who has shown that the higher the temperature of the air the smaller is the diameter of the vapor particles, so that, for instance, in winter, the average diameter is 0.00095 of an inch, but in summer 0.00061. Some physicists, following Halley and Leibnitz, have maintained that fog-particles are hollow vesicles of vapor, but Bravais has shown that if the thickness of the shell of the vesicle is greater than one-third the exterior diameter of the particle, the latter will then produce halos closely resembling, if not identical with, those of a solid drop. The internal structure of vapor-particles need not be considered in the explanation of coronæ, which, being due to diffraction only, depend simply upon the exterior diameter; but is, on the other hand, of importance in explaining the phenomena of aureolas or glories.

(2) *Aureolas* or *Glories.*—This term includes the bows, circles, etc. surrounding the shadow of the observer when it is projected upon a cloud or fog-bank or dew-covered grass. These colored rings are observed upon the upper surface of clouds by aëronauts, and have been well described by Flammarion. (See GLAISHER, *Travels in the Air*, London, 1871.) The phenomena in question are doubtless produced by the diffraction of the light reflected at a nearly perpendicular incidence from the surfaces of the particles of vapor. Aureolas and coronæ are seen in greatest perfection when the vapor-particles are of comparatively large and regular dimensions; the smaller the diameter, and the less of uniformity in the size of the particles, the larger is the breadth of the colored rings, and the more perfectly do they overlap, thereby producing a more perfect commingling of the individual colors, resulting in a simple white and faint fog-bow. The existence of this bow, in connection with the absence of colored bands, is held to be an argument against the existence of vesicles. (For an account of the arguments for and against the vesicular theory, see KOBER in *Pogg. Ann.*, 1871, bd. 144.)

(3) *Halos proper* consist of more or less complicated arrangements of arcs and circles of light surrounding the sun or moon, accompanied by others tangent to or intersecting them; near the points of tangency and intersection there appear spots of special brightness, known as parhelia, paraselenæ, sun-dogs, etc. Of these arcs of light, some are colorless, while others are composed of parallel colored bands; the light of some arcs is polarized, while that of others is not. The very various appearances of these halos can only be properly appreciated by means of colored drawings; in general they are due to reflection and refraction from crystals of ice floating in the air; and of those features, the origin of which has been satisfactorily explained, the following may be noted: (1) A circle of 22° radius, the inner edge well defined red, the outer edge ill defined blue, the light polarized in the direction of a tangent to the circumference. This halo is formed by light

passing through the alternate faces of hexagonal prismatic ice-crystals in the direction of minimum deviation. (2) A circle of 46° radius, the inner edge red, and the outer edge pale blue. This is formed by the rays passing in the direction of minimum deviation through the base and sides of right prisms of ice. (3) A circle of about 90° radius, of white light. This is probably due to rays that after entering an ice-prism are totally reflected, and emerge through an opposite face of the prism. (4) The parhelic circle. This is a colorless arc extending from the sun to the right and left, parallel to the horizon, and is produced by simple reflection of the sun's light from the outer vertical surfaces of such ice-prisms as are slowly settling down through tranquil air. (5) A vertical arc is similarly produced by the reflections from the horizontal surfaces of ice-crystals. The arc extends to a distance of 5° to 20° above and below the sun. (6) The parhelia and paraselenæ. These are spots of special brightness that are seen at the mutual intersections of the circular arcs; it is a sufficient explanation of these to consider that at these points two causes are combining to turn towards the eye a double portion of the solar rays, thereby producing the increased apparent brightness. This at least suffices to explain the parhelia that are distant 22° and 46° from the sun's centre. Anthelion (Ger. *Gegensonne*) would be a term properly applicable to the parhelion that is seen at a point on the parhelic circle directly opposite the sun, and which is probably sometimes due to the combination of reflections from sets of surfaces oblique to the horizon. (7) Tangential arcs. Of these, which are numerous and have variable positions, the most brilliant is that which touches the halo of 46° at its summit; this arc is only seen when the sun's altitude is between 12° and 30°, and is due to the refraction of the sun's light through prisms whose refracting edges are horizontal. (8) The rainbow may be very properly considered as a halo due to the action upon the sun's light of large drops of water, instead of smaller drops or of crystals of ice, and differs from a corona in that it is not due to diffraction. The rainbow phenomena consist principally of one, two, or three main arches of prismatic colors, known as the primary, secondary, and tertiary bows, whose radii, reckoned from the point opposite the sun, are respectively 41½°, 82¼°, and 136½°, and which are respectively formed by those rays that experience a minimum deviation after one, two, or three total reflections within the drop. The secondary bow is sometimes erroneously spoken of as a reflection of the primary. These arches are, especially near their summits, fringed on their concave sides by narrow supernumerary belts of color, due, as was first explained by Dr. Thomas Young (1804), to the interferences of those rays that enter and leave the drops very nearly at the angle of minimum deviation. CLEVELAND ABBE.

Hal'ogen ("salt-producer"), a name formerly given by some chemists to those elementary substances which by combination with a metal produced those compounds which Berzelius called haloid salts. The halogens are chlorine, bromine, iodine, and fluorine (simple halogens), while cyanogen was called a compound halogen. The simple halogens form a very natural and strongly marked group. All are perissad (monad) elements, and cyanogen is strongly analogous to them in its character.

Ha'loid Salts [ἅλς, "salt," so called because they are analogous in composition to common salt], a name given by Berzelius to compounds of some halogen with a metal. Common salt and iodide of potassium are familiar examples. The metallic chlorides, iodides, bromides, and fluorides are haloid salts, and to these the metallic cyanides have a close relationship.

Hal'pine (CHARLES G.), b. at Oldcastle, co. Meath, Ireland, in Nov. 1829, graduated at the University of Dublin in 1846. His father was a Protestant clergyman, and editor of the Dublin *Evening Mail*. The young Halpine entered upon the life of a journalist, and in 1847 came with his wife to New York, without money or friends. He was for a long time connected with the New York *Herald*, *Times*, and other papers. For the *Tribune* he wrote that famous piece, "Tear Down the Flaunting Lie." He also wrote for the Boston *Post*, and was for a time one of the editors of the *Carpet Bag* in that city. In 1861 he enlisted in the Union army, in which he speedily rose, reaching in 1864 a brigadier-generalship of volunteers. He was also a major in the regular army and brevet major-general. He resigned his army commissions in 1864. It was while in the army that he wrote the humorous pieces in prose and verse, under the name of "Private Miles O'Reilly," which were universal favorites. In 1864 he became editor, and then proprietor, of the *Citizen* newspaper. He was afterwards register of the county of New York. D. Aug. 3, 1868, in consequence of an overdose of chloroform. He was a brilliant and versatile writer, and a man fond of convivial life. He published two volumes of poetry, chiefly humorous, besides the *Miles O'Reilly* papers, in 2 vols.

Halsey Valley, post-v. of Tioga tp., Tioga co., N. Y. Pop. 163.

Hal'stead, town of England, in Essex, on the Colne, has manufactures of silk, satin, and velvet. Pop. 6749.

Hal'stead (MURAT), b. in Butler co., O., Sept. 2, 1829; graduated at Farmers' College, College Hill, O., in 1851, and in the fall of the same year went to Cincinnati, where he adopted writing for the newspapers as an occupation, furnishing tales and stories mostly. In 1853 he obtained a situation on the Cincinnati *Commercial*, and in May, 1854, became one of its proprietors. He was married in 1857, and has eight children. J. B. BISHOP.

Haltaus (CHRISTIAN GOTTLOB), b. at Leipsic in 1702; studied archæology and philology, especially German; was rector of the school of St. Nicolas in Leipsic, and d. there Feb. 11, 1758. His *Glossarium Germanicum Medii Ævi* (2 vols. fol., 1758) is highly valued on account of its erudition.

Hal'ton, fertile county of Ontario, Canada. Area, about 362 square miles. It extends N. W. from Lake Ontario. It is traversed by the Great Western and Grand Trunk Railways. Cap. Milton. Pop. 22,606.

Halys. See KIZIL-IRMAK.

Ham, the cured and smoked thigh of the domestic swine; also sometimes applied to the corresponding part of the sheep, the ox, or the calf treated in a similar manner. There are many recipes for the curing of hams, and much appears to depend also on the breed and feeding of swine, and perhaps on the climate. Westphalia and many of the English counties have high repute for the excellence of their hams. No finer hams are seen in the U. S. than those of the Piedmont region of Virginia. For smoking hams the wood of the sugar-maple, hickory, and sometimes oak, is preferred. In Westphalia juniper-twigs are employed. Peat is used in parts of England, and hams are sometimes hung in the chimney of the cottage. In the U. S. many prefer the smoke of corn-cobs, which impart a fine flavor, but require much care in the burning, for if they burst into flame there is but little smoke, and the hams are injured by the heat. Many dispense entirely with smoking.

Ham, town of France, in the department of Somme, on the Somme. Its old fortress, built in 1470, is now used as a state prison. Louis Napoleon was kept there from 1840 to 1846. Pop. 2836.

Ham, a son of the patriarch Noah and the brother of Shem and Japheth, was, according to Genesis, the father of those nations which inhabited the southern countries, Egypt, Libya, etc. The Coptic or native name of Egypt is *Kem*, Χήμια with Plutarch, *Chemé* in the Rosetta inscription, which signifies "hot" or "burnt;" and this circumstance has occasioned a very strange piece of reasoning. By supposing that the Hebrew name *Ham* is derived from the Hebrew root *hamam*, to be "hot," to be "burnt," and by supposing that this name of "hot," "burnt," "sunburnt," was given to the son of Noah prophetically with reference to his descendants, Gesenius has tried to establish an agreement between the biblical record and the historical fact. It must be remembered that the descendants of Ham were not all African. The Canaanites and Phœnicians, the Cushites of the Euphrates Valley, a South Arabian race of importance, all were Hamitic. Some of these peoples were closely associated with the Semitic races, and made use of languages essentially Semitic.

Hamadan', the ancient *Ecbatana*, town of Persia, in the province of Irak Ajemee, in lat. 34° 50′ N. and lon. 48° 32′ E. Its location on one of the routes from Bagdad to Erivan, Teheran, and Ispahan, makes it a trading-place of considerable importance; it has many caravanseries and extensive bazaars. The beautiful gardens and orchards which surround it diminish somewhat the dreary aspect of the ruins which cover the ground in the vicinity. Among its most remarkable monuments are the reputed tomb of Mordecai and Esther, and that of Avicenna, yearly visited by crowds of pilgrims. Pop. 50,000.

Hamadry'ads, or **Adry'ads** [plu., Gr. ἁμαδρυάς, ἁμαδρυαδες, or ἀδρυάς, ἀδρυαδες, from δρῦς, an "oak" or any lofty tree], in Greek mythology, the nymphs who were attached to particular trees, with which they came into existence and died. (See DRYADS.) They differed from most other nymphs in not possessing immortality.

Ha'mah, modern Arabic name of HAMATH (which see).

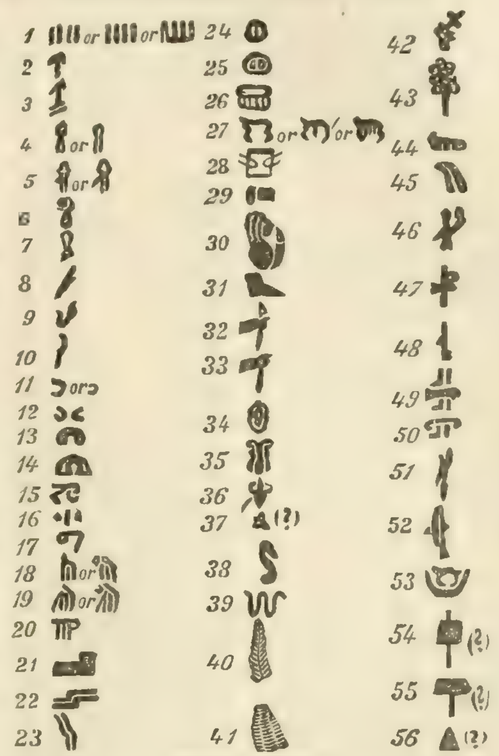
Ha'maker (HENDRIK ARENS), b. at Amsterdam Feb. 25, 1789; studied first the classic languages, then Oriental philology, and was in 1815 appointed professor in Arabic, Chaldæan, and Syriac at the Academy of Francker, whence he removed in 1817 to the University of Leyden. Here he

d. Oct. 10, 1835. He was a very prolific writer and a man of original ideas, but his knowledge was more multifarious than exhaustive, and his representation more striking than accurate. One of his principal works is *Specimen catalogi codicum MSS. orientalium Bibliothecæ academicæ Lugduno-Batavæ* (1820), in which he gives a description of each volume, a *résumé* of its contents, the biography of its author, the manner in which it was acquired, etc. Specially noteworthy among his many other writings are his Punic researches, *Diatribe philologica critica* (1822), *Lettre à M. Raoul Rochette* (1825), *Miscellanea Phœnicia* (1828).

Ha'mann (JOHANN GEORG), b. at Königsberg Aug. 27, 1730. He studied theology, law, philosophy, poetry, and philology in a miscellaneous manner; accepted in 1752 a place as tutor in a noble family in Livonia; changed it next year for another position of the same kind in Courland; entered in 1755 into the service of a commercial house in Riga, and visited on business Berlin, Lübeck, Holland, and England, in which latter country he spent about a year. After 1759 he lived for several years in his father's house in Königsberg in leisure, studying theology and philosophy, but from 1763 to 1787 he held various small offices in the tax department in his native city. In 1787 he was discharged. He then lived alternately in Düsseldorf and Münster, where he d. June 21, 1788, and was buried in the garden of the princess Gallitzin, who resembled him somewhat in mental qualities, and who was brought by him to a belief in Christianity, which became the ruling principle of her life. Their personal acquaintance was but short. In some of his writings, which consisted of small pamphlets or essays published on fly-leaves, he calls himself the "Northern magian," and this has now generally become his title. The public at large took no notice of him. He was in strong opposition to the reigning fashion of enlightenment. The depth of his religious intuitions, the eccentricity of his humor, and the numerous allusions which crowd his pages made him unintelligible to the general reader, but upon men like Herder, Goethe, and F. H. Jacobi he exercised great attraction, and in the subsequent generations all the most prominent minds have studied him with great attention. His writings were collected and published in 8 vols. in Berlin 1821–43 by Roth. (For a description of the character of his mind see the article on GERMAN THEOLOGY.) CLEMENS PETERSEN.

Ha'math [the *Epiphania* of the Greeks and Romans, now called *Hamah*], in Upper Syria, about halfway between Baalbek and Antioch, one of the oldest cities in the world, founded by the youngest (or last named) of the eleven sons of Canaan (Gen. x. 18). The "entrance of Hamath" (Num. xxxiv. 8), named at first as the northern boundary of the Promised Land, was probably the low screen of hills between the sources of the Leontes (*Litany*) and the sources of the Orontes. The small kingdom or province of which Hamath was the capital was in alliance with David and tributary to Solomon, but regained its independence after the revolt of the ten tribes (975 B. C.). Hamath was reconquered and dismantled by Jeroboam II. (823–772 B. C.), and not long afterwards fell under the power of Sennacherib (702–680 B. C.) of Assyria. In 638 A. D. it was taken by the Saracens, and in 1517 came into the hands of the Turks. Under the Arabs it was a place of considerable importance. Aboolfeda, the Arab geographer and historian, was b. there in 1273. The city now has some 40,000 inhabitants, one-fourth of whom are Greek and Jacobite Christians, and the rest Mohammedans, noted for their bigotry and fanaticism. The Orontes (*el-Asy*), spanned at this point by four bridges, divides the city into two parts. Huge Persian water-wheels (*nâ'ûrah*), 70 or 80 feet in diameter, turned by the current, supply the houses and gardens with water. The houses are built of sun-dried bricks and wood. The city keeps up a lively trade with the Bedaween. Recent archæological discoveries have made Hamath famous. In 1812, Burckhardt saw a stone there with "a kind of hieroglyphical inscription" upon it. In 1870 this stone and three others, all of black basalt and similarly inscribed (in relief), were found and examined by the Hon. J. Augustus Johnson, American consul general at Beiroot, and the Rev. Samuel Jessup, American missionary in Syria. Three years later these stones, by order of the Turkish government, were carried to Constantinople. But while in Beiroot, on their way to the capital, casts and squeezes of the inscriptions (five in all) were very carefully taken by Lieut. Steever and Prof. Paine, and fac-similes of the same were published by the American Palestine Exploration Society in 1873. The writing appears to be alphabetic mainly, but no clue has yet been found either to its meaning or its age. (See ROBINSON'S *Later Biblical Researches* (1856); BURTON and DRAKE'S *Unexplored Syria* (1872); and the Palestine Exploration Society's *Second Statement* (Sept., 1873).)
R. D. HITCHCOCK.

Ha'math Inscrip'tions, The. A peculiar kind of hieroglyphic writing has been found at Hamath, Syria, on four inscribed stones, forming what are called the Hamath Inscriptions. They were first mentioned by Burckhardt, but attracted no further attention until Mr. J. A. Johnson, the American consul at Beiroot, rediscovered them in 1870,



Hamath Alphabet.

and obtained imperfect copies. These copies, being published, attracted considerable attention, and two years later the stones, which were built into walls and houses in Hamath, were taken possession of by the Turkish government for the museum in Constantinople. Casts were taken by Prof. J. A. Paine at Beiroot, as stated in the article HAMATH (which see). On three of these stones the inscription, containing about sixty characters, is the same, except that in two places there are three or four variants, perhaps the names of kings. One of the three stones has the end of the lines broken off. The fourth stone begins with very nearly the same inscription, but continues it to a length eight or ten times as great. The characters are arranged in horizontal lines, in tiers of two or three over each other. The lines read *boustrophedon*, the characters being reversed as the direction of the line is reversed. The characters are of various conventional sorts, with some whose forms can be referred to portions of the human body or to weapons. They are about fifty-five in number, and entirely different from any other known hieroglyphic. Besides these Hamath stones another is known to be in Aleppo, not yet correctly copied, and there are in the British Museum a few seals from Nineveh with the same characters. Thus far, no clue has been discovered to their decipherment. The paucity of characters might suggest that they are syllabic, but even this is uncertain. No relation has been established with the Cypriote, Lycian, Assyrian, or any other character. The Hamath character must have had currency over a considerable territory before it was displaced by derivatives of the Phœnician alphabet. How early it was introduced we do not know, but it probably ceased to be employed about the seventh century B. C., when the kingdom of Hamath was destroyed. The seals probably belonged to the later kings of Hamath, of whom we know two, and from their names Lenormant has tried in vain to identify two or three characters. WM. HAYES WARD.

Hamba'to, town of Ecuador, South America, situated on a plateau 8860 feet above the sea. It has a lively trade in wheat, which under the equator can be grown at this elevation, and other products. Pop. 10,000.

Ham'blen, county of East Tennessee, organized since the census of 1870. Area, 130 square miles. It is bounded on the N. W. by Holston River, and is intersected by the

Virginia Tennessee and Georgia and the Cincinnati Cumberland Gap and Charleston R. Rs. Cap. Morristown.

Ham'blin, tp. of Brown co., Ind. Pop. 2011.

Ham'burg, a free city, one of the principal members of the old Hanseatic League, and the most important commercial port of the German empire, is situated on the Elbe, near its entrance into the North Sea. With its district it comprises an area of 158 square miles, with 338,974 inhabitants, of whom 240,251 live in the city and suburbs. Its present constitution dates from Sept. 28, 1860. The legislative power rests with a senate consisting of 18 members, and a municipal council consisting of 192 members; the executive power with the senate alone. The state of finances is as follows:

	Revenues.	Expenses.
1870	5,462,464	5,575,962
1871	5,348,044	5,575,600
1872	5,750,000	6,200,000
1873	6,550,000	6,839,000

At the end of 1871 the public debt amounted to 40,349,223 thalers. The commerce shows importations over sea of the value of 432,240,000 thalers in 1872, against 375,890,000 in 1871, mainly from

	1871.	1872.
Great Britain	243,480,000	255,590,000
United States	20,080,000	27,480,000
West coast of America	15,090,000	19,030,000
Brazil	10,470,000	14,300,000
France	9,870,000	14,700,000
The Netherlands	8,510,000	14,070,000

The value of the importations over land amounted in 1871 to 227,360,000 thalers; that of the total importation in 1871 to 603,450,000 thalers, against 369,640,000 in 1870; 427,860,000 in 1869; 409,020,000 in 1868. The exportations comprised 13,573,284 cwts. in 1872, chiefly to Great Britain, the U. S., the west coast of America, Brazil, and the Netherlands. Of the exportations, 4,928,344 cwts. were in German vessels; 8,644,940 in foreign. In 1872, 5913 sea-going vessels, of 1,387,275 tons burden, arrived, of which 778 vessels, of 327,048 tons burden, belonged to Hamburg. In the same year 5872 sea-going vessels, of 1,383,648 tons burden, cleared, of which 837 vessels, of 322,683 tons burden, belonged to the city. With Lübeck and Bremen, Hamburg furnishes as its military contingent the 75th and 76th (Hanseatic) regiments of infantry.

The city stands in a semicircle on the right bank of the Elbe, the depth of whose waters at high tide allows sea-going vessels not drawing more than 5.5 m. to enter the harbor, while an extensive river-traffic establishes a lively communication with the interior. Hamburg, which formerly was fortified, consists of the old and the new city, the former suburb of St. Georg, situated to the N. E., and the suburb of St. Pauli, situated to the W. Besides the Elbe, it has another small river, the Alster, which, coming from the N., forms within the city a small basin, called Binnen-Alster, and outside of it a larger one, called Aussen-Alster; it traverses the city by two main branches, which communicate by canals with the numerous branches of the Elbe. The harbor presents a grand and interesting aspect. It has recently been considerably enlarged, and is now 5500 m. wide, affording room for 400 sea-going vessels and 400 large and several hundreds of small river-craft. The westernmost part of the harbor is chiefly occupied by English coal-ships and the steamers of the Hamburg-American Steamship Co.; the lower harbor, situated more to the E., and safe against drifting ice, is especially intended for sailing vessels; farther to the E. stretch the Sandthorhafen and the Grasbrookhafen, with fine quays for steamboats. The easternmost part, the Brookthorhafen, the upper harbor and the lumber harbor, consist of shallow basins, and are occupied by lumber-craft and other small vessels coming down the river. The great dépôt belonging to the railway line destined to run through Bremen, Osnabrück, Wesel, and Maestricht to Paris, is situated between the Brookthorhafen and the upper harbor. The railway crosses a branch of the Elbe by an iron bridge above the dépôt, and turns then to the S., towards Harburg, crossing another branch of the Elbe on a second bridge. The Berlin dépôt is situated in the eastern part of the old town, Altstadt.

The best view of the city and the river is from the Elbe Hill, near the harbor. The finest part of the city is the Binnen-Alster, generally called the Alster Basin, and its surroundings. The quadrangular basin, 1750 m. in circumference, is on three sides lined with elegant buildings, among which are the best hotels, and has fine quays planted with trees—Jungfernstieg and Alsterdamm. Boats and small steamers cover the water, and all around is stirring with life. The Alster Pavilion and the Bazar, a trading-hall roofed over with glass, are situated on the Jungfernstieg. The northern side of the basin is formed by a dyke which separates the Binnen-Alster from the Aussen-Alster. Only in the middle is an opening through which the water flows, and which is crossed by the Lombard Bridge. A column with the bust of Prof. Büsch stands to the W. of the bridge; to the E. a statue of Schiller by Lippelt. At the N. E. corner of the Alster Basin, on the Alster Hill, the art-gallery is situated, finished in 1869 after the plans of Schirrmacher and Von der Hude, in Italian renaissance style. The lower story contains sculptures; the upper contains pictures by Calame, Camphausen, Verbockhoven, Vautier, Delaroche, Brendel, and others. The fortifications, extending from the art-gallery to the Berlin dépôt, have been transformed into promenades, and here an iron monument was erected in 1821 in honor of Count Adolph IV. of Holstein. Similar promenades stretch from the other end of the Lombard Bridge to the Elbe Hill and the harbor, separating the city proper from the suburb of St. Pauli, and connecting with the botanical garden, one of the richest in Germany, and with the zoological garden, also a magnificent institution. The new Zollverein dépôt is situated opposite to the zoological garden, an immense structure, covering 50,000 square mètres, and containing storerooms of all kinds, post-office, railway and telegraph stations, etc. Other remarkable buildings are the Bourse, where every noon more than 5000 men gather together, and which contains a commercial library of 40,000 volumes; the bank; the Nicolai church, built in 1842 after the plan of Gilbert Scott of London; the Catharine church, containing a remarkable altar and fine glass paintings; the Grosse Michaelis church, built in the middle of the eighteenth century; the Johanneum, containing a library of 250,000 volumes and 5000 manuscripts; and the Thalia theatre, built in 1842, in the renaissance style. The vicinity of Hamburg, especially the right bank of the Elbe, is covered with fine villas, beautiful promenades, and charming villages, such as Blankenese, Flottbeck, and others.

It is probable that Hamburg originated from one of the castles which Charlemagne built against the Slavi, and more especially from the so-called Gammerburg. In 831 it was made a bishopric, and in 834 an archbishopric, although at that time it was only a miserable fishing-village. In 980 it had grown into a small town, but in that year it was destroyed by the Obotrites. In 1215 it was made a free city by the emperor Otho IV., but in 1223 it was taken by the Danish king Knut VI. His son Waldemar sold it for 700 marks silver to the count of Schaumburg-Orlamunde, and he sold it again for 1500 marks silver to the citizens. Thus, Hamburg again became a free city. It chose Count Adolph IV. of Holstein for its patron, and he protected it successfully against the Danes, leaving it all its rights and conferring many benefits on it. In 1242 it made a covenant with Lübeck, by which the foundation was laid for the Hanseatic League, to which Hamburg owes much of its commercial importance and all of its political influence. After the fall of the league it still increased, and it lived through the Thirty Years' war without seeing a foreign soldier within its walls. After a series of internal disturbances, caused by the jealousy between the senate and the citizens, it formed a new constitution in 1712, and in 1770 it acquired a vote in the German diet. Its commerce increased immensely during the North American war of independence, as Great Britain allowed neutral vessels free entrance to the colonies. On Dec. 13, 1810, it was incorporated into France; and suffered very much during the sieges of 1813 and 1814. In 1842, by a terrible conflagration, 4219 houses were burnt. In 1867, Hamburg became a member of the North German Confederation, and in 1871 of the German empire.

August Niemann.

Hamburg, post-v., county-seat of Ashley co., Ark.

Hamburg, tp. and post-v. of Calhoun co., Ill., on the Mississippi River, 90 miles S. W. of Springfield. Pop. 707.

Hamburg, post-v. of Fremont co., Ia., on the Chicago Burlington and Quincy and the Kansas City St. Joseph and Council Bluffs R. Rs. It has 2 newspapers, 2 flour-mills, 1 foundry, 5 churches, 7 schools. Pop. 1431.

W. A. Putney, Ed. "Times."

Hamburg, tp. and post-v. of Livingston co., Mich. Pop. of v. 81; of tp. 907.

Hamburg, post-b. of Berks co., Pa., on the Philadelphia and Reading R. R., the E. bank of the Schuylkill River, and at the foot of the Blue Mountain. It has 1 rolling-mill that turns out 300 tons of iron per week, 1 building and savings association, 2 savings banks, 2 foundries, 2 steam-mills, 5 churches, 1 high and several graded schools, 1 German newspaper, 1 broom-factory, 6 hotels. The South Mountain R. R., now in course of construction, will pass through the town. Pop. 1590.

M. P. Doering, Ed. "Hamburger Schnellpost."

Hamburg, tp. of Edgefield co., S. C. Pop. 1120.

Hamburg, tp. of Vernon co., Wis. Pop. 1208.

Ham'burgh, post-tp. of Erie co., N. Y., on Lake Erie,

and on the Lake Shore R. R., 10 miles S. of Buffalo, N. Y. It contains several villages, and has important manufactures. Pop. of tp. 2361.

Ham'den, post-tp. of New Haven co., Conn., the next town N. of New Haven. It is bounded on the E. by Quinnipiac River, and contains several manufacturing villages. It is traversed by the New Haven and Northampton R. R. Pop. 3028.

Hamden, tp. and post-v. of Delaware co., N. Y., on the Delaware River and on the Delhi branch of the New York and Oswego Midland R. R. The township is mountainous, but has important manufactures. Pop. of v. 155; of tp. 1762.

Hamden, a v. of Clinton tp., Vinton co., O., on the Marietta and Cincinnati R. R., at the junction of the Portsmouth branch, 127 miles E. of Cincinnati. (P. O. Reed's Mill, Vinton co., O.) Pop. 364.

Ha'meln, town of the German empire, in Hanover, on the Weser, which here is crossed by a chain bridge 780 feet long. It has a very interesting aspect of antiquity with its walls and towers, and with its houses ornamented with wood-carving and their gables turned towards the streets. It has large breweries and tobacco manufactures. P. 8530.

Ha'mer, tp. of Highland co., O. Pop. 959.

Hamer (Thomas L.), b. in Pennsylvania; removed at an early age to Ohio, where he studied and practised law, and was elected a member and Speaker of the State legislature; also member of the House of Representatives 1833–39. During the war with Mexico he served as major of Ohio volunteers until appointed brigadier-general, July 1, 1846, distinguishing himself at Monterey, where he succeeded to the command of Butler's division after that officer was wounded. D. at Monterey Dec. 2, 1846. To communicate its regret at his loss, Congress voted a sword to be presented to his nearest male relative. G. C. Simmons.

Ha'mersville, post-v. of Brown co., O., in Clark tp. Pop. 151.

Ham'erton (Philip Gilbert), b. at Manchester, England, Sept. 10, 1834, of an old family of the N. of England; devoted himself to landscape-painting, living much in the wildest parts of Scotland; married a French lady in 1859, and has since lived chiefly at Autun; has brought forward a new process for etching; but his devotion to literature has interfered with his success as an artist. Author of *Observations on Heraldry* (1851); *Isles of Loch Awe* (poems, 1855); *Painter's Camp in the Highlands* (1862); *Thoughts about Art* (1862); *Etching and Etchers* (1866); *Contemporary French Painters* (1867); *Etcher's Handbook* (1868); *Wenderholme* (a novel, 1869); *The Unknown River* (1870); *The Intellectual Life* (1873); *Chapters on Animals* (1873); and several other volumes, besides many fugitive pieces, etc.

Hamil'car was the name of several Carthaginian generals, but the most celebrated of them was Hamilcar Barca ("lightning"), the father of Hannibal. While yet very young he was appointed commander of the Carthaginian army in Sicily (247 B. C.) during the first Punic war. At this time the Romans had nearly succeeded in driving the Carthaginians from the island, but when Hamilcar received the command fortune turned. He took up his position first at Mount Hercte, then at Mount Eryx, and from these points he steadily extended his sway. But in 241 B. C. the Carthaginian fleet was totally defeated off the Ægates Islands. Hamilcar was called back to Africa to defend the mother-city; peace was concluded shortly after, and Carthage lost Sardinia and Sicily. In order to procure for his native city another empire as profitable, and form a basis of operations from which Rome herself could be attacked, he entered upon his Spanish campaigns in 236 B. C. He was eminently successful, and had brought the whole southern and eastern part of Spain under Carthaginian rule when he was killed in a battle against the Vettones, in 228 B. C.

Ham'ilton, town of Scotland, in the county of Lanark, on the Clyde, 11 miles S. E. of Glasgow. Close by is Hamilton Palace, a fine building in the midst of extensive pleasure-grounds and containing a fine collection of pictures. Pop. 11,496.

Hamilton, a flourishing city and port of entry, cap. of Wentworth co., Ontario, Dominion of Canada, on the Great Western Railway, 40 miles S. W. of Toronto and 43 miles W. N. W. of the Suspension Bridge, on Burlington Bay, the western extremity of Lake Ontario. The bay constitutes a noble and capacious harbor, connected with the main lake by Burlington Bay Canal. The Desjardins Canal, a deepened channel, leads to the thriving town of Dundas. Hamilton has 5 branch banks, a board of trade, 25 churches, 10 athletic and sporting clubs, a fine system of public schools, Roman Catholic schools, a business college, an industrial school, a public library, a female college, a grammar school, a convent, a mechanics' institute, 8 Masonic bodies, 6 Odd Fellows' lodges, 2 daily, 3 weekly, and 3 monthly periodicals, 1 agricultural and 1 horticultural society, 6 benevolent associations, 2 literary societies, a hospital, a deaf and dumb asylum, a female home, 2 orphan asylums, a house of refuge, 2 Christian associations, and a Bible society. The city has excellent water and gas works, a large trade, and manufactures of machinery, iron goods, paper, sewing-machines, carriages, brushes, glass, gunpowder, soap, lumber, etc. It is called the "Ambitious City," and is a place of great enterprise and thrift. It is divided into five wards, and has a Roman Catholic bishop. Pop. in 1871, 26,716.

Hamilton, county of Florida, bounded on the N. by Georgia. Area, 400 square miles. It has extensive forests of pine timber and large swamps. Cotton and corn are staple products. It is intersected by the Florida division of the Atlantic and Gulf R. R. Cap. Jasper. Pop. 5749.

Hamilton, county in the S. E. of Illinois. Area, 432 square miles. It contains both timber and prairie land, and is fertile. Cattle, grain, tobacco, and wool are staple products. Woollen goods and carriages are leading manufactures. The county is traversed by the St. Louis and South-eastern R. R. Cap. McLeansboro'. Pop. 13,014.

Hamilton, county of Central Indiana. Area, 400 square miles. It is very fertile, and is partly level and partly undulating. Cattle, grain, and wool are staple products. Flour, lumber, carriages, and brick are leading articles of manufacture. It is traversed by the Indianapolis Peru and Chicago R. R. Cap. Noblesville. Pop. 20,882.

Hamilton, county in N. Central Iowa. Area, 576 square miles. It is undulating and fertile. Grain is the leading product. Coal is mined in the county. It is traversed by the Iowa division of the Illinois Central R. R. Cap. Webster City. Pop. 6055.

Hamilton, county of S. Central Nebraska. Area, 576 square miles. The surface is rolling and adapted to pasturage. The N. W. part is traversed by the river Platte and the Union Pacific R. R. Cap. Orville. Pop. 130.

Hamilton, county of N. E. Central New York. Area, 1745 square miles. It is a part of the great northern wilderness of New York, is rocky and mountainous, and chiefly covered by forests. It abounds in lakes and streams. Some of the valleys are productive. Peat, iron ore, limestone, sandstone, and graphite are found. Cap. Sageville. Pop. 2960.

Hamilton, the south-westernmost county of Ohio. Area, 390 square miles. It is the most populous county in the State. It is undulating, fertile, and well cultivated. Grain, fruits, dairy products, and live-stock are the great staples. The manufactures are very extensive and embrace nearly all kinds of goods. (See art. Cincinnati.) The county has extensive commerce by rail and river. It is traversed by numerous railroads. Capital, Cincinnati. Pop. 260,370.

Hamilton, county of Tennessee, bounded S. by Georgia. Area, 520 square miles. The surface is in part broken by spurs of the Cumberland Mountains. The soil is productive. Wheat and corn are staple products. Coal and iron abound, and iron is manufactured. The county is traversed by the navigable Tennessee River and by the railroads centring at Chattanooga, the capital. Pop. 17,241.

Hamilton, county of N. W. Central Texas. Area, 825 square miles. It is a fine rolling prairie region, well watered and timbered, and abounding in good building-stone. The soil is fertile. The chief products are live-stock, wool, and hides. Cap. Hamilton. Pop. 733.

Hamilton, tp. of Prairie co., Ark. Pop. 582.

Hamilton, tp. of Butte co., Cal., on Feather River. Pop. 1130.

Hamilton, post-v., cap. of Harris co., Ga., 22 miles N. of Columbus and 3 miles from the North and South R. R. It has an academy, a female college, a newspaper, 2 churches, and a hotel. P. 359. D. W. D. Boully, Pub. "Visitor."

Hamilton, tp. and post-v. of Hancock co., Ill., on the Mississippi River, opposite Keokuk, Ia., and at the foot of the Des Moines Rapids, is on the Toledo Peoria and Warsaw and the Keokuk branch of the Toledo Wabash and Western R. R. It has a monthly paper, 4 churches, good common schools, a flouring and a saw mill, a basket-factory, wagon and plough factories, and an immense water power, unimproved. The river is here crossed by a railroad bridge. In the midst of an excellent fruit-region. Pop. of tp. 1019. Th. Gregg, Ed. "Dollar Monthly."

Hamilton, tp. of Lee co., Ill. Pop. 186.

Hamilton, tp. of Delaware co., Ind. Pop. 1129.

Hamilton, tp. of Jackson co., Ind. Pop. 1565.

Hamilton, tp. of Sullivan co., Ind. It contains Sullivan, the county-seat. Pop. 3759.

Hamilton, tp. of Decatur co., Ia. Pop. 846.

Hamilton, tp. of Hamilton co., Ia. Pop. 546.

Hamilton, post-v. of Liberty tp., Marion co., Ia. P. 133.

Hamilton, post-tp. of Essex co., Mass., on the Eastern R. R., 24 miles N. E. of Boston. It is a good agricultural town, has manufactures of woollen goods, and a celebrated camp-meeting ground, known as Asbury Grove, owned by members of the Methodist Episcopal Church. Pop. 790.

Hamilton, tp. of Gratiot co., Mich. Pop. 294.

Hamilton, tp. of Van Buren co., Mich. Pop. 1172.

Hamilton, a v. of Houston co., Minn. Pop. 50.

Hamilton, post-v. and tp. of Caldwell co., Mo., 50 miles E. of St. Joseph, on the Hannibal and St. Joseph R. R. It has a bank, a newspaper, 5 churches, 3 hotels, stores, machine-shops, flouring-mills, etc. It is the centre of a fine agricultural section, and is an important point for shipping cattle, horses, hogs, and grain. Pop. of v. 975; of tp. 1658.
M. A. Low, Ed. "News."

Hamilton, post-v., cap. of White Pine co., Nev., 120 miles S. of Palisade, which is on the Central Pacific R. R. It has a bank, a Wells, Fargo & Co. express office, and 1 newspaper. Principal business, quartz silver-mining, in connection with which there are 7 mills, containing 122 stamps, and capable of crushing 150 tons of rock per day of 24 hours. The product of silver bullion during four years ending Jan. 1, 1874, has been nearly $9,000,000 in value. In the immediate vicinity are numerous "ranches" or farms, which produce hay and grain. Immense herds of live-stock are dispersed over the valleys during summer and winter, finding abundant feed the entire year. Pop. of tp. 3915. Fred. Elliott, Ed. "White Pine News."

Hamilton, tp. of Atlantic co., N. J. It contains May's Landing, the county-seat. Pop. 1271.

Hamilton, tp. of Mercer co., N. J., on the Delaware River, just below Trenton. It is traversed by several divisions of the Pennsylvania R. R., and has a very fertile soil. Pop. 5417.

Hamilton, post-v. and tp. of Madison co., N. Y., about 30 miles from Utica, on the Chenango Canal and the Utica Chenango and Binghamton R. R. It is the seat of Madison University, Hamilton Theological Seminary (Baptist), Colgate Academy, Hamilton Female Seminary, and a union graded school. It has a very fine park, 5 churches, 1 national bank, 2 weekly newspapers and a semi-monthly college paper, 1 foundry, a large coffin and burial-casket manufactory, a large wagon-works, a sash, blind, and door manufactory, etc. The tp. also contains Earlville, East Hamilton, Hubbardsville, and Poolville (which see). Pop. of v. 1529; of tp. 3687. Ed. "Democratic Republican."

Hamilton, tp. and post-v. of Martin co., N. C., on the S. bank of the Roanoke River. Large vessels can ascend to this point. Pop. of v. 200; of tp. 3957.

Hamilton, city, cap. of Butler co., O., on either bank of the Great Miami River, 25 miles N. of Cincinnati. The Cincinnati Hamilton and Dayton, Cincinnati and Indianapolis, Cincinnati Richmond and Chicago, and the Atlantic and Great Western R. Rs. and the Miami and Erie Canal pass through it. The river and canal afford unlimited water-power for manufacturing purposes. A railroad to connect the Cincinnati and Indianapolis road at this point with the Little Miami road at Morrow will soon be built, which will bring this city within easy reach of the Ohio coal fields. The city is a large manufacturing centre, and one of the largest exhibitors at the Industrial Exposition annually held at Cincinnati. Among its industries is a manufactory of railroad supplies; 1 of punches, reapers, mowers, etc.; 1 of engines, threshers, etc.; 1 of wood-working machinery, a plough company, and the variety works. A large capital is invested in sash, wood-bending, branduster, coinage, and other factories. There are 6 paper-mills, each representing about $50,000 capital; 1 woollen and 5 flouring mills, 2 national banks, 1 local insurance company and 32 agencies, a board of trade, a paid fire department and an electric fire-alarm telegraph, a projected street railway, 7 building associations with a capital of $2,225,000, 4 weekly newspapers, 21 corporations, 12 churches, 13 benevolent societies, and 2 parks. Pop. 11,081. F. H. Scobey, Ed. "Telegraph."

Hamilton, tp. of Franklin co., O. Pop. 1827.

Hamilton, tp. of Jackson co., O. Pop. 1108.

Hamilton, tp. of Lawrence co., O. Pop. 1108.

Hamilton, tp. of Warren co., O., on the Little Miami River and R. R. Pop. 2466.

Hamilton, tp. of Adams co., Pa. Pop. 1118.

Hamilton, tp. of Franklin co., Pa. Pop. 1630.

Hamilton, tp. of McKean co., Pa. Pop. 120.

Hamilton, tp. of Monroe co., Pa. Pop. 1892.

Hamilton, tp. of Tioga co., Pa., contains the villages of Blossburg and Morris Run, is traversed by the Tioga R. R., and has important mines of semi-bituminous coal.

Hamilton, tp. of Darlington co., S. C. Pop. 1814.

Hamilton, tp. of Cumberland co., Va. Pop. 2990.

Hamilton, post-v. of Loudoun co., Va., is the present terminus of the Washington and Ohio R. R., 40 miles W. from Washington City. It contains the usual number of stores and manufacturing establishments, has 2 weekly newspapers, a fine Masonic hall, the Virginia Normal Institute, and there are several churches in the town and immediate vicinity. It is a great resort for visitors from Washington during the summer months. Pop. about 500.
S. B. Mercier, Ed. "Loudoun Enterprise."

Hamilton, tp. of La Crosse co., Wis. Pop. 2261.

Hamilton (Alexander), b. in Nevis, an island of the West Indies, Jan. 11, 1757. His father was from Scotland; his mother, whose maiden name was Faucette, was of Huguenot stock. His father failed in business, and his mother died while her son was but a child. He was sent to the mother's relatives in Santa Cruz, where in 1769 he became a counting-house clerk of Mr. Nicholas Cruger; but on his discovering some literary taste, he was sent in 1772 to a grammar school at Elizabethtown, N. J. In 1773 he entered King's (now Columbia) College. In 1774 his speeches, pamphlets, and newspaper articles on the political affairs of the day won the applause of the people. In 1776 he received a captain's commission in the artillery, and served with honor in the army of Washington, whose aide-de-camp he became in 1777 with the rank of lieutenant-colonel. In this capacity he was employed by the commander in the most delicate and important trusts. In 1780 he married Eliza, a daughter of Gen. Schuyler. In 1781 he resigned his commission in consequence of a rebuke received from Gen. Washington. He next received command of a New York battalion of light infantry, of which he was lieutenant-colonel, and at the battle of Yorktown he served at its head with much distinction. He afterwards studied law, was a member of Congress (1782–83 and 1787–88), and served in the convention which drew up the Federal Constitution. He was the principal author of the papers afterwards called collectively *The Federalist;* was (1789–95) the first secretary of the U. S. treasury, and as such was the author of the funding system, the founder of the U. S. bank, and restorer of public credit. He afterwards had some share in the preparation of Washington's farewell address. He was at about this time involved in personal and political controversies with Jefferson and Monroe; but subsequently, when the House of Representatives was called upon to choose between Jefferson and Burr for the Presidency, he used his powerful influence for the former. In 1798, during the troubles with France, he was made inspector-general of the army with the rank of major-general, and was for a short time in 1799 commander-in-chief. In 1800 he was chosen president-general of the Cincinnati. He declined the chief-justiceship of the U. S. In 1804, when Aaron Burr unsuccessfully sought the governorship of New York, he was opposed earnestly, though not actively, by Hamilton, to whose influence Burr ascribed his defeat. Burr, smarting under his supposed injuries, challenged Hamilton; and the latter, though repudiating the code as barbarous and wrong in principle, accepted the challenge. The parties met at Weehawken, N. J., July 11, 1804. Hamilton declined to fire at his adversary, but at Burr's first fire was mortally wounded, and died on the following day. In person, Hamilton was thin, small, and erect, graceful and courtly in manners, aristocratic and reserved in social habits. Exceedingly able and industrious in public affairs, a ready and pleasing speaker, a strong and influential writer, his share in the settlement of the financial and other difficulties which early beset the republic was great and important. Far enough was he removed in his opinions and tastes from the democratic spirit of Jefferson and Madison; and it is probable that the antagonism of the two principles was necessary to the growth of a good government—one neither a central despotic power, nor a loose and weak association of separate communities, with no powers at all as a whole. (See his *Life,* by J. Renwick (1841); by his son, John C. Hamilton (1834–40); Hamilton's complete *Works* (7 vols., 1851).)
Chas. W. Greene.

Hamilton (Andrew), a merchant of Edinburgh; became deputy governor of New Jersey in 1686; was taken prisoner by the French in 1689; became deputy postmaster for the colonies in 1692; governor of East and West Jersey 1692–98 and 1699–1701; deputy governor of Pennsylvania

1701–03. D. at his residence, Amboy, N. J., Apr. 20, 1703. He was one of the proprietors of East Jersey.

Hamilton (ANDREW JACKSON), b. in Madison co., Ala., Jan. 28, 1815, the son of a farmer. He became clerk of the circuit court for the county, subsequently merchant, and then a lawyer. In 1846 he removed to Texas, where he was made attorney-general, besides holding other public positions. He was (1859–61) a member of Congress, and during the civil war actively supported the Federal government, and was made a brigadier-general of volunteers; was military governor of Texas 1862–65; provisional governor 1865–66; and afterwards one of the associate justices of the State supreme court. D. Apr. 11, 1875.

Hamilton (CHARLES S.), b. in New York Nov. 16, 1822; graduated at West Point, entered the army as brevet second lieutenant of infantry 1843, second lieutenant 1845, first lieutenant 1847; served with distinction in the Mexican war; brevetted captain for Contreras and Churubusco; severely wounded at Molino del Rey; subsequently on frontier duty till 1853, when he resigned and engaged in farming in Wisconsin. On the outbreak of the civil war he was appointed (May 11, 1861) colonel 3d Wisconsin Vols.; promoted to be brigadier-general of volunteers six days later, and major-general Sept., 1862. Served in Virginia during the siege of Yorktown, May, 1862, when he was transferred to Mississippi and commanded a division at Iuka and Corinth; subsequently in command of the left wing of the Army of Tennessee and of the 16th corps. Resigned Apr., 1863, since which time he has been engaged as a manufacturer at Fond du Lac, Wis. G. C. SIMMONS.

Hamilton (ELIZABETH), b. at Belfast, Ireland, July 25, 1758; was long a governess in Scotland. Author of *Letters of a Hindoo Rajah* (2 vols., 1796), *Memoirs of Modern Philosophers* (3 vols., 1800), *Letters on the Elementary Principles of Education* (2 vols., 1801–02), *Letters on the Formation of Religious and Moral Principles* (2 vols., 1806), *Cottagers of Glenburnie* (1808), *Rules of the Annuity Fund* (1808), *Exercises in Religious Knowledge* (1809), *Life of Agrippina* (2 vols., 1811), *Popular Essays on the Understanding*, etc. (2 vols., 1815), *Hints to Patrons of Schools* (1815). D. at Harrowgate July 25, 1816. (See her *Life*, by MISS BENGER, 2 vols., 1818.)

Hamilton (JAMES), b. about 1710, was a son of Andrew Hamilton of Philadelphia (d. 1741); was deputy governor of Pennsylvania for the proprietors 1748–54 and 1759–63; president of the council and acting-governor in 1771; was an able officer and royalist. D. in New York Aug. 14, 1783.

Hamilton (JAMES), b. at Charleston, S. C., May 8, 1786, was the son of Maj. James Hamilton of Washington's staff. The younger Hamilton received a good education, became a lawyer, served as a major in the war of 1812, and was for some years mayor of Charleston, besides holding other public offices. In 1822 he detected the conspiracy of Denmark Vesey. As a member of Congress (1822–29) he earnestly advocated State rights, free trade, direct taxes, and armed resistance to the tariff of 1828. As governor of South Carolina (1830–32) he recommended the passage of the Nullification act. He was afterwards made major-general commanding the State troops, and was later the minister plenipotentiary from Texas to the European powers. He was in 1857 elected from Texas to the U. S. Senate. On Oct. 15, 1857, he was drowned off the coast of Texas by the collision of the steamers Opelousas and Galveston, giving up, with characteristic manliness, his only chance of safety to a lady he had never seen before. He was active in commercial and literary enterprises, and declined the secretaryship of war and the post of U. S. minister to Mexico, both tendered him by Gen. Jackson.

Hamilton (JEFFERSON), D. D., b. in Ward, Worcester co., Mass., Aug. 23, 180[illegible]; educated and brought into the ministry of the Methodist Episcopal Church by Wilbur Fisk, D. D.; joined the New England conference May, 1831; preached four years in Hull, Randolph, Salem, and Boston; was transferred in 1836 to New Orleans on account of asthma, and in 1839 to the Alabama conference, in which he labored with almost unexampled zeal and success at Mobile, Montgomery, Tuscaloosa, and other places as pastor and presiding elder; acted as secretary of the Tract Society of the Methodist Episcopal Church, South, 1855–58. He was a member of the General Conference in 1844, in which measures were taken for the division of the Church; was a member of the Louisville convention at which the Methodist Episcopal Church, South, was organized, and of every General Conference till his death, Dec. 16, 1874, at Opelika, Ala. T. O. SUMMERS.

Hamilton (JOHN CHURCH), b. in Philadelphia in 1792, was a son of Alexander Hamilton; graduated at Columbia College; became a lawyer; was an aide on the staff of Gen. Harrison in the war of 1812–15. Author of *Memoirs of Alexander Hamilton* (2 vols., 1834–40), *History of the Republic as traced in the Writings of Alexander Hamilton* (2 vols., 1850–58), and edited his father's *Works* (7 vols., 1851).

Hamilton (SCHUYLER), a son of John Church Hamilton (b. 1792), and a grandson of Gen. Alexander Hamilton. Schuyler Hamilton was b. at New York July 25, 1822, and graduated at West Point in 1841. In the Mexican war he was twice wounded—once at Monterey, and again near Milflores, while in command of a scouting-party, with which he fought desperately a superior force. He was (1847–54) an officer on the staff of Gen. Scott. In 1855 he resigned and removed to Branford, Conn. In 1861 he enlisted as a private in the 7th New York, but soon received a commission; became in 1861 a colonel and afterwards a brigadier-general of volunteers; in 1862 major-general of volunteers. He took a prominent part in the actions at New Madrid, Mo., and Island No. 10. He resigned from the service in 1863. He published in 1853 a *History of the National Flag*.

Hamilton (Sir WILLIAM), BART., b. in Glasgow, Scotland, Mar. 8, 1788. He was the elder of two sons of Dr. William Hamilton, professor of anatomy and botany in the University of Glasgow. The only brother of Sir William was Capt. Thomas Hamilton, who served for a time in the British army. Having been severely wounded in the Peninsular war, Capt. Hamilton retired on half-pay and became a literary man. He was a frequent contributor to periodical literature. He was author of *Cyril Thornton*, a novel, and a book of travels in America. Sir William Hamilton belonged to an ancient Scotch family, several members of which are distinguished either in Church or State. One of these, Sir Robert Hamilton, was the commander of the Covenanters at Drumclog and Bothwell Bridge. (See Scott's notes to *Old Mortality*.) In 1603 the head of the family was made a baronet, but the family estate having been lost, the title had been in abeyance for nearly a century before Sir William's time, no one caring to claim the title. In 1816, Sir William made good his claim to it in the Scottish courts. From 1803 to 1806, Hamilton attended the yearly sessions of the University of Glasgow. In 1807 he entered Balliol College, Oxford, on the Snell foundation. This endowment was made for the education of students of Scottish birth, and it is worthy of remark that it secured the intellectual training (in addition to many others) of Adam Smith and Sir William Hamilton. Hamilton graduated at Oxford in 1810 with unprecedented honor, both for the extent of his reading and the difficulty of the authors which he presented for examination. Up to the time of his leaving Oxford he had been destined for the medical profession, and had made considerable progress in anatomical and physiological studies. Soon after this time, however, he decided upon the study of law, and in 1813 passed his examination as an advocate. In 1817 he visited Germany, and again in 1820. These visits seem to have laid the foundation of his taste for German literature. He does not seem to have been eminently successful as an advocate, and in 1820 he became a candidate for the chair of moral philosophy in the University of Edinburgh, made vacant by the death of Dr. Thomas Brown. Dugald Stewart up to that time had been the legal occupant of the chair, but by an arrangement between the two, Dr. Brown had for some time discharged its duties, on account of the age and infirmities of Mr. Stewart. At the death of Dr. Brown, Stewart resigned. The selection of the candidate was in the hands of the town council of Edinburgh. The rival candidate of Hamilton was John Wilson, author of the *Isle of Palms* and the dashing Tory editor of *Blackwood's Magazine*. There was no question of the immense superiority of Hamilton's learning and philosophical capacity, but the town council had a Tory majority, and the author of the *Noctes Ambrosianæ* was elected to the chair. Mar. 7, 1821, Hamilton was elected by the Faculty of Advocates professor of civil history in the University of Edinburgh. The salary attached to the chair was £100 a year, and as this was dependent upon a local duty on ale and beer, it was irregularly paid. As attendance upon this chair was not required for an academic degree, no previous occupant had formed a regular class. Hamilton, however, prepared a course of lectures on the modern history of Europe down to the period of the French Revolution, and secured classes from thirty to fifty in number. The topics which he discussed are strikingly analogous to those selected by Guizot in his lectures on European civilization. In 1826 he read a paper before the Royal Society of Edinburgh on phrenology, which had found strenuous advocates in Scotland under the leadership of George Combe. This was followed by another paper in 1827, and by a controversial correspondence with Mr. Combe, on the subject. In preparation for these papers he dissected a great number of brains, and made detailed examinations of the whole

subject, which he published from 1831 to 1850. Sir William says that his tables gave the results of an examination extended to 1000 brains of 50 species of animals—a wider examination "than had hitherto been instituted by any professional physiologist." In Oct., 1829, he wrote for the *Edinburgh Review* his celebrated criticism of Cousin's *Cours de Philosophie*, under the general title of the "Philosophy of the Unconditioned." This was followed in 1830 by his criticism of Brown; in 1831 by his discussion of the authorship of the *Epistolæ Obscurorum Virorum*, and by two articles on the state of the English universities. In 1832 he wrote his articles on the revolutions of medicine and on Johnson's translation of Tennemann. From 1833 to 1836 he wrote five articles upon general and professional education. In 1836 the chair of logic in the University of Edinburgh became vacant, and Hamilton presented himself as a candidate. His two principal opponents were Isaac Taylor, the author of the *Natural History of Enthusiasm*, and George Combe, the phrenologist. After an exciting canvass he was elected by a majority of two. In 1846 he published his edition of the works of Reid. In 1856 he completed his edition of the works of Dugald Stewart. It was his intention to add to this edition a memoir of Stewart, but he did not live to complete it. He continued to lecture till Apr., 1856. Although he had been struck by paralysis in 1844, his intellectual capacity continued unabated to the last. He d. May 6, 1856. M. B. ANDERSON.

Hamilton's (Sir William) Philosophy. For a man of so much practical power, the life of Hamilton was singularly quiet and unmixed with public life. Though he lost his election to the chair of moral philosophy by his unwillingness to avow himself a Tory, he never seems to have obtained any status among the Whig littérateurs of Edinburgh, or to have ever rendered any service to the party. His life was pre-eminently that of a scholar. The type of his scholarship was analogous to that of Erasmus and the Scaligers. He was so accurately trained in those languages which contain the world's thought that his industry was made in the highest degree available for the accumulation of knowledge. The range of his reading in literature was enormous. But beyond the subjects of anatomy and physiology his knowledge of physical science was not remarkable. But in all those branches of literature in any way connected with education, logic, or metaphysics his learning was equal, if not superior, to that of any man of his time; and he attempted minute investigation in every subject he undertook to study. This was his weakness, for upon so great variety of subjects special and minute learning is simply impossible for any human mind. He was unfortunately excitable and dogmatic, and when aroused by controversy, of which he was naturally fond, he was sometimes betrayed into statements which were erroneous or not well considered. The exaggerated estimate of his learning made by partial friends exposed him to the criticism of specialists, which was the more severe because of the extravagant claims made on his behalf. To sustain his arguments against religious tests in Oxford, he was led incidentally to attack Luther as having authorized in his speech and writings much of the heterodoxy of modern Germany. In the heat of this controversy his remarks were sweeping, bitter, and intense to such a degree that they furnished a presumption against their justice. The criticism of J. C. Hare, first published in his notes to the work entitled *The Mission of the Comforter*, met Sir William in all his weak points. He evidently trusted to his own general knowledge and to isolated extracts made by Luther's enemies as authority for assertions which a careful study and fair interpretation of Luther's works failed to justify. This controversy seems to have led Sir William to the detailed study of Luther's writings and the history of his times, with the view to the publication of a life of the great Reformer. Although much valuable time was spent upon the subject, and an immense amount of material accumulated, the life of Luther was never finished, and he appears to have left nothing among his papers in a condition fit for publication. This leads us to note another peculiarity of Sir William's mind. He seems never to have been willing to give the results of his own reflection upon any subject in a systematic form without previously studying the entire literature of the subject. He often exhausted his powers of production in the process of accumulating materials, and as a consequence has left no coherent systematic treatises which adequately represent either his learning or his power of thought. His mind was critical and dialectic, rather than constructive. He approached every subject from the point of view of an intellectual gladiator. This attitude of mind, connected with great power for clear and vigorous expression, renders his writings stimulating and suggestive almost without parallel. For the same reason they do not furnish safe guidance to a learner or to a person untrained in the processes and history of speculative thought. He manifestly had a constitutional dislike to regular and systematic composition. His works are all comparatively incomplete and fragmentary. In fact, with a partial exception in favor of his lectures on logic, his works are a series of magnificent torsos, grandly suggestive of range of learning and intellectual power. Like the unfinished statues of *Day* and *Night* by the great Florentine sculptor, Hamilton's works excite in the mind profound regret that they were never finished. Even his edition of Reid breaks off in the middle of a sentence. Though this unfinished work was published many years before his death, he could never be induced to complete it. An insatiable curiosity led him continually into the byways of literature, and caused him to waste valuable time in the critical reading of books whose contents had ceased, by the growth of thought, to have any present value. An illustration of this is found in his extensive study of modern Latin poetry, and his critical and out-of-the-way reading of the controversial literature of the period of the Reformation. His monograph upon the authorship of the *Epistolæ Obscurorum Virorum* is a proof of his accomplishments in this literature. His controversial tracts on education show a marvellous familiarity with the university system of modern Europe.

In the department of logic he awakened an interest which has steadily increased to the present time. In the reaction against the authority of Aristotle which marked the period of the Renaissance a prejudice was excited against the works of that great thinker which was unintelligent and undiscriminating. In Scotland this reaction took the form of opposition to the study of logic in any vigorous or systematic form. Though it formed a part of the Oxford curriculum, the subject was studied through meagre and inadequate manuals totally deficient in breadth of view and range of application. Whately's *Elements of Logic* was published in 1826, ten years before Hamilton's accession to his chair in the University of Edinburgh. This work furnished an intelligible, though not a profound, manual for instruction, but it aroused no deep and powerful interest in the subject. Hamilton's review articles and his lectures to his classes created a new epoch in the study of logic in Great Britain. The publication of his lectures since his death opened up an immense range of logical literature, illustrated the history of the science, and vindicated its uses as a means of academic discipline and as a test of right thinking in all departments of human inquiry. The actual advances in logical science due to Hamilton are not easily estimated. He never fully developed the doctrines which he claimed as new, and possibly overrated their importance. He certainly simplified logical processes by his quantification of the predicate and extending the possible significance of the copula. This has enabled teachers of logic to dispense with the cumbrous apparatus of figures and the complicated terminology which they involved. It is in great part due to the impulse which he communicated and left behind him that so many able and vigorous works have been written on the subject since his death. It may be safely said that in knowledge of the literature of the subject, in grasp of its principles, and in the impulse which his instructions gave to its study, Hamilton stands without a peer in the literature of Great Britain, and possibly in that of modern Europe.

The relations of Sir William Hamilton to psychology also are not easily defined. In his lectures and in the supplementary dissertations to his edition of Reid and his review articles he has left on record a great amount of acute discussion and profound remark, illustrated by an immense range of philosophical learning. These hold a distinguished place among the contributions which the present century has made to psychological science. But he has left no logically developed and coherent system. He commenced his philosophical career as a critic of the fundamental principles of Schelling so far as they had been expounded and adopted by Cousin. The celebrated article in the *Edinburgh Review* which contains this criticism was written hurriedly, under pressure, with a distinctly polemical aim. His object was to annihilate by one crushing blow that philosophy of the absolute which had seized the control of continental thinking. For the purposes of this discussion he availed himself of the methods and formulas of Kant. In his anxiety for a victory that should be complete he denied to man all knowledge of the infinite whatever, and set aside as untrustworthy those facts in the human consciousness which impose upon us the belief in an infinity of real existence, which quantitatively the same consciousness affirms itself unable to define and measure. In his anxiety to show the inability of our powers to comprehend or "go around" the infinite in the form of time, space, or power, he was led to a positive denial of the existence of the notion as an ineradicable element in the human consciousness. Hamilton failed to give simplicity and

clearness to his discussion of the doctrine in question by using the word "infinite" exclusively as a general term, including everything of which the word is used as a predicate. Had he denied to the human mind any notion of the infinite as applied to a right line in space, or to any of the specific infinite quantities of the mathematician, he could hardly have spoken with so much confidence. By using the phrase "the infinite" he shifts the discussion from specific cases to a concept of extreme generality, including within itself at the same time all conceivable infinite quantities, forces, and powers. Two points in space situated each in the same right line may be proved capable of approaching each other for ever without the possibility of meeting. So two points may be shown capable of receding from each other without limit in time or space. Now, the process by which the existence of these conditions is proved possible, involves the positive affirmation in thought of the infinitely great and the infinitely small in the domain of quantity. The denial implied in the term is not in any sense a denial of the existence of the infinitely great or the infinitely small, in fact or in thought, but it is the denial of our power to apply to them known units of measure. So far from the infinitely great or small being "the negation of thought," they are among the most positive affirmations of the human mind. They are named by appropriate terms in all cultivated languages, and are equally familiar in the symbols of the mathematician. The whole discussion of Hamilton, as well as that of Cousin, involves a want of discrimination between qualitative and quantitative thought. Cousin was right in affirming the positive nature and actual existence of the idea of infinitude, and wrong in the statement that it is essentially comprehensible or measurable. Hamilton was right in denying our capacity to apply units of measure, in fact or imagination, to infinite quantities, but wrong in defining them as the "negations of thought," and sharply limiting the sphere of mental activity to the finite in quantity or quality. It is, however, perfectly clear that infinite forces and quantities do become the subject-matter of thought, both subjectively as capacity and objectively in mathematical quantities. There are in the notion of the infinite two elements—one positive, the other negative. The positive side of the notion affirms the existence of the infinite in time and space, while the negative side of the notion is the denial of our power to subject them to a quantitative measurement or imaginative presentation. The denial of our power to measure the infinite is virtually a concession that the notion is actually present as an object of thought. As the necessary correlate of all thinking upon finite quantities, we are compelled to believe in its objective reality. All that was demanded of Sir William in his controversy with Cousin and the absolutists was to show the impotence of the human mind to comprehend or measure the infinite. But he went farther, and denied the existence of a notorious psychological fact.

Hamilton sought also, through his doctrine of the Unconditioned, to explain the origin and nature of the causal judgment. He makes the causal judgment the mere inability to think an absolute beginning. This statement is purely negative. The causal judgment comes into the mind in the presence of a change in what already exists. It is a change, a manifestation of power. No new existence appears. It affirms the event or the change to have had a cause. This affirmation is positive, both as a law of thought and a law of the objective change which calls out the affirmation from the mind of the observer. This effort on the part of Hamilton to account for the positive causal judgment by referring it to the impotence of the human mind, purely negative in its character, must be admitted to be a failure. The causal judgment is in the most emphatic sense positive, and no acuteness of psychological analysis can resolve it into a "tresculus of negations."

In like manner, the doctrine of the "relativity of knowledge" which plays so large a part in Hamilton's discussions is a distinctly Kantian doctrine, and entirely foreign from the teachings, spirit, and aims of Scottish philosophy properly so called. It is equally irreconcilable with that doctrine of "natural realism" which, in his lectures and his celebrated criticism of Brown, Hamilton so emphatically taught. This word "relativity," as connected with the theory of knowledge, is used in different senses. If by "relativity" we mean that the knowledge of any object is impossible unless that object comes into relation with the mind, the term is simple and contains an intelligible idea. But if by "the relativity of knowledge" is meant that the external object as existing, and the internal percept which that object has determined in the mind, are different from each other in such a sense that our knowledge of it is untrustworthy, the notion strikes at the foundation of all evidence and all knowledge. It is, besides, an assumption purely gratuitous. For if it be a fact that our mental apprehension of external objects is different from the objects themselves, and that the "thing in itself" is for ever shut out from our knowledge, how can we ever know the fact? How can we legitimately affirm that the form of our percept is unlike that of the object, which by its relation to our minds has marked out and determined our knowledge? By the conditions of the hypothesis the "thing in itself" is unknowable, consequently a comparison between it and the percept is impossible. No dialectic skill can harmonize this Kantian "relativity" with "natural realism" in any proper sense of the term.

There are few facts in the history of philosophy more remarkable than the attempt of Hamilton to combine into one system the Kantian doctrine of "relativity" and the direct and immediate knowledge of the external world which Hamilton taught with so much earnestness and zeal. The truth seems to be, that the criticism on Cousin in the *Edinburgh Review* was so able, so learned, and so profound that it startled the British public into admiration, and made Hamilton famous all over the Continent. When he had once taken a position he was as incapable as any one of his old Covenanting ancestors of receding from it. When he took the position against Brown of a defender of the Scottish philosophy of Reid, he was called upon to defend a system in many essential particulars entirely foreign from that which furnished him with his weapons in his battle with the absolutists. He was publicly committed to the defence of two antagonistic systems. Instead of rejecting either, he attempted to hold to both and reconcile them. In this he failed, for the task was simply impossible. The Kantian portion of Hamilton's philosophy, formulated as the Philosophy of the Unconditioned, has been adopted by Spencer and Mill, for it harmonizes with the "reasoned" materialism which is the basis of the psychology which they hold in common with their masters, Hobbes and James Mill. It was accepted also by Mansel as the foundation-principle of his *Limits of Religious Thought*, but it has been very generally repudiated by cautious psychologists, who are as earnest as Hamilton in repudiating the extravagant claims for the human capacities which distinguished the system of Cousin and the earlier teachings of Schelling.

Hamilton's effort to clarify, supplement, and give systematic form to the doctrine of immediate perception, somewhat vaguely set forth by Reid, is a clear contribution to psychological science. For this purpose he revived and defended that doctrine of the relation of the soul to the body which the mediæval philosophers adopted from Aristotle, and which has since then been adopted by Stahl and Berard, and is now known under the designation of Animism. Unfortunately, Hamilton failed to perceive that the analysis of the qualities of body into primary and secondary is unnecessary in a system which recognizes sensible knowledge as the result of a face-to-face relation established between the different human senses and the various forms of matter. This analysis, to the history of which he gave great time and attention, had its origin in an incorrect apprehension of the nature of those attenuated forms of matter which reach and affect only the more delicate human senses. It was perpetuated by the failure to subject the complex phenomena which are the gifts of the several senses into their constituent elements. When we bear in mind that the nerves of the eye have been so delicately differentiated as to detect and recognize the presence of rays of light, the olfactory nerves to detect odors, and the nerves of the ear to recognize the pulsations of the sound-wave, it becomes evident that all our senses are in fact but so many modifications of touch. This being the case, the elaborate analysis of Hamilton of the qualities of body into primary, secondary, and secundo-primary has no place in a system of psychology which accepts the doctrine of immediate knowledge through the senses. This discussion of Hamilton, which has been so much admired by his unquestioning followers, is also defective in confounding facts of physics and facts of psychology. The "natural realism" which in one part of his *Psychology* Hamilton so rigorously taught, requires and receives no aid from such an analysis of the qualities of body. Sound-waves are directly apprehended. The instrumentality which sets them in motion is, so far as the ear is concerned, a matter of inference. A similar statement may be made regarding the senses of smell and sight. In vindicating the doctrine of synchronous perception, and making clear the analysis of the formula of consciousness, as a condition of all forms of perception, Hamilton's labors are beyond all praise. It is true that he has limited the application of this formula to the case of perception of what he calls the primary qualities of body. In this limited range of application he has discussed it with great clearness and power. It is a fruitful principle, and we believe that it is capable of application in all forms of per-

ception and in all processes of thought. Properly apprehended and clearly stated, it forms an impregnable basis of argument against all the modifications of the so-called associational psychology. Although the formula of consciousness is implicated with greater or less clearness in all psychological systems, and in all analyses of the elements necessary in the construction of sentences in every human language, we know of no writer who has discussed this formula so successfully as Hamilton. He has failed only in limiting its application to the most obtrusive and emphatic forms of perception. We have not the space to give the reasons for considering it to be the universal condition of all acquisition of human knowledge and of every process of human thought. Herbert Spencer, in his *First Principles*, has taken notice of this limited application of the formula by Hamilton, and for this reason has set aside as valueless the argument which Hamilton founded upon it for the real existence of the conscious self as distinct from all forms of matter.

In respect to the doctrine of consciousness, Hamilton departed somewhat from his immediate Scotch predecessors. With him consciousness is not a distinct faculty of the soul, but that fundamental fact of which all powers of the mind are so many different modifications. He affirmed also, as a consequence, the direct and immediate consciousness of all forms of matter coming into relation with their appropriate senses. For the history of philosophical opinions Hamilton's labors are invaluable. Perhaps no literature, as a whole, is less satisfactory than the history of philosophy. This is due to the very general failure in the simple and exact analysis and statement of the processes of thought gone through, and conclusions arrived at, by the philosophers of the past, which it is the function of the historian to give us. Though Hamilton's labors in this field are scattered and fragmentary, they are valuable in the extreme. He sometimes makes errors in quotations, he sometimes is inaccurate in interpretation, but he gives the history of an author's thought upon special topics with a precision and clearness without a parallel. He gave to his generation a new exposition and proof of the value of learning in psychological inquiry. He made it clear to the careful student of his writings that, after making full allowance for all the vagaries of philosophical thought, there has been from the dawn of speculation a steady though not uniform progress towards truth—that there is a great body of philosophical doctrine which has been under various forms and disguises accepted and held for true by the ablest philosophers among all cultivated nations. He has helped, beyond most other men, to illustrate the great truth that all the conflicts of opinion in the past have wrought the "steady gain of man;" he has illustrated also with equal clearness that the errors and false systems of our own times are but reproductions of old foes to truth, which have been a thousand times met and a thousand times vanquished. Even his doctrine of the Unconditioned, exaggerated and without requisite limitations as we believe it to be, has called attention anew to the limitations of the human understanding, and to the vast number of insoluble problems which lie around us on every hand. None but minds of the very highest order have been able to make an appreciable impression upon the abstract thought of their time. The mass of thinkers receive and transmit the products of the past without essential modification. Very few have made additions to its volume or essentially modified its form. There may be comparatively little of addition to the sum-total of philosophical thought which will be left after Hamilton's works have been subjected to the winnowing processes of time. But that little will be sufficient to place him among the foremost scholars and thinkers of his time. In the impulse which his vast learning, his intense nature, and his mastery of expression gave to the thinking of his time, he can hardly be overrated. Whether we accept or reject his doctrines, no better gymnastic for the mind can be found than the best discussions of Sir William Hamilton. (See VEITCH'S *Memoir of Hamilton* (ed. 1869); *Ed. Essays Art.* by T. S. BAYNES.) M. B. ANDERSON.

Hamilton (Sir WILLIAM ROWAN), LL.D., b. in Dublin Aug. 5, 1805; educated at the Dublin University, graduating with high mathematical honors; became professor of astronomy and astronomer-royal for Ireland in 1827; was knighted in 1835; became president of the Royal Irish Academy in 1837. D. at Dublin Sept. 2, 1865. Author of very valuable papers on physics and mathematics, but his fame rests upon his great invention, the calculus of quaternions. His principal works are *Lectures on Quaternions* (1853) and *Elements of Quaternions* (1866). (See QUATERNIONS.)

Hamiltonban', tp. of Adams co., Pa. Pop. 1418.

Ham'ilton Col'lege, an institution of learning situated in Clinton, Oneida co., N. Y. It grew out of the Hamilton Oneida Academy, which was established in the same place in 1793 by the energy and liberality of Rev. Samuel Kirkland, for many years a missionary to the Indians of Central New York. The college received its charter from the State in 1812. The first class graduated in 1814. The whole number of its alumni up to the present time (1875) is 1538, of whom nearly 1200 are still living. A law school has been connected with the college since 1854, from which 86 students have been graduated. A valuable law library, numbering about 5000 volumes, was bequeathed to the college by William Curtis Noyes of New York. The general library of the college contains upward of 12,000 volumes. The public buildings consist of a chapel, three halls with rooms mainly for students, a library and memorial hall, an observatory, a chemical laboratory, and a hall of natural history. The observatory, endowed by Edwin C. Litchfield of New York, and bearing his name, contains an equatorial telescope with an object-glass of 13.5 inches in diameter and a focal length of nearly 16 feet; a smaller portable telescope (made by Steinheil Sons, Munich) with an object-glass of 4 (French) inches diameter and a focal length of 5 feet; a transit instrument, an astronomical clock, and a Bond's chronograph. The longitude of the observatory has been accurately determined by exchanging star-signals with the Harvard College observatory, and in turn this observatory has become the basis for determining the longitudes of Buffalo, Syracuse, Elmira, and Ogdensburg, of the western boundary of the State of New York, and of the observatory at Ann Arbor, Mich.; which latter forms the fundamental point for the longitudes of the lake survey. Twenty asteroids have been first discovered at the Litchfield observatory up to the present date (Jan., 1875) by the director and professor of astronomy, Dr. C. H. F. Peters. The cabinets contain upward of 17,000 specimens in geology, mineralogy, and natural history, besides a valuable herbarium of 8000 samples of plants carefully labelled and classified. The college grounds contain in all about 40 acres. The campus proper, of about 17 acres, is laid out with taste and planted with trees and hardy shrubs.

The faculty of the college consists of a president and twelve resident professors. The presidents of the college have been—Rev. Azel Backus, D. D., 1812–16; Rev. Henry Davis, D. D., 1817–33; Rev. Sereno Edwards Dwight, D. D., 1833–35; Rev. Joseph Penney, D. D., 1835–39; Rev. Simeon North, D. D., LL.D., 1839–57; Rev. Samuel Ware Fisher, D. D., LL.D., 1858–66; Rev. Samuel Gilman Brown, D. D., LL.D., 1866–81; Rev. Henry Darling, D. D., LL.D., 1881. S. G. BROWN.

Ham'ilton's, tp. of Catawba co., N. C. Pop. 1562.

Hamlet (called also OMAR), post-v. of Villenova tp., Chautauqua co., N. Y. Pop. 155.

Hamlet, the hero of Shakspeare's famous tragedy, was a prince who belonged to the mythical period of Danish history, but who, for many centuries, was the subject of a very vivid tradition among the Danish people; his grave is still shown near Elsinore, and the part of Jütland's Heath where was fought the battle between him and Viglet is still called Hamlet's Heath. His life has been told at some length by Saxo Grammaticus, a Danish historian of the latter part of the twelfth century, but there is no direct connection between Saxo's story and Shakspeare's tragedy, nor between Shakspeare's tragedy and Belleforest's novel, a French compilation of the middle of the sixteenth century. That which is common between Saxo and Shakspeare is very little, and is most probably derived from an older play which Shakspeare rewrote. But it is an interesting fact that Shakspeare's deviations from Saxo—the scene of Elsinore, the wanderings of the ghost, Hamlet's studying at Wittenberg, the drunkenness of the king, etc.—are neither loose vagaries nor deep speculations. They all relate, in a very simple manner, to actual circumstances in Denmark during the latter half of the sixteenth century, and it is not altogether impossible to trace the run of the gossip from the ramparts of Elsinore to the taverns of London. CLEMENS PETERSEN.

Ham'lin, county in the E. of Dakota. Area, 720 square miles. The Big Sioux River traverses the N. E. portion. It is not yet settled to any extent.

Hamlin, tp. of Mason co., Mich., on Lake Michigan. Pop. 124.

Hamlin, post-tp. of Monroe co., N. Y., on Lake Ontario. It has 5 churches. Pop. 2304.

Hamlin, tp. of McKean co., Pa. Pop. 121.

Hamlin, post-v., county-seat of Lincoln co., W. Va.

Hamlin (AUGUSTUS C.), A. M., M. D., b. at Columbia, Me., Aug. 28, 1829; graduated at Bowdoin College 1851; studied medicine in Boston and Paris; took his medical degree 1854; was surgeon in the army service 1861–65; became medical director of the 11th corps and medical inspector U. S. A.; removed to Bangor, Me., 1865. Author of a

Treatise on the Tourmaline; of brochures on *The Salmonidæ*, and on medical and scientific subjects; is preparing works on the diamond, sapphire, emerald, etc., and on alimentation, ventilation, etc. Is a member of several American and European learned societies; general secretary of the American Association for the Advancement of Sciences, etc.

Ham'lin (Hannibal), LL.D., b. at Paris, Me., Aug. 27, 1809, was for a time a printer; admitted to the bar in 1833, and several times was elected Speaker of the Maine house of representatives. He was (1843–47) a Democratic representative in Congress; U. S. Senator 1848–57, 1857–61, and 1869–75; governor of Maine in 1857, to which position he was chosen as a Republican, but resigned on his re-election to the U. S. Senate. He was (1861–64) Vice-President of the U. S. during Mr. Lincoln's first term, and in 1865 was for a time collector of the port of Boston. He was appointed U. S. minister to Spain July 1, 1881.

Ham'line (Leonidas Lent), D. D., b. in Burlington, Conn., May 10, 1797. Removing to the West, he was admitted to the bar in Ohio, but joined the Methodists in 1828, and entered their ministry in 1832. After editing the *Western Christian Advocate* and *Ladies' Repository*, he was bishop from 1844 to 1852, when he resigned. D. Feb. 22, 1867. His *Works* were published in New York in 1869.

Ham'lin Planta'tion, tp. of Aroostook co., Me. P. 558.

Hamlin's Grant, tract in Oxford co., Me. Pop. 95.

Hamm, town of Prussia, in the province of Westphalia, on the Lippe. It has considerable manufactures of linen and leather. Pop. 16,914.

Hamme, town of Belgium, in the province of West Flanders. It has manufactures of linen and lace and a great trade in flax and hemp. Pop. 10,143.

Hammer, Steam. See Steam-Hammer, by Coleman Sellers.

Ham'mer-Head, a name given to sharks of the genus

Hammer-head Shark.

Zygæna or *Sphyrniæ*, having, in the adult, the two sides of the head produced laterally till the head has somewhat the shape of a double-headed hammer. There is an eye on each end of the head. These fishes are very voracious, and extremely prolific, especially in warm seas. The *Z. malleus*, a man-eating shark, has been often caught on both sides of the North Atlantic. The *Z. tiburo* has the widest development of the hammer-shaped head.

Ham'merich (Martin Johannes), b. in Copenhagen Dec. 4, 1811; studied philology and mythology; travelled much; was director of the gymnasium of Christianshavn 1842; and retired in 1868 to his estate, Islinge, in the southern part of the island of Seeland. His principal works are *On the Myth of Ragnarokr* (1836), an excellent translation of the *Sakuntala* (1845), *Life of Thorwaldsen* (1870), besides a great number of minor essays relating to the Danish language and literature, and distinguished as much by their sound and broad views as by their elegant form.—His elder brother, Peter Frederik Adolph Hammerich, b. in Copenagen Aug. 9, 1809, studied theology, and became a minister in 1845, and in 1858 professor in theology at the University of Copenhagen, where he represented the ideas of Grundtvig. He published several works relating to the history of Denmark and Scandinavia—*Danmark under Valdemarerne* (1847), *Danmark under Adelsvælden* (1854), *Den hellige Birgitta* (1863), distinguished alike for their novel ideas and for their vigorous style. D. Feb. 9, 1877. Clemens Petersen.

Ham'mer-Purg'stall, von (Joseph), Baron, b. at Grätz, Austria, June 9, 1774; studied the Eastern languages at the Oriental Academy, Vienna; became in 1799 interpreter to the internuncio at the Porte; inspector of consulates 1800; secretary-dragoman in the Anglo-Turkish army 1801; secretary of Austrian legation in Turkey 1802; consular agent at Jassy 1806; court-interpreter at Vienna 1816; aulic counsellor 1817; baron 1837; president of the Academy of Vienna 1847–49; grand officer of the Medjidie 1855. D. at Vienna Nov. 24, 1856. He was a man of great wealth and an earnest lover of Oriental learning. He published a very large number of learned works on Eastern history, etc., still valuable, although their reputation has of late declined. Of these we may note *Encyklopädische Uebersicht der Wissenschaften des Orients* (1804); *Die Staatsverfassung und Staatsverwaltung des Osmanischen Reichs* (1815–16); *Geschichte der schönen Redekünste Persiens* (1818); *Umblick auf einer Reise von Konstantinopel nach dem Olympos* (1818); *Geschichte der Assassinen* (1818); *Montenebbi* (1824); *Geschichte des Osmanischen Reichs* (1827–34, 10 vols.); *Gesch. der Osmanischen Dichtkunst* (1836–38, 4 vols.); *Gesch. der goldenen Horde* (1840); *Literaturgeschichte der Araber* (7 vols., 1850–56); *Denkwürdigkeiten aus meinem Leben* (1858).

Ham'mersfest, town of Norway, in Finmark. It is the northernmost town in Europe, situated in lat. 70° 40′ N. In the two summer months, in which the weather is quite hot, the harbor of Hammersfest is the rendezvous of more than 200 fishing-vessels; the fishing can be carried on, however, the whole year round. Pop. 1125.

Ham'mersmith, town of England, in Middlesex, on the Thames, 4 miles above London, in the Kensington district. Its kitchen and flower gardens are famous. Pop. 24,520.

Ham'mertown, a v. of Pine Plains tp., Dutchess co., N. Y. (P. O. Pine Plains.) It has a large scythe-factory, employing about 50 operatives.

Ham'mock [a word of West Indian origin], a netting used as a suspended bed on shipboard and in houses, especially in warm countries. Sisal hammocks, made from agave fibre in Yucatan, are especially prized.

Ham'mond, tp. of Spencer co., Ind. Pop. 2626.

Hammond, a v. of Tangipahoa parish, La., on the Mississippi Central R. R., 54 miles N. of New Orleans.

Hammond, post-tp. of St. Lawrence co., N. Y., on the St. Lawrence River, includes a part of the Thousand Islands. Pop. 1757.

Hammond, tp. of Edgefield co., S. C. Pop. 2560.

Hammond, tp. and post-v. of St. Croix co., Wis., on the W. Wisconsin R. R., 37 m. E. of St. Paul, Minn. Pop. 895.

Hammond (Dudley Whitlock), M. D., was b. in Pickens co., S. C., May 12, 1809. In early life he went to Georgia, and received his diploma from the Medical College of that State in Augusta. After practising medicine for twenty years in Munroe co., he removed to Macon, where he now resides, and ranks high as a surgeon and physician. He has operated eighteen times for urinary calculus without losing a case, and in one instance the stone weighed six ounces. He originated a new method of removing gravel or foreign bodies lodged in the urethra. He has contributed valuable articles to medical journals. Paul F. Eve.

Hammond (Jabez D.), LL.D., was b. at New Bedford, Mass., Aug. 2, 1778. In 1799 he was a practising physician at Reading, Vt. In 1805 he became a lawyer at Cherry Valley, N. Y.; was a Democratic member of Congress 1815–17; a State senator 1817–21; a commissioner to settle State claims against the U. S. government 1825–26; a county judge in 1838; and one of the regents of the university 1845–55. He was the author of [illegible] (1851), *Political History of New York* [illegible], and a *Life of Silas Wright* (1848). D. Aug. 18, 1855.

Hammond (James Hamilton), b. in Newbury district, S. C., Nov. 15, 1807, was a son of Prof. Elisha Hammond of South Carolina College, at which the son graduated in 1825. In 1828 he became a lawyer and an editor, and as an advocate of State Rights served on the governor's staff as an officer of the nullification forces raised in 1833; was a member of Congress 1835–37; a general of State militia 1841; governor of South Carolina 1842–44; U. S. Senator 1857–60. (His father, Prof. Elisha Hammond, was a native of Rochester, Mass.) Governor Hammond was the reputed author of the expression "Cotton is king," and originated the epithet "mud-sills" as applied to the laboring classes. In his later life he abandoned his extreme nullification views. He possessed a large fortune, acquired by marriage. He was the author of numerous papers on agriculture, manufactures, politics, etc., published in various magazines. His papers on slavery were republished in a volume as *The Pro-slavery Argument* (1853). D. at Beach's Island, S. C., Nov. 13, 1864.

Hammond (Samuel) was b. in Richmond co., Va., Sept. 11, 1757, was well educated, and served in his youth in the Indian wars. During the Revolution he served with the greatest honor as an officer, mostly of cavalry, finally

holding a colonel's commission under Greene. He was present upon nearly every battle-field in the South, and received several wounds; removed after the war to Savannah, Ga.; became surveyor-general, and was at one time governor of the State; fought in the Creek war of 1793; was a member of Congress from Georgia 1803–05; civil and military commandant of Upper Louisiana 1805–24; also receiver of public moneys and president of a bank at St. Louis (now in Missouri). In 1827 he became surveyor-general of South Carolina, and (1831–35) secretary of state. D. at Horse Creek, Ga., Sept. 11, 1842.

Hammond (WILLIAM A.), M. D., b. at Annapolis, Md., Aug. 28, 1828; graduated M. D. at the New York University in 1848, and entered the U. S. army as assistant surgeon in 1849, in which he remained till Oct., 1860, when he resigned and accepted the appointment of professor of anatomy and physiology in the University of Maryland at Baltimore, where he also obtained a large practice. At the outbreak of the civil war he offered his services to the government, and was reappointed assistant surgeon May, 1861; on the reorganization of the medical department in 1862 he was appointed surgeon-general of the army, in which capacity he displayed great energy and ability. In the midst of these official duties he prepared and published *Physiological Memoirs* (1863) and *Lectures on Venereal Diseases* (1864). Leaving the service, he became a professor in Bellevue Hospital Medical College, New York, where he now resides. Author of *Military Hygiene* (1863); *Sleep and its Nervous Derangements* (1869); *The Physics and Physiology of Spiritualism* (1870); *A Treatise on Diseases of the Nervous System* (1871); *Insanity in its Relations to Crime* (1873).

GEO. C. SIMMONS.

Ham'mondsburg, post-v. of Warren co., Ia. Pop. 59.

Ham'mondsport, post-v. of Urbana tp., Steuben co., N. Y., at the head of Keuka Lake, has a box-factory, 4 churches, and a foundry, and is a great centre of grape-culture and wine-manufacture. It has a line of steamers to Penn Yan. Pop. 602.

Ham'mondsville, post-v. of Saline tp., Jefferson co., O., on the Cleveland and Pittsburg R. R. Pop. 504.

Ham'monton, post-v. of Atlantic co., N. J., 30 miles from Philadelphia, on the Camden and Atlantic R. R., just halfway to Atlantic City. It has 2 newspapers, 4 churches, a hall used by two religious societies, a boarding-school for both sexes, 1 hotel, 6 shoe-factories, a cotton and woollen mill, and several other mills and shops. It is noted for its luscious fruits, wheat, corn, and root-crops, especially Irish and sweet potatoes. Pop. 1404.

H. E. BOWLES, PUB. "REPUBLICAN" AND "ITEM."

Hamon (JEAN LOUIS), b. at Plouha May 5, 1821; studied in Paris under Paul Delaroche, and afterwards with G. C. Gleyre; exhibited first in 1848. He worked for a time in the porcelain manufactory at Sèvres, and while there distinguished himself by designs for vases. An enamelled casket of his gained a medal at the London Exposition of 1851. The following year he returned to his painting, and produced rapidly pictures, since familiar through engravings, of an idyllic character, representing classical fancies—*My Sister is Not at Home, Love and his Cortège, The Captive Butterfly, Aurora, Love on a Visit, It is Not I, The Muses at Pompeii,* and many others. M. Hamon has received third and second medals for his work, and in 1855 was created chevalier of the Legion of Honor. Hamon's pieces are esteemed for poetic sentiment and technical grace. D. May 29, 1874.

O. B. FROTHINGHAM.

Hamoon', a lake of Afghanistan. It is shallow, overgrown with reeds, and surrounded with forests of tamarisks. Its water is salt.

Hamp'den, county of Massachusetts, bounded on the S. by Connecticut, and intersected by the Connecticut River. Area, 670 square miles. The soil along the river is very fertile. Tobacco, hay, and dairy products are the staples. The manufacturing interests are important. Cotton, woollen, and metallic goods, whips, firearms, paper, leather, wooden wares, furniture, machinery, and building-stone are a few of the leading manufactures. Springfield, Holyoke, Chicopee, Westfield, and Palmer are the largest towns. The county is traversed by the Boston and Albany, the Connecticut River, the New York New Haven and Springfield, the New Haven and Northampton, the New London Northern, and other R. Rs. Cap. Springfield. Pop. 78,409.

Hampden, tp. and v. of Marengo co., Ala. Pop. of v. 40; of tp. 742.

Hampden, tp. and post-v. of Penobscot co., Me., on the W. bank of the Penobscot River, 5 miles below Bangor, has 2 paper-mills, an academy, 4 churches, and considerable shipping interests. Pop. 3068.

Hampden, post-tp. of Geauga co., O. Pop. 767.

Hampden, tp. of Cumberland co., Pa. Pop. 1199.

Hampden, tp. of Columbia co., Wis. Pop. 1000.

Hampden (JOHN) was b. in London in 1594. His father, William Hampden of Hampden, Buckinghamshire, belonged to an old Saxon family; his mother, Elizabeth Cromwell of Hinchingbrooke, Huntingdonshire, was the aunt of Oliver Cromwell. When he was three years old his father died and left him an immense fortune, consisting chiefly of landed property. He entered the University of Oxford in 1609, where he pursued his classical studies with earnestness and success, and in 1613 the Inner Temple, where he studied law. His life in London was gay and somewhat irregular, but in 1619 he married Elizabeth Symeon, retired to his estates, and settled down in steady and noble habits; she bore him three sons and six daughters. In Jan., 1621, he took his seat in the House of Commons as member for Grampound. He sat for Wendover in the first three Parliaments of Charles I. (June, 1625, Feb., 1626, and Mar., 1628), and for Buckingham in the last two (Apr., 1640, and Nov., 1640, the Long Parliament). He allied himself with the party in opposition, and took part, under James I., in the protest against the marriage of Prince Charles with a Spanish princess, in the impeachment of Bacon, etc.; and under Charles I. in all the measures which Parliament took against the encroachments and arbitrary rule of the Crown. But his position was in the beginning obscure, and later, although always respectable, still in the second rank, until in the spring of 1637 he at once became the most popular man in England. He had no brilliant talents, and achieved no dazzling feat which gathered people around him. But his ideas were those of the majority of the English people, and his character, strong, consistent, and noble of itself, was typical of the largest and most influential class of English citizens. He thus became the turning-point of the course of the history of England. He was no republican; he considered royalty as the natural, consequently as the best, form of government. But the royal power, whether more or less circumscribed, must be clearly defined and strictly kept within its legal boundaries. If the Crown encroached on the rights of the subjects, he considered it their duty to resist such encroachments, first by what legal means they might possess, and if this proved ineffectual, then by rebellion. These ideas he adhered to with unconquerable firmness, and when attacked he defended them with undaunted courage, and even with fierceness. The king was very much in need of money, and Parliament, which alone could vote him a subsidy, he would not convoke, or perhaps he dared not. He then undertook to levy a tax on his own authority, the so-called "ship-money." Such a tax had been levied previously without any special vote of Parliament, but only in the sea-towns and coast-districts, and only in time of war; it was simply another form of the old duty resting on this part of the country of furnishing ships for the navy. In 1636 the king arbitrarily extended this tax to the inland counties and to times of peace. Hampden was taxed twenty shillings, but refused to pay, and asked for a decision by the courts. In May, 1637, process was opened, and lasted for thirteen days; but, although Hampden was condemned to pay, the impression which the procedure produced on the English people was fatal to the king: he bought Hampden's twenty shillings with his crown and his head. It now became apparent that private property was not safe in England, and when, shortly after, the revolution broke out in Edinburgh, it found in England too the popular mind prepared for armed resistance against the king. It has been told that shortly after the condemnation of Hampden he, as well as Pym, Haslerig, Cromwell, and other patriots, determined to emigrate to America, and even had hired a ship, when they were detained by royal order; but the story has been doubted of late. In the Parliament of May, 1640, and in the Long Parliament of November of the same year, he stands as one of the most prominent leaders of the opposition; and he was one of the five members of the House of Commons whom the king accused of high treason (Jan. 3, 1642), but whom the House refused to deliver up for imprisonment. The king gave order to break by force into the House of Commons and arrest the five members in their seats, but they were warned by the French ambassador and the countess of Carlisle, and they kept themselves concealed. Meanwhile, insurrection arose in London, and the king was compelled to leave the city. Several months were spent in negotiations between the king and Parliament, but in August both parties took up arms, and the civil war began. Hampden now developed the greatest energy and activity in raising the militia and organizing an army; and after the brilliant success of the encounters at Edgehill and Brentford, in which he took part as leader of the cavalry, the House of Commons thought of making him commander-in-chief of the whole army, instead of the slow and hesitating Essex. But on June 17, 1643, in an

encounter at Chalgrove Field between the royal cavalry under Prince Rupert and that of Parliament under Hampden, the latter was mortally wounded, two balls entering his body at the first charge. He was brought to the house of one of his friends at Thame, and d. there six days after (June 24, 1643). The king rejoiced, but all England mourned. CLEMENS PETERSEN.

Hampden (RENN DICKSON), D. D., b. 1793 in Barbadoes; graduated B. A. as double first at Oriel College, Oxford, 1813; became a fellow of Oriel 1814; public examiner 1829; delivered 1832 the Bampton lecture on *The Scholastic Philosophy in its Relation to Christianity*, the orthodoxy of which was sharply assailed; principal of St. Mary's Hall, Oxford, 1833; professor of moral philosophy 1834; regius professor of divinity 1836, greatly to the discontent of the Anglo-Catholic party, then dominant at the university, the convocation of which in the same year passed a vote of censure upon him, High and Low Church parties uniting in the vote; but in 1842 he was unanimously chosen to the theological examining board, and in 1847, after a bitter controversy, he was consecrated bishop of Hereford. D. in London Apr. 23, 1868. He contributed very able philosophical and biographical matter to the *Encyclopædia Britannica* and the *Encyclopædia Metropolitana*; was author of a *Lecture on Tradition* (1839); *The Fathers of Greek Philosophy* (1862); *Philosophical Evidences of Christianity* (1827); *Lectures on Moral Philosophy* (1836); *Sermons* (1836, 1847).

Hampden-Sidney College is in Prince Edward co., Va., 7 miles from Farmville, in a district rapidly filling up with immigrants from the British Isles and the Northern States. The college was founded in 1775. The spirit of its founders is exhibited in the very name of the college, and still more significant is the following provision of its charter (1784): "In order to preserve in the minds of the students that sacred love and attachment which they should ever bear to the principles of the present glorious Revolution, the greatest care and caution shall be used in electing professors and masters, to the end that no person shall be so elected unless the uniform tenor of his conduct manifest to the world a sincere affection for the liberty and independence of the U. S. of America." In the list of the first trustees appointed under this charter occur the names of James Madison and Patrick Henry. The first president of Hampden-Sidney was the Rev. Samuel Stanhope Smith, D. D., afterwards president of Nassau Hall, Princeton, N. J. Dr. Smith was succeeded in his office by his brother, Rev. John Blair Smith, after whom came in succession Rev. Archibald Alexander and Rev. Dr. Moses Hoge. Among the alumni of the college are numbered many of the most distinguished men of our country, and its influence in the dissemination of knowledge and sound piety throughout the century of its existence can scarcely be estimated too highly.

It is strictly a college, sharply distinguished on the one hand from the university, and on the other from the mere classical school. It retains the old curriculum, and gives no diploma to any who have not passed through the full course of study prescribed. It includes no professional school, the Union Theological Seminary, though only a few hundred yards distant, being governed by a different corporation. Nor is there a preparatory school connected with the college, it being held by its authorities that the ends of discipline are more perfectly subserved by the separation of the youths attending the college classes from pupils of an inferior grade of study. The examinations are searching and rigid, and no one is allowed to pass to a higher class who does not evince a competent knowledge of the studies with which he has been engaged. J. M. P. ATKINSON.

Hamp'shire, Southamp'ton, or **Hants,** county of England, bordering S. on the English Channel, comprises, together with the Isle of Wight, which belongs to it, an area of 1625 square miles, with 543,837 inhabitants. It is traversed by the North and South Downs, but the soil is in most parts sandy or gravelly, and not very fertile. Hops are extensively cultivated, and a fine breed of sheep is reared. The south-western portion is covered with the New Forest, from which the dockyards of the English navy are supplied with oak and beech timber.

Hampshire, county of W. Central Massachusetts. Area, 524 square miles. The county is intersected by the Connecticut River. The soil along this river is remarkably fertile, and the scenery beautiful. Mounts Holyoke and Tom, and the Green Mountains in the W. part of the county, are the principal elevations. The county has fine water-power, which is well utilized. Tobacco, live-stock, and dairy products are the agricultural staples. Cotton and woollen goods, paper, brooms, lumber, wooden and metallic wares, straw goods, carriages, flour, brick, etc. are manufactured. The county is traversed by the New London Northern, the Massachusetts Central, the Connecticut River, the New Haven and Northampton, the Athol and Enfield, and the Ware River R. Rs. Cap. Northampton. Pop. 44,388.

Hampshire, county of West Virginia, having Maryland on the N. and Virginia on the E. Area, 640 square miles. It has high mountains and broad fertile valley-lands, well cultivated. Grain, stock, and wool are leading products. The N. part is traversed by the Baltimore and Ohio R. R. Cap. Romney. Pop. 7643.

Hampshire, post-tp. of Kane co., Ill. Pop. 1049.

Hampshire, tp. of Clinton co., Ia. Pop. 1030.

Hamp'stead, town of England, in the county of Middlesex, 4 miles N. W. of London. Its mineral springs were formerly much frequented, and the town still enjoys a high reputation for the beauty of its surroundings. Pop. 32,271.

Hampstead, tp. and post-v. of Carroll co., Md. Pop. of v. 235; of tp. 1742.

Hampstead, post-tp. of Rockingham co., N. H., 30 miles S. E. of Concord. It has manufactures of lumber, boxes, etc. Pop. 955.

Hamp'ton, a v. of England, in the county of Middlesex, on the left bank of the Thames. A mile from the village lie the palace and park of Hampton Court, originally erected by Cardinal Wolsey, and containing an interesting collection of pictures, among which are seven cartoons by Raphael. Pop. 6122; with surroundings, 10,175.

Hampton, post-v., cap. of Kings co., N. B., on the river Kennebeccasis and the European and North American Railway, 23 miles N. of St. Johns. Pop. about 250.

Hampton, post-v., cap. of Calhoun co., Ark. Pop. 138.

Hampton, tp. of Marion co., Ark. Pop. 217.

Hampton, tp. of Monroe co., Ark. Pop. 794.

Hampton, post-tp. of Windham co., Conn., 35 miles E. of Hartford. It has manufactures of woollens, etc. Pop. 891.

Hampton, tp. and post-v. of Rock Island co., Ill., at the rapids of the Mississippi River, and on the Western Union R. R., 10 miles N. E. of Rock Island. Pop. [illegible].

Hampton, post-v., cap. of Franklin co., Ia., on the Central R. R. of Iowa and the Iowa Pacific R. R. It has 3 churches, 2 weekly newspapers, a court house, a school house, fine business-blocks, and elegant residences. All kinds of mercantile business are represented. Pop. [illegible].

WHITNEY & HARWOOD, PUBS. "FRANKLIN RECORDER."

Hampton, tp. of Bay co., Mich., at the head of Saginaw Bay. Pop. 916.

Hampton, post-tp. of Dakota co., Minn. Pop. [illegible].

Hampton, post-tp. of Rockingham co., N. H., on the Atlantic coast and on the Eastern R. R., 10 miles N. of Newburyport, Mass. Hampton Beach is a fine summer resort. There are 3 churches and 8 well-kept hotels. The Boar's Head, a rocky promontory, is a picturesque object. Hampton has an academy, and manufactures of shoes, lumber, etc. Pop. 1177.

Hampton, tp. of Sussex co., N. J. Pop. 1023.

Hampton (P. O. WESTMORELAND), a v. of Westmoreland tp., Oneida co., N. Y., has several manufactories and 3 churches. Pop. 444.

Hampton, post-tp. of Washington co., N. Y., on the Vermont line. It is a fine farming township, and has manufactures of cheese, gunpowder, and woollens, and quarries of roofing-slate. Pop. 955.

Hampton, tp. of Allegheny co., Pa. Pop. 938.

Hampton, post-v., cap. of Elizabeth City co., Va., 3 miles from Fortress Monroe and 18 miles from Norfolk. It has 1 newspaper, 1 normal and agricultural institute for colored youth, a good harbor for small craft opening into Hampton Roads, a national cemetery and asylum for disabled soldiers in the suburbs, and 8 churches, 4 of them for colored people. Principal trade in fish, oysters, and garden-produce. Pop. 2300.

S. W. ARMISTEAD, *for Editor of* "SOUTHERN WORKMAN."

Hampton, tp. of Prince Edward co., Va. Pop. [illegible].

Hampton, tp. of Rappahannock co., Va. Pop. 1934.

Hampton (WADE), b. in South Carolina in 1754, served under Sumter and Marion; was a member of Congress 1795–97 and 1803–05, became a colonel U. S. army in 1808, a brigadier-general in 1809, and was major-general 1813–14; commanded (1809–12) at New Orleans, and (1813–14) on the Canadian frontier. He resigned in 1814, and afterwards acquired great wealth, at one time owning 3000 slaves. D. at Columbia, S. C., Feb. 4, 1835.

Hampton (WADE), grandson of the preceding, b. at Columbia, S. C., 1818, graduated at South Carolina Col-

lege; has served as member of both houses of the legislature of South Carolina. Commanded the Hampton Legion at the first battle of Bull Run, July, 1861, where he was wounded; promoted to be brigadier-general, and in command of a brigade at Seven Pines, May 31, 1862, where he was again wounded; engaged at the battle of Antietam, Sept., 1862, and upon the raid into Pennsylvania the following month; at Gettysburg, July, 1863, and a third time wounded; promoted to be lieutenant-general, and in command of body of cavalry in Lee's army during campaign of 1864, being frequently engaged; subsequently transferred to South Carolina, where in 1865 he commanded the cavalry forming the rear-guard of the Confederate army retiring before Gen. Sherman's advance northward; a spirited correspondence regarding the destruction of the city of Columbia by fire established the fact that it was not ordered by either Gens. Hampton or Sherman, but was owing to the vast quantity of cotton and other combustibles which had been accumulated here, and ordered to be destroyed before the evacuation of the city. He acted a prominent part in the Democratic national convention in New York City in 1868, that nominated Seymour and Blair for the Presidency and Vice-Presidency in that year.

Hamp'tonburg, tp. of Orange co., N. Y., traversed by the Walkill Valley R. R. Pop. 1224.

Hamp'ton Falls, tp. and post-v. of Rockingham co., N. H., on the Atlantic coast, and on the Eastern R. R., 8 miles N. of Newburyport, Mass. It has 3 churches and some manufactures. Pop. 679.

Hamp'ton Roads, the broad and deep channel leading from Chesapeake Bay into the James, Nansemond, and Elizabeth rivers. Its name is derived from Hampton, Va., a village situated on Hampton Creek, an arm of the roads. Forts Monroe and Wool serve for defence. Lat. of Thimble Shoal light, N. side of entrance, 37° 42′ N., lon. 76° 14′ [illegible]″ W. Hampton Roads was Mar. 8 and 9, 1862, the scene of important naval operations—the sinking of U. S. frigates Congress and Cumberland, and the contest between the iron-clads Monitor and Virginia.

Ham'ster, a name applied to certain rodent mammals of Europe and Asia of the rat family and of the genus *Cricetus*. *C. frumentarius* is the best known, but there are a number of other species. They all have large cheek-pouches, and all are very destructive to grain, which they store away in great quantities in their holes. They are vigorously hunted, not only for their skins, which are valuable, but for the grain they have buried. They are ill-tempered and pugnacious, but are extremely prolific. The full-grown hamster has a body nine inches long.

Ham'tranck, post-tp. of Wayne co., Mich. Pop. 2998.

Ha'nau, town of Germany, in Hesse-Cassel, at the confluence of the Kinzig and the Main. It is celebrated for its jewelry, and has extensive manufactures of cotton, silk, carpets, leather, gloves, and paper. Pop. 20,278.

Hancock, county in N. E. Central Georgia. Area, 500 square miles. The N. part has a clay soil; the S. part is sandy and covered with pine forests. Cotton and corn are leading products. Gold, lead, iron, and several kinds of precious stones have been found in the county, which is traversed by the Macon and Augusta R. R. Cap. Sparta. Pop. 11,317.

Hancock, county of Illinois, bounded W. by Missouri and Iowa. Area, 720 square miles. The soil is very fertile. Coal and limestone abound. Cattle, grain, and wool are staple products. Carriages, ploughs, metallic wares, harness, etc. are the leading manufactures. The county is traversed by several railroads. Cap. Carthage. P. 35,935.

Hancock, county of E. Central Indiana. Area, 312 square miles. It is level and fertile. Cattle, grain, and wool are staple products. Carriages and lumber are leading manufactures. The county is traversed by the Indiana Central and other railroads. Cap. Greenfield. P. 15,123.

Hancock, county in the N. of Iowa. Area, 625 square miles. The surface is rolling, the soil is good. It is traversed by the Iowa and Dakota division of the Milwaukee and St. Paul R. R. Grain and wool are staple products. Cap. Concord. Pop. 999.

Hancock, county of Kentucky, separated from Indiana by the Ohio River. Area, 500 square miles. The soil is very fertile, especially along the river. Tobacco and corn are staple crops. Coal is mined in this county. Cap. Hawesville. Pop. 6591.

Hancock, county in the S. E. of Maine, bounded S. by the Atlantic Ocean. It includes Mt. Desert and many smaller islands. Area, 1800 square miles. A part of the soil is quite fertile. Live-stock and wool are staple products. Lumber, cooperage, and bricks are leading manufactures. The fisheries and coasting-trade are of much importance, and there is some shipbuilding. Cap. Ellsworth. Pop. 36,495.

Hancock, county of Mississippi, bounded on the W. by the navigable Pearl River, which separates it from Louisiana, and on the S. by Mississippi Sound. The county is a part of the great pine region, and has a light soil. Area, 900 sq. m. It is intersected by the New Orleans Mobile and Texas R. R. Cap. Bay Saint Louis. P. 4239.

Hancock, county in N. W. Central Ohio. Area, 531 square miles. It has a fine fertile limestone soil. Cattle, grain, and wool are staple products. Lumber, flour, carriages, etc., are manufactured. It is traversed by the Lake Erie and Louisville and other railroads. Cap. Findlay. Pop. 23,847.

Hancock, county of Tennessee, bounded on the N. by Virginia. Area, 220 square miles. The surface is mountainous. Iron ore is found. The county is traversed by Clinch River. Corn is the principal product. Cap. Sneedsville. Pop. 7148.

Hancock, the northernmost county of West Virginia, at the extremity of the "Pan Handle," having the Ohio River and the State of Ohio on the W. and N., and Pennsylvania on the E. Area, 100 square miles. The surface is broken, but fertile and well cultivated. The county is famous for its excellent wool. Coal is mined, and brick is manufactured from fire-clay, which abounds. Cap. Fairview. Pop. 4363.

Hancock, tp. of Hancock co., Ill. Pop. 926.

Hancock, post-tp. on Frenchman's Bay, in Hancock co., Me., 9 miles E. of Ellsworth. It has four churches and some manufactures. Pop. 974.

Hancock, post-v. in Washington co., Md., on the Potomac River, opposite Hancock Station, Morgan co., West Va., on the Baltimore and Ohio R.R. It has several churches, and is traversed by the Chesapeake and Ohio Canal. Pop. of v. 860; of tp. 2139.

Hancock, a long and narrow post-tp. of Berkshire co., Mass., on the New York line, 158 miles W. of Boston. It has some manufactures of woollen and other goods, and is an excellent agricultural township, though mountainous. It has a settlement of Shakers in the S. part. There are many striking and picturesque views in this town. Pop. 882.

Hancock, tp. and post-v. of Houghton co., Mich., in the Lake Superior copper-region, is on Portage Lake, opposite Houghton. Pop. of tp. 2700.

Hancock, tp. of Carver co., Minn. Pop. 632.

Hancock, post-tp. of Hillsborough co., N. H., 36 miles S. W. of Concord. Pop. 692.

Hancock, post-v. and tp. of Delaware co., N. Y., on the Erie R. R., and near the Midland and Oswego R. R., 40 miles from Delhi. It has 2 newspapers, a graded school, 4 churches, 3 hotels, flouring-mills, shops, 12 stores, etc. Principal business, lumbering. Pop. of tp. 3069.

Ed. "Hancock Times."

Hancock, post-tp. of Addison co., Vt., 38 miles S. W. of Montpelier. Pop. 430.

Hancock, post-tp. of Waushara co., Wis. Pop. 438.

Hancock (John), LL.D., b. at Quincy, Mass., Jan. 12, 1737, was the son of the Rev. John Hancock. He graduated at Harvard in 1754, and in 1764 inherited the business and the greater part of the large fortune of Thomas, his uncle, in whose counting-house he had been trained to business. The young Hancock was present in 1760 at the coronation of George III. In 1768 his sloop Liberty was seized for evading the laws of commerce, and a riot followed; and in 1770 he delivered a fearless and eloquent address at the funeral of those slain at the Boston massacre. In 1774 he was president of the Provincial Congress. From 1775 to 1777 he was president of the General Congress at Philadelphia. He was the first of the signers of the Declaration of Independence. He was made in 1778 major-general of militia, and served in Rhode Island under Sullivan. He was governor of Massachusetts 1780–85; member of Congress 1785–86; again governor 1787–93, and held at times various other offices of honor. He was a man of strong and decided character, and dignified, courtly, and pleasing manners, and made a liberal use of his large fortune for benevolent purposes. D. Oct. 8, 1793.

Hancock (John), b. in Alabama Oct. 29, 1824; admitted to the bar in 1846; settled in Texas; elected judge of the district court in 1851; resigned in 1855; was in the legislature of 1860–61, when he was excluded for refusing to take the oath to support the Confederate constitution; was in the constitutional convention of Texas in 1866, and elected to the 42d, 43d, and 44th Congresses. Resides in Austin, Tex.

Hancock (WINFIELD SCOTT), b. in Montgomery co., Pa., Feb. 14, 1824; received his early education at the Norristown (Pa.) Academy, and in 1840 was appointed a cadet at the U. S. Military Academy, from whence he was graduated, and promoted in the army to be brevet second lieutenant of infantry July 1, 1844, receiving his full commission of second lieutenant in 1846; promoted to be first lieutenant 1853; in 1855 he was transferred to the quartermaster's department with the rank of captain; promoted to be major in same department 1863. For more than two years subsequent to his graduation he served on frontier duty; in the war with Mexico (1847–48) he served with his regiment at San Antonio, Churubusco, Molino del Rey, and the assault and capture of the city of Mexico, where he displayed conspicuous gallantry, receiving the brevet of first lieutenant for Contreras and Churubusco. From 1848 to 1855 he served with his regiment in the West, as quartermaster 1848–49, and adjutant 1849–55, when he was transferred to the quartermaster's department, on which duty he served in Florida during the Seminole hostilities, in Kansas during the disturbances of 1857, and in California, at Los Angeles, as chief quartermaster of the southern district, where we find him at the outbreak of the civil war in 1861, and where he exerted a powerful influence during that eventful period. Relieved from duty in California at his own request, he repaired to Washington and applied for active duty in the field; was assigned to Kentucky as chief quartermaster of Gen. Anderson's command, but before entering on that duty he was (Sept. 23, 1861) appointed a brigadier-general of volunteers; his subsequent history during the war is substantially that of the Army of the Potomac. During the fall and winter of 1861–62 he commanded a brigade at Lewinsville, Va.; in Mar., 1862, he accompanied Gen. McClellan's army to the Peninsula, being actively engaged with his command at the siege of Yorktown and the subsequent pursuit which resulted in the battle of Williamsburg, where he led the brilliant charge which captured Fort Magruder and gained the day. His services at the battles of Golding's Farm, Garnett's Hill, Savage's Station, and White Oak Swamp, and during the retreat to Harrison's Landing, were conspicuous and valuable; and the brevets of major, lieutenant-colonel, and colonel U. S. A. were conferred upon him, and he was recommended by General McClellan for promotion to major-general. He took part in the movement to Centreville, Va., Aug.–Sept., 1862; in the Maryland campaign he led his brigade at Crampton's Pass, South Mountain, and at Antietam, where he was placed in command of the 1st division 2d corps on the death of Gen. Richardson; Oct. 10–11, 1862, he conducted an important reconnaissance from Harper's Ferry to Charlestown, Va. Promoted to be major-general of volunteers Nov. 29, 1862, he continued in command of 1st division 2d corps, which he led at Fredericksburg, Dec., 1862, in the assault on Marye's Heights, and at Chancellorsville, May, 1863; in the following month he was placed in command of the 2d corps. At Gettysburg (July 1, 1863), after Reynolds had fallen, Hancock was sent forward from Taneytown by Gen. Meade to assume command; arriving on the field just as the rear of the beaten Union army was coming through Gettysburg, he at once made his presence felt, and after staying the retreat, extended the Union lines to Culp's Hill, when it was enabled to check the enemy's further advance. Perceiving its advantages, Gen. Hancock sent Gen. Meade such a report of the nature of the vicinity of Gettysburg as determined him to fight his battle there. On the following days (July 2–3), Hancock commanded the left centre, repulsing the grand final assault of Lee's army, July 3, himself falling severely wounded at the moment of victory. For his conspicuous services at Gettysburg, Gen. Hancock received the thanks of Congress. Because of his wounds he was disabled from resuming active duty till Dec., 1863, when he returned to the command of his corps; the army, however, being in winter-quarters and inactive, Gen. Hancock was requested to proceed to the North for the purpose of stimulating the recruiting of volunteers, much needed to fill the diminished ranks of his corps. His great reputation and popularity made his mission eminently successful, and at New York, Philadelphia, Boston, Albany, and other places visited he was tendered public receptions and the freedom of the cities. In Mar., 1864, he returned to his command, and in the campaign of that year, though still suffering from his wound, he bore a prominent part; in the battle of the Wilderness (May 5–7) his command amounted to more than 50,000 men; at the battle of the Po (May 10) he commanded the 2d and 5th corps, as well as in the assault near Spotsylvania Court house, May 12; at Spotsylvania he led his corps in its famous assault on the enemy's works, capturing upwards of 4000 prisoners, 20 pieces of artillery, and thousands of small-arms; in the subsequent operations of the army, including Cold Harbor and the assault of the lines before Petersburg, Gen. Hancock was conspicuous and indefatigable until compelled (June 17) by the outbreaking of his Gettysburg wound to relinquish his command for ten days, when he returned to the command of his corps in front of Petersburg. On Aug. 12 he was appointed a brigadier-general in the regular army. During the months of July and August the battles of Deep Bottom and Ream's Station, and of Boydton Plank-road (Oct. 27), were fought under his direction and command. In Nov., 1864, he was selected to organize the 1st army corps of veterans, remaining in Washington on that duty until Feb., 1865, when he was assigned to the command of the middle military division, and in July to that of the middle department; which latter he held until Aug., 1866, when he was transferred to the command of the department of Missouri, having in the mean time (July 26) relinquished his volunteer commission and been promoted to be major-general in the regular army. While commanding this department he conducted an expedition against hostile Indians on the Plains. From Sept., 1867, to Mar., 1868, he commanded the department of the Gulf; the military division of the Atlantic, Mar., 1868, to Mar., 1869; the department of Dakota 1869–72, when he was assigned the command of the division of the Atlantic, which he holds at this date. In 1869 the Democratic nomination for governor of Pennsylvania was tendered him, but declined. He was nominated June 24, 1880, by the Democratic Convention at Cincinnati, O., for President of the United States, but was defeated at the ensuing election. GEO. C. SIMMONS.

Hand, county of S. E. Central Dakota. Area, 1008 square miles. It is as yet unorganized, and is not settled to any extent by white inhabitants.

Händel (GEORG FRIEDRICH) was b. in Halle, Saxony, Feb. 23, 1685; d. in London Apr. 14, 1759. His father, designing to educate him as a doctor, kept him from the public schools; he forbade him any instrument, and took every other means to suppress his uncommon love of music. Händel, however, secretly taught himself to play on an old spinnet hidden in his garret. At eight years of age he was so proficient that when on a visit at the court of Saxe-Weissenfels, the duke, who overheard him playing on the chapel organ, exacted from the surprised father a promise that the boy should be educated as a musician. He commenced his studies at once under Zachau, organist of Halle. During the five years spent there he analyzed all the most important German and Italian compositions of that epoch, passed the severe ordeal of fugue and counterpoint, and finally composed every week a motet or a cantata for the church of Halle. At thirteen (1699) he was sent to study the operatic school in Berlin, where he remained but a short time with the amiable Ariosti and the vain Bononcini, who was already jealous of his genius. He next entered as a violinist the opera-house at Hamburg. His playing was poor, and for a while he won little else than sneers from his fellows: but at nineteen (1704) he one day assumed the direction of the orchestra during the absence of the leader, and displayed such ability that he was at once advanced to that position. He was invited to be organist of Lübeck, on condition that he would marry the daughter of the retiring organist, but he refused both the maid and the place. As composer he came into rivalry with Mattheson, his best friend. In a trifling professional dispute Händel's temper led them to fight a duel; Mattheson's sword broke on a button upon Händel's breast; they were then reconciled, and soon after reunited in friendship closer than ever before.

He now determined to visit Italy. With uncommon independence he refused money offered to aid his development, and preferred to earn his own privileges by giving lessons and practising economy. At twenty-one (1706) he came to Florence. At this age he was eminent as an organist and learned in the severe, scientific style of composition. But his early works are somewhat dull, lacking melody and sentiment. During two years he lived in Florence, Vienna, Rome, and Naples, composing operas which earned him some reputation, but little money. Failing to obtain an engagement, he returned to Germany. At twenty-five (1710) he was made chapel master to the elector of Hanover (afterwards King George I. of England) and given a salary of $1,500. While there he gained in grace and melody from an association with the elegant Italian composer Steffani. The elector twice gave him leave to visit London. On his second visit (1712) he received a pension of $1000 from Queen Anne, and unceremoniously prolonged his absence to a permanent residence. In 1714 the elector ascended the throne of England, and, naturally being angry with Händel, forbade him the court. But London was full of Händel's music, and it was not easy to ignore him. He wrote his *Water Music* for a royal festival on the Thames, and it so

charmed the king that he forgave his truant chapel-master and raised his pension to $2000. For a few years he lived under the roofs of Lord Burlington and of the duke of Chandos, enjoying the patronage of the nobles, the society of wits and poets, and a quiet, studious life. At thirty-five (1720) he was appointed director of the Royal Academy of Music at the Haymarket Theatre. Then commenced a period of twenty years in which he passed through the severest trials of party warfare. His haughty, irritable manner soon created enemies amongst his patrons and his singers, who formed a rival opera-troupe, in which Bononcini and other celebrated composers led the most eminent artists of the day. He poured from his fertile brain scores of mediocre Italian operas, generally lacking the charming qualities of the Italian school, which just then were the demand of the times. Some of these works had a short run on the stage, but most of them fell dead. An occasional performance of an oratorio or of sacred music upon the organ brought the people eagerly about him, but notwithstanding this hint he obstinately continued to follow opera, the success of his youth, the failure of his vigorous manhood. He gradually lost his noble patrons, social position, health, fortune, passed twice through bankruptcy, and finally sank into neglect, almost oblivion. Not till he was fifty-five years old (1741) did Händel give himself entirely to oratorio, his true work. He had written up to this time about 100 large works, only a few of which are now alive, and he wrote afterwards but a few, each of which is now a familiar masterpiece. Händel, more than any other composer, was made of sturdy Saxon strength, for which only the solemn, grand oratorio was a complete expression. It is therefore equally surprising and unfortunate that he passed the best twenty years of his life in fruitless efforts to become an Italian. The people of Dublin, for whom he wrote his greatest work, *The Messiah*, were the first to believe and prove the full height of his genius. By this and other oratorios he suddenly rose to the pinnacle of fame, and before his death became the idol of the English. He was stricken blind in 1751, but notwithstanding this calamity his closing years were prosperous and happy. He was buried in Westminster Abbey with the grandest ceremonies that could be devised.

Händel's industry was extraordinary. After his first years in London he refused to be a member of any household, established himself in his own rooms, and declined all invitations. The time not used in his theatrical duties he passed in writing with prodigious rapidity or in playing on his clavecin, the keys of which were worn out like spoons. He wrote *Israel* in twenty-seven days. He associated with only three friends—Smith, his copyist, Goupy, a painter, and Hurter, a dyer. It is believed that he never loved a woman, and was a strict celibate. He was economical in his personal expenses, but not parsimonious. There is no doubt of his honesty. The concerts given him during the last years of his life enabled him to pay his debts, leave $5000 to the Foundling Hospital of London, and $100,000 to his poor relatives in Germany. He was very fond of pictures, which were his only interest besides music. He was uncommonly isolated in his profession, having no companionship with musicians, and but little interest in their productions. Excepting a smattering of Latin, he knew almost nothing but music and the Italian language. Even his long residence in London did not teach him good English. His speech was a strange and often a comical mixture of German and Italian idioms. Though at times haughty and irritable, he was not ill-natured or unkind, and in his prosperous days he was even a genial companion, whose conversation flowed freely, in form grotesque, but vigorous with good sense and sparkling with humorous satire. His only dissipation was an occasional excess in wine. His figure was large and imposing, having considerable embonpoint, which made his walk and other movements heavy and ungraceful. His constitution, physical, mental, and moral, must have been of the strongest type to withstand so well his harassing and exhausting life. His massive face preserved its pleasant expression to the last, despite his outer and inner wars. His violent temper at times knew no restraint. When Cuzzoni once refused to sing a certain song, he seized her by the arm and attempted to throw her out of a window. The orchestra on one occasion took their places, unconscious that their instruments were not tuned; they commenced, of course, with a frightful discord. He rushed through their ranks, snatched up the kettledrum and threw it at the head of the leader, jumped upon the stage, losing his wig, and there, in the blaze of the footlights, stamped and choked with rage till the prince of Wales finally calmed him to his senses.

The prominent characteristics of Händel's music are sublimity and strength. Around these, grouped in secondary importance, are other qualities equally precious. He excelled all other composers in writing choruses, in which vigor of thought and clearness of form unite to carry the interest in crescendo through the most colossal effects. Mozart reverenced Händel, and declared it impossible to increase the power of these pieces. Beethoven bowed before his grandeur, which was attained by means he considered marvellous in simplicity. His most remarkable works are the oratorios *The Messiah*, *Judas Maccabæus*, *Israel in Egypt*, and *Samson*. He wrote no fewer than 52 operas, 23 oratorios, 22 compositions for the church, 13 for chamber-music, and 3 collections for organ and piano—in all 113. This amount is enormous when it is known that most of the works are colossal in conception and proportion.

C. H. Farnham.

Hand'icapping, in horse-racing, yachting, and other sporting contests, is the attempt to place all competitors upon equal terms. Thus, of two horses the one which has been found superior is made to carry such extra weight as it is thought will give his competitor a fair chance of winning the race.

Hand'ley (George) was b. near Sheffield, England, Feb. 9, 1752; emigrated to Savannah, Ga., in 1775; served actively throughout the Revolutionary war as an officer on the side of the colonies: afterwards held many public offices; was governor of Georgia in 1788, and collector of the port of Brunswick 1789–93. D. at Rae's Hill, Ga., Sept. 17, 1793.

Hands'boro', post-v. of Harrison co., Miss., 1 mile N. of the Gulf of Mexico, on Bayou Bernard, near its confluence with Biloxi Bay, and within 1 mile of the New Orleans Mobile and Texas R. R., midway between New Orleans and Mobile; lat. 30° 28′ 25″ N., lon. 89° 6′ 13″ W. It has 5 churches, 6 schools, 1 printing, 1 book-bindery, and 1 job office, 1 literary society, 3 large saw-mills, 3 planing-mills, 5 large stores, 1 machine-shop, a carriage-shop, 1 ship-yard, 1 newspaper, etc. It is a watering-place. Exports about 100,000 pounds of wool and 10,000,000 feet of lumber annually. Pop. 459. P. K. Mayers, Ed. "Democrat."

Hand, Structure of the. *In Mammals.*—The hand (*manus*) in mammals is the foremost extremity, and always present, though often very much modified. When contrasted with the foot in size, there is much variety. The kangaroo has a small hand and a large foot. In the mole there is a broad shovel-shaped hand and a delicate foot. The sloth has an immensely long hand. The foot of the beaver and seal is much larger than the hand. The differences between the hand and foot usually consist in greater delicacy and slenderness of the fingers, with corresponding refinement of function, since the hand has the more to do in protection, defence, nourishment, and delicate operations than has the foot, which is mainly of use in propelling and maintaining the attitudes of the body.

The hand presents the carpus, metacarpus, and phalanges for study, corresponding in general plan of structure to the tarsus, metatarsus, and phalanges of the foot. The relative dimensions of these parts vary exceedingly. The hoofed animals, the elephant, and those animals which use the fore legs mainly for support, have short and robust bones. On the other hand, the bat and pterodactyl have enormously developed fingers to support the web which gives them the wing. Climbing animals have the whole hand developed into slender and delicate manipulating organs. And in general, animals which do not enjoy *free lateral movements* of the fore legs have small and diminutively modified hands. The typical idea of the hand is so nearly the same with the foot that reference is made for information to the article on Foot, Structure of the.

The Human Hand.—The human hand is probably the most remarkable organ, not vital, in the whole animal kingdom. Its mechanism is somewhat complicated, and quite unlike human machinery, and its sensitiveness, suppleness, delicacy of movement, and beauty of form are marvellous in the range of animal organisms. "The consummation of all perfection as an instrument," says Sir Charles Bell. The hand bears a very close relation in its plan of structure to the foot, or is the analogue of the foot. Thus, the foot has a tarsus of seven bones, a metatarsus of five, and phalanges numbering fourteen. The hand has its carpus of eight bones, its metacarpus of five bones, and fourteen phalanges. And each of these members is joined to the two bones of the limb above it. The ideal structure of the hand is well shown by the diagram devised by Dr. G. M. Humphry of Cambridge, England, and the exact framework of the hand is seen in the cut from Holden's *Osteology*. The carpus is united to the radius and ulna by its peculiar articulations, which permit the motions of the hand as a whole in all directions, and almost as perfectly as the ball-and-socket joint. The eight bones of the carpus are arranged in two more or less complete rows running across the hand. The peculiar arrangement of the two

rows, and four segments in each row as represented in the eight bones, is designed to give flexibility, suppleness, and

FIG. 1.

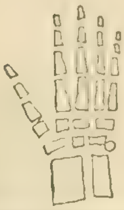


Diagram of the Human Hand.

FIG. 2.

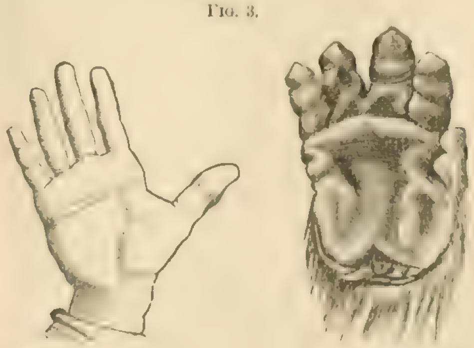
Bones of the Hand.

the peculiar strength to resist violent blows which the hand must so often receive. The long metacarpals, five in number, give the back and palm of the hand, which furnish a broad and firm surface for the apposition of the fingers in grasping anything and delicately manipulating minute and multiform objects. The slenderness and delicacy of the fingers are what give the elegant and beautiful proportions to the hand. To which, if we add the extensive mobility of the various parts, the flexion, extension, pronation, supination, adduction, and abduction of the organ and its parts, we see where all human machinery falls far short of the divine. The supination and pronation, or the turning of it on its longitudinal axis, is a prominent characteristic of the human hand. No animal equals or nearly approaches man in this respect. And the muscles which enable him to *point with the index-finger* are supplied to man alone, thus indicating a superior grade of being in him, as this movement could only be required for higher purposes than mere sense gratification or means of gaining a subsistence or self-protection.

Why are the fingers of different lengths? Regarding it in a typical sense, Prof. Owen says it is in obedience to the law of "simplification of the digits" (see FOOT, STRUCTURE OF THE), or that the longest digit is the most permanent one, and the shortest the first to disappear. Thus, the thumb (*pollex*), or first digit, is the shortest, the fourth finger, or fifth digit, the second in length, the second digit the next, the fourth next, and the third digit, or second finger, the longest of all. Another reason of the unequal lengths of the fingers is shown by placing a small rod—say, a Faber's lead-pencil—across the palm of the hand, and bending the fingers' ends down upon it. In this experiment we shall see that all the tips of the fingers reach the pencil at the same instant and press upon it with nearly equal force. This shows us that the lengths of the digits and the muscles controlling them are so arranged as to make the hand most effective in grasping even small objects.

Each hand with its fingers is moved directly by thirty-one pairs of muscles, which are located between the elbow-joint and the tips of the fingers. They vary in length from about 18 inches to 1 inch in length, and many of them are provided with very long tendons. Those of peculiar interest are the two used in flexing the fingers. These have their origin near to the elbow-joint, their fleshy portions lie one above the other in the fore arm, and their tendons are attached to the inner surface of the base of a part of the phalanges. The most superficial one sends its tendons to the second phalanx of the first, second, third, and fourth digits, and the other (deepest one) sends corresponding

FIG. 3.



The Human Hand. Hand of the Gorilla.

tendons to the last phalanx of the same digits. But in order to secure slenderness and delicacy to the fingers, with strength also, a peculiar mechanical arrangement is devised. The tendon supplying the second phalanges is split just above its point of attachment, so as to allow the tendon sent to the third phalanx not only perfect facility of motion, but also to supply the place of ligaments to keep it in place as it passes by the joint. Thus, both of these sets of tendons can act singly or conjointly; and not only does each set act by itself, but each division of the muscle may act on its own finger if the will only so directs. The relative lengths of the fingers of man and the gorilla are shown in Fig. 3.

Another interesting point in the muscles of the hand is, that the thumb and little finger are the most abundantly supplied with muscles, and hence muscular power. This is so arranged in order that the hand may more firmly grasp any object, and be especially efficient in the acts of pronation and supination; and peculiar care is always exercised by the surgeon in treating a mutilated hand to save, if possible, one or both of the extreme digits, as they are of much more relative importance in manipulation than are the other digits.

The sensitiveness of the skin of the hand to external impressions is one of the most important characteristics of this organ. This property resides in minute elevations of the skin, called *papillæ*. These measure from the $\frac{1}{100}$th to the $\frac{1}{200}$th of an inch in height, and contain always a lymphatic, blood-vessels, and nerves. They are the most numerous on the palm of the hand and at the tips of the fingers, rather than at the other joints. Thus, on a square line of the palmar surface of the tip of the last joint of the fore finger are 108 papillæ; on the second joint, same space, 40; and on the first phalanx, 15. It has been assumed that each nerve-fibre ends in a pencil of delicate filaments which gives sensibility over a circular or oval area of the hand covering $\frac{1}{400}$th of a square inch; and on many of the terminal nerve-fibres of the hand and foot, in addition to the simple filaments, there are minute oval bodies found somewhat sparsely, and very small, called "Pacinian bodies," which doubtless aid the sense of touch. The theory of touch is that pressure gives the sensation. But if this be the case, why does tickling with a feather or a speck in the eye produce so marked an impression? The sense of touch is more improvable by education than any other of the senses. This is well seen in blind people, who use their fingers as eyes with great delicacy of perception; the Bengalese throwsters are able to detect by touch twenty degrees of fineness in the fibres of the cocoon. EDWARD HITCHCOCK.

Hand Tree [Sp. *manita*], the *Cheirostemon platanoides*, a tree of Central America, rarely found in Mexico, where it was anciently worshipped. It is one of the order Sterculiaceæ. It resembles the plane and buttonwood tree in appearance. Its flower has no corolla, but its large calyx has five curved anthers, bearing some resemblance to a hand, whence the name.

Han'dy, tp. of Livingston co., Mich., traversed by the Detroit Lansing and Lake Michigan R. R. Pop. 1306.

Ha'ney, tp. of Crawford co., Wis. Pop. 489.

Hang-Chow-Foo, city of China, the capital of the province of Che-Kiang, on the Tsien-Tang-Kiang, 20 miles from its mouth in the bay of Hang-Chow-Foo, at the beginning of the Great Canal. It is one of the largest, most important, and most elegant cities of China, built in the true Chinese style, with narrow streets and only one-story houses, but with many rich and magnificent temples and other public buildings. Its manufactures of silks and satins are very celebrated, and its trade extensive. Its population is estimated at 800,000.

Hanging. See CAPITAL PUNISHMENT, EXECUTION, GALLOWS.

Hanging Gardens of Babylon, one of the Seven Wonders of the World (according to an ancient estimate), consisting of a succession of terraces supported by columns, and containing an area of about four acres, covered with groves, gardens, and fountains, and having a great reservoir at the top, supplied with water from the Euphrates. The mound El Kasr in the ruins of Babylon is thought to represent them. The hanging gardens were ascribed variously to Nebuchadnezzar, Semiramis, and others.

Hanging Grove, tp. of Jasper co., Ind. Pop. 393.

Han-Keoo, or **Han-Kow**, city of China, the capital of the province of Hoope, in the centre of China proper, at the confluence of the Han and the Yang-tse-Kiang, which here is navigable for large vessels. It has recently been opened to foreigners, and seems destined to become one of the great commercial centres of the world. Properly, it consists of several cities, Han Yang and Woo Chang, on opposite sides of the Han River. Pop. estimated at 800,000.

Han'ley, town of England, in the co. of Stafford, in the district called "The Potteries," forms, together with Shel-

ton, one town, and has 39,912 inhabitants, who are mostly engaged in the manufacture of earthenware and china.

Han'na, tp. of Henry co., Ill. Pop. 964.

Hanna, tp. of La Porte co., Ind. Pop. 486.

Han'nah (John), D. D., b. in Lincoln, England, Nov. 30, 1792; joined the Wesleyan conference in 1814, and became theological professor in Didsbury College in 1842. He was president of the Wesleyan conference in 1842 and 1851. He twice represented the Wesleyan Church before the General Conference of the American Methodist Episcopal Church, and d. at Didsbury Dec. 29, 1867.

Han'nahsville, tp. of Tucker co., W. Va. Pop. 433.

Han'nibal, city of Marion co., Mo., on the W. bank of the Mississippi River, 150 miles above St. Louis (by river), on the lines of the Hannibal and St. Joseph, the Missouri Kansas and Texas, the Toledo Wabash and Western, and the Mississippi Valley and Western R. Rs. It has 15 churches, 1 college, 7 public and several private schools, 1 daily and 2 weekly newspapers, 4 banks, 1 iron-foundry with machine-shops, extensive car-works, about 300 business establishments of all kinds, and a paid steam fire department. The extensive machine-shops and general offices of the Hannibal and St. Joseph R. R. are located here, and the Toledo Wabash and Western R. R. crosses the Mississippi River at this point upon a splendid iron bridge built in 1872. It has a very large lumber-trade with Missouri, Kansas, and Texas, the annual sales of this article reaching about 150,000,000 feet. The city is handsomely located and substantially built, with many fine residences upon the surrounding hills. Pop. 10,125.

J. R. Winchell, Ed. "Daily Courier."

Hannibal, post-v. and tp. of Oswego co., N. Y., 11 miles S. of Oswego, on the Lake Ontario Shore R. R. It has 3 churches, a graded school, a weekly newspaper, 1 stave and 2 barrel factories, mills, tanneries, and 5 stores. Pop. 454; of tp. 3234. A. N. Bradt, Ed. "Reveille."

Hannibal, one of the greatest generals and one of the most interesting characters of antiquity, was b. at Carthage 247 B. C. Carthage was at that time the largest and most opulent city on the Mediterranean. It had about 700,000 inhabitants, large dependencies in Africa, Sicily, Sardinia, Corsica, and Spain, and it could boast of an enterprise which never had been equalled; it worked the silver-mines of Spain and the tin-mines of Britain; it sent its vessels into the Baltic and its caravans to the Nile and the Niger. But it was only a commercial community. With the exception of a few inscriptions and a number of coins, the only monument it has left of itself is the name of Hannibal, and his history has been written by foreigners. The principal source is Polybius, who travelled over the route Hannibal had taken from Spain to Italy, and who conversed in Italy with many who had been eye-witnesses to his exploits. The next in importance is Livy; Plutarch and Cornelius Nepos have also interest. The first encounter between Rome and Carthage took place in Sicily. Both wished to come into sole possession of this beautiful island—the one for the sake of power, the other for the sake of gain. But after a protracted contest (the first Punic war, 264–241) Carthage had to sue for peace and give up all its possessions in the islands of the Mediterranean. Hamilcar Barca, the father of Hannibal, who had fought with great success against the Romans, and who at once saw his own fame destroyed and an enormous loss inflicted on his native city by the disaster of Hanno at the Ægates Isles, made his son swear on the altar eternal hatred to Rome; and the fulfilment of this oath became the object of Hannibal's life. He had only one passion—hatred to Rome; and all the glowing enthusiasm of his soul, all the great virtues of his character, all the wonderful fertility of his mind, were concentrated in this hatred. He grew up in his father's camp in Spain, but when Hamilcar died (in 229) he returned to Carthage, where he lived for four years. In 224 he returned to the army, and by Hasdrubal, his brother-in-law, was appointed commander of the cavalry. In 221, Hasdrubal was killed, and by acclamation the army chose the young Hannibal for its commander-in-chief. He accepted, and, feeling himself strong enough to act without the sanction of his government, he immediately turned the war from a war for gain into a war of hatred—from a war against Spain into a war against Rome. Saguntum was in alliance with Rome. With an army of 150,000 men Hannibal laid siege to it, and after a desperate resistance of eight months it was taken and razed. Rome demanded the surrender of the young general, and when the Carthaginian government hesitated and sought evasions, probably on account of the army, war was declared (the second Punic war, 219-201).

It was the plan of the Roman generals to carry on the war in Spain, and P. Cornelius Scipio the Elder was on the way thither with an army. But Hannibal wished to strike a deadly blow, and he thought that Rome would be much stronger in Spain than in Italy, partly because its Italian allies would cling more closely to it on a foreign soil, partly because the least reverse of fortune would give his own Spanish allies a chance of choice. He immediately broke up with his army, crossed the Pyrenees, the Rhone, and the Alps, and stood, after a march of five months, in the middle of Nov., 218, on the plains of Lombardy, at the Ticinus. It is uncertain at which point he crossed the Alps, but Polybius, who had seen the Alps himself, and who knew something about what it means to move an army, has a just appreciation of the tremendous magnitude of the undertaking, and gives a short but impressive description of the difficulties which Hannibal met with, and the ingenuity with which he encountered them. The crossing took fifteen days—the ascent nine, the descent three, and three were spent on the top in making some passages of the descent practicable. The army numbered 50,000 foot, 9000 horse, and 37 elephants when it encamped at the northern foot of the Alps; 20,000 foot, 6000 horse, and 1 elephant when it reached the southern. Here stood Scipio, who waited for them. He was defeated, however, in the battle of the Ticinus, chiefly by the superiority of the Numidian cavalry, and shortly after Sempronius was totally routed in the battle of the Trebia; thus the first year of the campaign ended. Next year (217) two new Roman armies under the two consuls, Servilius and Flaminius, stood ready to take up the contest with the invader; but Hannibal, after a long and perilous march through the marshy regions of the Upper Arno, succeeded in bringing the army of Flaminius in such a position between Cortona and Lake Thrasymenus that he could attack it at once in the front and in the rear. The victory was complete; half of the Roman army perished, and the rest were taken prisoners; even a part of Servilius's army, which was sent to the support of Flaminius, was lost. In this emergency Rome proclaimed Q. Fabius Maximus dictator, and the manner in which this prudent and sagacious man carried on the war contributed very much to save the republic. He never gave battle, but he followed Hannibal from place to place like his shadow, and thus he at once procured time for Rome to complete its fortifications and armament, and deterred its allies from deserting it. Once he even succeeded in surrounding the enemy at Callicula in Campania, but in the night Hannibal let loose on the enemy 2000 oxen with bundles of burning hay tied to their horns, and in the consternation and bewilderment thus caused he escaped. In Rome, however, this manner of carrying on the war was not much appreciated. Fabius received the surname *Cunctator*, and the two consuls of the next year (216), C. Terentius Varro and L. Æmilius Paulus, felt themselves obliged to give battle. They commanded an army of 80,000 men, while that of the enemy numbered hardly 50,000, and in courage, fortitude, and military training the Roman soldiers were second to none. But the talents of the respective commanders were so unequal that in the battle of Cannæ, Hannibal not only won a decided victory, but completely destroyed the Roman army; between 40,000 and 50,000 men were killed, and the rest were scattered. This battle was his greatest exploit, and it became the turning-point of his fortune.

All people, statesmen as well as generals, have wondered at the manner in which Hannibal used this victory. Why did he not march upon Rome? Why did he go to Capua? But Hannibal was not a hero; he was only a calculator. His genius was far-sightedness, his talent was shrewdness. As far as his calculation reached his courage and ingenuity were inexhaustible, but at the point where the calculation stopped the whole man stopped. He saw that Rome would be weaker in Italy than in Spain, and he crossed the Alps in order to make the war in Italy. He saw that Rome would fall when all its allies deserted it, and with a shrewdness which is so much the more admirable as it was not mixed up with falsehood he alienated one after the other of the allies. But he could not see—nay, he could not even understand—that Rome could be taken in any other way—for instance, by attacking it in a moment of panic—and instead of marching directly on its gates after the battle of Cannæ, he went into winter-quarters in Capua. New elements came into play which were far beyond any calculation. His soldiers grew tired of the war, and during a few months' rest in Capua they lost their discipline. Reverses followed—not many nor great, but still reverses. He lost Capua (212), Tarentum (210), etc. The mere circumstance that the campaign had lasted three years, and Rome was still unconquered, made the allies very cautious, and the only moment in which they perhaps could have been gathered in a siege around Rome was neglected. Furthermore, when he asked for reinforcements from home, a cold answer was returned, for his countrymen could not

understand how he could need reinforcements after such victories; and when at last his brother Hasdrubal was sent with an army to his support, this army was surprised, defeated, and destroyed on the Metaurus (207). Thus, while we begin to read his history with admiration for the young hero who is going to conquer Rome, we finish it with admiration for the old calculator whom Rome could not conquer. For the most striking proof of the talent of the man is the circumstance that he maintained himself in Italy for sixteen years. In 203 he was recalled. Scipio had landed in Africa, Masinissa, king of Numidia, had allied himself with Rome, and the situation of Carthage was extremely hazardous. In a short time Hannibal organized a new army and defeated Masinissa, but he saw the danger of encountering Scipio with his young, inexperienced force, and tried to avoid him. Pressed, however, by his countrymen, he had to give battle, and was defeated at Zama (202). Peace was now necessary, and although the Roman demands were heavy and humiliating, Carthage had to submit. But Hannibal did not give up the aim of his life. As the chief magistrate of his native city he commenced a thorough restoration of its corrupted and depraved society. With unrelenting vigor he pursued the shameless ringleaders who monopolized the offices in order to embezzle the revenues, and soon Carthage was rising once more. But the diplomatic negotiations which he carried on with Antiochus the Great, king of Syria, gave Rome an opportunity of interfering. It demanded his surrender, and the enmity which his reforms had created against him in Carthage was so great that he had to flee. Thus baffled a second time in his plans against Rome, he found a new chance to try his fortune. A combined action of Carthage and Syria, which might have been the ruin of Rome, he could not bring about, but he succeeded in instigating Antiochus to begin the war alone. Antiochus was defeated, however, and the Romans demanded the surrender of Hannibal. Hannibal fled, and was received by Prusias, king of Bithynia. Shortly after Bithynia began war against Rome. But Prusias was defeated, and the Romans again demanded the surrender of Hannibal. There was now not one more point along the whole horizon from which an operation against Rome could be started with any prospect of success. Hannibal gave up; he opened the bead on his ring and swallowed the poison it contained (183 B. C.). CLEMENS PETERSEN.

Han'no, the name of many historic Carthaginians, among whom the following are especially noteworthy: HANNO, a navigator who (probably in 570 B. C.) set sail with sixty ships and a large number of intended colonists, and coasted southward along the shores of the African continent, founding several towns on the way. On his return he set up in a temple a tablet containing an account of his voyage. Of this tablet a Greek version, the *Periplus*, is still extant.—HANNO THE GREAT, in the third century B. C., was the leader of the aristocratic party and the chief opponent of Hamilcar Barca and of Hannibal his son. Hanno was himself an able general.

Hannon, tp. of Mason co., West Va. Pop. 1551.

Han'over, formerly an independent kingdom, since 1866 a province of Prussia, bounded N. by the German Ocean and the Elbe, E. by Mecklenburg and Prussian Saxony, S. by Hesse Cassel and Westphalia, and W. by the Netherlands. Its area is 14,672 square miles. Pop. 1,963,618, of which 1,713,711 are Protestants, 233,809 Catholics, and 12,799 Jews, and distributed as follows:

Landdrosteien	Area, sq. m.	Pop. in 1871.	Chief towns.	Pop. in 1871.
Hanover	2300	404,968	Hanover	104,213
Hildesheim	1708	407,585	Hildesheim	20,801
Lüneburg	[illegible]	[illegible]	Lüneburg	14,411
Stade	2595	[illegible]	Stade	8,269
Osnabrück	2388	[illegible]	Osnabrück	23,308
Aurich	1144	[illegible]	Aurich	4,712
Clausthal	241	33,981	Clausthal	9,052

With exception of the inhabitants of the districts bordering on the German Ocean and the Netherlands, who are of Frisian descent, the Hanoverians are Saxons. The lower classes speak Platt Deutsch (Low German), and in the districts bordering on the Netherlands, Dutch and Frisian. The southern part of Hanover is covered with hills and low mountains, branches of the Hartz, which here seldom rise to the height of 3000 feet. They are covered with dense forests, and are very rich in minerals—gold, silver, lead, iron, coal, and salt. In 1860, 191 coal mines were worked, employing 6463 men, and 124 iron mines, and the works are steadily increasing. In 1853 the produce of the coal-mines was 1,750,000 cwt.; in 1860 it was 6,550,000 cwt. The produce of the salt works in 1849 was 517,300 cwt.; in 1860, 719,831 cwt. The northern part of the country is a low plain. The basins of the rivers Elbe, Weser (with its affluent Leine), and Ems, all of which run to the German Ocean, are fertile, and the soil is well suited to agriculture. Rye and flax are grown in great quantities. In 1861 the products of the Hanoverian linen manufactures were 14,410,010 yards, worth 1,419,442 thalers. Along the German Ocean are extensive marshes and peat-moors. Wherever these marshes have been well drained, they afford excellent pasturage, and the trade in cattle is considerable; in 1860, [illegible] oxen were exported. A large portion of Central Hanover is occupied by the Lüneburg Heath, a sandy and unproductive tract, with no other resources than the rearing of sheep and bees, which latter forms an important industry.

The territory which forms the present province of Hanover belonged from ancient times to the family of Brunswick-Lüneburg, though it at some times was divided up very much between the different lines of the family. In 1692 it was made an electorate, and when in 1714 its elector, George Lewis, came to the English throne, it began to play quite a conspicuous part in the history of Europe. In 1814 it was made a kingdom by the Congress of Vienna, and in 1837, at the death of William IV., it fell to Ernest August, duke of Cumberland, as the Salic law, which excludes heirs female, prevented Queen Victoria from inheriting it. In 1866 it was conquered by Prussia, and incorporated by that kingdom as a province.

Hanover, capital of the Prussian province of Hanover, contains, together with the suburb Linden, 104,234 inhabitants. The Ihme, a tributary of the Leine, separates Linden, which has 16,617 inhabitants, from the city proper. The old city, irregular and partly old-fashioned, is surrounded to the N. and E. by new and elegant quarters which have arisen since 1840, and, steadily increasing, group themselves around the railway station. Magnificent promenades, due to the sovereign, who formerly resided here, extend to the N. W. of the city, and to the N., E., and S. a large forest, the Eileriede, surrounds it in a semicircle. The new quarters, of which Georg street, Theatre street, Schiller street, Dépôt street, and King street are especially noticeable, are distinguished by the original architecture of many of their buildings. The materials are brick; the style is consistent, grave, and dignified. A row of interesting villas in pure Pompeian style has recently arisen on the Schiffgraben, parallel with King street. The most remarkable public places are—the Bahnhofsplatz, surrounded with large hotels, and containing the equestrian statue of King Ernst August, 10 m. high, cast in bronze after a model by Wolff, and raised on a pedestal of granite; the Theatre Platz, in the centre of which stands the theatre, one of the largest and most beautiful in Germany, containing seats for 1800 persons, and built 1845–52 by Laves; the Georgs Platz, with the statue of Schiller by Engelhardt; the Markt, in the centre of the old city; and the Waterloo Platz, a parade-ground, with the Waterloo column, 46 m. high. The most remarkable buildings are—the Museum, in Sophie street, finished in the round style by Hase in 1856, and containing collections of art, history, and natural science; the Polytechnic School, in Georg street; the Lyceum, on Georgs Platz; the former town-house, in the market-place, a Gothic structure of the middle of the fifteenth century; the royal palace, an extensive building of the eighteenth century, situated on the Leine, and containing a chapel with a celebrated altar-piece by Lucas Cranach. The palace overlooks the Waterloo Platz, containing large barracks and a fine arsenal. On going from the palace to the Waterloo Platz, the statue of Gen. Count von Alten, who commanded the Hanoverians at Waterloo, stands to the right, and behind it the library building arises, containing 170,000 volumes and 3000 MSS., among which are the literary bequests of Leibnitz. A monument to Leibnitz, consisting of a circular temple containing his bust, stands on a hill near the library, on the Waterloo Platz. The most remarkable churches are—the Market church, of the fourteenth century, restored in 18[illegible], with a quadrangular tower 90 m. high, and containing some beautiful glass-paintings and an altar carved in oak wood; Christ church, built of brick and finished in 1864 by Hase, also containing fine glass-paintings. Hanover has not many churches, and, with exception of the above mentioned, they are not beautiful. In the vicinity of Hanover stands the palace, Herrenhausen. It is situated in an extensive park laid out in French style by Le Nôtre, and containing a fountain more than 35 m. high and fine hothouses. Connected with the palace is an art-gallery with a collection of antique and modern sculptures. An avenue of linden trees, one of the most beautiful avenues which exist, two kilomètres long, 36 mètres broad, planted with four rows of old trees and provided with excellent drives, rides, and pathways, stretches from Hanover to Herrenhausen, and is on both sides surrounded with magnificent promenades, which on

the western side extend to Georgs Park. To the E. of the avenue the colossal Welfenschloss arises, in the round style, with five towers; the interior, however, has remained unfinished since the annexation to Prussia. The Eilenriede contains a zoological garden, with many tasteful buildings.

Hanover is first mentioned in history in 1163. It was at that time the residence of Henry the Lion, and with a few interruptions it remained in the possession of the Guelphs up to the present century. In 1481 it entered the Hanseatic League, and soon its commerce and wealth arose considerably. It suffered, however, very much from internal disturbances, brought on by the introduction of the Reformation. In 1837 it became the residence of the king of Hanover, and from that time it has made steady progress; especially since its annexation to Prussia it has increased both in size and splendor. AUGUST NIEMANN.

Hanover, county in the E. of Virginia. Area, 400 square miles. The soil and surface are varied, a portion being very fertile. Tobacco and grain are staple products. Flour is the leading article of manufacture. The county is traversed by the Chesapeake and Ohio and the Richmond and Fredericksburg R. Rs. Cap. Hanover Court-house. Pop. 16,455.

Hanover, post-tp. of Coosa co., Ala. Pop. 545.

Hanover, a v. of Clinton co., Ill., 45 miles E. of St. Louis. (P. O. name, GERMANTOWN.) It is inhabited by Germans. Pop. 391.

Hanover, tp. of Cook co., Ill. Pop. 1098.

Hanover, tp. of Jo Daviess co., Ill., on the Mississippi River. Pop. 1191.

Hanover, tp. of Jefferson co., Ind., on the Ohio River. Pop. of Hanover post-v. 564; of tp. 1399.

Hanover, tp. of Lake co., Ind. Pop. 973.

Hanover, tp. of Shelby co., Ind. Pop. 1572.

Hanover, tp. of Allamakee co., Ia. Pop. 550.

Hanover, tp. and post-v. of Oxford co., Me., on the Androscoggin River, has manufactures of woollens, flour, lumber, leather, furniture, and other goods. Pop. 188.

Hanover, post-tp. of Plymouth co., Mass., 26 miles from Boston, on the Hanover branch of the Old Colony R. R. It has 4 churches, an academy, a high school, and manufactures of iron, boots and shoes, lumber, etc. Here the first cast-iron ploughs were made, and the anchors of the frigate Constitution were forged. This town is fertile and pleasant. There was formerly considerable shipbuilding on the navigable North River. Pop. 1628.

Hanover, tp. and post-v. of Jackson co., Mich., on the Fort Wayne Jackson and Saginaw R. R., 14 miles S. S. W. of Jackson. Pop. 1093.

Hanover, tp. of Wexford co., Mich. Pop. 112.

Hanover, post-v. and tp. of Grafton co., N. H., on the Connecticut River, 73 miles from Portsmouth and 59 from Concord by railroad. It has 4 churches, 1 national and 1 savings bank, 1 weekly newspaper, and 1 hotel. It is also the seat of DARTMOUTH COLLEGE (which see). Lumber is manufactured to a considerable extent. Principal business, farming. Pop. of tp. 2085.

Hanover, tp. and post-v. of Morris co., N. J. The township contains numerous villages. Pop. of tp. 3623.

Hanover, tp. of Chautauqua co., N. Y., on Lake Erie, is a fertile tract, and contains several manufacturing villages, among which are Forestville, Irving, and silver Creek. Pop. 4037.

Hanover, tp. of Ashland co., O. Pop. 1832.

Hanover, tp. of Butler co., O., on the Cincinnati and Indianapolis R. R. Pop. 1460.

Hanover (P. O. MAYSVILLE), tp. and v. of Columbiana co., O., on the Cleveland and Pittsburg R. R., 75 miles from both Cleveland and Pittsburg. P. of v. 481; tp. 2310.

Hanover, tp. and post-v. of Licking co., O., on the Pittsburg Cincinnati and St. Louis R. R. Pop. of v. 322; of tp. 1165.

Hanover, tp. of Beaver co., Pa., on the Ohio line. Pop. 1500.

Hanover, tp. of Luzerne co., Pa., on the Susquehanna River and the Lehigh and Susquehanna R. R. It has mines of coal. Pop. 3035.

Hanover, tp. of Northampton co., Pa., on the Lehigh River, opposite Allentown. Pop. 499.

Hanover, tp. of Washington co., Pa., on the West Virginia line. Pop. 1898.

Hanover, post-b. of York co., Pa., 18 miles S. W. of York, 42 miles N. W. of Baltimore, Md., on the lines of the Hanover branch, the Gettysburg, and the Littlestown R. Rs., and the S. terminus of the Hanover and York R. R., now building. It has 2 banks, 3 English and 1 German newspaper, 1 monthly journal, 6 churches, 2 academies, 6 hotels, gas and water works, and a public fountain in Centre Square. The surrounding country abounds in iron ore. Principal business, manufacturing of flavine, leather, cigars, and carriages. Pop. 1839. M. O. SMITH, ED. "HERALD."

Hanover Court-house, the county-seat of Hanover co., Va., 20 miles N. of Richmond, was the birthplace of Henry Clay, the place of Patrick Henry's greatest forensic triumphs, and was the scene, on May 27, 1862, of a smart action, resulting in an advantage to the national arms.

Han'overton, post-v. of Hanover tp., Columbiana co., O.

Hanseat'ic League, or **Hanse Towns** [Old Ger. *Hansa*, a "union"]. These are names applied to an association of free cities of Northern Europe formed in the thirteenth century to protect their common commercial interests. The rude barbarians of the Teutonic race, after the old Roman empire gave way under their irruptions, gradually organized society anew. The new wants of settled life set on manufacturing industry and gave rise to trade and commerce. Thus, cities sprung up in Northern Europe as centres of the developing civilization. But the whole social organization was cast in the forms of feudalism under the controlling principle that "might makes right." The cities were subject to heavy exactions from their feudal lords; the avenues to each city were beset by armed bands, watching to plunder the passing merchant-trains; piracy was considered a legitimate business, and the seas were covered with the cruisers of the bold vikings of the North. Trade was altogether insecure, and the accumulating wealth of the cities was constantly exposed to pillage. Yet the profits of trade, being proportioned to its risks, were sufficient to stimulate activity and to prompt means of defence. The first attempt to relieve this state of things was the movement which is called the insurrection or affranchisement of the cities. The burgesses armed themselves; each made his house strong as a fort, and all joined to throw walls around the city. Then all rose together to resist the exactions of the feudal lord, and the war went on till a treaty of peace in the form of a charter defined the privileges and rights of each party. This was a general movement, but was carried on without concert of action between the different cities.

The Crusades carried the rude warriors of the West and North by thousands into contact with the higher civilization of the East and South, and created among them a demand for the luxuries of Asia and the beautiful products of Italian taste and skill. This gave fresh stimulus and a wider range to commerce. The merchants of Venice and others of the older cities on the Mediterranean gladly entered the new market thus opened for their goods, and established mercantile relations with the cities of the North. But this expansion of legitimate trade occasioned also a revival of piracy and systematic robbery. Sovereigns saw no benefit from commerce beyond the opportunity it offered for levying revenues for themselves; petty lords for nominal protection made severe exactions; swarms of pirates watched the straits into the Baltic Sea and the mouths of the Rhine, the Elbe, and the Trave. This condition of things gave rise to the Hanseatic League. There are traces of some joint defensive action of the cities as early as the middle of the twelfth century. In 1239, Hamburg, Ditsmarsh, and Hadeln joined in measures to keep the Elbe and the sea at its mouth clear of marauders. In 1241, Lübeck and Hamburg concluded a formal treaty to provide ships and soldiers to make trade secure between the Elbe and the Trave, and on the waters from Hamburg to the ocean, and to promote their common interests. This is usually regarded as the date of the organization of the league. Six years later Brunswick joined the compact. In 1252 deputies from the three cities met at Lübeck and took steps for establishing factories at London, Bruges, and Novgorod in Russia. Later, a factory was also established at Bergen. The door was open for other cities to enter the association, and its manifest advantages inclined them rapidly to seek admission, till at its height it embraced 85 cities. Many other cities, not regular members, came into commercial relations with the league, to their own advantage, while they added also to its influence and power. In 1260 its affairs were regulated by a convention which ordained a diet of delegates to assemble triennially, and an extraordinary meeting every ten years to renew the league. Lübeck was made the capital of the Hansa and the depository of its treasury and archives. The meetings were generally held at Lübeck, but occasionally at Hamburg, Cologne, and other places. For the details of administration the cities were distributed into four classes: (1) The Vandalic or Wendish towns of the Baltic, with Lübeck as capital. (2) The Westphalian, Rhenish, and

Netherland towns, capital Cologne. (3) The Saxon and Brandenburg towns, capital Brunswick. (4) The Prussian and Livonian towns, capital Dantzic. The magistrates at the head of each circle were charged with sovereign power to carry out the decrees of the league.

In the outset the league aimed simply to resist the extortions of feudal lords and sovereigns, to prevent robbery and piracy, to regulate and expand commerce, and to stimulate production, especially in the four departments of agriculture, fisheries, mines, and manufactures. It did much to define general principles of mercantile law, and to enlarge the scope and ennoble the spirit of commercial enterprise, by uniting many petty, narrow interests in a great common cause. It served greatly to increase the wealth of the cities themselves, and to develop in their populations taste, refinement, and genius for both the practical and the fine arts. By the stimulus which it imparted to agricultural industry it also waked a spirit of enterprise and a love of liberty in the breasts of the oppressed tillers of the soil, and thus joined with other influences to prepare the way for the emancipation of the serfs. The league thus touched the springs of social life and activity universally, to the advantage of all classes. In its leading ideas and policy, though crude and only partially developed, we find the germs of that law of reciprocity and freedom which is now so generally recognized as the basis of modern commerce.

The four principal factories of the league, at London, Bruges, Bergen, and Novgorod, were endowed by the sovereigns of those cities with special privileges, to which every merchant belonging to a Hanseatic town was entitled. These factories were set up as distinct establishments, with some features of the monastic order, under officers who were bound to celibacy and a common table. Through its organized association and system, with the privileges secured, the league to a great extent monopolized the trade of Northern Europe. By concessions from Henry III. and the sovereigns who succeeded him the London factory gained command of both the import and export trade of England, and engrossed the carrying trade almost to the exclusion of British merchants. Similar advantages were gained in each of its great centres. The power of the league was thus rapidly and strongly developed. It reached its culmination in the latter half of the fourteenth century. But now its aims and policy were changed. It had sought at first only protection for common interests and special favors for a great public good. Then it had established itself as an organization independent of other authorities. Now it abused the power gained for the maintenance of separate interests of its own, and the exercise of sovereign authority to perpetuate an oppressive monopoly. So it maintained armies and navies: by a victory over the kings of Denmark, Sweden, and Norway gained control of the passage of the Sound; assumed to depose the king of Sweden; carried on war against Denmark; and by a declaration of war compelled Edward IV. of England to grant larger concessions. Through the fifteenth century it thus maintained its power with growing haughtiness and arrogance, till it became intolerable and declined as rapidly as it rose.

Among the causes of its dissolution may be mentioned—(1) the general development of commercial activity, and the security gained for it through the agency of the league. This at the same time created competition and awakened jealousy of the exclusive privileges enjoyed by the league. (2) The centralization of national life on the decay of feudalism, and the consequent desire of both sovereign and people that each nation should control its own commerce and reap its benefits, now fully appreciated. This led to the repeal of the concessions which had been granted, and broke up the monopolies enjoyed. Thus, England in 1597 revoked all special privileges of the Hanseatic merchants. (3) In desperate efforts to resist these tendencies and retain its power money was freely expended, and the Hanse towns were heavily taxed to meet the cost. This caused disaffection, and the maritime cities of the Baltic withdrew when trade was opened for them directly with the Dutch and English. (4) The new direction and the new impulse and methods given to the commerce of the world by opening the passage to India by the Cape of Good Hope and the discovery of America, reduced the trade of the league to comparative insignificance. It had fulfilled its office, and there was no longer necessity for its existence. In 1630 a last general assembly was summoned to meet at Lübeck, but the deputies from the remaining towns came only to notify their withdrawal. Thus, after nearly 400 years, this confederacy was dissolved. Then the cities of Hamburg, Lübeck, and Bremen formed a new association called the Free Hanse Towns. Frankfort-on-the-Main was subsequently added. The four were recognized as the free cities of Germany, each exercising independent and sovereign jurisdiction till 1810, when Napoleon I. incorporated them with the French empire. In 1813 they became free members of the German confederation. In 1866 Frankfort-on-the-Main fell to Prussia. Bremen, Hamburg, and Lübeck are still independent, and perpetuate the name of Hanse Towns. A. L. CHAPIN.

Han'si, town of British India, in the N. W. Provinces, 90 miles N. W. of Delhi. It has a fort and some commercial importance. Pop. 9112.

Han'son, county in the S. E. of Dakota, established since the census of 1870. Its surface is diversified. It contains a part of the Coteau de Missouri, an elevated and broken plateau.

Hanson, post-v. and tp. of Plymouth co., Mass., on the Old Colony R. R., 25 miles S. E. of Boston. The chief pursuits are agriculture and the manufacture of lumber, shingles, boxes, tacks, nails, straw-braid, boots, shoes, etc. Iron ore and building-stone are found. Pop. 1219.

Han'steen (CHRISTOPHER), b. at Christiania, Norway, Sept. 25, 1784; studied mathematics at the University of Copenhagen, and was appointed teacher at the Latin school of Frederiksborg, in Seeland. While here he commenced his researches concerning the terrestrial magnetism, and a paper he prepared on this subject received a prize from the Academy of Science in Copenhagen. In 1814 he received a chair as professor of mathematics at the newly-established University of Christiania, where he still continued his scientific labors, the result of which he published in 1819 in Christiania. The book (*Researches concerning the Terrestrial Magnetism*), of which, however, only the first volume, with atlas, appeared, attracted much attention, and after a journey to London, Paris, and Berlin, Hansteen travelled from 1828 to 1830 through Western Siberia at the expense of the government. He published in 1863 *Magnetical, Astronomical, and Meteorological Observations on a Journey through Siberia.* Besides his strictly scientific labors, he also developed a great activity in a practical direction. In 1833 an observatory was erected at Christiania under his superintendence. In 1835 he published a manual of geometry, and in 1836 one of mechanics. He was also president of a committee for the regulation of weights and measures, and had chief charge of the triangulation of the country. After 1823 he edited, in connection with Maschmann and Sandh, a *Magazine for Natural Science.* D. in Christiania in 1873.

Hants, county of Nova Scotia, having Cobequid Bay and the Basin of Minas on the N. W. The surface is broken, the soil fertile. Gypsum abounds, and coal is found to some extent. The county is traversed by the Nova Scotia and the Windsor and Annapolis Railways. There are considerable manufacturing interests. Area, 1176 square miles. Cap. Windsor. Pop. 21,302.

Hants, England. See HAMPSHIRE.

Hants Har'bor, port of entry and fishing-town of Trinity district, Newfoundland. It has some shipbuilding. Pop. 730.

Haplo'mi [from ἁπλόος, "simple," and ὦμος, "shoulder"], a sub-order of fishes, belonging to the order Teleocephali, which have the brain-case confined behind the orbits; symplectic bones developed; pterotics normal; the usual opercular bones all present; lower pharyngeal bones distinct and sub-triangular; upper in three or four pairs; anterior as well as other dorsal vertebræ normal and distinct; shoulder-girdle with the meso-coracoid atrophied (whence, probably, the name); and the air-bladder communicating through a duct with the intestinal canal. The fishes embraced in this group vary in form and general appearance, and to it belong the pikes, killy-fishes or minnows, and kindred types; these have been arranged under the families Esocidæ, Umbridæ, and Cyprinodontidæ. The Cyprinodontidæ were referred, by the older naturalists, near the Cyprinidæ, but they have no real relations with those fishes. THEODORE GILL.

Hap'py Camp, post-tp. of Del Norte co., Cal. P. 382.

Haps'burg, or **Habs'burg, House of,** named from the old castle of Habsburg (Habichtsburg), near Brugg, in Aargau, Switzerland, which was erected by Count Radbod von Altenburg about 1020 A. D. The castle is now in ruins, only the walls of the tower remaining. The first count was Werner of Habsburg, who d. 1096, and was descended from an ancient Suabian family of distinction, probably related to the Guelphs. Gontran the Rich, count of Alsace (eighth century), was the earliest ancestor of whom we are certain. In 1232 the line parted into two branches—Hapsburg-Hapsburg and Hapsburg-Lauffenburg. The latter parted again into two lines—Hapsburg-Lauffenburg proper (extinct in the male line 1408, but still represented by the Feilding family in England), and the Hapsburg-Kyburg line (of which the last count d. 1415). The first German emperor of this family was Rudolph I., who founded the Austrian house, which from 1438 to 1866

held the German imperial crown, and since that time has held that of Austria. In Spain, Burgundy, Tuscany, and Modena, Hapsburg monarchs have also borne sway.

Harafo'ra, Arafoo'ra, or **Alfoo'roo,** a name applied to an aboriginal or non-Malay race of the Spice Islands, Celebes, Papua, etc., according to some ethnologists embracing the native race of Australia, and indeed all the Melanesian tribes, including the extinct Tasmanians and the black forest tribes (Negrillos) of Malacca and the Philippines. These peoples are all exceedingly rude, have black or very dark skins, and for the most part crisp or woolly hair; but from the character of their languages they are considered quite distinct from the black races of Africa. From this people the sea N. of Australia and S. of the Malay Archipelago is called the Arafura Sea. The name is of Portuguese origin, and originally meant "foreigners."

Har'alson, county in the N. W. of Georgia, bounded on the W. by Alabama. Area, 390 square miles. The surface is hilly. Grain is the leading product. Cap. Buchanan. Pop. 4004.

Haralson (HUGH A.), b. Nov. 13, 1805, in Greene co., Ga.; graduated at the State University in 1825; was admitted to the bar and rose rapidly in the legal profession; was many years a member of the State legislature, and was member of Congress from Georgia 1843–51; was a major-general in the State militia; and d. in La Grange, where he had resided for many years, in Oct., 1854.

Har'baugh (HENRY), D. D., a divine of the (German) Reformed Church in America, was b. near Waynesborough, Pa., Oct. 24, 1817. He was the descendant of a Swiss immigrant named Herbach, who came to this country in 1736. Young Harbaugh worked upon a farm, then became a carpenter, then a mill-operative, and next a teacher. In 1840 he entered Marshall College at Mercersburg, Pa., and after a partial course in academical and theological studies was ordained in 1843. He held pastorates in Lewisburg, Lancaster, and Lebanon, Pa., and in 1864 became professor of theology at Mercersburg, where he d. Dec. 28, 1867, in consequence of overwork. He was during the last year of his life editor of the *Mercersburg Review*, and had been for sixteen years previous to this editor of the *Guardian*. He was an advocate of the "Mercersburg theology," and belonged to the High Church school of his denomination. He was an indefatigable worker, and besides his numerous and highly popular religious books published some excellent poems in the so-called "Pennsylvania Dutch" dialect of the German language. Among his most important works are *Heaven* (1848), *The Heavenly Recognition* (1851), *Heavenly Home* (1853), *Life of Michael Schlatter* (1857), *The Fathers of the German Reformed Church* (3 vols., 1857–58), *Christological Theology* (1864), a volume of *Poems* (1860), and an illustrated work on the *Birds of the Bible* (1854).

Har'bison, tp. of Dubois co., Ind. Pop. 1590.

Har'bor. The word is by Webster derived from the O. H. German *heriberga* (*here*, "host," "army;" *bergan*, to "shelter," to "protect," and allied with the French *auberge*, an "inn"), and in its naval signification is defined "a refuge for ships; a port or haven."

A *natural* harbor may be more precisely defined as "a bay, recess, or inlet of the sea, or the mouth of a river, which affords good anchorage and a safe station for ships." The two great requisites (adequate *depth* both of entrance and interior area being assumed) are *shelter* from wave-violence and *accessibility*.* That there should be shelter it is necessary that the communication with the ocean should be as nearly as possible reduced to a channel of entrance of adequate width—*i. e.* that the waters of the harbor be, in expressive nautical phrase, "landlocked," and that the entrance should be, from the configuration and character of the adjacent coast, considered in conjunction with prevailing winds, safely and easily *accessible*. Natural harbors are ranked according as they possess more or less perfectly the combination of these qualities. Sea-waves owe their origin to the wind, and their most violent line of action is that of its direction. Hence, a mere indentation in the shore-line may afford a quite adequate harbor if it be in a windward shore, but in general the quality of being "landlocked" is essential. The harbors of Queenstown (Ireland), of Portland, Me., of New York, may be mentioned as possessing in a high degree the essentials. The qualities of a natural harbor are easily recognized; as well, also, as lack of these qualities. As an engineering problem, it is the supplying to natural harbors of such essentials as may be lacking, or the *creation* of a harbor where all essentials are absent, that is to be solved. The violence of the ocean waves being that against which protection is needed, it becomes important, especially in considering the strength of works erected to protect against their violence, to have some measure of its action. The following observations have been made (see also article BREAKWATER): "In Loch Awe (Scotland), where the fetch is under 14 miles, a stone weighing a quarter of a ton was torn out of the masonry of the landing-slip and overturned. . . . In Nov., 1817, the waves of the German Ocean overturned, just after it had been finished, a column of freestone 36 feet high and 17 feet base. We know of a block of 50 tons weight being moved by the sea at Barrahead, one of the Hebrides; and, what is far more extraordinary, we know, and can vouch for the fact, that blocks of 6 tons weight have been quarried or broken out of their beds *in situ*, on the top of the Bound Skerry of Whalsey in Zetland, elevated 17 feet above high-water spring tides. The Bound Skerry and neighboring rocks, which are in the German Ocean, certainly furnish by far the most wonderful proof that has yet been discovered of the great force which is developed by the billows of the ocean when suddenly checked by opposing rocks." (MR. THOS. STEVENSON'S "Harbor," *Encyc. Brit.*) At the Skerryvore lighthouse Mr. Alan Stevenson observed the following: . . . "2d. Stones, some of which weighed as much as 5 tons, were swept by the waves over the top of the rock; and much floating wreck-timber has been seen to pass close to it. 3d. The force of the waves, as indicated by the marine dynamometer, has amounted to 6000 pounds per square foot. 4th. Two iron beacons were successively destroyed on the Bopheg Rock in Hynish Bay, 12 miles landward of the Skerryvore Rock, one of which was of a pillar form, and the other was a cone of iron plates like that proposed by Mr. Gordon, having the lower part of the void filled. Before the plate-beacon was carried away a hole of two feet in diameter was broken through one of the plates, most probably by a heavy spar urged end on by the waves." "At the Alguada Reef (India), Col. Fraser, R. E., states that he has seen stones over two tons in weight driven along the rocks by a summer sea; and that in the S. W. monsoon similar stones have been whipped out of the foundation-pit of the lighthouse 5 feet below the surface of the rocks, and swept along the rocks."

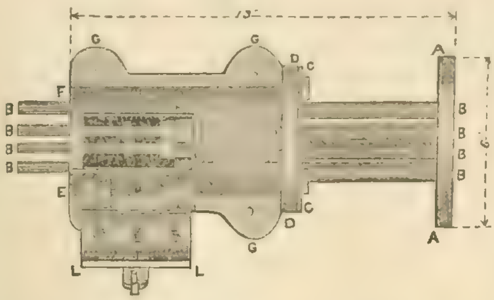
At the mouth of the Loire (*Annales des Ponts et Chaussées*, Apr., 1869) a beacon-tower of circular base (11 feet in diameter), 21 feet high, of excellent stone masonry, founded upon a rock ("*Du Petit Charpentier*"), the surface of which is $11\frac{1}{2}$ feet above extreme low and $7\frac{1}{2}$ *below* extreme high tides, was fractured through and through a few feet above its base and the upper part weighing about 50 tons, moved an inch or more. The engineer of *Ponts et Chaussées*, La Ferme, calculated that the average pressure per square foot was at least 6000 pounds. The vertical *range* of this determination had for its inferior limit the position of the line of fracture, and for its superior the top of the beacon; the extent was nearly 16 feet, commencing at a level of 3 feet below extreme high tides. The French example proves a large vertical range to this pressure, but does not determine its limits, though it does determine that it extends undiminished to over 12 feet above high tide. Smeaton built the Eddystone lighthouse solid to 27 feet above high tide, assuming that to be the extreme limit of violent wave-force. At Cherbourg it is found that the lower limit of violent wave-action is 5 mètres (nearly 17 feet) below extreme low tide. As all storms producing violent wave-action on any coast speedily heap up the water, it is fair to assume that powerful wave-action extends to *more* than 17 feet below the *actual* water-surface. In default of more definite information, we must assume, therefore, the vertical range of powerful action to be from 17 feet below low tide to 27 feet above the water-surface.

For the direct measurement of wave-force Mr. Thos. Stevenson invented the marine dynamometer (see *Trans. R. S. of Ed.* and *Encyc. Brit.*), which the following diagram and description will make intelligible. D E F D is a cast-iron cylinder which is firmly bolted at the projecting flanges G to the rock where the experiments are to be made. This cylinder has a circular flange at D. L is a door which is opened when the observation is to be read off. A is a circular disk on which the waves impinge. Fastened to the disk are four guide-rods B, which pass through a circular plate C, which is screwed down to the flange D, and also through holes in the bottom E F. Within the cylinder there is attached to the plate C a powerful steel spring, to the other or free end of which is fastened the small circular plate K, which again is secured to the guide-rods B. There are also rings of leather T, which slide on the guide-rods, and serve as indices for registering how far the rods have been pushed through the holes in the bottom, or, in other words, how far the spring has been drawn out by the action

* In this relation more than one entrance with different exposures to the wind is desirable, but seldom attainable, even in purely artificial harbors.

of the waves against the disk A. With this instrument the inventor "found the force of the waves of the German Ocean during hard gales to be 1½ tons per superficial foot at the Bell Rock, and of the Atlantic Ocean 3 tons per superficial foot at the Skerryvore lighthouse. But," he adds, "these results may still be far short of the maxima." *

Fig. 1.



The element most influential in developing wave-force (the generative winds supposed the same) is the line of maximum exposure, or, in other words, the greatest reach of open sea. According to Mr. Thomas Stevenson, the limited observations as to this matter seem to indicate that the height of waves increases in the ratio of the square root of their distances from the windward shore. But *action* upon a certain shore will depend also on the angle of incidence of the waves on the walls of the harbor. Mr. Stevenson utters the following dictum: Let x = the greatest force that can assail a pier, h = height of waves which produce (after being corrected for obliquity) the maximum effect, and which are due to the line of maximum effective exposure. Sin a = sine of azimuthal angle formed between directions of pier and line of maximum effective exposure, radius being unity. Then x is proportional to $h \sin^2 a$ when the force is resolved normal to the line of the pier; but if the force is resolved again in the direction of the waves themselves, the expression becomes $x \propto h \sin^3 a$.

Tidal currents are also influential in the development of wave-force, and Mr. Stevenson mentions the effect of three successive waves carrying away in Peterhead harbor a bulwark wall 315 feet long, founded 9½ feet above high spring tides, one piece of which, weighing 13 tons, was moved 50 feet, and the extreme violence of which he attributes to tidal influence.

Another circumstance affecting the exposure of any marine work is the depth of water in front of it. The great mountainous billows so commonly met with in the Atlantic Ocean cannot be generated in shallow seas. It becomes, therefore, of great consequence to ascertain the maximum possible wave in a given depth of water. Mr. Scott Russell has stated that if waves be propagated in a channel whose depth diminishes uniformly, the waves will break when their height above the surface of the level fluid becomes equal to the depth of the bottom below the surface. (For a more full exposition of WAVES, see that heading; also *Revue Maritime et Coloniale*, Jan., 1873, which summarizes the recent Italian work *Sul Moto Ondoloso dal Mare*, by Cialdi; also *Naval Science*, Jan., 1873; also Airy's "Tides and Waves," *Encyc. Metrop.*)

The foregoing facts sufficiently prove that sea-waves act, under certain circumstances, with enormous destructive force against opposed barriers. Inasmuch as wave-motion is (at least in its simplest form) merely an orbital motion of individual particles in closed curves, without resultant motion of translation (illustrated by the superficial wave produced by the wind in the tops of wheat in a large field or the wave of *form* translated along a shaken carpet), it is contended that a vertical wall descending to considerable depth in the ocean would merely reflect the sea-wave, suffering no shock; † and hence that vertical barriers are best adapted to resist waves. (Refer also to article BREAKWATER.) Against this postulate is, however, to be offered the fact that the sea bottom, sloping up and shoaling shoreward, *does* generate motions of translation, and with them the destructive wave-forces; and that sea-walls in general are exposed to such already generated forces. Col. Emy (*Mouvement des Ondes*, Paris, 1831), developing this view, deduced the proposition that the exposed profile of a sea-wall or barrier should be a *curve* commencing tangentially with the bottom. On the other hand, advocates of the "long slope" and the "vertical" wall have based their contending arguments on their differing views as to the causes which develop wave-violence. Were other things equal, there can be no doubt that a long slope would be preferable, *but* a long slope requires corresponding extent of base, and hence an immense amount of material. Moreover, it is not practicable to unite this material into the same homogeneous and mutually sustaining mass as that which the vertical wall may be made to form. "It therefore appears," says Mr. Thomas Stevenson, "that the method generally resorted to, of forming deep water harbors of masses of rubble stone with long slopes, so as to form an artificial beach for the waves to spend themselves on, is, in most circumstances, the best and cheapest kind of construction. We incline, however, to the adoption of an upright wall, founded on the rubble as a basis, in preference to long paved slopes, etc., etc. . . . Much, however, depends on local peculiarities in selecting the best design for any work; and the nature of the bottom is all important. Where the bottom is soft, a vertical wall can hardly, if ever, be attempted. In making these remarks we must not be understood as condemning the adoption of vertical walls in cases where the foundation is good. All that we assert is the opinion that waves of translation do exist in deep water, and therefore that harbors of refuge will prove failures unless they are built in such a manner as to resist the impact of those waves of translation. . . .

The ultimate object of constructing harbors is by lowering the height of the waves to preserve the tranquillity of the area of water enclosed by the piers. Hence it is desirable to be able to predict, with some approximation to accuracy, to what extent such an effect will be produced by the proposed structure. The only formula attempted is that of Mr. Thos. Stevenson. (*Edin. New Phil.*, July, 1843, and *Encyc. Brit.*, art. "Harbors.")

When the piers are high enough to screen the inner area from the wind, where the depth is uniform, the width of entrance not very great in comparison with the width of the wave, and when the quay-walls are vertical, and the distance not less than 50 feet, let

H = height of waves in the open sea.

x = reduced height of waves in feet at place of observation in the interior of the harbor.

b = breadth of entrance to harbor, in feet.

B = breadth of harbor at place of observation, in feet.

D = distance from mouth of harbor to place of observation, in feet.

$$x = H\left\{\sqrt{\frac{b}{B}} - \frac{1}{50}\left(1+\sqrt{\frac{b}{B}}\right)\sqrt[4]{D}\right\}.$$

This formula has been found to give good approximations at several harbors where the heights of the waves were registered. When H is assumed as unity, x will represent the *reductive power* of the harbor; or, in other words, $\frac{x}{H}$ measures that reductive power. In situations where the highest waves cross the harbor mouth at an oblique angle, a further reduction is due to this cause, but data are wanting for determination of its amount. (For an application of the above formula to a projected harbor, see *Prof. Papers, Corps of Engrs., U. S. A.*, No. 22, "North Sea Canal of Holland.")

In the providing of harbors of refuge, and more especially in the improvement of ports, the problem usually is to supply some lacking element. Thus a natural bay or deep indentation in the coast may, by artificial construction partially closing its mouth, be made to possess the qualities of a landlocked harbor. It is thus that at Cherbourg and Plymouth and (with some modification of phraseology) at Portland, Holyhead, etc. (England), and at our own Delaware breakwater, harbors of refuge have been formed. (See art. BREAKWATER.) But it sometimes happens that the *creation* of a harbor is needed where no natural element of one is found in the configuration of the shore. The most important examples are the harbor of Port Saïd to the Suez Canal, and that where the North Sea Canal of Holland connects with the North Sea. In both cases the coast and sea bottom are of sand, and the shore-lines rectilinear and wholly destitute of harbor qualities.

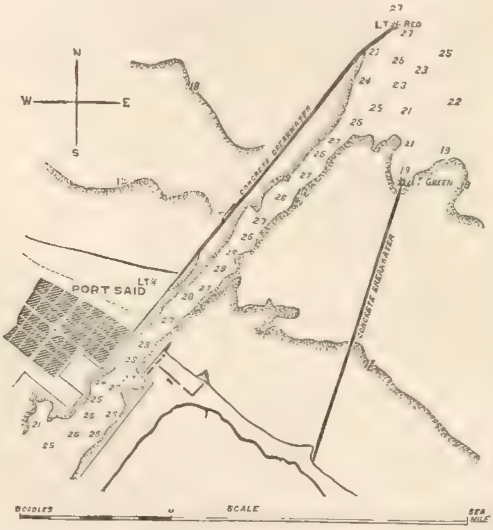
"Port Saïd, though affording sufficiently good anchorage for small vessels, cannot be considered a harbor, either in respect of extent or depth, for vessels of large tonnage and great draught of water. It is formed by two rough, narrow, and low breakwaters of unfinished appearance, enclosing an area of some 450 acres, with an average depth of only 13 or 14 feet of water, except in the ship channel leading to the inner basins, where the depth is from 25 to 28 feet. The western breakwater, which extends for 6940 feet at right angles to the shore, and is slightly curved to the

* At the Delaware breakwater stones of 6000 pounds have been moved several feet. This is, however, far from being an open or exposed site.

† Lieut.-Col. Houston, corps of engineers U. S. A., sets forth in the *Report of the Chief of Engineers* for 1872 some interesting views on this subject. It is certain that powerful wave-force is sometimes developed in mid-ocean, of which fact the terrific blows received by ships furnish proof.

eastward towards its extremity, was commenced in 1860, and carried out about 1300 feet, beyond which point, and at a short distance from it, was deposited a heap of stones that was surrounded by iron piles, and from its detached position was called 'the island.' The work was then left untouched till 1866, when the breakwater was joined to the island, and it was continued to its present length, and finished in 1868. From the mainland to the island the breakwater is formed, on its inner side, of a bank of rubble-stone, surmounted by a promenade, over which the spray breaks with a very moderate N. W. wind, and on the outer or sea-front of concrete blocks; but beyond the island to its termination it is entirely constructed of large blocks of artificial stone, composed of 1 part of French hydraulic lime with 2 parts of sand, and some of which were transferred to it from the eastern breakwater. This latter, which is also constructed of large masses of concrete, is of more recent construction; it extends about 6020 feet, and converges towards the western breakwater." (*Report of Messrs. Richards and Clarke*, 1869.) These concrete blocks are made from sand and lime from Theil; two months of exposure to the air suffices to harden them, and their subsequent immersion in water adds to their hardness. Each block weighs 25,000 kilogrammes. Steam-cranes lift them up and put them in their places. The joints between the artificial blocks are filled in with small pebbles, which, assisted by the action of the sea, form a compact and solid mass. "Both structures," says the report before cited, "are deficient in width, and from the rough way in which the blocks are deposited some amount of silt finds its way through the interstices, while from their slight elevation the sea, during fresh N. W. winds, washes over them, bringing with it a certain quantity of sand." Recent statements represent the entrance to be "shallowing so rapidly as to call loudly for an immediate extension of the west pier."

FIG. 2.



The canal now in progress, to furnish to the port of Amsterdam direct communication with the North Sea, has its sea-entrance and artificial harbor on a coast of sand "dunes," the trend of which is about N. by E. The axis of the harbor projected from the coast into the North Sea is nearly normal to the coast-line. The width of this entrance is 260 mètres. The two piers are to be extended to the depth of 8 mètres below the level of low water, corresponding with about 9.50 mètres below daily high water, and 8.50 mètres below A. P. (*i. e.* the established Amsterdam level). The roots of these piers, at the foot of the downs on the beach, are 1200 mètres distant one from another. Their directions converge, so as to make an angle of about 77° with their base-line. At 1200 mètres from their origin the piers, distant 660 mètres from one another, commence to converge more rapidly; so that, with an increment of length of 345 mètres (1545 in all), they terminate 260 mètres (868 feet) apart at the harbor-mouth. To obtain the requisite depth the area between these piers is to be dredged to an elliptic form for a width of 650 mètres, and to a depth of 8.50 m. below A. P. at the entrance, 7.50 m. on the land side, the *harbor* area being 55 hectares (135 acres); while the total area enclosed by the piers is fully 100 hectares.

The method of construction in this case is, forming on the sand a "rip-rap" foundation of small stone, and to lay regularly, from a huge derrick working from the built-up end of the pier itself, a wall of concrete blocks, as represented in the section (Fig. 4). (For a more detailed account see *Prof. Papers, Corps of Engrs.*, No. 22.)

FIG. 3.

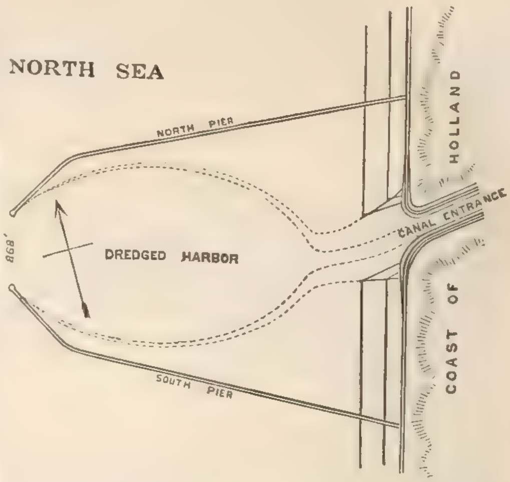
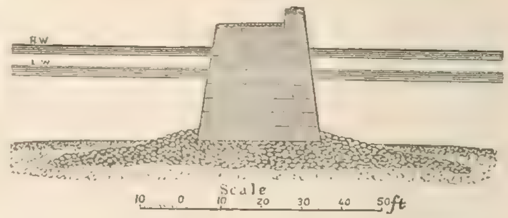


FIG. 4.



The last official report (for 1873) reports 1273 mètres length of the northern and 1165 mètres of the southern pier completed at the end of that year.* Serious damage had been caused by the autumnal storms, by which 470 mètres of the northern and 340 mètres (length) of the southern pier were greatly damaged by shattering and (in part) carrying away of the béton blocks; and, experience proving their resistance inadequate, the Dutch parliament proposes (Dec., 1874) to apply 3,340,000 guilders to reinforcing externally these piers with huge concrete blocks.

Mouths of great rivers not only constitute, in many cases, natural harbors, but seaports of cities, the marts of commerce for the products of the tributary territory. These mouths are most commonly obstructed by "bars," and offer the most interesting as well as the most difficult engineering problems of harbor improvement. One of the most interesting works of this character is that recently executed in Holland for the navigable communication of Rotterdam with the sea. Naught but a map can exhibit the relations of that city to the remarkable reticulation of fluvial channels by which the waters of the Rhine, the Meuse, and the Scheldt mutually communicate and discharge themselves into the North Sea. The shortest and most natural route is to follow the Nieuwe Maas to its outlet between the Hook of Holland and the island of Voorne; and this channel, formerly much used, becoming deteriorated, ships of modern large dimensions have been compelled of late years, by circuitous channels 60 or more miles in length, to reach the Brouwershaven Inlet. The direct communication, just alluded to, 15 miles in length, the Nieuwe Maas,† is deflected, near its mouth, from its course by the Hook of Holland, and discharges itself over extensive shoals; whereas, the Brouwershaven Inlet has ample depth of water. In former years the "Voorne Canal" had been made in order to reach the Goeree Inlet; but through various causes‡ had ceased to subserve fully its object. Another ship-canal by which to reach the Brouwershaven was projected, but was rejected not only in consequence of (in the language of the Dutch commission) the *admitted inferiority of canal to open river navigation*, but

* On May 20, 1871, these lengths were 651 and 477 mètres respectively; the advance of each pier was 500 mètres, about, in the ensuing nine months, or an average of 27 mètres (90 feet) per month. The year 1873 was very unfavorable, and the mean advance of the N. and S. piers was but 10 and 12 mètres per month.

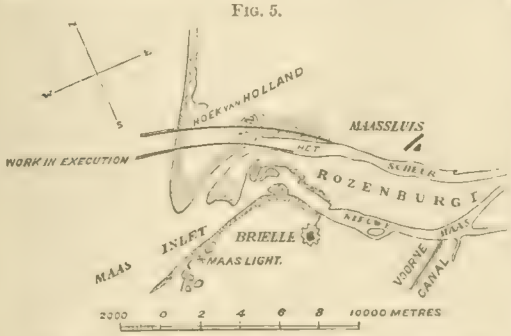
† The main body of the Rhine River flows by Rotterdam, bearing this name, the ancient arm which, through the Netherlands, alone bears the name of "Rhine," having long since ceased to be an outlet.

‡ The locks were 294 by 46¼ feet: the draught could be made 23 feet, and was considered adequate; but the Goeree Inlet had deficiency of depth on its bar and shoals.

in consequence of the existence of river-shoals in the route, "the removal of which was by no means assured."

The project finally adopted by the commission, and successfully executed, was to cut a new outlet to the Nieuwe Maas through the Hook of Holland, and to prolong it into deep-sea water by parallel piers (jetties). These two jetties in the North Sea constitute the proper river-mouth, consist of fascine-work with stone, and have a total length of 2800 mètres, the northern pier reaching to 6.50 m. below mean low (8.20 m. below mean high) water, and the southern one so much shorter that a tide-catching form is given to the entrance. (This latter arrangement, however, is found unsatisfactory, and the southern pier is to be lengthened by 1200 mètres in 1875 and 1876.)

Fig. 5.



These works have proved completely successful, though their ultimate results are not yet fully attained. There are now 18 feet depth (at ordinary high tides), which is constantly increasing. The entire commerce of Rotterdam with the sea now passes this channel, averaging 600 vessels per month. The autumnal storms of 1874 inflicted no serious injury, nor has any been experienced during the prosecution of the work. A report of the second legislative chamber of Holland announces: "the doubts formerly expressed as to the possibility of making piers at sea on our coast are entirely removed by the full success of the works at the Hook of Holland." The engineer, Mr. P. Caland, has been promoted to be "Inspector" of the Waterstaat in recognition of his success. For an account of the work see (by the writer) *Prof. Papers, Corps of Engrs.*, No. 22. The peculiar *construction* will be found described in article JETTY.

A more celebrated instance of the improvement of a river-mouth by the use of "parallel piers" or jetties is that of the Sulina mouth of the Danube. The piers as designed were of "rip-rap" thrown in from a staging of piles, subsequently reinforced and made permanent by covering with large blocks of concrete. As designed, the piers were 5850 and 4310 feet long, starting at points on shore 2500 feet apart, and converging to parallelism about 600 feet apart. The results are thus stated by Sir Chas. Hartley (*Minutes of Proceedings of Institution of Civil Engineers*, vol. xxxvi.,

Fig. 6.

Sulina Mouth of the Danube.

pp. 208, 209): 1. That when the European commission of the Danube began its labors in 1856, the entrance to the Sulina branch was a wild, open seaboard stream, with wrecks, the hulls and masts of which, sticking out of submerged sandbanks, gave to mariners the only guide where the deepest channel was to be found. 2. That the depth of channel varied from 7 feet to 11 feet, and was rarely more than 9 feet. . . . 5. That on the completion of the provisional piers (in 1861) the depth on the bar increased to 17 feet, and Sulina, instead of being the worst harbor, at once took the highest rank among the best commercial harbors in the Black Sea. Finally, by prolonging the south pier, consolidating and rendering *permanent* the work at an expense equal to the first cost of the temporary structure, and by other improvements, an effective depth of 20 feet was attained in 1872, and since maintained.

The Danube bears a proportion by volume of sediment of $\frac{1}{1728}$, nearly the same as for the Mississippi. The case was cited by the writer (*Ex. Docs.* 113, H. R. p. 98, and No. 220, p. 112, 43d Cong., 1st Sess.), not as a *proof*, but as an example, that to the great river of the West, the Mississippi, instead of abandoning the mouths and resorting to canal—inadequate at best, and of doubtful success—a navigable "open mouth" might be given.*

The subject of "tidal harbors," so important in England, is of slight importance in this country, natural harbors of superabundant depth being superfluously numerous in the limited portions of the North American continent where the range of tide is great; and space will not allow more ample description than has been given of artificial harbor-construction. Of recent and interesting works not described reference may be made to the following: that of Oamara, New Zealand, *Engineering*, Apr. 25, 1873; of Kurrachee, India, *Engineering*, June 6, 1873 (the Manora breakwater, which belongs to it, is described in art. BREAKWATER); Holyhead, *Engineering*, Sept. 26, 1873; Alexandria (new harbor), *Van Nostrand's Eng. Mag.*, Feb., 1873. In *Engineering*, Mar., 1873, will be found a novel project for an "island harbor" at Boulogne, by Col. A. Clarke, Royal Engineers.

J. G. BARNARD.

Harbors of American Lakes. The great lakes of North America—viz. Lakes Superior, Michigan, Huron, Erie, and Ontario—discharging their waters into the Atlantic by the St. Lawrence River, constitute one of the most important features in the geography of the continent, and the one which has been predominant in the development of the great grain-producing section of the U. S. Navigated from the earliest discovery of the country, they now bear a commerce which rivals that of the ocean. Owing to their great size, navigation on them is almost as dangerous as on the high seas,† rendering good harbors as necessary as on the sea-coast. There is on these lakes a great deficiency of natural harbors, especially in those portions where the principal cities have been located, and where harbors are most needed for the purposes of commerce. The principal natural harbors are formed by islands, by indentations in the coast, or by the straits connecting the great lakes; but, with the exception of Detroit, there is no port of importance which possesses a harbor that is not to a great extent artificial.

The watershed of these lakes is comparatively small, and we find no large streams emptying into them. Proceeding but a short distance from the shores, the drainage on the N. is into Hudson's Bay, on the W. into the Mississippi River, and on the S. into the Ohio, Susquehanna, and Delaware rivers. Most of the cities and towns are located at the mouths of small streams, which would naturally be selected in early times when vessels of light draft were used. These are generally so insignificant that the discharge, except in times of freshets, is insufficient to maintain an adequate navigable channel over their bars, and for many years the commerce at large cities, like Chicago and Milwaukee, was carried on at open piers built out into the lake on piles. During storms, vessels were obliged to anchor in the lake where the bottom was favorable for the purpose. Such a state of things could not meet the increasing demands of commerce, and attention was directed to making harbors of the streams by works at the mouths, and dredging to obtain the requisite width and depth.

The principal port on the lakes is Chicago, Ill., where the annual number of arrivals and departures of vessels is about 25,000, with a tonnage of over 6,000,000. The Chicago River, as it is called, was originally an insignificant stream, with but a few feet of water on the bar, and wholly unsuited for commercial purposes. The stream has two

* In the article which follows (by Col. Houston, U. S. Engs.) will be found some [illegible] considerations concerning the effect of jetties at river-mouth.

† The waves attain a very great [illegible]. Mr. D. Stevenson (*[illegible]*) describes the harbors on Lake Erie as reminding him of those of the British Isles, and mentions having seen a stone weighing more than half a ton which had been torn from its bed in the pier at Buffalo, moved several feet, and overturned.

branches—one running N., and the other S. These branches join and form the main stream, running E. a distance of about 1 mile to the lake. Most of the harbor improvements on the lakes are of the same general character as those at Chicago; and they consist in widening and deepening the channel out to the deep water of the lake, and in revetting the sides of the excavated channel. It is generally found that immediately inside of the mouth these streams have considerable depth, but this is separated from the deep water of the lake by what is known as the bar. This is composed generally of sand or shingle. The existence of bars is sometimes ascribed to the deposit of sediment brought down by rivers, but this is not the case with bars at the mouths of rivers emptying into the lakes, as far as the writer's observation has extended. The streams are generally free from sedimentary matter, and when, as in some instances, they hold such matter in suspension, it is not found on the bar, but is diffused by the action of the waves. The idea of these bars can best be formed by imagining a new stream suddenly finding an outlet into the lake. If we suppose a stream suddenly projected into the lake in a direction perpendicular to the coast when the latter is straight, it is evident that a direct channel will be excavated by the current. It is also evident that immediately after the current passes the line of the shore its force will be diminished as it meets the resistance of the water of the lake and spreads out, so that the depth of the channel produced by it will diminish from the shore outward. The consequence is, that there will be a bank of sand or shingle extending from shore to shore in a semicircular form, which is called the "bar." This supposes the lake to be without storms or currents. The bar, therefore, is not caused by the river, but is the material composing the natural bottom of the lake or sea which the river-current in its diminished force is unable to disturb.

The depth and width of the channel over the bar depend on the strength of the current. This bar, however, is subject to various modifications in form and extent by the action of the lake storms and currents, especially in the case of streams where the depth on the bar is small. The effect of waves is to stir up to a certain limited depth the material on the bottom, and this material, being held temporarily in suspension, is moved about by the current.

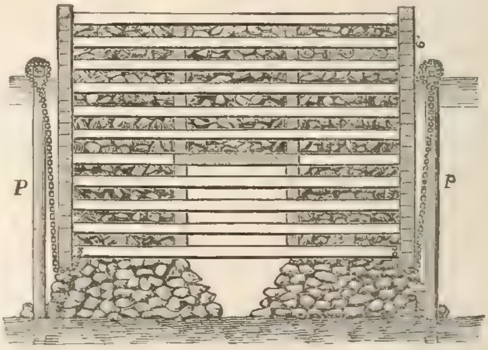
The southern portion of the W. side of Lake Michigan is a good example of the effects of waves and currents. The principal storms affecting this portion of the lake are from the N. E. The waves constantly strike the shore at an angle of about 45°, and produce a strong littoral current in a southerly direction. The material on or near the shore out to a varying depth, according to the height of the waves, is stirred up and moved to the S. When it meets the mouth of a stream, it is carried out and deposited on the N. side of the channel, so that the channel of the river is forced to the S. As stated above, the discharge from these streams is small, and insufficient to maintain a channel suited for navigation. What natural channels do exist are crooked and changing by the action of storms. It is evident from the foregoing that if a channel were dredged through the bar, it would speedily fill up unless some means were taken to prevent it. This is done by revetting the banks of the channel, and extending the revetment out to a depth of water beyond which the waves will not disturb the bottom. This depth may be practically assumed at from 18 to 24 feet in Lake Michigan. The class of harbor improvements which we are considering may be stated, then, to consist in making a channel of proper width and depth from the deep water of the great lake to the deep water of the river, lake, or artificial basin inside, and the construction of works for the maintenance of this channel. This is generally the ultimate plan of these improvements, but in their progress we may so place our works as to get the benefit of the river-current in making a better channel, especially during freshets.

In making the channel through the bar we are to consider, *first*, its width and depth; *second*, its direction; *third*, the character of the works for its maintenance. Its width should be, in the first place, sufficient to allow a free discharge of the river-water during freshets; and, secondly, to accommodate the necessities of commerce. The direction given to the channel has generally been perpendicular to the shore, and this is perhaps the best, except in special cases. The works executed for the protection of the channel are generally parallel piers extending from the shore at a distance apart equal to the width of the channel. The piers and breakwaters in the lakes are constructed either of cribs of timber and iron filled with stone, or of pile-work. The details of these methods of construction are too well known to require description here. But it should be remarked that they are in a certain sense temporary structures, requiring frequent repairs.

The work under water, if put together so as to resist the forces to which it is subjected, may be considered permanent, as timber under fresh water will last indefinitely. Above water the timber-work will last from ten to fifteen years, when it must be renewed. This portion of the work, known as the "superstructure," may be replaced by masonry when substantial cribs are used. It is impossible, except under the most favorable circumstances, to make cribs remain in their places on the ordinary lake-bottom without preparing a substantial foundation of loose stone. The bottom is generally clay overlaid with a stratum of sand of varying thickness. If a storm occurs after the crib is placed, it has the effect of washing out the sand underneath the crib, causing the latter to tip over, and in some instances to move it bodily from its place. In order to remedy this difficulty, a trench is sometimes excavated to make a bed for the crib, but this is an expensive and uncertain process. The frequent recurrence of storms causes the trench to fill up, in whole or part, before the crib can be placed, causing either delays in the work or an uneven bottom for the crib to rest on. Another remedy which has been adopted is to make the bottom of the crib a grillage of timber, with openings from two to three feet square. These openings are designed to admit stone through them to fill up the space below, and thus form a foundation. This remedy is but partial, and it has happened that severe gales, occurring soon after the crib was placed, have so shaken it up as to cause all the stone-filling to pass through, and the consequent loss of the crib.

It would be an improvement on the present system if the centre part of the crib, dividing it lengthwise into three equal parts, were made with a close bottom, and partitions put in to hold the stone over this portion. The object of the grillage would be secured by permitting the stone to pass through next to the sides, while we would have a large immovable mass in the centre, sufficient of itself to hold the crib under ordinary circumstances. This plan has been successfully tried at Chicago. (See Fig. 1.) Six

FIG. 1.



double or pairs of piles P P are driven on each side of the site of the crib. The piles are capped with a stick of oak timber running the whole length of the crib. The crib is built in three compartments by partitions running lengthwise. The middle compartment has a close bottom, about thirteen courses below the top. The outer compartments have entirely open bottoms, or may have a single longitudinal stick, as shown in the drawing. Chains are attached to the lower cross-timbers of the crib, three on each side. The chains are made of sufficient length to enable them to be securely fastened to the oak timber between each pair of piles when the crib is lowered to its required position. The piles having been driven and capped, and the crib framed, the latter is lowered to its position and weighed down with stone until its bottom is (say) four feet above the bottom of the lake. The chains are then secured to the oak timbers in the manner described. The filling then proceeds, care being taken not to put too much stone in the middle compartment, to bring too great a strain on the chains until the outer compartments are filled. These outer compartments, having open bottoms, allow the stone to pass through freely. Foundations are thus formed on which the crib rests. In case of any undermining the stone passes down without taking the crib with it, and thus prevents any displacement or settlement of the crib. The stone in the middle compartment, which has a close bottom, does not move, and is sufficient to secure the crib in its place in case of storms, and prevents the possibility of the crib rising by the sifting of the stone through the grillage bottom, as has sometimes occurred. It is considered that the bottom of this middle compartment may be nearer to the top of the crib. It is believed that the Holland method of combining fascines and stone for such struc-

tures (described by Gen. Barnard, *Prof. Papers, Corps of Eng's.*, No. 22) might be advantageously used on the lakes.

As commerce increases it is found that in many cases the streams do not afford all the harbor facilities needed. The Chicago River is not generally more than 200 feet wide, and in many places less. This has led to the construction of breakwaters in the lake parallel to the shore, so as to make a safe anchorage for vessels inside the breakwater, and to permit the construction of wharves on the lake-shore. Examples of these are found at Chicago, Buffalo, Dunkirk, and Oswego. Harbors formed in this way afford ample space and depth of water, whereas in constructing harbors of streams passing through large cities dredging must be constantly resorted to, collisions are frequent, and the public is put to expense and inconvenience by the use of drawbridges. A "harbor of refuge" is now in process of construction at Sand Beach on the W. coast of Lake Huron, consisting of a breakwater parallel to the shore, and connected with the latter at its northern end by a pier.

There are two essential differences in the problem of harbor improvements on the lakes and on the sea-shore. First, the fresh water of the lakes, which permits the use of timber for permanent work under water; second, the absence of the tides. The lake surface, however, is in a constant state of oscillation, due to various causes, of such extent and frequency as to give to the lower portions of the streams emptying into them the character of tidal rivers. These oscillations are sometimes as great as three feet, but they are irregular as to extent and time of occurrence. They frequently take place several times a day, causing an alternate ebb and flood current at the river-mouth much in excess of the volume due to the discharge proper of the river. An oscillation of a foot is quite frequent. When we find, as is frequently the case, small lakes or "lagoons" separated from the great lakes only by narrow strips of sand, the outlet of these lakes is maintained by this ebb and flow, as on the sea-shore.

Among the natural harbors on the lakes are—on Lake Ontario, Sackett's harbor and Toronto harbor; on Lake Erie, the bay formed by Long-Tailed Point and the roadsteads formed by the islands at its western end; on Lake Huron, Ottawa Bay, Thunder Bay, Middle Island, False Presque Isle, Hammond's Bay, the mouth of the St. Mary's River, the Duck Islands, and Michael Bay; on Lake Michigan, which is entirely destitute of natural harbors except at its northern end, the Porte des Morts, Grand Traverse Bay, and the roadsteads formed by the Beaver and Manitou groups of islands; on Lake Superior, Grand Island, L'Anse, and Bayfield harbors. There are about seventy harbors on the great lakes, wholly or in part artificial, and examinations have been made at many other points for the purpose of making plans and estimates for improvements. The multiplicity of these harbors tends directly to the safety of navigation. These improvements have nearly all been conducted under the supervision of the corps of engineers of the U. S. army. It is only, however, since the year 1865 that Congress has made large and continuous appropriations for this purpose, and these have not been commensurate with the necessities of commerce. There is no branch of the public service in which the benefits to the public are more evident than in that of river and harbor improvement, by which commerce is fostered, transportation cheapened, and a great saving in life and property secured. D. C. HOUSTON.

Har'bor Brit'on, a port of entry, cap. of Fortune Bay district, Newfoundland, has a fine and beautiful harbor. It has a jail. Pop. 360.

Har'bor Creek, tp. and post-v. of Erie co., Pa., on Lake Erie and the Lake Shore R. R., 1 mile E. of Erie. Pop. 1974.

Har'bor Grace, next to St. John's the most important town of Newfoundland, is the capital of Harbor Grace district. Lat. 47° 41' 28'' N., lon. 53° 12' 33'' W. Its harbor is large, and the inner port is very secure. Harbor Grace has a court-house, jail, and a fine cathedral. It is the seat of a Roman Catholic bishop. Has an extensive trade, 1 weekly newspaper, a government savings bank, a fire company, gasworks, a water-supply, a convent, schools, literary institute, and various benevolent societies. Pop. 6770.

Har'bor Main, the capital of Harbor Main district, Newfoundland, is a fishing-town at the head of Conception Bay. It has a convent and Roman Catholic school. P. 670.

Har'burg, town of Hanover, on the southern branch of the Elbe, 4 miles S. of Hamburg. It has large tanneries and extensive manufactures of woollens and linens, and its transit trade with Hamburg is of importance. Pop. 16,506.

Har'by (ISAAC), the grandson of a Moorish Jew, was b. at Charleston, S. C., in 1788. He was editor of various journals, and the author of several plays and numerous essays, orations, and critiques. D. in New York Nov. 14, 1828. A sketch of his life, with selections from his writings, by H. L. Pinckney and A. Moise, was published in 1829.

Har'court (SIR WILLIAM GEORGE GRANVILLE VENABLES VERNON, LL.D., Q. C., known as SIR VERNON HARCOURT), b. Oct. 14, 1827; graduated M. A. at Trinity College, Cambridge, with high distinction; came to the bar 1854; became Q. C. 1866; prof. of international law at Cambridge 1869; knight bachelor 1873; solicitor general 1873–74; entered Parliament for Oxford city 1868. Author of pamphlets and papers in the *Saturday Review* and London *Times*, signed "Historicus," etc. Sec. of state for home dept., Eng., 1880.

Har'dee (WILLIAM J.), b. in Georgia about 1819; graduated at West Point 1838, and appointed a second lieutenant of dragoons; promoted to be first lieutenant 1839, and captain 1844. For gallant conduct in the Mexican war he was brevetted major and lieutenant-colonel. In 1855 he was promoted to be major 2d Cavalry, and in 1856 was appointed commandant of cadets at West Point, with local rank of lieutenant-colonel, performing at the same time the duties of instructor in cavalry, infantry, and artillery tactics. Promoted to be lieutenant colonel of cavalry in 1860, he resigned his commission Jan. 31, 1861, and joined the Confederate cause, being appointed a brigadier-general C. S. A. the following June. For bravery at the battle of Shiloh he was promoted to be major-general, and placed in command of a division in Gen. Bragg's army. At the battle of Chaplin's Hills (Perryville) he commanded the left wing of Bragg's army, and was promoted for gallantry to the rank of lieutenant-general. He also took part in the battle of Murfreesboro'. After the fall of Vicksburg he commanded a camp of paroled prisoners in Alabama. Engaged at battle of Chattanooga Nov. 23–25, 1863, and subsequent operations, up to and including siege and fall of Atlanta, when he was transferred to the command at Savannah, Ga., which place he evacuated Dec. 20, 1864, as he did Charleston Feb. 17, 1865, finally surrendering with Johnston's army at Durham Station, N. C., Apr. 26, 1865. Author of *Hardee's Tactics*, adopted for use in the U. S. army and for the militia. D. at Wytheville, Va., Nov. 6, 1873.

Har'deman, county in the S. W. of Tennessee. Area, 614 sq. m. It is traversed by the Big Hatchie River and the Mobile and Ohio R. R. It is very fertile. Cattle, maize, and cotton are staple products. Cap. Bolivar. Pop. 18,074.

Hardeman, an unorganized county in the N. W. of Texas. Area, 1650 square miles. It has steep ridges, and is adapted to pasturage rather than agriculture.

Hardeman (THOMAS, JR.), b. in Eatonton, Putnam co., Ga., Jan. 12, 1825; was member of Congress from Georgia 1859–61; resigned on the passage by his State of the ordinance of secession, and energetically supported the Confederate cause; has been often a member of the State legislature, and repeatedly Speaker of the house. A. H. STEPHENS.

Har'den (JOHN MCPHERSON BERRIEN), M. D., b. in 1810; d. near Tallahassee, Fla., Feb. 16, 1848. He graduated M. D. at the Med. Coll. of S. C. in 1836, and practised his profession in Liberty co., Ga. His contributions to the *American Journal of the Medical Sciences* and the *Southern Medical and Surgical Journal*, especially his researches on isopathia or the parallelism of diseases, stamped him an indefatigable student and one of decided ability. PAUL F. EVE.

Hardenberg, von (K. A.). See APPENDIX.

Har'denburg, post tp. of Ulster co., N. Y., in a wild, mountainous region. Pop. 628.

Har'derwyk, or **Harderwijk,** town of the Netherlands, in the province of Geldern, on the Zuyder Zee. It is much engaged in herring fishing. Pop. 6086.

Hardicanute (*Harthacnut*), king of England, was a son of Canute by Emma, widow of Ethelred II.; was chosen king of the West Saxons in 1035, while Harold, his reputed half brother, ruled the rest of England. In 1036 he became king of Denmark, where he was already viceroy; was deposed as king of Wessex 1037, "because he was too long in Denmark;" made preparations for invading England, when he heard of Harold's death; was unanimously chosen king of England at the Witenagemote. Hardicanute's reign was short, but stained with dreadful crimes. D. at Lambeth June 8, 1042.

Har'die (JAMES ALLEN), b. in the city of New York May 5, 1823; graduated from the U. S. Military Academy July 1, 1843, entering the army in the artillery service; served as assistant professor at West Point, and as company officer in garrison, frontier, and Indian service till 1861, being, during a portion of the time, aide-de-camp to Gen. Wool. Served during the civil war as aide-de-camp to Maj.-Gen. McClellan during his campaigns with the Army of the Potomac, before Richmond, in the Maryland campaign, etc.; on the staff of Maj.-Gen. Burnside in the Rappahannock campaign; judge advocate general of the Army

of the Potomac, staff of Maj.-Gen. Hooker; brigadier-general of volunteers Nov. 29, 1862; appointed assistant adjutant-general (rank of major) Feb. 19, 1863; assigned to special duty in the war department till 1866; assistant to Mr. Secretary Stanton until he vacated office; thereafter with Gens. Grant, Schofield, and Rawlins, as acting secretary of war; appointed inspector-general (rank of colonel) Mar. 24, 1864; brevet brigadier-general and brevet-major-general U. S. A. Mar. 13, 1865; in 1866 senior member of commission to inspect the ordnance and ordnance stores in forts and arsenals of the U. S., with reference to the disposition of munitions, the accumulation of the war; commissioner to audit the military claims of Kansas, Montana, Dakota, California and Oregon. Writer of various contributions to the press; author of numerous military reports. D. at Washington, D. C., Dec. 14, 1876. G. C. Simmons.

Har'din, county of Illinois, bounded on the E. and S. by the Ohio River. Area, 200 square miles. It has a fertile soil, and grain is the leading product. Coal is found in the N. E. part. Cap. Elizabethtown. Pop. 5113.

Hardin, county of N. E. Central Iowa. Area, 576 square miles. It is a rolling prairie, with fertile soil. Grain is the chief product. There are important coal-mines. It is traversed by the Iowa Central and the Dubuque and Sioux City R. Rs. Cap. Eldora. Pop. 13,684.

Hardin, county of N. W. Central Kentucky. Area, 500 square miles. Its surface is diversified, with a productive soil. Cattle, grain, tobacco, and wool are leading products. It is traversed by the Louisville and Nashville R. R. Cap. Elizabethtown. Pop. 15,705.

Hardin, county of N. W. Central Ohio. Area, 476 square miles. It is level and fertile, but some parts are marshy. Cattle, grain, wool, and lumber are leading products. The county is traversed by the Cincinnati Sandusky and Cleveland and other R. Rs. Cap. Kenton. P. 18,714.

Hardin, county of Tennessee, bounded on the S. by Mississippi and Alabama. Area, 650 square miles. It is divided by the navigable Tennessee River. Iron ore is found. The soil is fertile. Cattle, wool, corn, and cotton are staple products. Cap. Savannah. Pop. 11,768.

Hardin, county in the S. E. of Texas, bounded on the E. by the Neches River. It is well watered, and heavily timbered with pine. Some cotton, rice, and tobacco is produced. Area, 1832 sq. m. Cap. Hardin. Pop. 1460.

Hardin, tp. of Conway co., Ark. Pop. 730.

Hardin, post-v. and tp., cap. of Calhoun co., Ill., on the Illinois River, 50 miles N. of St. Louis. It has a church, a school, 2 weekly newspapers, 3 hotels, a mill, and a machine-shop. It is a good shipping-point. Pop. of tp. 650.

Albert G. Ansell, Ed. "Calhoun Co. Democrat."

Hardin, tp. of Pike co., Ill. Pop. 1468.

Hardin, tp. of Greene co., Ia. Pop. 195.

Hardin, tp. of Hardin co., Ia. Pop. 2013.

Hardin, tp. of Johnson co., Ia. Pop. 737.

Hardin, tp. of Webster co., Ia. Pop. 432.

Hardin, tp. of Clinton co., Mo. Pop. 1925.

Hardin, post-v. of Shelby co., O. Pop. 87.

Hardin, post-v., cap. of Hardin co., Tex., 78 miles E. N. E. of Houston.

Hardin (John), b. in Fauquier co., Va., Oct. 1, 1753; served as lieutenant in the Revolutionary war in Morgan's rifle corps, and as lieutenant-colonel of Kentucky militia commanded detachment under Gen. Harmar in his fight with the Miami Indians in 1790; commanded advance of a successful expedition in 1791 against the Indians on the Wabash; served under Gen. Wilkinson in Ohio, and was killed (1792) by Indians while advancing under a flag of truce.

Hardin (John J.), son of Major M. D. Hardin, b. at Frankfort, Ky., in 1810; educated at Transylvania University; studied and practised law at Jacksonville, Ill.; member of the Illinois State legislature 1836–42, and representative in Congress 1843–45; in the war with Mexico he served as colonel of the 1st Ill. Vols., which regiment he led at Buena Vista, where, on the second day, while heading a charge, he was killed, Feb. 23, 1847.

Hardin (Martin D.), a son of Col. John Hardin (1753–92), a famous Indian fighter and Revolutionary patriot of Virginia and Kentucky. The younger Hardin was b. June 21, 1780, in Western Pennsylvania; settled with his father in Kentucky in 1786; became a lawyer; was secretary of State for Kentucky 1812; served with distinction under Harrison as major in that year; was U. S. Senator 1816–17. Author of a vol. of legal reports, 1810. Was a lawyer of great ability. D. in Franklin co., Ky., Oct. 8, 1823.

Har'ding, tp. of Pottawattomie co., Ia. Pop. 122.

Harding (Chester), b. in Conway, Mass., Sept. 1, 1793; d. in Boston Apr. 1, 1866; began his art-life as a sign-painter; had his enthusiasm for higher art awakened by a man of no repute, who painted likenesses of himself and his wife. Without instruction or encouragement, he took up the profession, painted a hundred portraits in six months at $25 each; went to Philadelphia to study; thence to St. Louis, where he resided for some years; then established himself in Boston and became at once the fashion. In 1823, Harding went to Liverpool, and remained abroad three years, studying and painting. The dukes of Sussex, Hamilton, and Norfolk, the historian Alison, and the poet Rogers sat to him. On his return home success awaited him. Among the eminent persons who sat to him were Daniel Webster, Madison, Monroe, J. Q. Adams, Chief-Justice Marshall, Henry Clay, and J. C. Calhoun. Mr. Harding was a tall, robust man, of frank, social disposition and genial manners. His presence was very attractive, and his company delightful. To his personal qualities he probably owed much of his extraordinary popularity, for, though sometimes excellent as likenesses, his portraits lacked the accuracy of drawing and the color that distinguish the best works of art. O. B. Frothingham.

Har'dinge (Charles Stewart), second viscount, b. Sept. 12, 1822; studied at Eton and Christ Church, Oxford; B. A. 1844; served in the Sikh wars, and as secretary to his father in India; in Parliament for Downpatrick 1851–56; succeeded to the peerage 1856; under-secretary of state for war 1858–59. Author of *Views in India* (1847), a costly work, illustrated by himself.

Hardinge (Henry), Viscount, b. at Wrotham, Kent, Eng., Mar. 30, 1785; entered the army 1798; made lieutenant 1802, captain 1804; served in the Peninsula 1808–14; deputy quartermaster-general 1809–13; wounded at Vimeira, Vittoria, and Ligny, where he lost an arm while commanding a German brigade; K. C. B. 1815; entered Parliament for Durham 1820; married a daughter of Lord Castlereagh 1821; privy councillor, secretary at war 1828; chief secretary for Ireland 1830, 1834–35, and 1841–44; governor-general of India 1844–48, and performed the duties of that office with ability. In 1845 he gained a victory over the Sikhs at Ferozeshah, and fought in that bloody campaign, chiefly as a volunteer under Gough. In 1846 he was made Viscount Hardinge; master-general of ordnance 1852; commander-in-chief 1852; field-marshal 1855. D. at Southport Sept. 24, 1856.

Har'dinsburg, post-v. of Washington co., Ind. P. 199.

Hardinsburg, post-v., county-seat of Breckenridge co., Ky., 120 miles S. W. of Frankfort, has a seminary and several public buildings. Pop. 455.

Har'dinsville, a v. of Shelby co., Ky. Pop. 88.

Hard'ness, Scale of. In comparing the hardness of minerals, the mineralogist uses an arbitrary scale composed of ten minerals, representing from one to ten gradually increasing degrees of hardness. The minerals generally selected, and forming what is known as "Moh's scale," are—1, talc; 2, gypsum (we prefer rock-salt); 3, calcite; 4, fluorite; 5, apatite; 6, feldspar; 7, quartz; 8, topaz; 9, corundum; 10, diamond. Transparent crystalline varieties are chosen. A simple scale may be extemporized by use of the thumb-nail, of an old-fashioned copper-coin (which exactly equals No. 3), of a piece of glass, and of a hard steel file, which will give approximately all the degrees below 8. By a little practice, however, the student will learn to readily recognize the degrees below 8 by simply passing the file over the mineral and noting the resulting sound. Edward C. H. Day.

Hardouin (Jean), b. at Quimper, in Brittany, 1646; was appointed in 1683 librarian of the Collége Louis-le-Grand; devoted himself to the study of Greek and Latin, philosophy, theology, and numismatology. He maintained in his *Chronologia ex nummis antiquis restituta* (1697), and in his *Prolegomena ad Censuram veterum Scriptorum*, that the works ascribed to the Greek and Latin authors, with the exception of Cicero, Pliny the Elder, the *Georgics* of Virgil, and the *Satires* and *Epistles* of Horace, were the productions of the monks of the thirteenth century, and that most of the so-called ancient coins were of recent origin. Virgil's *Æneid* he considered an allegorical representation of St. Peter's journey to Rome. He also disputed the genuineness of the proceedings of the Church councils before that of Trent. Hardouin was one of the editors of the *Scriptores Latini in usum Delphini*, for which collection he prepared, with valuable notes and a copious index, *Plinii Historia Naturalis* (Paris, 1685, 5 vols. 4to; reissued 1723, 3 vols. fol.). He also published a *Conciliorum Collectio* (12 vols. fol., Paris, 1715), which was suppressed by authority of Parliament. D. Sept. 3, 1729. H. Drisler.

Hard'ware, a term applied to those articles of common use made of iron, copper, brass, or bronze. A general assortment of hardware comprises an almost infinite variety of articles manufactured wholly or in part from the metals or alloys named above. For the convenience of both dealers and customers, this assortment is divided into several classes, and the wholesale dealers or jobbers usually confine themselves to a single class. Thus, *builders' hardware* includes locks, keys, bolts of all sorts, door and other knobs, hinges, springs, latches, hooks, staples, window fasteners, window-weights, spikes, nails, brads, tacks, clothes-hooks, screws, nuts, anchors (for fastening brick walls), and perhaps also crowbars and jackscrews. *Carpenters' or joiners' hardware* includes not only all descriptions of carpenters' tools, a great variety of saws, planes, bitts and bitt-stocks, augers, gimlets, chisels, mortising tools, screwdrivers, hammers, hatchets, adzes, broad-axes, etc., but also the smaller articles, nails, screws, locks, and the like of builders' hardware. *Housekeepers' hardware* is a still larger department, embracing every kitchen utensil either wholly or in part of iron, steel, copper, brass, bronze, or block-tin, and, as generally construed, all articles of table cutlery and every description of tinned or galvanized-iron ware. It is often also made to include plated goods for household use, and many wooden articles, such as pails, tubs, boxes, etc., more appropriately belonging to wooden-ware, as well as the cheaper forms of glass-and-metal wares for domestic use, such as cans for fruit, preserve-jars, etc. An ordinary stock of housekeeping hardware may include as many as 10,000 different articles.

These are the principal divisions, but there are others of considerable importance in large cities, such as *saddlers', harness and trunk makers' hardware,* which comprises a considerable number of items; *miners' and contractors' hardware,* including picks, crowbars, spades, shovels, etc.; *machinists' hardware,* including those descriptions used by stove, range, heater, furnace, and boiler makers, plumbers and gasfitters, tinsmiths, etc.; *stationers' hardware,* including copying-presses, cash-boxes, fine cutlery, ink-standishes, match-safes, cigar-holders, etc.; *car-builders' hardware,* which includes all the metallic fixtures of a railway car; *furniture and house-furnishing hardware,* a large department of the business; and, finally, *fancy and toy hardware,* which includes a great variety of fanciful goods belonging rather to the realm of luxury than of mere utility. Many of these articles are treated under their specific names, but the general term, *hardware,* applying to them all, is too important to be overlooked. The amount of goods appropriately belonging to this title produced in a year is enormous: in 1871 the amount reported to the British government from the great hardware marts exceeded £12,000,000 = $60,000,000. In the U. S. in 1870, according to the census, the different branches of the hardware trade produced $142,836,272. L. P. BROCKETT.

Hard'wick, post-tp. of Worcester co., Mass., 75 miles W. of Boston, on the Ware River R. R. It is hilly, but fertile, and has abundant water-power and manufactures of paper and woollen goods. Pop. 2219.

Hardwick, post-tp. of Warren co., N. J. Pop. 638.

Hardwick, post-tp. of Caledonia co., Vt., 24 miles N. E. of Montpelier, is on the Portland and Ogdensburg R. R. It has an academy, 3 churches, and manufactures of sash, doors, blinds, furniture, woollens, carriages, leather, and other goods. Pop. 1519.

Hardwick (CHARLES), b. at Slingsby, Yorkshire, Sept. 22, 1821; lost his life by a fall in climbing the Pyrenees Aug. 18, 1859, and was buried in the Protestant cemetery of Luchon. Apparently of humble parentage, he made his way at the University of Cambridge by his talents and industry. In 1853 he was appointed professor of divinity in Queen's College, Birmingham, and in 1855 lecturer on divinity in King's College, Cambridge. He had been ordained deacon in 1846 and priest in 1847, and only a few months before his untimely death was made archdeacon of Ely. His scholarship was both broad and accurate, and he was a versatile and rapid worker. He published other books, but his fame will rest on these four: *History of the Articles of Religion* (1851; 2d ed. 1859), *History of the Middle Age of the Church* (1853), *History of the Reformation* (1856), *Christ and Other Masters* (in 4 parts, 1855–58; 3d ed. by Francis Procter, 1874). R. D. HITCHCOCK.

Hard'wicke, EARLS OF. (1) PHILIP **Yorke,** b. at Dover, Eng., Dec. 1, 1690; was a merchant's son; called to the bar at the Middle Temple 1715; M. P. for Lewes 1719; became solicitor-general 1720; was attorney-general 1723–33; lord chief justice 1733–37; Baron Hardwicke 1733; lord high chancellor 1737–56; Viscount Royston and earl of Hardwicke 1754. D. in London Mar. 6, 1764. He was one of the ablest jurists that ever occupied the woolsack. (2) PHILIP, second earl, b. Dec. 9, 1720; was educated at Cambridge, where he took the doctorate of laws, and in 1762 became chancellor of the university. D. May 16, 1790; contributed to *Athenian Letters* (1741–43). His other principal works are *Miscellaneous State Papers* and *Walpoliana.* (3) CHARLES PHILIP, fifth earl, b. Apr. 23, 1836; succeeded to the peerage 1873.

Har'dy, county of West Virginia, bounded on the S. E. by Virginia. It is a fertile and romantic mountain-region, with broad and rich valleys. Grain and live-stock are leading products. Coal and iron are found. Area, about 480 square miles. Cap. Moorefield. Pop. 5518.

Hardy, tp. of Holmes co., O. Pop. 2857.

Hardy, tp. of Isle of Wight co., Va. Pop. 3171.

Hardy, tp. of Logan co., W. Va. Pop. 1472.

Hardy (JAMES WARD), a minister of the Methodist Episcopal Church, South, b. in Georgia Jan. 19, 1815; d. in Alabama Aug. 14, 1853; graduated with distinction at Randolph-Macon College, Va., in 1837, and was elected in 1838 to the chair of natural science in that institution. He was several years a professor of mathematics, and afterward president of La Grange College, Ala. He was a profound scholar and an eloquent preacher. T. O. SUMMERS.

Hardy (ROBERT SPENCE), b. at Preston, Lancashire, England, July 1, 1803; joined the Wesleyan conference in 1825, and went as missionary to Ceylon, laboring there for twenty-three years, and then returning to England. *The British Government and the Idolatry of Ceylon* (1841), *Eastern Monachism* (1850), *A Manual of Buddhism in its Modern Developments, translated from Singhalese MSS.* (1853), *Legends and Theories of the Buddhists compared with History and Science* (1867), were published by him. D. at Headingly, Yorkshire, Apr. 16, 1868. His writings have thrown much light upon Booddhism, and he was regarded as one of the best of recent Pali scholars.

Hardy (Sir THOMAS DUFFUS), D. C. L., b. in 1804 at Port Royal, Jamaica; became in 1819 a clerk in the Tower of London, and in 1861 deputy keeper of the public records; won great distinction by his editions of ancient MSS., old public records, and rolls, catalogues of state papers, a *Life* of Lord Langdale (1852), and other works of much historical value. D. June 15, 1878.

Har'dyston, tp. of Sussex co., N. J. Pop. 1668.

Har'dyville, post-v. of Mohave co., Ar., on the E. bank of the Colorado River, above Mohave City. Pop. 20.

Hardyville, post-v. of Hart co., Ky. Pop. 68.

Hare, a name properly belonging to those rodent mammals of the family Leporidæ which are in the main solitary in their habits, and which construct forms or nests upon the surface of the ground, but do not have burrows; for the social and burrowing Leporidæ are rabbits. According to this distinction, it is probable that there are no true rabbits in America, except the descendants of those brought from Europe. Our wild rabbits are therefore hares. With the exception of the calling hares (*Lagomys,* of which genus the U. S. have one species, the little chief hare, *L. princeps* of the Rocky Mountains), the hares and rabbits are all of the genus *Lepus.* Of more than forty known species, nearly half are North American. The more important are the common gray rabbit (*L. sylvaticus*), so extensively taken as food by traps, snares, and firearms; the great white hare (*L. Americanus*); the jackass rabbits (*L. callotis* and *Texanus*) of the Far West; Baird's hare (*L. Bairdii*), remarkable from the fact that the males as well as females give milk and suckle their young; and the water-hares of the South (*L. palustris* and *aquaticus*), both good swimmers and inhabitants of swamps. The most common of the European hares is the *L. timidus,* so extensively coursed by greyhounds and pursued by harriers and beagles. The hares have been considered partial ruminants; but it is stated by good authorities that the apparent rumination is performed for the purpose of grinding down the teeth and fitting them for gnawing. Their progression is by a series of leaps. Most of them are very swift, their only defence from enemies being in escape. It having been discovered in France that the European hare and rabbit breed freely together, and that the hybrid offspring, called *leporides,* are unusually good for the table, quite an industry in the breeding of them is reported to have sprung up.

Hare (AUGUSTUS JOHN CUTHBERT), b. at Rome Mar. 13, 1834. Author of *Epitaphs for Country Churchyards* (1856); *Winter at Mentone* (1862); *Walks in Rome* (1871); *Memorials of a Quiet Life* (1872), which relate to the Hare family; *Wanderings in Spain* (1873); *Days near Rome* (2 vols., 1874).

Hare (EDWARD), b. at Hull in 1774; served in the British navy, and entered the Wesleyan ministry in 1798. D. in 1818. *A Treatise on the Scriptural Doctrine of Justi-*

fication (1839) and *Sermons* (the latter from his MSS., with his memoir, written by Joseph Benson) were his productions.

Hare (GEORGE EMLEN), D. D., LL.D., b. at Philadelphia Sept. 4, 1808; graduated at Union College 1825; entered the Protestant Episcopal ministry; rector of St. John's, Carlisle, Pa., 1830–34; of Trinity church, Princeton, N. J., 1834–43; became in 1844 rector of St. Matthew's, Philadelphia, and in 1858 professor of biblical learning in the Divinity School, Philadelphia. Author of *Christ to Return;* received the degree of D. D. from Columbia College, of LL.D. from the University of Pennsylvania.

Hare (JOHN INNES CLARK), son of Prof. Robert Hare, b. at Philadelphia 1817; became a lawyer; associate judge of the district court of Philadelphia 1851; was afterwards chosen presiding judge of that court; with H. B. Wallace author of *American Leading Cases* (2 vols., 1847), and has ably edited and annotated several important reprints of English law-treatises.

Hare (JULIUS CHARLES), M. A., b. at Herstmonceux, Sussex, Eng., 1796; took his master's degree 1819, and a fellowship at Trinity College, Cambridge; became vicar of Herstmonceux 1832, archdeacon of Lewes 1840, a prebendary of Chichester 1851, chaplain to the queen 1853. D. at Herstmonceux Jan. 23, 1855. With his brother, A. W. Hare, wrote *Guesses at Truth* (1827, 1848); with Thirlwall translated Niebuhr's *History of Rome* (1828); author of *Mission of the Comforter* (1846); *Memoir of John Sterling* (1848); *Vindication of Luther* (1854), and other works.—His brother, AUGUSTUS WILLIAM (b. 1793), became a fellow of New College, Oxford; rector of Alton-Barnes 1829. D. at Rome Feb. 18, 1834. Joint author of *Guesses at Truth* (see above); author of *Sermons to a Country Congregation* (2 vols., 1837).

Hare (ROBERT), A. M., M. D., b. in Philadelphia, Pa., Jan. 17, 1781, was the son of an English brewer, and early turned his attention to scientific experiments. In 1802 he invented the oxyhydrogen blow-pipe, which won for him the Rumford medal of the American Academy. In 1806 he received the degree of M. D. from Yale, *honoris causa*, and from Harvard also in 1816, in which year he brought forward the calorimotor, a form of galvanic battery by which intense heat may be generated. In 1831 he made successful experiments in subaqueous blasting by means of the galvanic current. Among his other inventions are the gallows-screw and several improved processes in chemistry, toxicology, and pharmacy. In 1818 he was called to the chair of chemistry in William and Mary College, and he held the chemical professorship in the University of Pennsylvania from 1818 to 1847. Late in life he became a believer in Spiritualism. He published *Brief Views of the Policy of the U. S.* (1811); *Chemical Apparatus* (1836); *Spiritual Manifestations Scientifically Demonstrated* (1855), and other works, besides an immense number of scientific papers. He was a member of various learned societies. His excellent and ingenious apparatus he gave to the Smithsonian Institution, in which he felt a deep interest. Dr. Hare excelled as an instructor in his favorite sciences. D. at Philadelphia May 15, 1858.

Harebell. See BLUEBELL.

Har'eld, Old'wife, or **Long-Tailed Duck,** the *Harelda glacialis*, a beautiful wild-duck of the oceanic group, common in both hemispheres. Its summer residence is in the sub-arctic regions, but in winter it flies as far S. as Texas. Its nest is lined with choice down, as good as eider-down. It is a very lively bird, a good diver, and of rapid flight. Its flesh is good.

Hare Lip, a congenital deformity of the human upper lip, characterized by a fissure (rarely median, like that normal in the hare or the cat), usually a little to one side, and more frequently on the left, but sometimes occurring on both sides at once. When simple and uncomplicated with cleft palate (a frequent accompaniment), a simple surgical operation will commonly cure it perfectly, and infancy is the proper time for operation; but the operation for cleft palate (staphyloraphy) should usually be deferred to a maturer age. The fissure itself normally exists in the fœtal state; by arrest of development it remains open after birth. When two fissures exist, it is not unusual to find the incisor segment (intermaxillary bone) of the upper jaw detached from, or rather ununited to, the jaw, and the deformity may amount to a double cleft palate. The rare case of median hare-lip is quite analogous to *spina bifida*, for the intermaxillary bone is the representative of the spinous process of the first cephalic vertebra.

REVISED BY WILLARD PARKER.

Ha'rem [Arab., a "sanctuary"], a word properly applicable to any sacred place, but in European usage limited entirely to the apartments where Oriental women are kept. A harem does not necessarily include more than one wife with her attendant women and eunuchs. By Mohammedan law no man can have more than four wives, but there is no such restriction as to the number of his concubines and slave-women. As to the practical workings of the system, accounts differ. Many Frankish ladies have been freely admitted to visit the harems (from which all men but the husband and near relatives are jealously excluded). Some of these ladies have reported a most unhappy and altogether debased condition as that generally prevalent in the harems; others have found the Turkish and other women remarkably happy, and quite refined in their tastes. Considerable liberty is often allowed the inmates of the harem, but they must always go out closely veiled and suitably attended.

Har'ford, county of Maryland, bounded on the N. by Pennsylvania, and on the E. and S. E. by the Susquehanna and Chesapeake Bay. Area, 480 square miles. The surface and soil are various, but highly productive. Cattle, grain, wool, fruit, hay, and dairy products are important staples. There are some manufactures and important fisheries. Iron, chrome, building-stone, and kaolin are found. The county is traversed by the Philadelphia Wilmington and Baltimore R. R. Cap. Belair. Pop. 22,605.

Harford, tp. and post-v. of Cortland co., N. Y., on the Southern Central R. R., 41 miles S. by E. of Auburn. It has a large lumber-trade. Pop. 997.

Harford, tp. and post-v. of Susquehanna co., Pa. P. 1595.

Har'graves (EDMUND HAMMOND), b. at Gosport, England, about 1815; went to sea at an early age, and for a time was settled in Australia; subsequently embarked for California (1849), and upon his arrival at the gold-fields was so impressed with the similarity of the country to that he had just left that on his return he entered upon explorations which resulted in the discovery of the valuable gold-fields of Australia. Disclosing his discovery to the colonial secretary at Sydney, he was subsequently appointed commissioner of crown-lands, receiving also many valuable testimonials, among which was a grant of £10,000 by the authorities of New South Wales; in 1854 he returned to England, and published the following year an account of his discoveries, entitled *Australia and its Gold-Fields*.

Har'greaves (JAMES), inventor of a carding-machine (1760), and of the spinning-jenny (1764, 1767), was an unlettered hand-spinner and weaver, b. at Stanhill, near Blackburn, England. He had tried in vain to spin several cotton threads at one and the same time, but failed. One day his little child overturned his spinning-wheel, and as he saw the spindle revolving vertically, he resolved to construct a machine with several vertical spindles. This proved a success, and was kept a secret; but his neighbors, seeing how much yarn he and his family produced, broke into the house and destroyed the machine. In 1778 he went to Nottingham and set up as a machine-spinner, but never had much success. He got a patent on his invention, but it was set aside by the courts, and he d. (a poor man) Apr., 1778.

Ha'ri-ka'ri [Chinese for "happy despatch"], a form of suicide performed in Japan by cutting open the abdomen by two crosswise cuts with the sword. Officials who are guilty of misdemeanors are often commanded to perform hari-kari. If they comply, their children inherit the father's property and position, but not so if the suicide has taken place unbidden. Persons who have suffered unendurable affront, which cannot otherwise be satisfied, sometimes accomplish suicide in this way.

Har'ington (Sir JOHN), K. B., b. at Kelston, near Bath, England, 1561, son of John Harington (author of the excellent *Verses made on Isabella Markhame*) by an illegitimate daughter of Henry VIII. Queen Elizabeth stood sponsor at his christening, and he studied at Eton and Cambridge. He went in command of some horse to Ireland with Essex, who as lord lieutenant knighted him on the field, to the great dissatisfaction of Elizabeth, who in 1596 excluded Harington from court on account of the publication of his *Metamorphosis of Ajax*, a poem. The queen had, however, a great liking for her godson, and soon recalled him. James I. made him a knight of the Bath 1603. D. 1612. His other chief works are a translation of *Orlando Furioso* (in heroic verse, 1591); *Epigrams* (1615); *The Englishman's Doctor* (1609); *History of Polindor, etc.* (1651); *Briefe View of the State of the Church of England* (1653); *Nugæ Antiquæ* (with memoir, compiled by Henry Harington, 3 vols., 1769–79).

Harîri, Al [Arab., "the silk-mercer"], a name of ABU MOHAMMED AL KÂSIM, b. at Bassora in 1054. Author of *Makamat* ("The Assemblies"), an Arabian classic of the first importance, written in prose and verse; also of *Molhat-*

al-Irab, a grammar, and *Dorrat-al-Gawas* ("The Diver's Pearl"), a treatise on the Arabic language, and other works. D. 1121. The best and completest English version is that of Prof. Thomas Chenery of Oxford (1867). Theodore Preston of Cambridge (1850) translated twenty of the pieces. The spirited free translation into German by F. Rückert (1826) should be mentioned.

Harivan'sa, a kind of epic written in Sanscrit, regarded as a supplement to the *Mahabhârata*. Its critical character is not high. It treats of Vishnu in his avatar as Krishna, of cosmogony, and of ancient history.

Har'ker (CHARLES G.), b. in New Jersey Dec. 2, 1837; graduated at the U. S. Military Academy July, 1858, and entered the army as brevet second lieutenant of infantry, receiving his full commission as second lieutenant in September following; promoted to be first lieutenant May, 1861, and captain Oct., 1861. Prior to the civil war he served on frontier duty, and on the outbreak of the war was assigned to the organization and drill of volunteers in Ohio; in Nov., 1861, he was appointed colonel 65th Ohio Vols., and led his regiment in the battle of Shiloh and the subsequent advance upon Corinth; assigned to command of a brigade in June, 1862, he participated in the battles of Stone River and Chickamauga. He was appointed brigadier-general of volunteers Sept. 20, 1863, for gallant conduct at Chickamauga, and engaged at the battles of Missionary Ridge, Resaca, Dallas, and Kenesaw Mountain. In the latter engagement he fell, at the head of his command, June 27, 1864.

Hark'ness (WILLIAM), A. M., LL.D., b. in Ecclefechan, Dumfriesshire, Scotland, Dec. 17, 1837; graduated at Rochester University, N. Y., in 1858, and was appointed professor of mathematics U. S. N. Aug. 24, 1863. Author of several astronomical and physical papers published by the U. S. naval observatory and the Smithsonian Institution. Was in charge of U. S. Transit of Venus expedition in 1874, at Hobart Town, Tasmania.

Har'lan, county of Kentucky, bounded on the S. E. by Virginia. Area, 600 square miles. It is a mountain-region, containing beds of iron ore and coal. Corn and pork are the principal agricultural products. There are extensive forests. Cap. Harlan. Pop. 4415.

Harlan, county in the W. of Nebraska, bounded on the S. by Kansas. It is drained by the Republican River and its branches, and is a fine grazing country. Area, 576 square miles. Cap. Alma. Pop. not given in census of 1870.

Harlan, tp. of Fayette co., Ia. Pop. 312.

Harlan, tp. of Page co., Ia. Pop. 756.

Harlan, post-v. and tp., cap. of Shelby co., Ia., in the beautiful valley of the Nishnabatona, 40 miles N. E. of Council Bluffs. It has 2 churches, a graded school, a newspaper, a large flouring-mill, and a hotel. It has a good trade from the fine agricultural region surrounding. Pop. of v. 128; of tp. 466. A. F. HOLCOMB, ED. "RECORD."

Harlan, post-v., county-seat of Harlan co., Ky.

Harlan, tp. of Warren co., O. Pop. 2396.

Harlan (JAMES), b. in Clarke co., Ill., Aug. 25, 1820; graduated at Indiana Asbury University 1845; became a lawyer; superintendent of public instruction in Iowa 1847; president of Iowa Wesleyan University 1853; U. S. Senator from Iowa 1855–65; secretary of the interior 1865–66; again U. S. Senator 1866–73.

Harlan (RICHARD), M. D., b. in Philadelphia Sept. 19, 1796; made a voyage as ship's surgeon to Calcutta, and in 1817 graduated M. D., and became a practitioner in Philadelphia, whence in 1838 he removed to New Orleans, La., where he d. Sept. 30, 1843. He published *Fauna Americana* (1825); *Medical and Physical Researches* (1835); *On the Genus Salamandra* (1824); *American Herpetology* (1827).

Harlay, de (ACHILLE), b. at Paris Mar. 7, 1536; d. there Oct. 21, 1616. Appointed first president of the Parliament, the highest judicial court in France, by Henry III. in 1582, he remained faithful to him during the civil war of the League, and made this Puritan-like answer to those who threatened him: "It is a great pity when the servant puts his master out; but my soul belongs to God, my heart to the king, and my body is in the hands of the wicked; let them do with it what they please." He was left untouched for some time, but was thrown afterwards into the Bastile, after the surrender of Paris to Henry IV., who maintained Harlay at the head of the Parliament. He used his power to counteract the manœuvres of the Ultramontanes, and caused the condemnation of the books of Bellarmin and Mariana. Author of *La Coutume d'Orléans*, 1583. He was very witty, and the collection of his *bons mots* was published under the title of *Harlæana*.

Harlay de Sancy (NICOLAS), b. in 1546; d. in 1629, is principally known as having been the owner of the celebrated diamond, named after him the Sancy diamond, the largest in Europe, and which belonged afterwards to the crown of France. Harlay de Sancy was ambassador and superintendent of finances under Henry III. and Henry IV. He was a kind of free-thinker, and he changed his creed so often that the famous Protestant writer D'Aubigné published about him a bitter satire under the name of *Catholic Confession of Sancy*. FÉLIX AUCAIGNE.

Har'leeville, tp. of Marion co., S. C. Pop. 1314.

Har'leian Collec'tion, a mass of MSS. collected by Robert Harley, earl of Oxford (1661–1724), and by Edward, his son. In 1723 it was purchased by the British government for £10,000, and the documents are now in the British Museum. There are some 8000 MSS., many of them of very great value, and there were originally above 400,000 pamphlets. Volumes of *Harleian Miscellanies* have been from time to time published, being compilations from the collected documents. Harley's printed books were sold to a private person.

Har'lem, tp. of Stephenson co., Ill., on the Illinois Central R. R. Pop. 1243.

Harlem, tp. and post-v. of Winnebago co., Ill., on the Chicago and North-western R. R. Pop. 781.

Harlem, that part of New York City above 106th street, and between the East River and 8th avenue. It was once a distinct corporation. (See NEW YORK.)

Harlem, tp. and post-v. of Delaware co., O. Pop. 1149.

Har'lem Riv'er, the channel which extends northward from the East River at Hell Gate, forming a portion of the eastern boundary of Manhattan Island, upon which New York City is mainly situated. Harlem River is, throughout a large part of its extent, navigable for large vessels. It is connected with the Hudson River to the N. by the Spuyten Duyvil Creek, a shallow and tortuous passage.

Harlem Springs, post-v. of Carroll co., O., is the seat of Harlem Springs College.

Har'lequin, in mediæval and modern pantomime, the lover of Columbine, and her protector from the machinations of Pantaloon and the Clown. He wears tight-fitting garments covered with spangles, and often has the assistance of good fairies. (See PANTOMIME.)

Harlequin Duck (*Histrionicus torquatus*), a small and very beautiful wild-duck of Northern North America, rarely seen in Europe. It is often seen swimming in rapids and rough waters. Its color is blackish, but it is finely mottled with other colors.

Harles (GOTTLIEB CHRISTOPH, or THEOPHILUS CHRISTOPHORUS), a learned bibliographer and classical editor, b. at Culmbach June 21, 1738; studied philology in the University of Erlangen; was made professor of Greek and Hebrew in the gymnasium at Coburg 1765; professor of poetry and eloquence 1770 in the University of Erlangen; in 1776 university librarian; and in 1777 founded the philological seminary. Edited with notes the *Plutus* of Aristophanes, Aristotle's *Poetics*, Cicero's *De Oratore* and *Verrine Orations*, Cornelius Nepos, Theocritus Bion and Moschus, and other classic authors. Wrote numerous works on Greek and Latin literary history and bibliography, especially *Introductio in historiam Græcæ linguæ* (2d ed., 2 vols., Altenburg, 1792–95); *Supplementa* (2 vols., Jena, 1804–06); *Introductio in notitiam literaturæ Romanæ* (2d ed., Leipsic, 1794); *Brevior notitia lit. Rom.* (Leipsic, 1789); *Supplementa* (completed by Klügling, 3 vols., Leipsic, 1799–1817); published also *Vitæ philologorum* (4 vols., Bremen, 1764–72). His chief work was the new and enlarged edition of *Fabricii Bibliotheca Græca* (12 vols. 4to, Hamburg, 1790–1809). D. Nov. 2, 1815. H. DRISLER.

Har'less, von (GOTTLIEB CHRISTOPH ADOLF), D. D., b. at Nuremberg, Bavaria, Nov. 21, 1806; studied at Erlangen and Halle; held (1829–45) a theological professorship at Erlangen, and afterwards one at Leipsic; and in 1852 became an ecclesiastical councillor to the Bavarian government and president of the superior consistory of Munich. Author of a commentary on *Ephesians* (1834, 2d ed. 1858); *Theological Encyclopædia* (1837); *Christian Ethics* (1842); *Jacob Böhme and the Alchemists* (1870); and other valuable works.

Harley (ROBERT). See OXFORD, EARL OF.

Har'lingen, town of the Netherlands, in the province of West Friesland, on the Zuyder Zee. It has a very lively trade with England, especially in butter. Pop. 9900.

Har'mar (Gen. JOSIAH), b. at Philadelphia in 1753, where he was educated; in 1776 he was made captain 1st Pennsylvania regiment, and lieutenant-colonel in 1777, which command he retained until the close of the Revolution, serving with Gen. Washington in his campaigns 1778–80; in the South with Gen. Greene 1781–82; bre-

vet colonel 1st U. S. regiment 1783; in 1784 was selected to bear the ratification of the definitive treaty to France, and in the following year was present as Indian agent at the treaty at Fort Mackintosh; appointed (Aug., 1784) lieutenant-colonel of infantry under the Confederation; brevet brigadier-general by resolution of Congress 1787, and general-in-chief of the army Sept. 29, 1789, which post he held until 1792, when he resigned. Adjutant-general of Pennsylvania 1793–99. D. at Philadelphia Aug. 20, 1813.

Harmat'tan [Arabic], a hot, dry wind which blows westward from the Great Desert of Africa. It is of the same character with the sirocco of the Mediterranean, but is represented as more severe in its effects upon the human system. It prevails in the winter months.

Har'mer, post-v. of Washington co., O., in Marietta tp., is on the Ohio River, and on the S. side of the navigable Muskingum River, at its mouth, opposite Marietta. It has steamboat-building and manufactures of cooperage, iron, brick, and other goods. Pop. 1511.

Harmo'dius, a beautiful youth of Athens, who was warmly attached to a citizen named ARISTOGITON, his remote kinsman, both belonging to the Gephyræi. It appears that Hipparchus, brother of the tyrant Hippias, desired to sever the relationship which existed between the friends, and to attach Harmodius to himself, and, failing, put repeated insults upon the two friends. Accordingly, they determined to put to death not only Hipparchus, but his brother the tyrant. On the feast of the great Panathenæa (514 B. C.) Hipparchus was assaulted and slain, but Harmodius was at once killed by the guards. Aristogiton, put to the torture, named the chief friends of Hippias as his accomplices, and they were accordingly put to death. After the expulsion of Hippias (510 B. C.), Harmodius and Aristogiton came to be highly honored as martyrs for the cause of liberty. They were, however, doubtless quite unworthy of the immortality which their supposed patriotism has conferred upon them.

Har'mon, post-tp. of Lee co., Ill., 8 miles S. W. of Dixon. Pop. 542.

Harmon (OSCAR F.), b. at Wheatland, N. Y., May 31, 1827; studied law, and in 1853 removed to Danville, Ill., where he practised his profession with great success. In 1862 he was appointed colonel 125th Illinois Vols., which regiment he led with ability. At the battle of Kenesaw Mountain, Gen. McCook being wounded, the command of the brigade fell upon Harmon, and while at the head of his command he was killed June 27, 1864.

Harmo'nia, the fabled daughter of Ares and Aphrodite, or of Zeus and Electra, and wife of Cadmus. She is chiefly remembered for the fatal necklace which her husband bestowed upon her on her wedding-day. This necklace brought bad luck to all its owners, and after several generations of heirs had been cursed with it, it was dedicated to Athena in her temple at Delphi, whence it was stolen by Phayllus as a gift for his paramour, whom it brought to utter ruin.

Harmon'ica, a musical instrument improved by Dr. Franklin (but known long before his time) consisting of a series of revolving glass cups, which upon being pressed by the tip of the finger or a suitable bow give forth musical tones of a peculiarly fine quality. Though much admired, the instrument soon passed out of notice. Various harmonicas have been since brought forward. The "chemical harmonica" is a long, straight, open tube of glass, one end of which is held over a flaming jet of hydrogen. A musical sound is given out, varying in pitch and other qualities with the proportions of the tube. The phenomenon is caused by a series of minute explosions produced by the burning gas, which communicate a vibration to the tube.

Harmon'ic Mo'tion, in mechanics. If a point move uniformly in a circle, its *projection* on any diameter changes by a simple *harmonic motion.* If a planet or satellite, moving uniformly in a circular orbit about its primary, be viewed from a very distant position in the plane of its orbit, it will appear to move backward and forward in a straight line with a simple harmonic motion—*e. g.* the satellites of Jupiter seen from the earth. Such motion as we describe is approximately that of the simplest species of *vibrations* of a sounding body, a tuning-fork or pianoforte wire, whence the name; it is also that of the various media in which waves of sound, light, heat, etc. are propagated, and it enters extensively into the theories of these phenomena, as well as into those of astronomy and mechanics. The *amplitude* is the range on one side or the other of the middle point of the course. The *argument* is the circular arc described by the projected point, and measured from any arbitrary fixed point. It is proportional of course to the time measured from period of passage through that arbitrary point. The distance of a point moving with simple harmonic motion from the middle of its course is a *simple harmonic function of the time*, the *argument* of which has just been defined. The *period* of such motion is the time of a complete course to and fro. The *phase* at any instant is the fraction of the whole period elapsed since the moving point passed through its middle position in a positive direction. The *epoch* is the time from the era of reckoning to the reaching of greatest elongation, in the direction reckoned as positive, from its mean position or middle of the course. (For HARMONIC ANALYSIS ("spherical"), see LAPLACE'S *Coefficients.*) J. G. BARNARD.

Harmon'ic Ra'tio, in mathematics. "If a pencil of four right lines meeting in a point O, be intersected by a fifth right line in the four points A, P, P', B, then the ratio $\frac{AP.P'B}{AP'.PB}$ is constant, no matter how the intersecting line be drawn." This ratio is called the *anharmonic ratio* of the pencil; and if it be *minus unity*, it is a *harmonic ratio* and the pencil is a *harmonic pencil.* In this case the angle AOB will be divided internally and externally into parts of which the sines are in the same ratio; and the line $P'P$ will be harmonically divided by the points A and B—one *on* it and the other on its prolongation, and AB is a harmonic mean between $P'B$ and PB. If B is at an infinite distance—that is, if the intersecting line be parallel to AB (and the pencil *harmonic*)—PP' is bisected at the point A. The division of a musical string into lengths denoted by the reciprocals of the numerical series 1, 2, 3, 4, 5, 6, etc. produces a great many of the essential sounds of our musical system. Hence, such a progression, or more generally that of reciprocals of any series in arithmetical progression, is called *harmonic.* If from four points taken on a conic section a pencil be drawn to any variable fifth point of the curve, the anharmonic ratio of the pencil thus formed will be constant. So, too, will that formed by the four tangents which can be drawn to a curve of the 3d degree from any point *on* the curve. Hence, it may be inferred that the harmonic and anharmonic properties of conic sections admit of many applications in the theory of these curves, and form an important branch of modern geometry. The name "anharmonic" is due to Chasles. (See his *Histoire de Géométrie*; also SALMON'S *Conic Sections.*)

J. G. BARNARD.

Harmon'ics, in music, certain secondary or accessory sounds which are given out by sonorous bodies, besides the principal sound, and different from it, but bearing also to such sound a determinate harmonic relation. It is probable that no musical sound is absolutely pure and simple, but that every well-defined sound is the generator or root of several other sounds, which are more or less audible to our ears. A single string, or monochord, produces not only its own proper sound, but also its octave, twelfth, fifteenth, seventeenth, nineteenth, etc., or the sounds belonging to one-half, one-third, one-fourth, one-fifth, one-sixth, etc. of its length. These secondary sounds, in combination with the principal one, are found to be the elements of the perfect *major-triad*—*i. e.* the root or fundamental tone—with its third and fifth, or their octaves and double octaves. A musical ear readily detects several of these in the sound of a large church-bell (the larger the better), and these harmonics are more or less perfect in proportion as the bell is regularly formed, well cast, free from cracks or flaws, and of uniform density. Sounding bodies not only give out primary tones and accompanying harmonics from their own substance, but also, under certain conditions, induce similar sounds in other bodies within reach of their vibrations. A string vibrating at a certain rate—*e. g.* 120 times in a second—will by "sympathy" cause equivalent vibrations in another contiguous string of the same length, thickness, and tension, and will also excite the more rapid vibrations of strings tuned to sound its octaves, thirds, and fifths; the vibrations or undulations on which sound depends meeting, coalescing, or touching each other at certain regular distances, longer or shorter, and thus producing the harmonic intervals just named. A long-continued note on an open string of a violin will thus cause vibrations in the corresponding string of another violin hanging against the wall. A tuning-fork forcibly struck, and set on the sounding-board of a pianoforte, will occasion all the strings in harmonic relation with it to vibrate in sympathy. The jarring of window-sashes, the jingling of glass vessels, and the rattling of loose articles of furniture, when musical notes *of a certain pitch* (and not otherwise) are sounded, are facts easily explainable on the same principle. Telegraph wires also, during a brisk wind, often give out harmonic tones, though the proper sound of the wire is inaudible. These derived or sympathetic vibrations are, in very large strings, sensible to the touch, and may even be visible to the eye (especially when aided by a magnifying-

glasses, though the sounds produced are too faint to be appreciated by the ear when the experiment is confined to a single string. But when *several* strings are struck simultaneously, the sympathetic vibrations of a large number of other strings contiguous to them become distinctly audible to any ear by the manifest access of power thus given to the original sound. When a full chord, for example, is forcibly struck on a pianoforte, with *the dampers raised* by using the loud pedal, the quantity of sound produced is much greater than otherwise, because, the strings being now all free, every octave, fifth, and major third, with their octaves and double octaves, throughout the whole instrument, respond by sympathy to the notes actually struck, and the general effect is quite sensible to the ear. Composers of pianoforte music often avail themselves of this fact when they wish to give to certain chords the highest degree of force, richness, and brilliance. In the following example the chords at *a* and *b* are precisely the same, but the latter will far exceed the former in power, because the use of the pedal on each note sets the strings free to contribute their harmonics, and thus to intensify the notes under the fingers:

In the large pipes of an organ (chiefly the stopped diapason and bourdon) the harmonic or accessory sounds are often disagreeably perceptible, sometimes causing an indistinctness or uncertainty as to the real tonal pitch of the pipe. In such cases the organist hears distinctly the harmonic fifth or twelfth, while the proper sound of the pipe is barely appreciable. A pipe may also, by an over pressure of wind, be made to sound one or other of its harmonics *instead* of, or in union with, its own proper tone, as in the quintaton stop of German organs, where the pipes are so "overblown" as to yield a piercing quality of tone many degrees higher than that proper to their length or capacity.

Under harmonics, or those below the natural sound, are frequently heard from large bells, forming a booming or deep humming sound. It has also been found that two pipes of moderate size, under certain relations of length and diameter, if sounded simultaneously, will generate a third sound far deeper than their own, and this foreign sound will so predominate as to substitute itself for the proper sounds of the two pipes. Advantage of this curious fact has been taken by modern organ-builders, in obtaining from two pipes—*e. g.* one of them eight feet long, and the other only about five—a derived or harmonic tone equivalent to that of a pipe sixteen feet in length, thereby economizing both space and expense. It is obvious that an organ of moderate size may thus be made to produce tones similar in depth to those for which pipes of the largest class are commonly required. WILLIAM STAUNTON.

Harmon'ic Stops, in a large organ, certain stops consisting of two, three, four, or more ranks of pipes, tuned in octaves, double octaves, and double or triple thirds and fifths above the natural pitch of the keys. These are the cornet, sesquialtera, mixture, furniture, etc.; but, comprehensively, the term may also include those stops having only a single rank of pipes, which are tuned in thirds, fifths, and their octaves above the pitch represented on the keyboard. These latter are known as "mutation stops," among which are the quint, twelfth, tierce, larigot, and several others. The use of these stops is not only to add power to the "foundation stops" of the instrument—*i. e.* those which give the primary or *true* sound and its octaves—but also to produce clearness, variety, and greater or less degrees of brilliance, according to the character and requirements of the music under performance. Hence, these stops are found in largest number on the keyboard or "manual" designated as the "great organ," though several of them have place also on the "choir organ," the "swell," and the "pedal organ."

In considering the peculiar *effects* of these harmonic stops, we arrive at some very curious and singular results, arising from the discovery that much of the sound produced by such stops must, in the nature of things, be utterly discordant and contradictory to the harmony under performance by the organist. Taking the diapasons as the standard (because tuned to the true and natural pitch), it is easy to understand that no ill effects of this kind would ensue by connecting with them another stop (*e. g.* the principal), sounding simply an octave higher, or still another (the fifteenth), sounding a *double* octave above each note on the keyboard. The effect would be only an increase of force and brilliancy, as in the addition of female to male voices. But when we add to the diapason such a stop as the twelfth, which makes *a perfect fifth* (on the octave above) to *every note* under the organist's fingers, we perceive that contradictory elements are now introduced, and more or less of discord must inevitably be the result. To a person not familiar with the organ, it seems incredible that a stop whose pipes are tuned a fifth or double fifth above the proper pitch should be admissible, inasmuch as such a stop must necessarily deliver in the key of the *dominant* that which the organist plays in the *tonic* or proper key.

The natural conclusion from this would be, that an organ provided with mutation and compound stops must be the most discordant of all instruments; and yet it is a known fact that these very stops contribute largely to the richness, majesty, and roundness of pure organ-tones. Experience proves that in their absence the diapasons, with mere duplicates in unison, octaves, and double octaves (as the principal, fifteenth, twenty-second, etc.), yield but a thin, meagre, and disagreeably harsh quality of tone—a tone unsatisfactory to the ear for want of an infusion of some other element to give it substance and body. The explanation of the enriching effect of the twelfth, tierce, sesquialtera, and similar stops, though seemingly difficult, is not so in reality, as it is nothing more than the carrying out of the laws of *harmonics*, by applying them to each individual note on the keyboard of the organ. (See HARMONICS.) As a sounding body naturally gives forth not only its own proper tone, but also several accessory sounds (as the 8th, 12th, 15th, 17th, etc.), so the organ-builder seeks to strengthen the diapasons and other "foundation stops" by adding to them certain other stops or ranks of pipes, which are tuned (not as duplicates, but) in *imitation of the harmonic or secondary sounds* which are already faintly produced by the standard or fundamental stops. Each note of a complete organ, therefore, carries and exhibits all these harmonic elements in their perfection; and the ordinary ear recognizes *not the several constituents* of the sound, but *the whole blended together* in unity, as if produced by a single pipe. Hence it is that in playing a scale movement on the full organ the consecutive fifths and major thirds of the mutation and compound stops are not offensively apparent; and even in full chords the clashing of contradictory harmonics with their primaries is overborne and neutralized by the greater power of the stops sounding the root-tones, with octaves and double octaves superadded, and coming in *the same region with* the harmonics. Bad effects can ensue only when harmonic stops are drawn *without* those stops which are their foundation or correctives, as when we use the sesquialtera, etc. *without* the diapasons, principal, and fifteenth, at the least, as the basis from which they spring and the source of their meaning. WILLIAM STAUNTON.

Har'monist, in music, one who is familiar with the principles and laws of musical harmony; more popularly, one who, in addition to a theoretical acquaintance with harmony, is also a practical composer or arranger of music. There are many harmonists who are not composers, as there are many composers who are very indifferent harmonists.

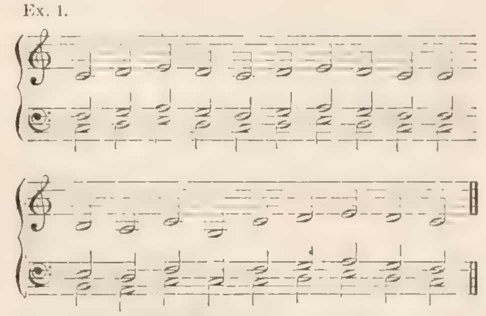
Har'monists, the followers of George Rapp (1770–1847), a German of Würtemberg, who, believing that he was divinely called to restore Christianity to its primitive purity, organized a community which held their goods in common. Disturbed by the authorities, they removed in 1803 to the U. S.; settled in 1805 at Harmony, Butler co., Pa., and removed in 1815 to New Harmony, Ind., which in 1824 they sold to Robert Owen. They then removed to Economy, Pa., 17 miles N. W. of Pittsburg. They own 3500 acres of land, and have important manufactures. They do not marry, lead strictly moral lives, and number some 1300 persons.

Har'mony [Gr. ἁρμονία, a "fitting" together, from ἁρμόζω, to "join"]. Music is commonly viewed as consisting of melody and harmony, the former being a varied *succession* of single or simple tones, and the latter the union of two or more such melodies, or the combination of several tones in one *simultaneous* utterance in accordance with certain regulating principles. Harmony, as now understood and practised, is a science of comparatively modern times, having risen from its rudest form to its present perfection within the last three or four centuries. There is no evidence that the ancients had any acquaintance with the laws indicating the relations of combined musical sounds, or any conception of the rich and beautiful effects resulting from those combinations under scientific and æsthetic treatment. The speculations of Greek writers concerning the origin,

relations, and proportions of intervals, and their theory of the diatonic, chromatic, and enharmonic genera, contributed nothing of consequence to the development of harmony, and possibly as little to the improvement of melody. It is also very certain that for the discovery and cultivation of harmony all abstruse and independent reasoning is fruitless *in the absence of instruments* of such compass, perfection, and regularity of scale as are requisite for the production, adjustment, and testing of chords in their great variety of relation and form. Ancient instruments, however elegant in figure and rich in workmanship, were of very limited range, and too imperfect and defective in their scales to suggest even the first principles of regular harmony. It is capable of proof that contrapuntal science made little advance till the invention of the more perfect classes of instruments, such as the keyed organ and the precursors of the harpsichord and pianoforte. When these instruments came into existence it became possible, for the first time, to reduce to experiment and proof all kinds of musical combinations, and to deduce from actual test some fundamental rules on which chords might be classified, and their progressions determined in an orderly and scientific manner.

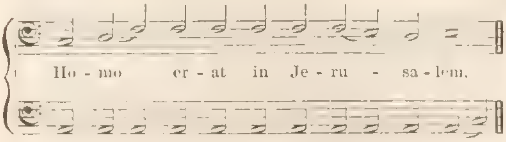
Even as late as the eleventh century we find that the music of the Church—chiefly Gregorian plain-song—was but a simple melody, more or less inflected, without any accompanying harmony, except such as might be supplied by a rude and arbitrary use of occasional octaves, fifths, and fourths. It is questionable, indeed, whether even the term "melody," as now understood, can with justice be applied to those successions of notes which seem to us so bald and unmeaning, but which, nevertheless, constituted what our forefathers regarded as "music," and extolled as consonant with their own ideas of perfection. Of the music of that age Dr. Burney gives some curious relics, which will illustrate what we have here said. "Guido," he remarks, "speaks of *diaphonia*, which means *discant*, or, as he calls it, '*organum*.' This consisted in singing a part *under* the plain-song or chant. Some used only *fourths* for this purpose, but it was allowable to double either the plain-song or the 'organum' by octaves *ad libitum*." The following is an example quoted from Guido by Dr. Burney. For greater convenience we give it in modern notation; and the reader will be able to judge of the condition of musical science and sensibility at a time when so hideous a succession of fourths, fifths, and octaves could be tolerated in divine service or anywhere else:

Ex. 1.



By such writing, Guido, though learned enough in such matters as tetrachords and the ordinary plain-song, proves himself ignorant of the simplest principles of counterpoint, and utterly insensible to the pain created by such semi-barbarous attempts at harmony. Guido, however, improved upon this, as we have reason to infer from later specimens as given in his *Micrologus*, of which the following is one:

Ex. 2.



In all the examples extant of that age the same wretched poverty of thought appears. The writers of music were groping in the dark, without rule, and without any apparent inward feeling to indicate the direction which such rule should take. Some ideas they had about simple intervals, but none concerning their use and relations. Fourths, fifths, and sixths succeed each other without order or reason; and it is remarkable that the fourth seems to have been a rather favorite interval. What further advances the musicians of that period made it is not easy to determine, but it is inconceivable that either Guido or his fellow-laborers ever produced anything which modern ears would tolerate, except for the satisfaction of a not unreasonable curiosity.

The first attempts at harmony seem to have been in the line of *extemporizing* a secondary part to any well-known melody, by running under it a parallel train of notes in fourths, fifths, or octaves (as is often done by ignorant people at the present day). For the sake of variety, as in the last example, the accompanying part would sometimes form a kind of ground-bass, *not* following the movement of the melody, and ending with a clumsily-formed cadence. This two-part or "double singing," as it was called, was common in the twelfth century, and even earlier. The constant hearing of the ecclesiastical chant rendered that chant familiar to the people, and its scales and inflections had a general influence over the style even of the secular songs of that day. By a kind of natural instinct, some diversity would be sought by those who were weary of a dry uniformity of song either in the church or the field, and with very little effort one singer might invent a free and artless under-strain to enliven or improve upon the song of his companion and neighbor. It is said that even at the present day the peasantry of Wales "may commonly be heard singing unwritten three-part music." And "the Rev. Sir Frederick A. G. Ouseley has recently shown that the untaught practice of extempore part-singing prevails among the Russian peasantry; and there is plentiful authority for the assertion that this exists in all Northern lands, and has existed since the utmost range of man's memory or its records." This part-singing was also much favored and promoted in and after the twelfth century by the facility which the organs then coming into use afforded for sounding two or more notes at once. The ear was thus in some degree trained to perceive the effect of perfect and imperfect intervals, and very gradually some rules were arrived at to regulate their succession. Some evidences of such improvement are discernible at this era, as will appear from the following harmonies of Marchetto da Padova:

Ex. 3.

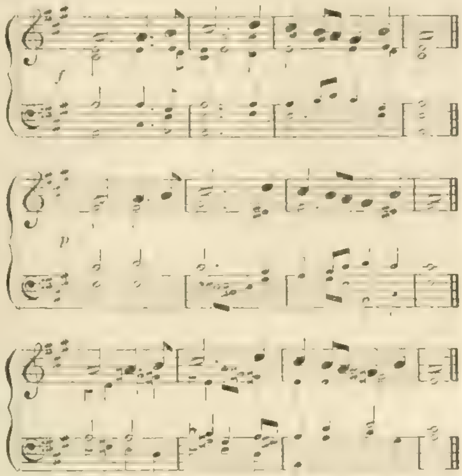
The organs of that age, however, though important as *suggestive* of harmony, were of small dimensions and of clumsy construction, containing but an octave or two of pipes, sufficiently harsh and noisy to be heard at a great distance, and played by keys requiring the force of the hand rather than the mere pressure of the fingers. But by the end of the fourteenth century these instruments had reached a far higher degree of perfection, having regular keyboards, numerous stops, and a compass of several octaves with the semitones. In consequence of this, a new stimulus was given to the study of harmonious combinations and progressions, but still the advance in this direction continued to be slow and uncertain. Even as late as the middle of the fourteenth century, according to the statement of Dr. Burney, "the rules in use were of the rudest kind, and the ordinary ear in church service was not offended, probably, by any number of fifths and octaves in succession." From this to the time when Palestrina flourished (b. 1529; d. 1594) was a period when counterpoint was first successfully developed, its true principles discovered, carefully applied, and cast into a scientific form. The works of that renowned writer, though deficient in melody and the elegance and refined sentiment of modern music, abound with proofs of a profound acquaintance with counterpoint, even in its most subtle and intricate departments, and of wonderful skill in the most elaborate kinds of composition. Of the steps by which this great advance was reached, through a period of two centuries before Palestrina—an advance comparatively sudden, after more than 4000 years of almost total darkness on the subject of musical science—we have no full and accurate account. But it is certain that within that time the leading principles of harmony had been discovered, and applied with singular unanimity; compositions showing an exact knowledge of counterpoint had been produced; and already the nature and structure of *fugue* and *canon* had become familiar to musical writers.

The masters of the sixteenth and seventeenth centuries appear to little advantage as originators or students of *melody*, but their devotion to *harmony*, even in the most abstruse forms of canon, fugue, imitation, musical enigmas, etc., was all-absorbing, and almost marvellous in its results. Their successors, however, with less pedantry and more regard for the beautiful and imaginative, advanced the art by adding to their studies the cultivation of this further department of melody. And thus was completed the labor of centuries, by bringing into combination all the resources of pure *harmony*, and the glowing beauty and deep expressiveness of its *melodious counterpart*.

When we bring these two great elements of music into

comparison, it will be found that harmony has a certain controlling power over melody—*i. e.* the sentiment or mental effect of a given melody is largely dependent on the harmony affixed to it. A change of the harmony, either within the same key or by digression into another key or mode, may alter and even reverse the whole drift and spirit of a melody. Thus, without the variation of a single note, the character of a given melody may be alternately joyful, sad, or otherwise, according to the relations impressed upon it by diversified and skilful harmony. The following example will be sufficient to show how an air may be affected in sentiment by changes in the quality of its accompaniment:

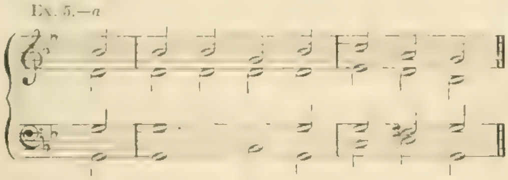
Ex. 4.



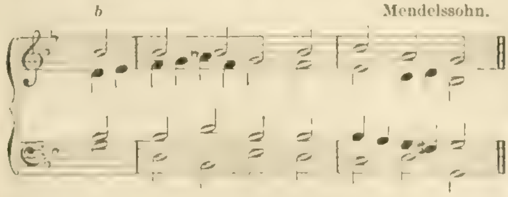
No. 1. No. 2. No. 3.

Very plain and even unmeaning melodies may also be impressed with a new beauty by the sole effect of a pleasing accompaniment. In the following example this is illustrated, the refined harmony at *b* giving the melody a far higher interest than it could have under the common treatment, as shown at *a*:

Ex. 5.—*a*



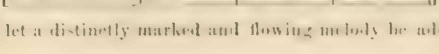
b Mendelssohn.



Hence it is that, as a general rule, the mind of a composer naturally associates some definite harmony with his conception of a new melody. Whether conscious of it or not, certain harmonious forms and progressions, key relations, modulations, and even particularities of counterpoint, are in the background of his thoughts, and quietly determine the spirit and significance of the melodic strain. And for this reason it becomes impossible to have a just conception of the sentiment intended to be expressed by a given melody till we see or hear the very harmony in which it was invested by the composer.

There is one aspect also in which *melody* may be viewed as holding a similar directive influence over *harmony*, or at least the power of conferring beauty on masses of chords which would otherwise be void of color and expression. A series of chords, quite regular in progression, may easily be written in which the ear detects nothing attractive or descriptive of any peculiar line of thought and feeling—such, for instance, as the following:

Ex. 6.



But let a distinctly marked and flowing melody be added, and these naked chords will acquire a meaning and connection which the ear recognizes at once, though due entirely to the suggestions of the melody. See this illustrated in Ex. 7:

Ex. 7.

This office of melody, as an element capable of throwing an air of ideal beauty over a train of dull and apparently aimless harmonies, is often lost sight of by young composers. The charm of chromatic and involved masses of chords obscures their sense of design, outline, rhythm, and breadth and symmetry of structure. And for this reason their early compositions are often overlaid and deformed with crude attempts at what they regard as "scientific" harmony, a superfluity of dissonant combinations and extravagant transitions into remote keys. Harmony may thus be abused till it becomes unmeaning and tiresome, like patches of color thrown at random on canvas, with an absence of all distinctly marked objects and graceful forms.

The various schools of harmony, German, Italian, French, and English, while differing much in matters of detail in the classification of chords, the nomenclature of their respective systems, and their mode of analyzing and explaining certain combinations and progressions, agree, notwithstanding, in the leading principles of contrapuntal science. The position that all musical harmony is an outgrowth of two fundamental chords with their inversions, supplemented by a few anomalous chords and musical idioms, is very generally received, as simpler and more satisfactory than the cumbrous systems which have become antiquated by the advances of modern art.

Into the systematic treatment of harmony as a science we shall not enter in the present article, as our design has been only to give such a general and historical view of the subject as might prepare the way for a full discussion under the head of MUSIC (which see). WILLIAM STAUNTON.

Harmony, tp. of Hancock co., Ill. Pop. 1457.

Harmony, post v. of Van Buren tp., Clay co., Ind., on the St. Louis Vandalia Terre Haute and Indianapolis R. R. Pop. 597.

Harmony, tp. of Posey co., Ind. Pop. 2231.

Harmony, tp. of Union co., Ind. Pop. 734.

Harmony, post tp. of Somerset co., Me., 25 miles N. by E. of Norridgewock. Pop. 978.

Harmony, tp. of Caroline co., Md. Pop. 2527.

Harmony, post-tp. of Fillmore co., Minn. Pop. 890.

Harmony, post-tp. of Washington co., Mo. Pop. 1485.

Harmony, post-tp. of Warren co., N. J. Pop. 1405.

Harmony, post-tp. of Chautauqua co., N. Y., bounded on the N. E. by Chautauqua Lake. It has 10 churches, several manufacturing villages, and fine sandstone-quarries, and is traversed by the Atlantic and Great Western R. R. Pop. 3416.

Harmony, tp. of Clark co., O. Pop. 1821.

Harmony, tp. of Morrow co., O. Pop. 773.

Harmony, tp. of Beaver co., Pa., on the right (E.) bank of the Ohio River. It contains Economy, an abode of the Harmonists, followers of George Rapp. Pop 225.

Harmony, post-b. of Jackson tp., Butler co., Pa. It was once an abode of the Harmonists. Pop. 414.

Harmony, tp. of Forest co., Pa., in the oil-region, and on the W. bank of the Allegheny River. Pop. 1226.

Harmony, tp. of Susquehanna co., Pa. Pop. 1212.

Harmony, tp. of Clarendon co., S. C. Pop. 480.

Harmony, tp. of Rock co., Wis. Pop. 1214.

Harmony, post-tp. of Vernon co., Wis. Pop. 781.

Harmony (DAVID B.), U. S. N., b. Sept. 3, 1832, in Easton, Pa., entered the navy as a midshipman Apr. 7, 1847; became a passed midshipman in 1853, a lieutenant in 1855, a lieutenant-commander in 1862, a commander in 1866; served on board the Iroquois at the passage of Forts Jackson and St. Philip and capture of New Orleans, and in many severe engagements with the batteries at Vicksburg and Grand Gulf; was executive officer of the iron-clad Nahant in the first attack upon Fort Sumter, Apr. 7, 1863, and in the engagement with the ram Atlanta, June 17, 1863; is honorably mentioned in the reports of Coms. De Camp, Palmer, and Downes. FOXHALL A. PARKER.

Harmony of the Gospels. There being four separate narratives of the life of our Lord, Christians from the earliest times have attempted to arrange them in such a way as to present at one view all their facts and teachings. The earliest efforts to accomplish this have perished, but appear to have been of the nature of a *diatessaron*, or a continuous narrative embracing all that is contained in the four Gospels, rather than of a "harmony," strictly so called. Tatian (about A. D. 170) prepared such a work, of which a spurious Latin translation still exists. In the earlier part of the third century, Ammonius of Alexandria prepared a harmony, traces of which remain in the so-called *Ammonian Sections*, combined with the *Canons* of Eusebius. These are of great importance, having been placed in the margin of nearly all manuscripts of the Gospels since the middle of the fourth century. They are simply tables of reference by which may be found any passage in one Gospel either parallel or similar to a passage in one or more of the others. Each Gospel is divided into sections; the sections of St. Matthew being arranged in a column in the order of their numbers, the numbers of the sections corresponding to this in the other Gospels are placed opposite. Thus, the first table, or *canon*, is formed of parallel passages in the four Gospels. There are ten such canons, containing the parallel passages in three Gospels, in two, and those found only in one. In the margins of manuscripts the number of the section is written above, and that of the canon by which the similar passages may be found, below in the form of a fraction. Since Eusebius every age has abounded in harmonies constructed on a variety of principles.

On the most cursory examination of the Gospels it is plain that the same events are not related in them all in the same order. Some of them, at least, must have arranged the details of the narrative on some other principle than that of chronological sequence. It is generally agreed that St. John, who gives minute notes of time, has carefully observed the chronological order of the history; but comparatively few facts are common to this Gospel and the others. Assuming in regard to these points the order of St. John, how shall the remaining events be grouped around them? St. Luke, in his introduction (i. 3), expresses his purpose to write "in order." Does this mean in chronological order? Some harmonists, and among them Tischendorf, have so understood it; but on examining the index of his *Synopsis Evangelica* it is plain that he has found himself obliged to disturb the order of St. Luke quite as much as is ordinarily done. It seems more probable that St. Luke's "in order" is equivalent to "systematically." He is remarkable for relating each event and discourse in careful connection with the circumstances under which it occurred; but it would be impossible to observe the order of St. Luke without violating that of all the other Evangelists, and at the same time, what would seem to be the most probable succession of events. The same things may be said with even more force of the first Gospel; indeed, it is soon evident to the student that exact chronological order was no part of the purpose of St. Matthew. St. Mark remains; and on comparing the points common to him and to St. John, it will be found that they exactly agree. On further arranging events in what seemed on the whole the most probable sequence, several harmonists (notably Robinson; see his *Introduction*) have found that they had hit upon the order of St. Mark. There has come, therefore, to be a general disposition to adopt the order of St. John as more fully carried out by St. Mark. On this plan the order of two of the Gospels is preserved intact, which cannot be accomplished in any other way.

Another debated question, which somewhat affects the structure of a harmony, is the length of our Lord's public ministry. Three theories have been proposed, severally known as the *Bi-paschal*, the *Tri-paschal*, and the *Quadri-paschal* schemes, according as they suppose that ministry to have included two, three, or four Passovers, and thus to have continued, in addition to the first half year, one, two, or three years. Until the time of Eusebius opinions on this point were very vague and various, and do not seem to have really been definitely formed at all. He investigated the subject carefully, and decided in favor of the quadri-paschal scheme; and this view was adopted on his authority for many ages without much further investigation. In modern times much research has been devoted to the point with varying results. The bi-paschal scheme has been generally abandoned, but in Germany the tri-paschal has found great favor, having been adopted by such men as Wieseler and Tischendorf. In England also it has some eminent advocates, as well as in this country; but the balance of opinion, both there and here, is decidedly in favor of the quadri-paschal. A weighty argument for this has been found in the reading of the *Codex Sinaiticus* in John v. 1, which renders it in the highest degree probable that the feast there mentioned must have been a Passover, and there are three other Passovers distinctly mentioned. Independently of that reading, however, and before it was known, the argument of Robinson to show that it was really the passover has never been satisfactorily met.

When all doubtful questions have been determined, there will still remain a certain number of passages whose chronological position cannot be fixed with certainty, because they contain no notes of time. These, however, are comparatively few and of secondary importance. On comparing the harmonies published in Germany, England, and America within the last fifty years, it will be found there is a general and striking agreement in the order of all the main points of the Gospel history, even among those who differ in regard to the whole length of our Lord's ministry. There is more difference of opinion as to whether miracles of a similar character, yet narrated with certain circumstantial differences in the different Gospels, should be considered as the same or as actually different. The tendency of the earlier harmonists was to consider such events different when the circumstances were at all differently narrated, as, *e. g.*, when the healing was of one demoniac or two, when the blind was cured as Jesus was entering into or departing from Jericho; later harmonists make more allowance for individual differences of narration, and in such cases identify the events, whether the data can be found (as they generally can) to explain these differences or not.

There is still greater difference in regard to the longer discourses of our Lord as given in the first Evangelist, such as the Sermon on the Mount and the charge to the Twelve (ch. x.), parts of which are given by the other synoptic Evangelists at other times and under different circumstances. Were these repetitions, or are the discourses as given in St. Matthew groupings together of several discourses uttered at different times? In most cases the other Evangelists give parts of the discourses in the same connection with St. Matthew, and other parts in connection with events or circumstances, especially the Perean journey of our Lord, of which St. Matthew makes no mention. (See the subject discussed in the *Bibliotheca Sacra* for July, 1864.)

The uses of a harmony are very obvious. It enables the critical scholar to compare readily the language of the several writers in the narration of the same things; it gives to the exegetical student the fullest material for the interpretation of our Lord's acts and words; and to every Christian it affords a ready and convenient method of seeing at once all that is recorded of each scene and event and discourse.

FREDERIC GARDINER.

Harmony of the Spheres, a kind of music which the ancients imagined was produced by the motions of the heavenly bodies. This sound, said they, we do not hear, because we have always heard it, and cannot contrast it with absolute silence, of which we know nothing. Others thought the sound too powerful for our hearing, or that our senses are too gross to perceive it.

Harms (CLAUS), b. May 25, 1778, at Fahrstedt, Holstein; was educated at Kiel, and became in 1816 an archdeacon in that town. His work, *Das sind die 95 Theses*, published in orthodox spirit, and just at the time of the jubilee of the Reformation, made a great sensation. He published six collections of sermons between 1808 and 1847, which became very extensively used in Germany as means of edification. D. Feb. 1, 1855.

Harms (LUDWIG), (*Pastor Harms*), b. in 1809 at Hermannsburg, on the Lüneberger Heath, in Hanover, was the son of a Lutheran parish minister; was educated at Celle and Göttingen; became awakened to a new religious life, and in 1844 became assistant pastor in his native village. Here he built a large missionary college, trusting to Providence for funds; organized his great parish into a home and foreign missionary society; founded in 1854 an extensive printing establishment, where he published a missionary journal and many books. Pastor Harms was a prodigiously active man, and an admirable manager of the business affairs of his vast enterprises, for he supported missionaries in Africa, Asia, America, and Australia at an expense of not less than $40,000 per annum. A man of profound spirituality, he was tenderly beloved by his parishioners, and was their adviser in business, their confessor, and their ruler. He was also a man of considerable learning, of strong and eccentric character; in many respects one of the grandest figures of his time. Beggars feared him, and he hated beggars, since, as he said, he never asked any man for anything, but his novel missionary enterprise and his spirited journal appealed far more effectively for help than any direct solicitation could do. D. Nov. 14, 1865.

Harnett', county of Central North Carolina. Area, 675 square miles. It is traversed by the Cape Fear River. Its surface is varied, its soil generally good. Corn, tobacco,

and pork are the chief products. Cap. Harnett Court-house. Pop. 8895.

Harnett, tp. of New Hanover co., N. C. Pop. 1543.

Harnett (CORNELIUS), b. in England Apr. 20, 1723; became owner of a large estate near Wilmington, N. C., and was early interested in the cause of American liberty. He was (1770–71) an active member of the provincial assembly; in 1775 president of the provincial council, and afterward acting governor; in 1776 a member of the provincial Congress at Halifax, in which he used his active influence in favor of independence, and was one of a committee to draft a State constitution and bill of rights, in which he procured the insertion of the clause declaring for religious freedom. In 1777–80 he was in Congress, and signed the Articles of Confederation. D. at Wilmington, N. C., Apr. 20, 1781.

Harnett Court-house, post-v., cap. of Harnett co., N. C., on Cape Fear River, 26 miles S. by W. of Raleigh.

Har'ney (WILLIAM SELBY), b. in Louisiana in 1798; appointed second lieutenant of infantry U. S. army Feb., 1818; in 1833 appointed paymaster with rank of major, and in 1836 was transferred to the 2d Dragoons as lieutenant-colonel, taking an active part in the Florida war against the Indians; brevet colonel Dec., 1840, for gallant conduct; appointed colonel 1846; served with distinction in the war with Mexico (brevetted brigadier-general), and in 1858 was promoted to be brigadier-general. While in command on the Pacific coast he took possession of the then neutral territory of San Juan Island, Puget's Sound, which was, however, soon evacuated by the U. S. In the early days of the civil war he commanded in Missouri, but for an unauthorized truce with Gen. Price was soon relieved, and in 1863 retired from active service.

Ha'ro, town of Spain, in the province of Logroño, on the Ebro. It carries on a considerable trade in wine and fruits. Pop. 5928.

Haro, de (ALONZO MUÑEZ), S. T. D., b. at Villagarcia, Spain, Oct. 31, 1729; studied in the Royal University and at Bologna, in each university receiving the doctorate, and in the latter becoming rector and professor of sacred literature. He was appointed about 1770 archbishop of Mexico, and was there distinguished by eloquence, charities, and love of learning. He founded a free Roman Catholic school in New York City, and presented to St. Peter's church, New York, some paintings and gifts of money. D. May 26, 1800.

Har'old I. (HAREFOOT, so named from his swiftness), king of England, was the reputed son of Canute by Elgiva of Northampton, who was either wife or concubine of the king; but whether Harold was really their offspring is doubtful. In 1035, Harold was chosen as Canute's successor by the Danish party, and began to reign N. of the Thames; but Hardicanute (*Hardicanut*), the late king's recognized heir, was preferred by the English party. Before this time it is believed that Harold had ruled Denmark for Canute. Hardicanute was chosen king of Wessex, and Emma, his mother, was his regent, he being then absent in Denmark. Harold soon rid the kingdom of the Anglo-Saxon princes (Æthelings), and in 1037 he was chosen king of all England. He banished Queen Emma, and d. at Oxford Mar. 17, 1040. The history of his reign is obscure.

Harold II., king of England, the last sovereign of the Anglo-Saxon race, was second son of Godwin, the great earl of the West Saxons, by Gytha, a Danish lady, and was consequently not of the royal line of England; assisted his father in his quarrels with Edward the Confessor, with whom he became reconciled 1052; with Tostig, his brother, conquered Wales 1063; was shipwrecked at the mouth of the Somme, Normandy, made prisoner, and compelled to swear to give support to Duke William's claim to the English crown, 1065; caused himself to be proclaimed king, and was crowned Jan. 10, 1066; defeated and slew Harold Hardrada, who supported the claims of Tostig, Harold's brother, Sept. 25, 1066; fought William the Conqueror at the bloody battle of Hastings, and was killed there Oct. 14, 1066.

Har'old (or **Har'ald**) **I. Haar'fager** (the "fair-haired"), first king of Norway in the historic period. He loved Gyfa, a jarl's daughter, who refused to marry him until he had conquered all Norway; and accordingly in 865 he took a vow never to comb or cut his hair till all the jarls submitted to his sway. His great sea-fight at Hafursfiord (885) released him from his twenty-years' vow. D. at Trondjem 933, and was succeeded by Eric I.

Har'old (or **Har'ald**) **III. Hardra'da** (HARDRADE, "hard ruler"), king of Norway, b. about 1015, became a kind of knight-errant in the East; served in the Byzantine armies 1038–40, and was distinguished by his exploits in Sicily and at Jerusalem; became sole king of Norway on the death of Magnus the Good, his nephew, 1047; invaded England 1066 to avenge the supposed wrongs of Tostig, brother to Harold II. of England; gained the battle of Fulford (Sept. 20), but was defeated and killed in the battle of Stamford Bridge, Sept. 25, 1066.

Haroun' al Rasch'id (*Aaron the Just*), caliph of Bagdad, the fifth of the Abbasides, was a son of the caliph Mohammed Mahadi by a slave-woman, and was b. at Rei in 765 A. D. (148 A. H.); invaded the Greek empire 781; encamped opposite Constantinople, and compelled the empress Irene to pay yearly 70,000 dinars in gold; succeeded Mousa al Hadi, his brother, in 786; raised the caliphate to its greatest pitch of splendor, chiefly by the aid of Jahia and Jiaffar the Barmecides, whom he treacherously murdered (803); sent an embassy with presents to Charlemagne (probably in 801); was frequently and with almost uniform success engaged in fierce wars with the Byzantines; made Bagdad a centre of learning, commerce, and industry. D. in Khorassan Apr. 2, 809.

Harp [Lat. *harpa*], a musical instrument highly esteemed by the ancients, and used by Egyptians, Hebrews, Greeks, and in Celtic nations, particularly in Wales and Ireland, as well as among the Teutonic nations of antiquity. In modern times its power and sweetness have been much improved, especially by Sébastien Érard. The harp is generally of a somewhat triangular outline, and has strings of wire or catgut.

Harp, tp. of De Witt co., Ill. Pop. 1161.

Har'palus, a nephew of Philip of Macedon, and a close associate of the youthful Alexander; was banished 337 B. C. by Philip for intriguing to bring about Alexander's marriage with the daughter of Pixodarus; was recalled by Alexander, and set out with his master into Asia, acting as superintendent of the treasury; but, having stolen a part of the king's treasure, was compelled to flee (333 B. C.); was pardoned by Alexander 331, and received his former office; became satrap of Babylon 326, and was guilty of disgraceful excesses; fled to Athens 324; was imprisoned, but escaped, and went with some troops to Crete, where he was murdered, probably in 324 B. C.

Harpe, La. See LA HARPE.

Har'per, county of Kansas, bounded on the S. by the Indian Territory. Area, 1188 square miles. It is about equidistant from the E. and S. borders of the State, and is a good grazing region. Cap. Bluff City.

Harper, tp. of Roane co., West Va. Pop. 955.

Harper (ROBERT GOODLOE), LL.D., was b. in 1765 near Fredericksburg, Va., and while young removed with his parents to Granville, N. C. He joined the Revolutionary army when fifteen years old. He graduated at Princeton in 1785, and was (1791–1801) a Federalist member of Congress from South Carolina. He married a daughter of Charles Carroll of Carrollton, and became a leading lawyer of Baltimore. He was (1815–16) U. S. Senator from Maryland, and a major-general of militia in the war of 1812. He was an active supporter of the Colonization Society, and the town of Harper, near Cape Palmas, was named in his honor. He published numerous letters, speeches, pamphlets, etc., and a volume of his select writings appeared in 1814. D. at Baltimore Jan. 15, 1825.

Harper (WILLIAM), b. in Antigua Jan. 17, 1790; studied at Baltimore, and in 1802 settled with his father in Columbia, S. C. He graduated at South Carolina College in 1808, and became a lawyer; in 1818 removed to Missouri, and held several public offices. In 1823 he returned to Columbia, where he published a volume of legal reports. He was (1826) a U. S. Senator; in 1828 Speaker of the South Carolina house of representatives; became in 1831 judge of the court of appeals; and was (1834–47) chancellor of the State. He was a zealous State rights man and an able jurist. D. Oct. 10, 1847.

Harper & Brothers, the name of a firm of brothers, originally comprising James (b. 1795), John (b. 1797), Joseph Wesley (b. 1801), and Fletcher (b. 1806) Harper, universally known as American publishers. They were b. at Newtown, Long Island, their father being a farmer. The founders of the present extensive house were James and John, who, having concluded an apprenticeship at the printer's trade, commenced the printing business on their own account, and subsequently engaged in publishing under the firm-name of J. & J. Harper, which style was maintained until about 1825, when Joseph Wesley and Fletcher, both having served a term of apprenticeship to their brothers, were admitted to the business, and the name of the firm changed to Harper & Brothers. From small beginnings the firm constantly increased in importance until it became the leading publishing-house in America. In Dec., 1853, their extensive publishing house was destroyed by fire, and a loss of nearly $1,000,000 sustained.

Their present fireproof establishment was erected on the old site. Besides their extensive catalogue of books, they publish *Harper's Magazine*, a monthly; *Harper's Weekly*, an illustrated journal; *Harper's Bazar*, a weekly journal devoted to fashion and domestic life. In 1844, James Harper was elected mayor of the city of New York, the only public office held by him. In Mar., 1869, while driving with his daughter, he was thrown from his carriage and killed. Wesley d. the following year. Soon after John retired from active participation, and d. Apr. 22, 1875. The firm is now composed of sons of members of the original firm, all well-educated and capable business-men. Fletcher Harper, the last of the original firm, d. May 29, 1877.

Har'per's Fer'ry, post-v. of Jefferson co., W. Va., picturesquely situated at the confluence of the Potomac and Shenandoah rivers, and in the basin formed by the steep heights known as Maryland, Loudoun, and Bolivar Heights, which tower high above the village. The scenery at this point, where the combined streams break through the Blue Ridge, is grand and beautiful. Jefferson declared "the passage of the Potomac through the Blue Ridge one of the most stupendous scenes in nature, and well worth a voyage across the Atlantic to witness." An unusual historic interest also attaches to this locality. In Oct., 1859, the place was entered by John Brown and his followers, and the U. S. arsenal and national armory seized and held for upwards of twenty-four hours. During the civil strife it was among the first to feel the ravages of war. In Apr., 1861, the small party of regulars guarding the public buildings evacuated the place before an approaching body of insurgents, and the town was occupied and held by the Confederates until the following June, when it was in turn evacuated by them, after destroying the arsenal and armory, and the bridge across the Potomac. Again in Sept., 1862, during Lee's invasion of Maryland, the place was invested by the Confederates, and after a futile defence, the heights not having been fortified, was surrendered by Col. Miles, who was himself shot dead while bearing the white flag betokening surrender; 12,000 prisoners, 73 guns, and upwards of 13,000 small-arms, besides a large quantity of stores, thus fell into the hands of the Confederates. The place was reoccupied by Gen. McClellan after the battle of Antietam, and was not again out of possession of the U. S. The Baltimore and Ohio and the Winchester and Potomac R. Rs. unite here. The Chesapeake and Ohio Canal also passes by on the Maryland shore. Harper's Ferry is the seat of Stover College. Pop. about 2500.

Har'persfield, tp. and post-v. of Delaware co., N. Y. It has 5 churches, and is one of the best grazing towns in the State. Pop. 1485.

Harpersfield, post-tp. of Ashtabula co., O. P. 1120.

Har'persville, tp. of Shelby co., Ala. Pop. 1334.

Harpersville, post-v. of Colesville tp., Broome co., N. Y., on the Susquehanna River. It has 3 churches, and is on the Albany and Susquehanna R. R., 22 miles from Binghamton. Pop. 218.

Har'peth Riv'er rises in Williamson co., Tenn., flows N. W. in Cheatham and Dickson counties, and after a course of 100 miles falls into the Cumberland. It affords abundant water-power.

Harpeth Shoals, a shallow part of the Cumberland River, 40 miles below Nashville, Tenn., which during low water seriously obstructs steamboat navigation.

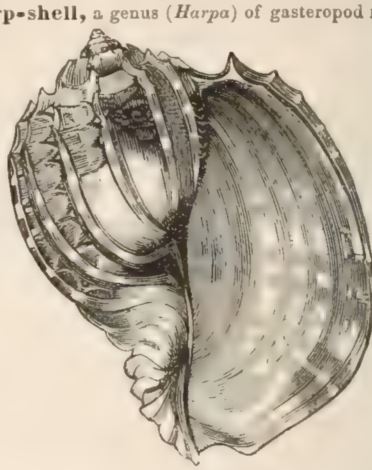
Har'pies [Gr. Ἅρπυιαι, the "swift spoilers"], in Greek mythology, certain hideous monsters of the female sex, often described as birds with the heads of women and having huge claws. Their number and all the circumstances of their mythus are variously related. They were commonly said to reside at the isles called Strophades. Some writers make them symbolical of storm-winds—others, of the forms of death.

Harpoc'rates [Egyptian *Harpa Khrut*, "Horus the child"], the Younger Horus, a divinity of the ancient Egyptians, son of Osiris and Isis, worshipped in later times in Greece and Rome as the god of silence, but not so esteemed by the Egyptians. His sculptures show him as a child placing his finger upon his lips—an infantile act which the Greeks incorrectly thought to be expressive of a command to preserve silence. The Romans honored him as the sender of prophetic dreams. He seems to have originally symbolized the feeble vegetal life of the winter months.

Harpocra'tion (Ἁρποκρατίων), with the Roman surname VALERIUS, a Greek rhetorician and lexicographer who flourished at Alexandria, but of whose life no particulars are preserved. Even the period when he flourished is uncertain. An important work for the explanation of legal and political terms is ascribed to him, entitled λεξικὸν τῶν δέκα ῥητόρων, containing in somewhat irregular alphabetical order an explanation of peculiarities of expression and of proper names in the ten chief Attic orators. Suidas and the *Etymologicon Magnum* have borrowed much from him. The best editions are that of Bekker (Berlin, 1833) and that of G. Dindorf (Oxford, 1855). H. DRISLER.

Harp Seal, the *Pagophilus grœnlandicus*, commercially the most important of the seal family. It inhabits the coasts of Greenland, Labrador, and Newfoundland; also found in the N. of Europe and of Asia. It is the most extensively caught of all the seals sought in the Newfoundland fisheries, many steamers as well as sailing vessels being employed in its pursuit. It yields great quantities of excellent oil, and its skin is also valuable. It takes its name from the rudely harp-shaped markings upon its back.

Harp-shell, a genus (*Harpa*) of gasteropod mollusks



The Harp-shell.

of the whelk family, natives of the Indian and Pacific oceans. There are several species, of which *H. ventricosa* is best known. It is caught as food at the Mauritius, and the shells are highly valued.

Harp'sichord, a keyed musical instrument, in form resembling the grand piano, but smaller, and strung with steel and brass wires, two to each note, which are struck by *jacks* furnished with quill plectrums. Stops, swells, and double rows of keys were sometimes employed to affect the power of the wires. When skilfully played upon, the instrument gave forth a feeble but not unpleasing tone, which was susceptible of delicate modulations. The harpsichord was in common use in the twelfth and thirteenth centuries; it was brought to England in the seventeenth, but is now wholly superseded by the pianoforte, of which it was the rude suggestion, and is probably nowhere manufactured at present.

Harps'well, post-tp. of Cumberland co., Me., comprising many islands in the E. part of Casco Bay. It is some 14 miles E. of Portland by water. It has 5 churches and a fire insurance company, and is interesting as the scene of many traditions of much interest. Pop. 1749.

Harquebus. See ARQUEBUS.

Harpy Eagle. See EAGLE.

Har'rel's, tp. of Mitchell co., N. C. Pop. 479.

Har'rell's Cross-Roads, tp. of Dallas co., Ala. Pop. 3778.

Har'rellsville, tp. of Hertford co., N. C. Pop. 1743.

Har'rier, a small fox-hound, bred and trained to follow the hare. It is chiefly used in the British Islands, where several breeds are distinguished.

Harrier, a general name for the hawks of the genus *Circus*. Of some fifteen species, only one (*Circus hudsonicus*), the marsh-hawk, is a native of the U. S. Like the goshawks, they fly along the ground in search of prey. In this genus feathers radiate from the eyes, giving the bird a rather owl-like appearance. Many of the species are European.

Har'rietstown, tp. of Franklin co., N. Y., in the Adirondacks, contains many lakes and mountains. Pop. 416.

Har'riman (WALTER), b. in Warner, N. H., about 1817. As a teacher, Universalist preacher, Democratic politician, and orator he won much renown; was 1862–65 the commander of the 11th New Hampshire Vols. in the civil war; secretary of state in New Hampshire 1865–67; Republican governor of New Hampshire 1867–69; and was then appointed naval officer of the port of Boston, Mass.

Har'rington, post-v. of Kent co., Del., at the union of the Junction and Breakwater R. R. with the Delaware R. R., 16 miles S. of Dover.

Harrington, post-tp. of Washington co., Me., on the sea-coast, 20 miles W. of Machias. Shipbuilding is an important interest. Pop. 1142.

Harrington, tp. of Bergen co., N. J., having the Hudson River on the E. and the New York State line on the N. E. Pop. 2664.

Harrington (James), b. at Upton, North Hants, England, Jan., 1611; was educated at Trinity College, Oxford; served in the Low Countries, and became groom of the bed-chamber to Charles I., to whom he was faithful, though an enthusiastic republican. His chief work, *Oceana* (1656), a description of an ideal republic, was dedicated to Cromwell, upon whom, however, it contained severe reflections. Soon after Charles II.'s restoration, Harrington was confined in the Tower as a traitor, and became insane during his imprisonment. His minor works are mostly upon the theory of government, but among them is a translation of four books of the *Æneid* into English verse. D. at Westminster Sept. 11, 1677.

Harrington (Purnell F.), U. S. N., b. June 6, 1844, in Delaware; graduated at the Naval Academy in 1863; became a master in 1866, a lieutenant in 1867, a lieutenant-commander in 1868; served on board the Monongahela at the battle of Mobile Bay, Aug. 6, 1864, and was commended for gallant conduct by Com. James H. Strong.

Foxhall A. Parker.

Harrington (Samuel Maxwell), LL.D., b. at Dover, Del., Feb. 5, 1803; graduated at Washington College, Md., 1823; secretary of state for Delaware in 1829; chief-justice of the State supreme court 1831; and afterwards was an associate judge of the superior court; again chief-justice 1855; chancellor of Delaware 1857–65. D. at Philadelphia Nov. 28, 1865. Author of three volumes of law reports (1837–44), and was at the head of the commission of 1849 for codifying the laws of his State.

Har'riott (Thomas), b. at Oxford, England, 1560; studied at St. Mary's Hall, Oxford; graduated B. A. 1579; went with his patron, Raleigh, to Virginia 1584–85; published a *Briefe and True Report of the New Found Land of Virginia* (1588, republished in Hakluyt's 3d vol.); became a pensioner of the earl of Northumberland; made very important algebraical improvements; greatly simplified the theory of equations, and was the first to conceive the possibility of putting all the terms of the equation into the same side. He was also an able observer of the phenomena of physics. D. in London July 2, 1621. The posthumous *Artis analyticæ Praxis nova ad æquationes resolvendas* (1631), is his most important work.

Har'ris, county of Georgia, separated from Alabama by the Chattahoochee River. Area, 500 square miles. The surface is varied, the soil generally good. The county contains extensive forests. Cotton and corn are staple products. Cap. Hamilton. Pop. 13,284.

Harris, county in the S. E. of Texas. Area, 1832 square miles. It has mostly a light soil, but is profitably cultivated from its proximity to markets, and there are extensive tracts of high fertility. Cotton, lumber, and corn are leading products. The surface is mostly level, and only one-sixth is timber-land. The county is traversed by several navigable bayous flowing into Galveston Bay, and by the various railroads which centre at Houston, the capital. The manufacturing interests are quite important. Pop. 17,375.

Harris, tp. of Izard co., Ark. Pop. 122.

Harris, tp. of Fulton co., Ill. Pop. 1029.

Harris, tp. of St. Joseph co., Ind. Pop. 408.

Harris, tp. of Ripley co., Mo. Pop. 160.

Harris, tp. of Franklin co., N. C. Pop. 1266.

Harris, tp. of Stanley co., N. C. Pop. 924.

Harris, tp. of Ottawa co., O. Pop. 2190.

Harris, tp. of Centre co., Pa. Here the State Agricultural College is situated (Agricultural College P. O.). Pop. 1999.

Harris, tp. of Wood co., West Va. Pop. 1699.

Harris, tp. of Marquette co., Wis. Pop. 498.

Harris (Chapin A.), A. M., M. D., D. D. S., b. in Pompey, N. Y., 1806; d. in Baltimore in 1860. He organized the Baltimore Dental College in 1839—the first of the kind. He established the *American Journal and Library of Dental Science*; published the *Dental Art*; the *Principles and Practice of Dental Surgery*; and the *Dental Dictionary*—works which have immortalized his name. A worthy contemporary, the venerable Dr. Parmley, said of him: "He has labored more assiduously as a practitioner, more untiringly as a writer, and more devotedly as a teacher of the principles and practice of dental surgery than any person who has in any way or in any country been connected with our professional art." He was for many years a prominent member of the Methodist Episcopal Church. He founded the first dental college in the world, and his publications on this art still remain unrivalled. P. F. Eve.

Harris (Charles), b. in England in 1772; educated in France; migrated to Georgia 1788; studied law in Savannah, where he was admitted to the bar, and rose to the highest distinction in his profession; was twice elected to the judgeship of his circuit, and twice declined; on the retirement of Gov. Milledge from the U. S. Senate (1809), the position was tendered him by both parties; this he also declined. D. Mar., 1827, lamented by all classes of people. It was in honor of him that the county of Harris in his State was named. "Mr. Harris was of a highly respectable family. His father was William Harris, barrister, who was first cousin of Lord Malmesbury. His mother was the sister of the hereditary champion of England, Charles Dymock, who attended at the coronation of George III., and his father was one of the two squires of the champion who attended the coronation. The Dymocks were a branch of the De Bergs, who had been champions of England from the accession of the Norman family." (See White's *Statistics of Georgia.*) A. H. Stephens.

Harris (David Bullock), b. at Frederick's Hall, Louisa co., Va., Sept. 28, 1814; graduated at the U. S. Military Academy at West Point in 1833, and entered the army as a brevet second lieutenant of the 1st Artillery; served a year with that regiment in the field, and was assigned to duty as assistant professor of engineering at West Point, a position which he filled until Aug. 30, 1835, when he resigned from the army. For several years thereafter he was employed as a civil engineer on important works, such as the James River and Kanawha Canal; but subsequently for some years was largely and successfully engaged in Kentucky, and London, England, where he resided for a time, and in Virginia as an exporter of tobacco to Europe and of flour to South America. Residing on his plantation in Virginia when that State seceded from the Union in Apr., 1861, he re-entered the military career as a captain of engineers of the Virginia forces, and was at once put on duty at Culpeper Court-house. It was Capt. Harris who first reconnoitred the line of Bull Run, and determined its defensive and strategic value; and when the position of Manassas Junction was occupied in force late in May, 1861, he laid out and constructed the works for its defence. Having soon acquired the complete confidence of Gen. Beauregard, he was ever after associated with that commander. In the battle of Bull Run, attached specially to the staff of Gen. Philip St. George Cocke, Capt. Harris was not less conspicuous for his cool courage than for his skill at several critical moments in the disposition of the Confederate troops, notably in their encounter with Sherman's brigade. He accompanied Beauregard early in 1862 to the West, and there planned and constructed the works at Island 10 and Fort Pillow on the Mississippi River, and subsequently the river defences at Vicksburg. When Gen. Beauregard was transferred to Charleston in Oct., 1862, Capt. Harris was also called there, and charged with the direction of the engineer operations of that remarkable defence. In 1864 (meanwhile promoted to the grade of colonel of engineers and second in rank in his corps) he went back with Gen. Beauregard to Virginia, where he gave signal evidence of his rare capacities as an engineer on the Confederate lines before Petersburg. But it having been thought best for him to return to Charleston, Capt. Harris was attacked with the yellow fever, and d. in the vicinity of that city on Oct. 10, 1864, just as he had been tardily commissioned a brigadier-general in a service of which he was among the very ablest soldiers. Thomas Jordan.

Harris (Henry R.), b. in Sparta, Ga., Feb. 2, 1828; graduated at Emory College 1847, settled in Greenville, Meriwether co.; by profession a planter; was a member of the Georgia secession convention 1861, and a member of the 43d and 44th Congresses from his native State.

Harris (Howell), b. at Trevecca, Wales, in 1714; studied at Oxford, and on returning to Wales took the field as an evangelist and open air preacher, founding societies and awakening the whole principality by his zealous labors. Though, like Wesley and Whitefield, a churchman, he received little or no sympathy from the clergy, but the two great evangelists heartily recognized him. In a few years he had formed no less than 300 societies. Wesley and Whitefield frequently traversed the principality in his company, preaching daily. Wesley describes Harris as a "powerful orator." He may be considered the chief founder of "Calvinistic Methodism," now the most prevalent form of dissent in Wales. Harris raised and commanded a regiment, mostly of his own people, during the French war, when the invasion of England was expected.

For about three years he preached in his camps and in the market-places whenever his troops moved. D. at Trevecca July 21, 1773. A. STEVENS.

Harris (IRA), b. in Charleston, Montgomery co., N. Y., May 31, 1802; graduated at Union College in 1824; became a lawyer in Albany; served in the legislature 1844–46, and in the constitutional conventions of 1845 and 1867; was a judge of the State supreme court 1847–60; U. S. Senator 1862–68. D. at Albany, N. Y., Dec. 2, 1875.

Harris (IRA), U. S. N., b. May 4, 1843, in New York; graduated at the Naval Academy in 1863; became a lieutenant in 1866, a lieutenant-commander in 1868; served with gallantry in the assault upon Fort Fisher, Jan. 13, 1865, and was severely wounded in the right leg. Resigned Mar. 21, 1871. FOXHALL A. PARKER.

Harris (ISHAM G.), a distinguished Tennessee politician; was a member of Congress from 1849 to 1853; was governor of the State 1857–61; was an ardent advocate of secession, and after the war became a merchant of Liverpool, England. He now resides at Memphis, Tenn.

Harris (IVERSON L.), b. at Watkinsville, Ga., Jan. 7, 1805; graduated at State University 1823; studied law; admitted to the bar; settled in Milledgeville; was elevated to the circuit and then to the supreme court bench of the State, retiring in 1868; was trustee of the State University, but resigned in 1872 on account of ill-health. A. H. STEPHENS.

Harris (JAMES), nephew of Lord Shaftesbury, was b. at Salisbury July 20, 1709; was educated at Wadham College, Oxford, and at Lincoln's Inn; entered parliament for Christchurch 1761; a lord of the admiralty 1762; a lord of the treasury 1763; secretary and comptroller to the queen 1774. D. Dec. 22, 1780. Author of *Three Treatises* on art, music, etc., and on happiness (1744); *Hermes* (1751), a work on language and general grammar, still highly valued. His later works are *Spring*, a pastoral (1762), *Philosophical Arrangements* (1775, part of an unfinished work on Aristotle's *Logic*), and *Philological Inquiries* (1780).—His son, JAMES (1746–1820), became in 1788 a baron, and in 1800 was created earl of Malmesbury.

Harris (JOHN), D. D., b. at Ugborough, Devon, England, Mar. 8, 1802; was educated at Hoxton College, and in 1827 became an independent minister of Epsom; president of Cheshunt College 1837; principal and professor of theology in New College, St. John's Wood, near London, 1850, where he d. Dec. 21, 1856. Author of *The Great Teacher* (1835); *Mammon* (1836); *Britannia* (1837); *The Great Commission* (1842); *Pre-Adamite Earth* (1847); *Man Primeval* (1849); *Patriarchy* (1855), and other works.

Harris (SAMUEL), the "apostle of Virginia," so called, was b. in Hanover co., Va., Jan. 12, 1724. He became a colonel of militia in Pittsylvania co., and held important public offices. In 1769 he was ordained a Baptist minister, having for years zealously preached in the Baptist churches with great power. He gave a large share of his property to charitable causes, and underwent much persecution from the then Established Church of Virginia. In 1774 he was ordained an "apostle" by the General Association of Separate Baptists. Date of death uncertain.

Harris (SAMUEL), D. D., LL.D., b. in East Machias, Me., June 14, 1814; graduated at Bowdoin College in 1833, and at Andover Theological Seminary in 1838. He was a teacher at Limerick, Me., 1833–34, and at East Machias 1834–35 and 1838–41. He was pastor of the Congregational church in Conway, Mass., 1841–51, and of the South Congregational church in Pittsfield, Mass., 1851–55. From 1855 to 1867 he was professor of systematic theology in the Theological Seminary in Bangor, Me.; president of Bowdoin College 1867–71; and in 1871 took the chair of systematic theology in the theological department of Yale College. He received the degree of D. D. from Williams College in 1855, and the degree of LL.D. from Bowdoin College in 1871. He has published *Zaccheus, or the Scriptural Plan of Benevolence* (1850), *Christ's Prayer for His Redeemed* (1862), *The Kingdom of Christ on Earth* (1874), and several minor works. R. D. HITCHCOCK.

Harris (THADDEUS MASON), D. D., a Unitarian divine, b. at Charlestown (now Boston), Mass., July 17, 1768; graduated at Harvard in 1787; was appointed private secretary to Gen. Washington, but sickness prevented his acceptance. In 1790 he delivered the Phi Beta Kappa address at Cambridge, where he studied divinity; was librarian of Harvard University 1791–93; pastor of the First church, Dorchester, 1793–1839; d. at Dorchester, Mass., Apr. 3, 1842. He was the author of many works, among which are *The Minor Encyclopædia* (1803, 4 vols.); *Journal of a Tour into the North-west Territory* (1803); *Natural History of the Bible* (1820), an admirable work for its day; and *Memoirs of Oglethorpe* (1841).

Harris (THADDEUS WILLIAM), M. D., a son of Dr. T. M. Harris (1768–1842), was b. at Dorchester, Mass., Nov. 12, 1795; graduated at Harvard in 1815, and studied medicine, which he practised at Milton, Mass. He was (1831–56) librarian of Harvard College, and for a time was instructor in botany and natural history, and won especial distinction as an entomologist, being one of the pioneers of that science in North America. D. at Cambridge, Mass., Jan. 16, 1856. His most important works are a *Systematic Catalogue of the Insects of Massachusetts*, and a valuable treatise *On Insects Injurious to Vegetation* (1841; enlarged eds. 1842, 1852, 1862). He also published many scientific and antiquarian papers.—His sons, WILLIAM THADDEUS (1826–54) and EDWARD D. HARRIS, have attained distinction as genealogists and historical students.

Harris (THOMAS C.), U. S. N., b. Nov. 18, 1825, in Philadelphia, Pa.; entered the navy as a midshipman Sept. 9, 1841; became a passed midshipman in 1847, a lieutenant in 1855, a lieutenant-commander in 1862, a commander in 1866, a captain in 1872. During the civil war he commanded the Chippewa and the Yantic, in the former participating in several attacks on Fort Wagner, and in the latter taking part in both engagements with Fort Fisher. For cool performance of duty in action recommended for promotion by Rear-admiral Porter, Jan. 28, 1865. FOXHALL A. PARKER.

Harris (THOMAS L.), b. at Norwich, Conn., Oct. 29, 1816; graduated at Trinity College, Hartford, in 1841; became a lawyer in Virginia in 1842, but removed to Petersburg, Ill., in that year; was a State senator in 1846; as major commanding the 4th Illinois Volunteers in Mexico was distinguished at Vera Cruz and Cerro Gordo; was a member of Congress 1849–55. D. at Petersburg, Ill., Nov. 24, 1858.

Harris (THOMAS LAKE), b. May 15, 1823, at Fenny Stratford, England, and when four years old came to America with his parents, who settled at Utica, N. Y. He early attained some distinction as a writer, and became a minister of the Universalist faith in New York City and elsewhere. From 1850 to 1855 he labored as a lecturer upon Spiritualism, in which he became an earnest believer. He preached in Great Britain 1858–61, winning many followers to his system, which appears to combine the Swedenborgian theology and the Platonic philosophy with some of the doctrines of Fourier. His followers, "The Brotherhood of the New Life," are found in Great Britain, the U. S., India, and Japan. Their chief establishment, co-operative, but not communistic, was at Wassaic, Dutchess co., N. Y., from 1861 to 1867, when it was removed to Brocton, Chautauqua co., N. Y., where it still remains. The Scriptures and the marriage relation are esteemed sacred by them; proselytism is repudiated; and self-renunciation is regarded as one of the supreme duties of man. Mr. Harris is the author of numerous poetical and prose works, explaining and illustrating his mystical philosophy.

Harris (WILLIAM), S. T. D., b. at Springfield, Mass., Apr. 29, 1765; graduated at Harvard in 1786; was rector of an Episcopal church in Marblehead, Mass., and at the same time instructor in an academy 1791–1802; rector of St. Mark's, New York City, 1802–16; and the founder of an excellent classical school. From 1811 to 1829 he was president of Columbia College. D. Oct. 18, 1829. In early life he was a licensed preacher of the Congregationalist denomination.

Harris (WILLIAM L.), D. D., b. Nov. 4, 1817, in Ohio; he joined the Michigan conference in 1837, and after travelling some ten years as an itinerant preacher, was elected principal of the Baldwin Institute; he subsequently served some ten years as professor in the Ohio Wesleyan University. In 1860 he was elected assistant secretary to the Missionary Society of the Methodist Episcopal Church. At the General Conference of his Church in 1872 he was elected bishop. He has been energetically devoted to his denomination in her greatest enterprises, and was especially eminent in her anti-slavery struggle.

Harris (WILLIAM TORREY), A. M., LL.D., b. at Killingly, Conn., Sept. 10, 1835; entered Yale College in 1854; became a teacher in St. Louis, Mo., 1857; became superintendent of public schools there 1867; was in 1866 one of the founders of the Philosophical Society at St. Louis; founded the *Journal of Speculative Philosophy* 1867, which he has since edited, and in which he has published many translations and original articles upon philosophical questions. It is the only journal of the kind in the English language. His school reports are widely sought for and read both in this country and Europe, and large extracts from them have been republished in England and Germany.

Har'risburg, post-v., county-seat of Poinsett co., Ark., 55 miles N. W. of Memphis, Tenn.

Harrisburg, post-v. and tp., cap. of Saline co., Ill., on the Cairo and Vincennes R. R. It has 2 churches, a high school, 2 flouring-mills, an agricultural implement manufactory, 1 weekly newspaper, and is in the centre of a country abounding in coal, iron, lead, and salt. Pop. of v. 590; of tp. 1,140. F. M. Pickett, Ed. "Chronicle."

Harrisburg, tp. of Van Buren co., Ia. Pop. 1089.

Harrisburg, post-tp. of Lewis co., N. Y., has 6 cheese-factories, and is a fine dairy tract. Pop. 1090.

Harrisburg, post-v. of Franklin co., O. Pop. 153.

Harrisburg, city, cap. of Dauphin co. and of the State of Pennsylvania, situated on the E. bank of the Susquehanna River, 60 miles from its mouth. It is 106 miles from Philadelphia, and 121 miles from Washington City; lat. 40° 15' N., lon. 76° 12' W., and stands chiefly on a plateau from 26 to 50 feet above low water in the river. The Cumberland Valley, Northern Central, Pennsylvania, and Philadelphia and Reading R. Rs. all centre here, while the Pennsylvania Canal, with its outlets and feeders, adds much to its facilities for trade. It is an extensive depôt for lumber *via* the Susquehanna River. Four bridges, each over a mile in length—three for railroads and one a carriage bridge—span the river at this point. The State Capitol buildings,

State Capitol, Harrisburg, Pa., west front.

embracing offices for the different departments of the State government, are located in the midst of a beautiful park of ten acres on a gentle rise of ground. They are plain brick edifices: the Capitol proper has large porticoes on the E. and W. fronts, and a spacious rotunda surmounted by a dome which commands a fine view of the picturesque Susquehanna. The State Library comprises 40,000 volumes, and a monument erected to the memory of the soldiers who fell in the Mexican war adorns the Capitol park. Harrisburg has 38 churches, and 2 national and 7 banks of discount. It contains the court-house and county prison, and has 3 daily and 6 weekly newspapers, besides several monthly publications. Besides the Harrisburg Academy and Institute, St. Genevieve's Academy, and a young ladies' seminary, it has 15 large and a number of small public school buildings, accommodating 41 schools and 5000 scholars. Its local charities are a house for the friendless, city hospital, and the Pennsylvania Lunatic Asylum, a State institution. Harrisburg has a well-regulated fire department, an electric fire-alarm telegraph, and a horse railway. The new waterworks are extensive, and, with the old, cost $750,000. The streets are macadamized and supplied with gas. It has a fine opera-house, with a seating capacity of 1600. The prosperity of Harrisburg does not depend upon its being the capital of the State, but upon its railway and canal communication with the coal and iron resources of the State; and it is these remarkable resources that have invited the large manufacturing establishments of iron, steel, boilers, galvanized iron cornices, brick, and tile. Among these we may specify the Pennsylvania Bessemer steel-works, the Lochiel, Franklin, Central, and Pennsylvania Car Co.'s iron-works, the Chesapeake nail works, the McCormick's, Wistar's, Price's, and Dock's blast-furnaces, the Harrisburg cotton-mill, the Eagle, the Harrisburg, and other machine-works. It has, besides, 5 carriage, 1 shoe, and 2 broom factories, file-works, 3 large flouring-mills, and 7 extensive saw and planing establishments, with numerous smaller manufacturing interests, employing a capital of $12,000,000. It is the fifth city in the State. It is the seat of a Roman Catholic bishop. Pop. 23,104.

William H. Egle, *Author of History of Pa.*

Harrisburg, post-v. of Harris co., Tex., 11 miles N. of Galveston, at the junction of the Galveston Houston and Henderson and the Galveston Harrisburg and San Antonio R. Rs. It is on Buffalo Bayou. Pop. 571.

Harris Gore, tp. of Washington co., Vt. Pop. 12.

Har'rison, county of Indiana, bounded on the S. by the Ohio River. Area, 475 square miles. The surface is finely diversified, the soil calcareous and fertile. There are several caverns. Cattle, grain, and wool are staple products; flour, cooperage, and lumber are leading manufactures. Cap. Corydon. Pop. 19,913.

Harrison, county of Iowa, bounded on the W. by the

Missouri River, which separates it from Nebraska. The soil is productive. Cattle, grain, and wool are the staples. It is traversed by the Chicago and North-western and the Sioux City and Pacific R. Rs. Cap. Logan. Pop. 8931.

Harrison, county of N. E. Central Kentucky. Area, 357 square miles. Its surface is varied, its soil mostly fertile. Cattle, grain, tobacco, and wool are staple products; distilled liquors and wagons are the leading articles of manufacture. It is traversed by the Kentucky Central R. R. Cap. Cynthiana. Pop. 12,993.

Harrison, county of Mississippi, bounded on the S. by the Gulf of Mexico (Mississippi Sound). Area, 970 square miles. The soil is light, and generally covered with pine forests. Rice and lumber are the principal products. The county is traversed by the New Orleans Mobile and Texas R. R. Cap. Mississippi City. Pop. 5795.

Harrison, county in the N. N. W. of Missouri, bounded on the N. by Iowa. Area, 720 square miles. It is chiefly prairie, most of which is fertile. Cattle, grain, tobacco, and wool are the staples. Cap. Bethany. Pop. 14,635.

Harrison, former county of Nebraska, parcelled out to other counties since the U. S. census. Pop. in 1870, 631.

Harrison, county in the E. of Ohio. Area, 400 square miles. It is hilly, but very fertile. Coal and limestone abound. Cattle, grain, and especially wool, are the staple products. The county is traversed by the Pittsburg Cincinnati and St. Louis R. R. Cap. Cadiz. Pop. 18,682.

Harrison, county of Texas, bounded E. by Louisiana, N. E. by Caddo Lake, and S. W. by the navigable Sabine River. Area, 964 square miles. Cotton, corn, fruit, and pork are extensively produced. The county is fertile, well watered, well timbered, and healthful. Leather, lumber, etc. are manufactured. The county is traversed by the Texas Pacific R. R. Cap. Marshall. Pop. 13,241.

Harrison, county in the N. of West Virginia. Area, 440 square miles. It is a hilly and rolling country, with broad valleys and a very rich soil. Timber, coal, iron, and salt are among its resources; cattle, grain, tobacco, and wool are the staple products. It is traversed by the Baltimore and Ohio R. R. Cap. Clarksburg. Pop. 16,714.

Harrison, tp. of Hale co., Ala. Pop. 800.

Harrison, post-v. and tp., cap. of Boone co., Ark., in Crooked Creek Valley. It has the U. S. land-office, a fine school-building, 5 general stores, 2 drug-stores, and 1 newspaper. Principal business, farming. Pop. of tp. 826.

Thomas Newman, Ed. "Highlander."

Harrison, tp. of Columbia co., Ark. Pop. 960.

Harrison, tp. of Union co., Ark. Pop. 729.

Harrison, tp. of White co., Ark. Pop. 972.

Harrison, post-tp. of Winnebago co., Ill. Pop. 725.

Harrison, tp. of Bartholomew co., Ind. Pop. 1228.

Harrison, tp. of Blackford co., Ind. Pop. 1680.

Harrison, tp. of Boone co., Ind. Pop. 1209.

Harrison, tp. of Cass co., Ind. Pop. 1171.

Harrison, tp. of Clay co., Ind. Pop. 2241.

Harrison, tp. of Daviess co., Ind. Pop. 1084.

Harrison, tp. of Dearborn co., Ind. Pop. 1086.

Harrison, tp. of Delaware co., Ind. Pop. 1400.

Harrison, tp. of Elkhart co., Ind. Pop. 1655.

Harrison, tp. of Fayette co., Ind. Pop. 867.

Harrison, tp. of Harrison co., Ind. Pop. 3462. It contains the town of Corydon (which see).

Harrison, tp. of Henry co., Ind. Pop. 1888.

Harrison, tp. of Howard co., Ind. Pop. 807.

Harrison, tp. of Knox co., Ind. Pop. 2812.

Harrison, tp. of Kosciusko co., Ind. Pop. 1745.

Harrison, tp. of Miami co., Ind. Pop. 1202.

Harrison, tp. of Morgan co., Ind. Pop. 378.

Harrison, tp. of Owen co., Ind. Pop. 451.

Harrison, tp. of Pulaski co., Ind. Pop. 753.

Harrison, tp. of Spencer co., Ind. Pop. 1977.

Harrison, tp. of Union co., Ind. Pop. 759.

Harrison, tp. of Vigo co., Ind. Pop. 870.

Harrison, tp. of Wayne co., Ind. Pop. 580.

Harrison, tp. of Wells co., Ind. Pop. 2961.

Harrison, tp. of Adair co., Ia. Pop. 434.

Harrison, tp. of Benton co., Ia. Pop. 502.

Harrison, tp. of Harrison co., Ia. Pop. 830.

Harrison, tp. of Lee co., Ia. Pop. 988.

Harrison, tp. of Mahaska co., Ia. Pop. 1270.

Harrison, tp. of Franklin co., Kan. Pop. 923.

Harrison, tp. and post-v. of Cumberland co., Me., 35 miles N. W. of Portland. It has a fire insurance company and manufactures of woollens, wire, agricultural machines, etc. Pop. 1219.

Harrison, tp. of Macomb co., Mich. Pop. 605.

Harrison, tp. of Monongalia co., Minn. Pop. 356.

Harrison, tp. of Daviess co., Mo. Pop. 831.

Harrison, tp. of Mercer co., Mo. Pop. 914.

Harrison, tp. of Moniteau co., Mo. Pop. 1585.

Harrison, tp. of Scotland co., Mo. Pop. 1491.

Harrison, tp. of Vernon co., Mo. Pop. 415.

Harrison, tp. of Gloucester co., N. J. Pop. 3038.

Harrison, city of Hudson co., N. J., on the Passaic River, opposite Newark. It has 2 weekly newspapers. Pop. 4129.

Harrison, tp. and post-v. of Westchester co., N. Y., on the New York and New Haven R. R. Pop. 787.

Harrison, tp. of Carroll co., O. Pop. 1024.

Harrison, tp. of Champaign co., O. Pop. 944.

Harrison, tp. of Darke co., O. Pop. 2007.

Harrison, tp. of Gallia co., O. Pop. 1329.

Harrison, tp. of Hamilton co., O. Pop. 758.

Harrison, post-v. of Hamilton co., O., on the Cincinnati and Whitewater R. R., 25 miles W. N. W. from Cincinnati, in a picturesque and agricultural district. It contains 6 churches, 2 schools, 3 flouring-mills, 2 tanneries, 2 brush-factories, 1 corn-drill factory, 1 woollen and 1 furniture factory, a sash and door factory, railroad-shops, etc. It has 1 weekly newspaper. Pop. 1417.

Will R. Hartpence, Ed. "Harrison News."

Harrison, tp. of Henry co., O. Pop. 1295.

Harrison, tp. of Knox co., O. Pop. 687.

Harrison, tp. of Licking co., O. Pop. 1242.

Harrison, tp. of Logan co., O. Pop. 994.

Harrison, tp. of Montgomery co., O. Pop. 2116.

Harrison, tp. of Muskingum co., O. Pop. 1197.

Harrison, tp. of Paulding co., O. Pop. 304.

Harrison, tp. of Perry co., O. Pop. 1202.

Harrison, tp. of Pickaway co., O. Pop. 1271.

Harrison, tp. of Preble co., O. Pop. 2294.

Harrison, tp. of Ross co., O. Pop. 1150.

Harrison, tp. of Scioto co., O. Pop. 1032.

Harrison, tp. of Van Wert co., O. Pop. 1319.

Harrison, tp. of Vinton co., O. Pop. 782.

Harrison, tp. of Allegheny co., Pa. Pop. 1870.

Harrison, tp. of Bedford co., Pa. Pop. 783.

Harrison, tp. of Potter co., Pa. Pop. 1052.

Harrison, post-v., cap. of James co., Tenn., on the E. bank of the Tennessee River, 12 miles above Chattanooga.

Harrison, tp. of Charles City co., Va. Pop. 1684.

Harrison, tp. of Calumet co., Wis., at the N. extremity of Lake Winnebago. Pop. 1562.

Harrison, tp. of Grant co., Wis. Pop. 1045.

Harrison (Benjamin), one of the signers of the Declaration of Independence, b. about 1740 at Berkeley, Charles co., Va.; was educated at William and Mary College. He took an early and prominent part in public affairs, and in 1764 was Speaker of the house of burgesses, and again 1777–82. He was a member of the General Congress from 1774–77, and governor of Virginia 1782–85. — He was the brother of Gen. Charles Harrison, a Revolutionary officer, and President W. H. Harrison was a son of Gov. Harrison, who d. in Apr., 1791.

Harrison (John), b. at Faulby, Yorkshire, England, 1693; was bred a carpenter; produced a new escapement for clocks and watches and a compensation (gridiron) pendulum 1725; went to London 1735; invented the nautical chronometer 1736, and perfected it in 1759; received in consequence (1767) a prize of £20,000 offered in 1714 for the invention of means by which mariners could tell their longitude within thirty miles. He made various improvements in clocks and watches. D. in London Mar., 1776.

Harrison (John Hoffman), M. D., b. in Washington City, D. C., Aug. 30, 1808; d. in New Orleans Mar. 19, 1849, of consumption. He received his diploma from the University of Maryland, was resident surgeon of its charity hospital 1833–36; was the founder of the *New Orleans Medical and Surgical Journal* in 1845, and edited it for four years. He published a valuable and elaborate work on the nervous system in 1849, and contributed several

important articles to the medical journals. His experiments in reference to the yellow fever are noticed by Dr. Drake in his elaborate work on the *Diseases of the Mississippi Valley*. PAUL F. EVE.

Harrison (NAPOLEON B.), U. S. N., b. Feb. 19, 1823, in Virginia; entered the navy as a midshipman Feb. 26, 1838; became a passed midshipman in 1844, a lieutenant in 1853, a commander in 1862, a captain in 1868. D. while in command of the Congress, Oct. 27, 1870. Capt. Harrison was a man of fine character, and greatly beloved by his brother officers. He had had the distinguished honor of leading the starboard column of the fleet by Forts Jackson and St. Philip on its way to New Orleans (Apr. 24, 1862), and "displayed masterly ability in steering his vessel under a hurricane of shot and shell, and afterward in manœuvring and fighting her." His death was universally regretted. FOXHALL A. PARKER.

Harrison (ROBERT A.), Q. C., D. C. L., Canadian barrister, was b. at Montreal Aug. 13, 1833, was called to the bar in 1855, and became a prominent lawyer of Toronto. He wrote several standard works upon the law of Upper Canada, and held important public offices. D. Nov. 1, 1878.

Harrison (WILLIAM HENRY), the ninth President of the U. S., was b. Feb. 9, 1773, in Charles co., Va., at Berkeley, the residence of his father, Gov. Benjamin Harrison. He studied at Hampden-Sidney College with a view to entering the profession of medicine. In 1791 he became an ensign in the army, and in 1792 a lieutenant on Wayne's staff. In 1795 he was made captain and commandant of Fort Washington, now Cincinnati, O. In 1797–98 he was secretary of the North-west Territory, and in 1799–1800 its delegate in Congress. He was (1801–13) governor of Indiana Territory and superintendent of Indian affairs, and as such concluded thirteen important treaties and gained the battle of Tippecanoe, Nov. 7, 1811. In 1812 he was made major-general of Kentucky militia and brigadier-general in the army, with the command of the north-west frontier. In 1813 he was made major-general, and as such won much renown by the defence of Fort Meigs and the battle of the Thames, Oct. 5, 1813. In 1814 he left the army, and was employed in Indian affairs by the government. He was a member of Congress from Ohio 1816–19; State senator 1819–21; U. S. Senator 1825–28; Presidential elector 1821 and 1825; U. S. minister to Colombia 1828–29; after which he retired to his farm at North Bend, Hamilton co., O., 16 miles below Cincinnati, where for twelve years he was clerk of the county court. In 1839 he was nominated for the Presidency by the Whigs at Harrisburg, Pa., Mr. Van Buren being the Democratic candidate, and Gen. Harrison received 234 electoral votes against 60 for his opponent. This election is memorable chiefly for the then extraordinary means employed during the canvass for popular votes. Mass meetings and processions were introduced, and the watchwords "log cabin" and "hard cider" (referring to statements of his political adversaries as to the general's habitation and his favorite drink) were effectively used by the Whigs, and aroused a wonderful popular enthusiasm. Pres. Harrison d. Apr. 4, 1841, just thirty-one days after his inauguration. He published in 1838 a small work on the Indians of the Ohio Valley. (See his *Life* by MOSES DAWSON, 1824; by JAMES HALL, 1836; by R. HILDRETH, 1839; by S. J. BURR, 1840; by ISAAC R. JACKSON, and others.)

Har'risonburg, post-v., cap. of Catahoula parish, La., on the navigable Ouachita River. It has 1 weekly newspaper. Pop. 217.

Harrisonburg, post-v. and tp., cap. of Rockingham co., Va., in the Shenandoah Valley, on the Baltimore and Ohio and the Valley R. Rs., and on the Washington and St. Louis narrow gauge R. R., which will connect it with the iron and coal fields of West Virginia. It has a national bank, about 30 stores of various kinds, 2 weekly newspapers, and 5 white and 2 colored schools. Rawley Springs are 12 miles E. of Harrisonburg. Pop. of v. 2036; of tp. 2828. JNO. H. WARTMANN, ED. "REGISTER."

Har'rison Square, post-v. of Suffolk co., Mass., now included in Boston, is on the Old Colony R. R., Shawmut and Milton branch.

Har'risonville, tp. and post-v. of Monroe co., Ill., on the Mississippi River, 28 miles below St. Louis, in a fertile region. Pop. 178.

Harrisonville, post-v., cap. of Cass co., Mo., 45 miles S. S. E. of Kansas City, on the Osage division of the Missouri Kansas and Texas R. R. It has 1 private bank, 1 newspaper, a high school, a steam flouring mill, stores and shops. Pop. 1032. J. E. PAYNE, ED. "COURIER."

Harrisonville, post-v. of Meigs co., O., in Scipio tp. Pop. 160.

Har'ristown, tp. and post-v. of Macon co., Ill., on the Toledo Wabash and Western R. R., 7 miles W. of Decatur. Pop. 984.

Har'risville, post-v., county-seat of Alcona co., Mich., on Lake Huron. Pop. 464.

Harrisville, tp. and post-v. of Cheshire co., N. H., 42 miles S. W. of Concord. It has manufactures of woollen goods, lumber, and wooden ware.

Harrisville, thriving post-v. of Diana tp., Lewis co., N. Y., has manufactures of lumber, chairs, leather, etc.

Harrisville, post-v. of Short Creek tp., Harrison co., O. Pop. 258.

Harrisville, tp. of Medina co., O. Pop. 1182.

Harrisville, post-b. of Mercer tp., Butler co., Pa., on the Shenango and Allegheny R. R., 33 miles S. E. of Greenville. Pop. 352.

Harrisville, manufacturing village of Burrillville tp., Providence co., R. I., on the Providence and Springfield R. R., 21 miles from Providence.

Harrisville (P. O., RITCHIE C. H.), cap. of Ritchie co., W. Va., 3 miles S. of the Baltimore and Ohio R. R. It has 1 weekly newspaper. Pop. 140.

Har'rodsburg, post-v., cap. of Mercer co., Ky., is 3 miles from the line of the Cincinnati Southern R. R. It has 6 churches for white and 2 for colored people, Daughters' College, common schools, 2 banks, 1 weekly newspaper, a hemp-factory, and a barrel-factory. It has good mineral waters, and fertile land around it. Pop. 2205.
JAMES B. CLARK, ED. and PROP. "KENTUCKY PEOPLE."

Har'rogate, or **Har'rowgate,** town in Yorkshire, England. Its sulphurous springs are much frequented during summer, and have very beneficial effects in diseases of the skin, scrofula, dyspepsia, and gout. Pop. with surroundings, 10,829.

Har'row (ON-THE-HILL), town and parish of Middlesex, England, on the London-Birmingham Railway, 12 miles N. W. of London, chiefly famous for its school, founded in 1571 by John Lyon, a yeoman, as a free school for poor boys. It is at present one of the most exclusive of English schools, few youth of the middle classes attending it. It has thirty-three masters and sub-masters, and special attention is given to Greek and Latin classics. Pop., with surroundings, 10,867.

Hart. See STAG.

Hart, county in the N. E. of Georgia, bounded on the N. E. by the Savannah River, which separates it from South Carolina. Area, 330 square miles. The surface is varied. Cotton, corn, and tobacco are the staple products. Cap. Hartwell. Pop. 6783.

Hart, county in the so-called "Barrens" of W. Central Kentucky. Area, 425 square miles. It is hilly, and generally productive. Limestone abounds. There are numerous caves. Live-stock, tobacco, grain, and wool are the staple products. The county is traversed by Green River and by the Louisville and Nashville R. R. Cap. Munfordsville. Pop. 13,687.

Hart, tp. of Warrick co., Ind. Pop. 1892.

Hart, post-v. and tp., cap. of Oceana co., Mich., about 8 miles from Lake Michigan. It has 2 churches, a union school-building, a court-house, 7 stores, a good water-power, 3 mills, 1 weekly newspaper, and a factory. Pop. of tp. 1001. J. PALMITER, ED. "OCEANA COUNTY JOURNAL."

Hart, tp. of Winona co., Minn. Pop. 859.

Hart (JAMES MCDOUGAL), b. at Kilmarnock, Scotland, in 1828; came when a child to America, and lived at Albany, N. Y.; went to Düsseldorf, Germany, in 1851, and studied landscape-painting about a year; returned to Albany in 1852; removed to New York in 1856; was made an academician in 1859. His pictures are admired for their harmony of color and the quiet peacefulness of their tone. *Woods in Autumn*, *Moonrise in the Adirondacks*, *Peaceful Homes*, are best known. O. B. FROTHINGHAM.

Hart (JOEL T.), b. in Clarke co., Ky., 1810; was bred a mason, and learned to read by the light of a wood fire. While working in 1830 at Lexington, Ky., as a stone-cutter, he began modelling in clay, and soon won reputation. His famous statue of Henry Clay, on which he began to work in 1846, owing to a shipwreck and other causes of delay, was not set up for many years. The *Angelina*, *Woman Triumphant*, and *Il Penseroso* are among his best works. He excelled in portrait busts, and had much facility and taste as a poet. D. at Florence, Italy, Mar. 2, 1877.

Hart (JOHN), one of the signers of the Declaration of Independence, was b. at Hopewell, N. J., in 1708. He was a farmer, and a man of noble simplicity and purity of character, often sent to the provincial legislature, and known as "honest John Hart." He was in the Continental Con-

gress 1774–77, and was until after the battle of Trenton much persecuted by the Tories, who hunted their patriotic neighbor for a long time from place to place. D. at Hopewell, N. J., in 1780.

Hart (John Seely), LL.D., b. in Stockbridge, Mass., Jan. 28, 1810, and in 1812 removed with his family to Luzerne co., Pa. He graduated in 1830 at Princeton with the first honors; was principal of Natchez Academy, Miss., 1830–31; became in 1832 tutor, and in 1834 adjunct professor of ancient languages, at Princeton; taught in the Edgehill School, Princeton, 1836–41; was principal of the Philadelphia High School 1842–59; teacher and principal of the New Jersey Normal School, Trenton, 1862–71; and in 1872 became professor of rhetoric and the English language and literature in Princeton College. Author of a large number of educational and religious works, and has written many reviews and reports. Has been editorially connected with a number of periodicals, and an active promoter of the Sunday-school cause. D. Mar. 26, 1877.

Hart (Nancy), a noted heroine of Revolutionary fame in the annals of Georgia. Though ignorant of letters and the civilities of life, yet she was a zealous lover of liberty and the "Liberty boys," as she called the Whigs, and did many valorous acts in support of their cause which rendered her name illustrious. On one occasion, by her own prowess and strategy, she overcame a party of five of the enemy who came to her humble cabin for the purpose of insult, outrage, and plunder: one she killed outright, another she put *hors de combat*, and compelled the other three to surrender as prisoners at her discretion to avoid a similar fate. (See Mrs. Ellet's *Heroic Women of the American Revolution*, and White's *Statistics of Georgia*.) In honor of this courageous woman the county of Hart in this State, embracing the place of her residence, was named.

Hart (Col. Ossian B.), a native of Florida, fought during the civil war on the side of the Union, and after the return of peace became a judge of the supreme court of the State. In 1870 he was sent to the U. S. Senate by the Republicans, but rejected by the Senate. In 1872 he was chosen governor of Florida for a term of four years. D. at Jacksonville, Fla., May 18, 1874.

Hart (William), elder brother of J. M. Hart, b. at Paisley, Scotland, in 1823; came to the U. S. in 1831; was bred a mechanic, and apprenticed to a coach-maker at Albany, but, exhibiting talent and taste for art, left the ornamental painting of carriages for the painting of canvas. His first publicly exhibited landscape picture in 1848 gained favorable notice. In 1850 the generosity of a friend enabled him to revisit his native land, and three years spent abroad in study advanced him greatly in his art. He has been from the first a frequent exhibitor at the National Academy, and became an academician in 1858. Mr. Hart has done very good work in water-color. The Water-Color Society owed its existence in large measure to him; for three years he was its president. O. B. Frothingham.

Harte (Francis Bret), b. Aug. 25, 1839, at Albany, N. Y. In 1854 he went to California, digged gold, taught school, engaged in the express business, set type in the office of the *Golden Era*, became editor of the *Californian*, a literary weekly, and was appointed secretary of the U. S. branch mint in San Francisco in 1864. Some of the poems which he published in San Francisco papers during the following years—*The Society upon the Stanislaus*, *The Pliocene Skull*, *John Burns of Gettysburg*, etc.—attracted great attention, and in 1868 he started a new magazine, the *Overland Monthly*. The two sketches which he contributed to this paper, *The Luck of Roaring Camp* and *The Outcasts of Poker Flat*, made quite a sensation, and with the publication in 1870 of his poem, *The Heathen Chinee*, his popularity culminated. In the same year he was appointed professor in modern literature at the University of California, but in 1871 he resigned his chair and returned to the Eastern States, settling in the city of New York. He has a decided talent for the description of life, as it appears when for some reason or other it falls outside of civilized society and has to start anew. The latent despair which is likely to be found at the bottom of such a form of life is perceptible in Bret Harte's pictures, without making them sentimental or painful; and the rudeness and harshness both of characters and events which are necessarily connected with it are painted with an astonishing realism, without becoming offensive or disagreeable. His style and his language help him. His style is sketchy and abrupt, but it is forcible, insinuating, and makes the impression that it always skips the worst and tells the best. His language is slang, but it is always characteristic, often witty, and now and then set off by an almost sublime simplicity. By this means he has succeeded in giving short but powerful glimpses of human nature, and the novelty and freshness of his productions have produced a great impression. But he has sometimes attempted to use other means, another language, another style, another subject, and has then been less successful. Within its proper limit his talent is a very delightful one. Clemens Petersen.

Harte-Beest [Dutch], or **Caama,** *Alcelaphus caama*, a large antelope of S. Africa, which goes in great herds, is extremely swift, and is hunted for its flesh, which resembles beef. It is often domesticated. The bastaard hartebeest, or sassaby (*Antilope lunata*), also lives in S. Africa, towards the tropic. It runs in small herds, and has excellent flesh.

Hart'enstein (Gustav), b. at Plauen, Germany, Mar. 18, 1808; became in 1834 extraordinary, and in 1836 regular, professor of philosophy at Leipsic; is of Herbart's school of thought, and has done much to make his master's teachings understood. Among his works are *Probleme und Grundlehren der Allgemeinen Metaphysik* (1836), *Die Grundbegriffe der ethischen Wissenschaften* (1844), *Historisch-philosophische Abhandlungen* (1870); has edited Herbart's and Kant's complete *Works*.

Har'ter, tp. of Clay co., Ill. Pop. 2785.

Hart'field, post-v. of Chautauqua tp. and co., N. Y. Pop. 59.

Hart'ford, county of Connecticut, bounded on the N. by Massachusetts, and intersected by the navigable Connecticut River. Area, 807 square miles. The surface is varied, the soil generally productive, especially along the Connecticut River. Tobacco, grain, fruit, live-stock, and wool are produced extensively. There are important manufactures of metallic wares, firearms, brick, flour, lumber, machinery, carriages, harnesses, woollens, furniture, and many other kinds of goods. The county is traversed by the New York New Haven and Hartford, the Hartford Providence and Fishkill, the New Haven and Northampton, and other R. Rs. Cap. Hartford. Pop. 109,007.

Hartford, the capital of Connecticut and the county-seat of Hartford co., is on the W. side of Connecticut River, 60 miles from its mouth, and the head of navigation except for small boats; lat. 41° 45′ 59″ N., lon. 72° 40′ 45″ W. It is on the New York New Haven and Hartford R. R., 111 miles from New York and 124 from Boston; is the eastern terminus of the Connecticut Western R. R., connecting W. with Albany, Poughkeepsie, and Fishkill; the northern terminus of the Connecticut Valley R. R., extending to Long Island Sound at Saybrook, 44 miles. The Hartford Providence and Fishkill R. R., a part of the New York and New England line, connects for Boston *viâ* Willimantic, and extends E. to Providence and W. to Waterbury, and is projected to the Hudson River at Fishkill. The city invested $1,250,000 in stock to secure the facilities furnished by the Connecticut Western and Valley roads. It has a daily steamboat line to New York, and freight lines to Philadelphia, Baltimore, and Albany, besides 150 to 200 sailing craft in the coasting-trade.

Hartford was settled in 1635 by emigrants from Newtown (now Cambridge, Mass.). The Indian name for the locality was *Suckiaug*, and the settlers secured a deed in 1636 from Sunckquassen (or Sequassen), chief of the Suckiaug tribe, but to secure a certain title the lands were repurchased in 1670. The settlement was first named Newtown, but changed to Hartford, after Hertford, England, said to have been the birthplace of Rev. Samuel Stone, teacher of the church. The Dutch built a fort on the river in 1633, but were dispossessed by the general court in 1654. Among the early settlers were men who had been eminent in England and in the Massachusetts colony. Emigrants from Hartford settled Farmington in 1645, Middletown and Norwalk in 1650, and Hadley, Mass., in 1659. In 1637, 42 of its 90 men went to the Pequot war. In 1775 a small committee of gentlemen met in Hartford and made arrangements for men and money which resulted in the memorable capture of Ticonderoga by Col. Ethan Allen. The first school was established in 1638, and the same year Ludlow, Haynes, Wolcott, Hopkins, and Hooker formed a written constitution, completed in 1639, which was the first framed in America, and embodied the main points of all subsequent State and of the Federal Constitution. The first code of laws was drawn up by Ludlow in 1650, reducing the capital offences from 160 (in England) to 15. The first mission was started in 1650 for the Christianization of the Indians. A prominent event in the history of the town was the effort of Sir Edmund Andros, governor-general of New England in 1687, to secure the charter granted to the colonists in 1662 by King Charles II. Andros made formal demand for the instrument in the general court, and while discussion was in progress Capt. Joseph Wadsworth carried off the charter and secreted it in the famous "charter oak;" or perhaps the original charter was secreted in the oak in June, 1687, and Wadsworth carried off the duplicate. The historic tree survived till 1856, when it was blown

down. It was an object of interest to every visitor to the city, and gave a name to the "Charter Oak City," as well as to a street and to numerous societies and business corporations, and furnishes a "trade-mark" for many industrial productions. Its wood has been worked and carved into innumerable relics. A young tree from the old oak is now growing in the park. The charter remained concealed until 1689. It is now preserved in the State-house, framed in wood of the "charter oak." The remains of the duplicate are in the Connecticut Historical Society. The State-house also contains a full-length portrait of Washington by Stuart, and portraits of most of the governors of the colony and State to the present time. Hartford was the sole capital of the Connecticut colony until 1701, made so by the vote of the freemen. In 1701 the October sessions of the general court were, by legislative act, ordered to be held at New Haven, while the May session was held at Hartford. The adoption of the constitution of 1818, though it did away with the October session, legally established the double-capital system. In 1873, after years of controversy, a constitutional amendment was adopted making Hartford again the sole capital. The State had previously appropriated $500,000, and Hartford $500,000, for the erection of a new State-house. Hartford purchased the Trinity

New State Capitol (Hartford, Conn.).

College grounds for $600,000, and presented the site to the State, and in 1873 the State appropriated $500,000 more towards the edifice. Subsequent appropriations make the entire cost about $2,500,000. It is of white marble, and occupies a commanding position in the West Park, visible from trains on railroads passing through the city. The park, with the State-house grounds, contains 46 acres, is tastefully laid out with walks, drives, fountains, etc., and has bronze statues of Gen. Israel Putnam and of Dr. Horace Wells, discoverer of anæsthesia, whose home was here. An agricultural park and fair-grounds border on the railroad S. of the city. A horse railroad runs from the northern limit of the city through Main street to Wethersfield, 4 miles S., and from the river on the E. to the city line W. The prominent business interest of the city is insurance. Its underwriters have a wide and honorable reputation. The capital of its 10 fire companies (including one steam-boiler and two mutual) is $6,500,000, and their gross assets in July, 1874, $14,420,411. Hartford companies paid $12,000,000 in losses by the great Chicago and Boston fires (1871–72) alone. The capital of its 11 life insurance companies (including 3 mutual and 1 partially and 2 wholly accident) is $2,300,000, and their assets in July, 1874, $90,741,400. It has 10 national and 2 State banks, with capital and surplus of $10,591,072; 5 savings banks, with deposits of $10,825,887; 3 trust companies, with deposits of $1,737,603 in 1874. There are 7 Congregational, 3 Baptist, 2 Methodist, 7 Episcopal, 1 Presbyterian, 3 Catholic, 1 Universalist, and 1 Hebrew church edifice, besides several chapels and some religious organizations which have no church buildings. It is the seat of a Roman Catholic bishop. The first church organization was brought from Cambridge by the settlers, with their ministers, Rev. Thomas Hooker, pastor, Rev. Samuel Stone, reader, and William Goodwin, ruling elder, and is now the First or Centre Congregational church. The Second or South Congregational church was organized in 1669–70. The first church edifice was built in 1638. The educational institutions are—Trinity College (Episcopal), founded in 1823 as Washington College, and now (1874) preparing to erect new buildings, models of scholastic architecture; Hartford Theological Institute; Hartford High and Grammar School, the latter the oldest educational institution in the State (the high school building cost $160,000); a thorough system of public schools, with fine buildings, one costing with land $185,000, and another $150,000; Hartford Female Seminary; 2 nunneries and 2 free Catholic schools. Its libraries are the Watkinson library of reference, 25,000 vols.; Young Men's Institute, 25,000; Trinity College, 13,500; Theological Institute, 7000; the Historical Society's library; and the State law library, which is very complete. In this library are preserved many letters from English kings to the colonial governors. Wadsworth Atheneum contains the Watkinson, Young Men's Institute, and Historical libraries; the rooms of the Historical Society, filled with relics and records covering the whole history of the country, open to the public free; a statuary room, containing the works of Edward S. Bartholomew, a deceased Hartford sculptor, and others; a picture-gallery, containing 100 paintings, among them the historical war-pictures of Trumbull, and a full-length portrait of Benjamin West by Sir Thomas Lawrence.

There are a few extensive manufactories in the city, and Hartford capital is largely invested in manufacturing in other towns. The Hartford Carpet Co., works at Thompsonville, capital $1,500,000; Collins Co., edge tools, Collins-

ville, capital $1,000,000; Willimantic Linen Co., capital $1,000,000; Cheney Bros., silk-works, here and at South Manchester, capital $1,000,000; Connecticut Screw Co., Tariffville, capital $500,000,—all have their principal offices here, and much of the stock of the Holyoke, Mass., Water-Power Co. is owned here. The Colt Firearms Co.'s works, capital $1,000,000, are built within a dyke over 1½ miles long, 32½ feet high, and 30 to 50 wide, reclaiming 123 acres of land from overflow by the river. Col. Colt, the patentee of the famous revolver, built the dyke at a cost of over $80,000. The beautiful memorial church of the Good Shepherd and many private residences stand within this enclosure, and "Armsmear," the elegant residence of Mrs. Colt, overlooks it. Other manufactories are the Weed Sewing Machine Co., National Screw Co., Hartford Foundry and Machine Co., Woodruff iron-works and foundry, Geo. S. Lincoln & Co.'s iron-works and foundry, Pitkin Bros., machinists and boiler-works, Beach & Co., boiler-works, Roper Arms Co. and Sharp Rifle-works, Pratt, Whitney & Co., machinery, and large printing and lithographing establishments, railroad car and repair shops, car-wheel works, lumber and flouring-mills, marble-works, carriage manufactories, pump-works, and various other establishments. The corporations located here, but some having their factories elsewhere, represent a capital of about $17,000,000. The publication of subscription books is a prominent interest. The mercantile business, wholesale and retail, is extensive. The city has a paid fire department and electric fire-alarm telegraph. It has a water-supply from the Connecticut River by powerful pumping engines, and also from large reservoirs in West Hartford, storing the water of mountain-streams. The entire works have cost $1,500,000, and the rents now pay interest and expenses. An artesian well 1584 feet deep upon the Colt estate supplies 50 gallons a minute. Hartford is a central market for Connecticut seed-leaf tobacco, the principal crop cultivated in the fertile Connecticut Valley. Wadsworth's Tower, on Talcott Mountain, W., affords one of the finest views in New England. The Governor's Foot Guard was organized in 1771, and the Horse Guards in 1778—both now in existence. The first steam locomotive was run in Hartford streets in 1797–99, invented by A. Kinsley, who also invented the first brick-pressing machine. The first patent for a lever printing-press was issued to John I. Wells in 1819. The first printing-office in the city was started in 1764 by Thomas Green, who the same year established the *Connecticut Courant,* which has been published regularly to the present time. The American Asylum for Deaf and Dumb, started here by Rev. Thomas H. Gallaudet in 1816, who brought Laurent Clerc from Paris to assist him, is the oldest institution of the kind in the country. There is a retreat for the insane, the Hartford Hospital, the Hartford Orphan Asylum, and an almshouse. City missionaries, supported mainly by individuals, but in part by churches, take watchful care of the deserving poor. A woman's Christian association seeks to aid working women. The Union for Home-work, an association of benevolent women, systematically manages a wide range of practical charities. Hartford has 3 daily, 7 weekly, and 3 monthly journals, besides 5 advertising sheets. The city has been the home of many persons noted in politics, art, or literature. Besides the buildings already named, there are the State arsenal, a jail, a government building containing the post-office, U. S. courts, pension and revenue offices; 2 granite insurance buildings costing $750,000 each; and many fine residences and business blocks. Pop. 37,180; of tp. and city, 37,743. S. A. HUBBARD, ED. "COURANT."

Hartford, tp. of Adams co., Ind. Pop. 935.

Hartford, tp. of Iowa co., Ia. Pop. 1234.

Hartford, post-v. of Warren co., Ia. Pop. 295.

Hartford, post-v., cap. of Ohio co., Ky., situated on Rough Creek, 12 miles above its confluence with Green River, and 4 miles from the Louisville Paducah and Southwestern R. R. It has 1 wagon manufactory, 2 machine, repair, and blacksmith shops, and a common school. Extensive coal-mines are in operation within 5 miles from here. Pop. 511. JOHN O'FLAHERTY, ED. OF "JOURNAL."

Hartford, tp. of Oxford co., Me., on the Portland and Oxford Central R. R., 60 miles N. of Portland. It has manufactures of leather. Pop. 996.

Hartford, post-v. of Van-Buren co., Mich., 19 miles N. E. of St. Joseph, on the Chicago and Michigan Lake Shore R. R. It has a fine union school, 2 churches, 1 newspaper, 4 dry-goods and 2 hardware stores, 2 hotels, 1 large stove-factory. It is in a great fruit and agricultural region. Pop. 1709. O. D. HADSELL, ED. "DAY SPRING."

Hartford, post-tp. of Todd co., Minn. Pop. 269.

Hartford, tp. of Pike co., Mo. Pop. 1583.

Hartford, post-tp. of Washington co., N. Y. It has excellent slate and limestone, and contains several caves and mineral springs. Pop. 1989.

Hartford, a v. of Valley tp., Guernsey co., O. P. 98.

Hartford (CROTON P. O.), post-v. and tp. of Licking co., O. Pop. of v. 229; of tp. 1017.

Hartford, post-tp. of Trumbull co., O. Pop. 1314.

Hartford, post-tp. of Windsor co., Vt., 42 miles S. E. of Montpelier, on the Connecticut and White rivers, and on the various railroads centring at WHITE RIVER JUNCTION (which see), which is a village in this township. Hartford has great water-power, and has manufactures of carriages, sleighs, furniture, lumber, agricultural tools, paper, boxes, woollen goods, shoes, and other commodities. Pop. 2480.

Hartford, tp. and post-v. of Washington co., Wis., on the Milwaukee and St. Paul R. R., 37 miles N. W. of Milwaukee. Pop. 2685.

Hartford City, a v. of Blackford co., Ind., 40 miles S. of Fort Wayne and 34 miles from the Ohio line, on the Pittsburg Cincinnati and St. Louis and the Fort Wayne Muncie and Cincinnati R. Rs. It has 3 churches, 2 newspapers, good public schools, an extensive hub and spoke factory, a heading-factory, a stave-factory, a first-class flouring-mill, a saw-mill, and several stores. Pop. 878.
J. M. RUCKMAN, ED. "NEWS."

Hartford City, or **Hartford,** post-v. of Mason co., W. Va., has manufactures of salt from wells. Pop. 918.

Hartford Convention. This convention, celebrated in the political history of the U. S., met at Hartford, Conn., Dec. 15, 1814, and adjourned without day Jan. 5, 1815. It consisted of 12 delegates from Massachusetts, 7 from Connecticut, 3 from Rhode Island (appointed by the legislatures of those States respectively), of 2 representing certain portions of New Hampshire, and of 1 from the county of Windham, Vt. The president, George Cabot of Massachusetts, and all the members, belonged to the Federal party, which had opposed the war then existing and the other leading measures of the administration. The members were among the worthiest political men whom the U. S. have produced, the objects contemplated were not in violation of the Constitution, and yet the greatest obloquy was heaped upon the delegates, and upon the party through the Union to which they belonged, and which, outside of New England, gave no unanimous or decided approval of the plan of such an assembly. It was falsely charged upon them that their meeting looked towards a dissolution of the Union; the party became obnoxious to censure as endeavoring to weaken the hands of the government during the war of 1812–15 with Great Britain. Soon after the convention met, the repulse of the British army at New Orleans brought fresh credit to the administration, and its adjournment was speedily followed in February by the Peace of Ghent. Federalism was already on the wane, and the appearance of disloyalty during war, of separating the interests of New England, where the Federalists were strongest, from those of the country as a whole, did more than anything else to give the deathblow to that honest and intelligent party, at the head of which, when it arose, stood Washington and the other principal leaders of the Revolution.

The journal of the convention, together with the acts of the States calling it together, and a sketch of the times, was published by Theodore Dwight, secretary of the convention, in 1833. With the light of the documents we may say—(1) that the New England States felt that the measures of the administration in regard to the militia were a great grievance, as well as unconstitutional, and that, while part of the coast, from Castine eastward, was in the military occupation of the enemy, they were left to themselves for their defence. (2) They, or the coast States at least, thought that a state of war had disclosed defects in the Federal Constitution, so that some check by new guaranties to the States needed to be put on the powers of the general government. (3) In the acts of the three States calling the convention there was care taken to declare, that the means of security and defence, to be devised by that body for the eastern section of the U. S., were to be "not repugnant to their obligations as members of the Union." Such was the language of Massachusetts. In the resolution of the general assembly of Connecticut the convention was to meet "for the purpose of devising and recommending such measures for the safety and welfare of these States as might consist with their obligations as members of the national Union." Rhode Island used similar words. There cannot be a doubt that nothing disloyal to the Union was intended.

When the convention met, it sat with closed doors, the members were bound to secrecy, and the journal, which at the close of the sessions was put into the hands of Mr. Cabot, the president, was not open to inspection until some time after the adjournment. This gave room to all sorts

of false reports respecting its proceedings and intentions. When the report and resolutions were made public, these stories had done their work, and an almost ineradicable persuasion, that there was an evil design in this meeting of Federalists, was spread far and wide. As we examine the documents, however, while a strong party feeling is shown in it, and a fear that the "Union may be destined to dissolution by reason of the multiplied abuses of bad administrations," nothing beyond this is discoverable, except the recommendation of certain measures, important indeed, but such as any State legislature or any other body of men might propose. These propositions are of several kinds: *First*, to recommend to the legislatures of the States represented in the convention, to protect the citizens of these States from the operation of all acts of Congress "subjecting the militia or other citizens to forcible drafts, conscriptions, or impressments not authorized by the Constitution of the U. S." *Again*, that the general government should be requested to consent to some arrangement by which the States, separately or in concert, should be empowered to assume the defence of their territory against the enemy, they receiving into their treasuries for such service a reasonable portion of the taxes collected within their borders. *Further*, it was recommended that the legislatures of the three States should authorize the governors, etc. to make detachments from the militia, or to form voluntary corps, which should be ready for service within the State, and, on application of the governor of one of the other States, be sent there also in order to repel invasions made or attempted by the enemy. Besides these three measures the convention recommended the following amendments of the Constitution: that representatives and direct taxes should be apportioned among the States of the Union according to the number of *free persons* within the same; that new States should be admitted only by a vote of two-thirds of both houses; that Congress should lay no embargo on vessels belonging to citizens of the U. S. for more than sixty days, nor, except by vote of two-thirds, interdict commercial intercourse between the U. S. and foreign nations, nor declare war without a vote of two-thirds, except in case of actual invasion of our territory; that no person hereafter naturalized should be eligible into either house of Congress or capable of holding any civil office under the authority of the U. S.; and, finally, that the same person should not be elected President of the U. S. a second time, and that the same State should not furnish a President for two terms in succession.

The convention contemplated the possibility of another similar convention being appointed by the legislatures, in case peace should not be concluded and the defence of the States be neglected. It also empowered three of its members to call another meeting of their own body to be held at Boston, if in their judgment the situation of the country should urgently require it. T. D. WOOLSEY.

Hart'land, post-v. and tp. of Hartford, Conn., 21 miles N. W. from Hartford. Pop. 789.

Hartland, tp. of McHenry co., Ill. Pop. 1037.

Hartland, post-tp. of Worth co., Ia. Pop. 575.

Hartland, post-tp. of Somerset co., Me., 25 miles N. E. of Skowhegan. It has manufactures of woollens and other goods. Pop. 1120.

Hartland, post-tp. of Livingston co., Mich. P. 1159.

Hartland, post-tp. of Freeborn co., Minn. Pop. 485.

Hartland, post-tp. of Niagara co., N. Y., is one of the best agricultural towns in the State. Pop. 3226.

Hartland, post-tp. of Huron co., O. Pop. 953.

Hartland, post-tp. of Windsor co., Vt., on the Connecticut River and the Vermont Central R. R., 10 miles S. of White River Junction. It has manufactures of lumber, sash, blinds, castings, and wooden wares. Pop. 1710.

Hartland, tp. of Pierce co., Wis. Pop. 574.

Hartland, tp. of Shawano co., Wis. Pop. 541.

Har'tlepool, town of England, in the county of Durham. It is situated on a peninsula projecting into the North Sea, and has a good harbor. It was formerly a well-frequented bathing place, but is now chiefly engaged in the coal-trade. Pop. 13,164; of the parliamentary borough, including West Hartlepool, etc., 38,302.

Hartlepool, West, a young but rapidly growing town of England, in the county of Durham, 1 mile from Hartlepool. It was founded in 1847, in which year its port was visited by 160 vessels, and it shipped 51,202 tons of coal; in 1861 the number of vessels visiting its harbor was 5964, and it shipped 975,319 tons of coal. Pop. 12,601.

Har'tleton, post-v. of Lewis tp., Union co., Pa. P. 292.

Hart'ley, tp. of Union co., Pa. It contains iron-works. Pop. 1115.

Hart'ley (Sir CHARLES AUGUSTUS), F. R. S. E., b. at Heworth, Durham, in 1825; at the age of twenty he became engaged in the construction of railways in Scotland, where he continued until 1848, when he was appointed resident engineer on harbor works at Plymouth and Devon, under the late Joseph Locke, M. P., C. E. On June 22, 1855, he received the queen's commission as captain in the Turkish contingent engineers, and served at Kertch with that force until the conclusion of the Crimean war. He was appointed Jan. 1, 1857, engineer-in-chief to the European commission of the Danube, and, "as a mark of Her Majesty's approbation of his services" here, he received in 1862 the honor of knighthood from the queen. During his engagement with the Danube commission he has also been employed by the Austrian government to report on the respective merits of various schemes for improving the port of Trieste; by the Turkish government to report on dock accommodation at Constantinople; by the Russian government to inspect and report on the mouths of the Don; by the British government to report on the nature of certain proposed works on the Scheldt; by the Indian government to report on the improvement of the Hooghly; and by the Roumanian government to prepare detailed plans and estimates for harbor accommodation on the Roumanian coast. He has received the imperial order of the Medjidie and the Turkish war-medal from the sultan of Turkey; the Stephenson prize, the Telford medal, the Telford premium, and the Manby premium from the Institution of Civil Engineers; and in 1867 the emperor of Russia's grand competition prize of 8000 silver roubles, by a special commission of experts, for his plans for improving the harbor of Odessa. He is a member of the Institution of Civil Engineers, London; a fellow of the Royal Society, Edinburgh, and consulting engineer to the European commission of the Danube, with his residences at the Sulina mouth of the Danube, Turkey, and at London. J. G. BARNARD.

Hartley (DAVID), M. D., b. at Armley, Yorkshire, Aug. 30, 1705; became a fellow of Jesus College, Cambridge, where he graduated M. A. in 1729; was designed for the Church, but on account of conscientious scruples chose rather the profession of medicine; practised at Newark, Bury St. Edmund's, London, and Bath, where he d. Aug. 28, 1757. He was a man of simple and benevolent character and virtuous life; wrote some medical works, but is chiefly remembered for his *Theory of the Human Mind* (1775) and his *Observations on Man* (1749), which gave him a brilliant though transient fame. He was a firm necessitarian, and was perhaps the first philosopher who attempted to explain psychological phenomena by reasoning based mainly upon physiological data. He nevertheless repelled the charge of materialism. He made some valuable observations, especially upon the theory of the association of ideas, anticipating certain very recent theories.

Hart'mann, von (EDUARD), b. in Berlin Feb. 23, 1840. He was educated at the School of Artillery, and became an officer in 1861. But in 1862 he accidentally hurt his foot, and an incurable disease which set in has since that time confined him almost without interruption to his bed, where he occupies himself with literary and philosophical studies. In 1868 he published *Ueber die dialektische Methode*; in 1869, *Schelling's Positive Philosophie*; in 1871, *Das Ding an sich und seine Beschaffenheit;* but his principal work is his *Philosophie des Unbewussten* (1869). His idea is to connect the results of the abstract philosophy with those of the concrete inductions of natural science. The point in which these two lines of research meet each other and prove each other is the unconscious. The unconscious in nature has a will—not a merely blind, irrational will (*Schopenhauer*), but one which can determine itself to prototypal ideas; and an idea—not a merely logical idea (*Hegel*), but one which can reach reality by will. In the mind this will and this idea become conscious by means of brain and nerves, but the unconscious is still at work in the instincts, in love, in the formation of language, etc., and in the unconscious the "first principles" are to be found. The execution of this idea is very ingenious, and has attracted great attention in Germany, in spite of the sad coloring of pessimism which pervades it.

Hartmann, von (JACOB), BARON, was b. a French citizen Feb. 4, 1795, in the Bavarian palatinate; received his education in the military institutions of Bonn and St. Cyr; and entered Dec. 1, 1811, as a lieutenant the 1st regiment of the grand duchy of Berg. He fought 1813–15 under French colors in the 27th regiment of the line. At Waterloo he saved the eagle of the regiment, and was made a knight of the Legion of Honor. After the peace of Paris (1815) he left the French service and entered the 10th Bavarian regiment of infantry. In the topographical department and by travels in foreign countries he extended his knowledge, and was attached to the staff in 1821. In 1842 he

was appointed adjutant to the crown prince Maximilian, and in 1848 he became major-general and adjutant to the king. In this position he exerted himself for the improvement of the Bavarian army, its organization, and its fighting capacity, but he encountered great difficulties from the political situation of the kingdom. In 1854 he visited France, especially Paris, and published later an excellent military work, based partly on French experience, partly on his own studies, on the Italian war in 1859. In 1861 he became lieutenant-general and commander of the 4th division of infantry, and as such he took part in the war of 1866. In 1869 he became a general of infantry, and led the 2d Bavarian army corps against France in 1870 and 1871. He took part with great distinction in the encounter at Weissenburg, contributed considerably to the victory in the battle of Wörth by his energetic advance on the French left wing and line of retreat, took the fortress of Marsal, fought at Sedan, and kept, during the siege of Paris, the plateau of Chatillon occupied. D. Feb. 22, 1873.
A. NIEMANN.

Hartmann, von (JULIUS), was b. Mar. 2, 1817, at Hanover, in whose military school he received his education. In 1834 he entered the 10th Prussian regiment of hussars, and in 1848 he was attached to the staff. He was often employed in diplomatic missions on account of his elegant education and address; thus, he was sent in 1850 to Sleswick-Holstein, and later to Austria and Saxony, to represent Prussian interests. After various occupations in the ministry of war and in the staff, he was made a major-general in 1865, and commander of Coblentz. In 1866 he commanded a division of cavalry, and took part in the encounters of Zwithau, Tobitschau, and Rokeinitz. In 1867 he was given the difficult task of reorganizing the Bavarian army in harmony with the army organization of Prussia; which task he fulfilled with great success. In the Franco-German war he received the command of the 1st division of cavalry, and fought at Courcelles and Gravelotte. Jan. 6, 1871, was appointed commander of a larger detachment, comprising all arms, with which he operated in the region between the Loire and the Loir, and took Tours Jan. 13. After peace he became governor of Strasburg, a position of great political importance, and in 1874 was made a general of cavalry. D. Apr. 30, 1878. A. NIEMANN.

Hart'mann (MORITZ), b. of Jewish stock at Daschnik, in Bohemia, Oct. 15, 1821; was educated at Prague and Vienna; left the empire on account of his political liberalism 1844; published *Kelch und Schwert* (1845), a volume of poems expressive of his opinions, followed by *Neuere Gedichte* (1847). He was in the Frankfort Parliament of 1848; went to Vienna, and escaped thence with some difficulty; lived for a time in the East, and then in Paris; began in 1860 to lecture on German history and letters in the Academy at Geneva; went to Stuttgart 1863, to Vienna 1868. Besides the above works he has written *Reimchronik des Pfaffen Maurizius* (1849), a brilliant political satire, and the novels *Der Krieg um den Wald* (1850), *Die Gefangene von Chillon* (1863), *Die letzten Tage eines Königs* (1866), *Nach der Natur* (1866), *Die Diamanten der Baronin* (1868), and others. Among his works are *Schatten* (1851), *Tagebuch aus der Provence und Languedoc* (1853), *Briefe aus Irland*, and the idyllic poem *Adam und Eva* (1851).

Har'tranft (JOHN FREDERIC), b. in New Hanover tp., Montgomery co., Pa., Dec. 16, 1830; graduated at Union College, N. Y., 1853; admitted to the bar of Montgomery co., Pa., 1859. At the outbreak of the civil war he was colonel of militia, and among the first to tender his services to the governor. As commander of the 4th Pennsylvania he served during the three months' term, and as volunteer aide to Gen. Franklin in the first battle of Bull Run. Commissioned colonel 51st Pennsylvania Vols. July 27, 1861, and with it accompanied the "Burnside expedition," leading it in the attack on Roanoke Island, Feb. 7, and in the battle near Newbern, N. C., Mar. 13, 1862; in temporary command of a brigade covering the rear of Pope's retreating army, was engaged in the second battle of Bull Run and Chantilly, and in the Maryland campaign at South Mountain and Antietam, in which latter battle he led his regiment in the brilliant charge which carried the bridge after repeated unsuccessful attempts by superior numbers. At Fredericksburg he led his regiment against the intrenchments, and with Burnside's transfer to the department of the Ohio was ordered to Kentucky. In June, 1863, he commanded a brigade before Vicksburg, and subsequently accompanied Gen. Sherman in his advance to Jackson, Miss. In command of a division which fought the battle of Campbell's Station, Nov., 1863, and participated in the repulse of Longstreet from before Knoxville, continuing in command of the division until his regiment was ordered home on veteran furlough. In the Richmond campaign of 1864 he commanded a brigade in the battles of the Wilderness and Spotsylvania; commissioned brigadier general May 12, 1864, and engaged in all the army movements to and before Petersburg, and brevetted major-general for conspicuous gallantry in recapturing Fort Steadman, Mar. 25, 1865. In Oct., 1865, he was elected auditor-general of Pennsylvania, and re-elected in 1868. In Oct., 1872, he was elected governor of that Commonwealth, and inaugurated Jan. 21, 1873. G. C. SIMMONS.

Hart's Creek, tp. of Lincoln co., West Va. Pop. 858.

Hart'sell's, tp. of Morgan co., Ala. Pop. 317.

Hart's Falls, or **Schaghticoke Point,** post-v. in Schaghticoke tp., Rensselaer co., N. Y. Pop. 1111.

Harts'grove, post-tp. of Ashtabula co., O. Pop. 799.

Hartshorn. See AMMONIA, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Hart'shorne (EDWARD), A. M., M. D., son of Dr. Joseph Hartshorne, was b. in Philadelphia in 1818; graduated at Princeton A. B. in 1837, A. M. in 1840, and M. D. at the University of Pennsylvania in 1840; was elected assistant physician to the new hospital for the insane of the Pennsylvania Hospital on its opening, Jan. 1, 1841; was elected resident surgeon to the Pennsylvania Hospital in Apr., 1841, and after two years' service there was elected physician to the Eastern State Penitentiary of Pennsylvania. A residence of fifteen months in the medical charge of this penitentiary, and constant observation of the working of the "separate system of prison discipline," led him to prepare two reports (1843 and 1844) in favor of the innocuous sanitary influence of the system when properly administered, which attracted much attention in Europe and this country as the first evidence of the kind derived from practical experience upon the spot. He engaged in general practice in Philadelphia after more than two years' travel and study among the hospitals, asylums, and prisons of Europe, and subsequently among those of the Northern Atlantic States of this country; was soon elected one of the attending surgeons of Wills' (eye) Hospital, and subsequently one of the attending surgeons of the Pennsylvania Hospital; served throughout the civil war as consulting surgeon and in other professional capacities in the U. S. army medical service, chiefly in Philadelphia U. S. army hospitals; also as active member and secretary of the executive committee of the U. S. Sanitary Commission in Philadelphia. During many years he has been an active member of the board of managers of the Episcopal Hospital of Philadelphia. He served as secretary to the first prison discipline convention in Philadelphia (1847), and to the first sanitary convention in the U. S. (Philadelphia, 1857), also as secretary for several years of the College of Physicians of Philadelphia, and subsequently one of the censors of the college and secretary and chairman of the building and hall committee. Among other offices of trust, the most important held by him were those of president of the Pathological Society of Philadelphia (two terms); chairman of the executive committee of the society of the medical alumni of the University of Pennsylvania, and for one year vice-president of that society; and chairman of the committee of arrangements for the meeting of the American Medical Association at Philadelphia in 1872. During many years he was a frequent contributor to the *American Journal of the Medical Sciences*, the *North American Medico-Chirurgical Review*, and the *Medical Examiner* of Philadelphia, chiefly in their review departments. He was editor for a few months of the *Journal of Prison Discipline and Philanthropy*. His most important book-work was the editing, under the permission of the editor, of two successive editions of Taylor's *Manual of Medical Jurisprudence*, with American notes and references, the most of which were incorporated, with acknowledgment, by the author in subsequent original editions. His longest continuous service in a professional position is that of medical adviser and examiner to the Penn Mutual Life Insurance Company since its origin in 1847. Although descended from Quaker ancestors on both sides through at least seven generations in this country, he became a communicant of the Protestant Episcopal Church in 1852.

Hartshorne (HENRY), A. M., M. D., son of Dr. Joseph Hartshorne, was b. in Philadelphia in 1823; graduated B. A. at Haverford College in 1839, and M. D. in the medical department of the University of Pennsylvania in 1845. After a two years' residence in the Pennsylvania Hospital, he was appointed in 1859 professor of the practice of medicine in the medical department of Pennsylvania College. In 1865 he was elected the first professor of hygiene in the University of Pennsylvania, on the institution of this, with several other chairs, in the medical department, under an endowment for the purpose by Dr. George B. Wood. He has held also successively a number of other professorships, the most important of which were at Haver-

ford College and in the Woman's Medical College of Pennsylvania, besides the office of attending physician, held for several years, in the Episcopal Hospital of Philadelphia. He is the author of several works, chiefly medical: a *Monograph on Glycerine*, *Essay on Cholera*, *Guide to the Medicine Chest*, *Conspectus of the Medical Sciences*, and *Essentials of the Principles and Practice of Medicine*. The last-named reached its fourth edition in 1874. For several years he was a frequent contributor to the *American Journal of the Medical Sciences* and to other medical journals; also, more rarely, to the *American Naturalist* and *Lippincott's Magazine*. He published a small volume of poems, *Summer Songs*, in 1865, and became editor of the *Friends' Review* in 1871. He has contributed several articles to this *Cyclopædia*, of which the most important is that on EVOLUTION.

Hartshorne (JOSEPH), M. D., b. near Alexandria, Va., in 1779; became a resident pupil at the Pennsylvania Hospital and a medical student in the University of Pennsylvania in 1800, and graduated M. D. in 1805, after a five years' training under Rush, Wistar, Physick, and others. After two voyages to the East Indies and a three months' residence in Batavia, he settled in Philadelphia, and gradually engaged in a very extensive practice. He was elected a colleague of Physick as one of the attending surgeons of the Pennsylvania Hospital, and served also in other similar posts. He continued in active private and consulting practice until broken down by the fatigues of the cholera epidemic of 1849, and d. in Aug., 1850. The few papers contributed by him to the medical journals of his day were brief and strictly practical. His only other publication was an appendix, with illustrations, to an American edition of a London translation of Boyer's work on *Diseases and Injuries of the Bones*, in which he reports a number of important cases, and describes a dressing for fractured clavicle and a new apparatus for the treatment of fractured thigh, afterwards popular for many years as Hartshorne's splints. He was, by descent and conviction, a member of the religious Society of Friends, his paternal ancestor, Richard Hartshorne, having emigrated from Leicestershire, England, in 1669, to escape from persecution as a follower of George Fox, and settled in New Jersey on land bought from the natives, and still held by his descendants; being afterwards associated with William Penn as one of the proprietary rulers of the province of East Jersey. Few members of his profession have left a better reputation for upright manliness of character and for practical experience and ability, as well as independent and original habits of thought and action.

Hart's Island (or **Spectacle Island**), an island in Long Island Sound, belongs to Rye tp., Westchester co., N. Y. It is the property of New York City, and was used for military purposes by the U. S. government during the late civil war.

Hart's Location, a tract of land in the White Mountain region of Carroll co., N. H., is a place of summer resort. Pop. 26.

Harts'town, a post-b. of West Fallowfield tp., Crawford co., Pa. Pop. 188.

Hart'suff (GEORGE L.), b. at Tyre, Seneca co., N. Y., May 28, 1830; graduated at the U. S. Military Academy, and entered the army as brevet second lieutenant of artillery July 1, 1852, in which capacity he did duty in garrison and on the Texas frontier till 1853, when he was promoted to be second lieutenant and engaged in Florida (1854-56) on topographical duty, where, in a skirmish with the Seminoles, he was severely wounded, one ball remaining in his chest till his death. From 1856 to 1859 he was on duty at West Point as assistant instructor of artillery tactics. From 1859 to 1860 he served on frontier duty at Fort Mackinac. While in execution of his duty he was a passenger on the steamer Lady Elgin, which was wrecked on Lake Michigan, Hartsuff escaping by seizing a piece of floating timber, on which he was washed ashore. In Mar., 1861, he was appointed a captain and assistant adjutant general, and in April sent to Fort Pickens with the secret expedition under Gen. Brown. In July he became chief of staff to Gen. Rosecrans in Western Virginia, participating in the action at Carnifex Ferry, Sept. 10, and subsequent operations of the campaign. In Apr., 1862, he was appointed a brigadier general of volunteers, and assigned to special duty in the war department. In May he took command of a brigade, and was engaged at the battles of Cedar Mountain and Manassas. He also bore a conspicuous part in the battles of South Mountain and Antietam, being severely wounded in the last named action, and incapacitated from duty in the field till Apr., 1863; serving in the mean time, upon his convalescence, as member of a board to revise the rules and articles of war, and to prepare a code for the government of armies in the field. Having been promoted to be major general of volunteers Nov., 1862, he commanded the 23d army corps in the West from April to Nov., 1863, when he was compelled to relinquish this command from incapacity arising from his Antietam wound, and was employed on bureau duty till Mar., 1865, when he commanded the Bermuda front of the siege-works before Petersburg, assuming command of that city on its capture, and subsequently of the district of Nottoway, which command he held till he was mustered out of the volunteer service, Aug., 1865. He afterwards resumed duty in the adjutant-general's department, with the rank of lieutenant-colonel, serving in various military districts and divisions till June, 1871, when, still suffering from his wound, he was retired from active service on the full rank of major-general U. S. A. After some time he went abroad, and interested himself in bringing American improvements in artillery to European attention. D. at New York May 16, 1874. GEORGE C. SIMMONS.

Hart'suggs, tp. of Van Buren co., Ark. Pop. 297.

Harts'ville, post-v. of Bartholomew co., Ind., on Clifty Creek, 40 miles S. S. E. of Indianapolis, in Haw Creek tp. It contains Hartsville University, and a theological school of the United Brethren, connected with the university. Pop. 433.

Hartsville, tp. of Steuben co., N. Y. Pop. 993.

Hartsville, post-v., cap. of Trousdale co., Tenn., 42 miles N. E. of Nashville. It has a Masonic hall, a male and female institute, 3 churches, 2 hotels, 1 newspaper. Large deposits of lead ore, and siliceous sand suitable for glass manufacture, exist. Principal business, farming. Pop. about 500. A. C. WELCH, ED. "SENTINEL."

Hartt (CHARLES FREDERICK), b. about 1838 in Nova Scotia; educated at the Wolfville Institute, N. S.; became in 1862 a pupil of Agassiz; accompanied the latter on his Brazilian expedition, in which he had the charge of the exploration of Southern Brazil; made several subsequent visits to that empire; was professor of geology and physical geography in Cornell University. His principal work is *Geology and Physical Geography of Brazil* (1870). D. 1878.

Hart'ville, post-v. of Wright co., Mo., on the Gasconade River, in a fine agricultural country. It has a high school, a newspaper, a good steam saw and grist mill, a carding-mill, 1 hotel. P. about 500. F. A. MASON, ED. "NEWS."

Hart'well, post-v., county-seat of Hart co., Ga., 50 miles N. E. from Augusta. Pop. 154.

Hartwell, post-v. of Springfield tp., Hamilton co., O., on the Cincinnati Hamilton and Dayton R. R., N. of Cincinnati. Pop. 67.

Hart'wick, tp. of Osceola co., Mich. Pop. 47.

Hartwick, post-tp. of Otsego co., N. Y., on the Cooperstown and Susquehanna Valley R. R., and on the Susquehanna River, contains several cotton manufacturing villages, and is the seat of Hartwick Theological and Classical Seminary (Lutheran). Pop. 2339.

Hart'wig (JOHN CHRISTOPHER), a German Lutheran minister, b. in 1716; came to America as a chaplain in the British army; was a member of the first Lutheran synod in America (1748); held pastorates in New Jersey, Pennsylvania, and New York, and founded the Hartwick Theological Seminary at Hartwick, Otsego co., N. Y., which was opened in 1815. He received in 1761 a patent of 21,500 acres of land, comprising the greater part of the present town of Hartwick. D. in 1796, on his eightieth birthday, having forty years before predicted the day and hour of his death. He was a man of eccentric but noble character.

Hart'wood, tp. and p. v. of Stafford co., Va. P. 1536.

Hartz, or **Harz,** an insulated group of mountains in North-western Germany, or, rather, an elevated plateau, intersected with deep valleys and rising in different places into high peaks. These mountains, which cover an area of about 800 square miles, occupying Brunswick and parts of Hanover and Prussian Saxony, are covered with forests, and are exceedingly rich in minerals—gold, silver, lead, iron, marble, and alabaster. The highest peak is the Brocken, 3740 feet high, which is the birthplace of numerous superstitions and fairy-tales, mostly of a hideous and humorous turn.

Haruga'ri is the name of a German order in the U. S., established in 1847, and numbering about 20,000 members. The word, derived from *haruc*, a "forest," denoted with the ancient Teutons a priest. The aim of the order is principally benevolent and social, though the introduction to the constitution also sets forth, as a general purpose, the preservation and extension of the German language in the U. S. The organization comprises [illegible] subordinate lodges, which in the different States combine into great State lodges, and these again into one national lodge. Since

1869 the order has its own organ, called *Deutschen Eiche* ("German Oaks"). Most of the lodges possess libraries, and lectures are often given in the lodge-rooms.

Haruspices. See AUSPICES.

Har'vard, post-v. of McHenry co., Ill., 63 miles N. W. of Chicago, at the junction of the Green Bay, the St. Paul, and the Kenosha and Rockford divisions of the Chicago and North western R. R. It has 4 churches, 1 newspaper, a private bank, 3 hotels, several large mills and shops. Pop. 1120. A. M. LELAND, ED. "INDEPENDENT."

Harvard, tp. and post-v. of Worcester co., Mass., 38 miles N. W. of Boston. The township is very fertile, and is traversed by the Worcester and Nashua R. R. It has 3 churches and a public library, and is the seat of a flourishing community of Shakers. Pop. 1341.

Harvard, post-v. of Clay co., Neb., on the Burlington and Missouri River R. R., 81 miles W. of Lincoln, the State capital. It has 3 organized church societies, a lodge of Good Templars, 1 of Freemasons, 1 hotel. It is the centre of a thriving agricultural community. Pop. about 400.

WM. A. CONNELL, ED. "ADVOCATE."

Harvard (JOHN), M. A., the founder of Harvard College, was b. in England about 1608, probably in Middlesex, and was educated at Emanuel College, Cambridge. He came to New England, and in 1637 became a freeman of the Massachusetts colony. In 1638 some land was set off for him in Charlestown, where he performed the duties of minister. In that year he was one of a committee to consider matters "tending towards a body of laws." D. Sept. 14, 1638, and left half his estate, or £779 17*s.* 2*d.*, towards the founding of a college, besides more than 300 volumes of books from his library. Mr. Everett delivered the address at the dedication of his monument at Charlestown in 1828. But little is known of Mr. Harvard's life.

Harvard University. In the year 1636, less than sixteen years after the landing of the Pilgrims at Plymouth, the general court of the colony of Massachusetts Bay voted to give the sum of "four hundred pounds towards a school or college," one-half to be paid the following year, and the remainder when the work was done. Preliminary steps towards the establishment of a college at Newtown (afterwards Cambridge) were taken the following year. In 1638, John Harvard, a non-conforming clergyman of England, who had been in the colony about one year, left at his death half of his whole property and his entire library (about 300 volumes) to the institution. The value of this bequest was more than double the sum originally voted by the court, and it was resolved to open the college at once, and to give it the name of Harvard. The first class was formed in the same year, and graduated, nine in number, in 1642. From that date to the present there has been, with five exceptions—all occurring during the first fifty years of the existence of the college—no year without a graduating class. The last triennial catalogue (1872) contains the names of 12,175 persons who have received degrees from the university, nearly 7000 of whom are still living. The invested funds of the university amounted Sept. 1, 1873, to over $2,750,000, exclusive of the grounds, libraries, and buildings occupied for purposes of instruction, which, yielding no direct income, have no place in the treasurer's accounts. The government of the college was at first confided to a board of overseers, established and empowered by an act of the general court; but in 1650 a charter was granted, by which the college was made a *corporation*, consisting of the president, five fellows, and a treasurer, to be called by the name of "President and Fellows of Harvard College." This corporation had the power to fill vacancies in its numbers with the approval of the overseers, and continues to the present day in its original form as the *corporation*, acting under the original charter as first issued in 1650, and with its rights and privileges confirmed by a special section in the constitution of the commonwealth of Massachusetts, framed in 1780. The board of overseers has also continued in existence to the present day, but not without important changes in its constitution and modifications of its powers. At the outset the magistrates of the colony and certain preachers formed, *ex-officio*, the board, and it was not until the year 1810 that steps were taken to make a part of the number elective. The State government retained a more or less direct control over the constitution of this board until the year 1865, when all official connection between the college and the State was broken by the passage of a legislative act, according to which vacancies in the board of overseers were to be filled thereafter by the alumni of the college "voting on commencement day in the city of Cambridge." By this transfer of power to the graduates, the college was freed from any dependence upon political bodies, as it had been previously freed from the influences of sectarianism. The property of the university is held and managed entirely by the corporation, the board of overseers having ordinarily no voice in the investment or other disposition of university funds; but in all matters relating to statutes and regulations, the appointment of professors and other instructors, and in general the internal administration of college affairs, the consent of the overseers is necessary. That board consists, at present, of the president and treasurer of the university, *ex-officio*, and of thirty other persons elected for terms of six years, five retiring each year. The teaching force of the university consists now of 46 professors, 25 assistant professors, 23 tutors and instructors, and 35 other officers engaged in the duties of instruction or government. The number of students in all the departments is about 1200.

The central department of the university is Harvard College, in the restricted sense of the term. The number of undergraduates has risen from scarcely 400 in 1857 to over 700 in 1874. This increase is very largely due to the introduction of the "elective system." It is no longer required that every student pursue the same course of study and pass the same examinations as the condition of obtaining the degree of bachelor of arts. After the freshman year, in which the studies are all prescribed, the student is practically at liberty to mark out his own course of study. There are this year (1875) 91 elective courses, giving in the aggregate 232 hours of recitation or lecture per week during the year, from which the student has to choose. About one-seventh part of the instruction provided is all that it is possible for any one college student to pursue during his whole residence. The elective courses are classified under the heads of ancient languages, classics, modern languages, philosophy, history, mathematics, physics, chemistry, natural history, music, and the fine arts. In these groups the courses are in general so arranged that there shall be a regular gradation from the simpler to the more difficult, and a student is thus enabled at the end of his freshman year to lay out a progressive course of study for the remaining three years. An incidental advantage of the system is that the sections are, as a rule, much smaller than in former years, and each student receives a larger amount of personal instruction from the professor, especially in the more advanced courses. The requisitions for admission have been raised gradually as circumstances would allow, and as rapidly as the preparatory schools could follow; the result of which has been that the average age of students entering the college is nearly a year greater than it was a few years ago.

The buildings of the college proper at Cambridge comprise nine dormitories (containing over 400 rooms), five buildings for recitations and examinations or for laboratories and collections, the library, the chapel, and Memorial Hall, erected in 1874 by subscriptions from the alumni. The rooms are rented to students at prices varying according to position and desirableness, a sufficiently large number being held at a merely nominal price to satisfy the wants of the poorer students. The college has also received large gifts of money to be applied in aiding poor but capable students in meeting their necessary expenses. This aid is given partly in the form of scholarships, of which there have been 92 established in the college, with an income of about $250 apiece on the average, and partly through beneficiary and loan funds. There are daily devotional services in the chapel at which the undergraduates are required to be present; on Sundays those who do not spend the day with their families must attend public worship at least once, but each student may select his own place of worship if he be of age. In 1782 the first steps were taken by the corporation towards the establishment of professional schools in connection with the college by the appointment of professors in medical subjects, but it was not till about thirty years later that a separate college was built for the medical department. The medical college was erected in Boston for the sake of the advantages of the hospitals. Its funds amount to $50,000, and 9 professors, 5 assistant professors, 7 instructors, 7 lecturers, and 1 assistant demonstrator are engaged in giving instruction. The library of the school, although not large, is valuable, and the anatomical museum is recognized as the best in the country. In the year 1868 a new department of this school was established in Boston for the purpose of giving instruction in the art of dentistry, in which 4 professors and 6 other instructors are engaged, besides the teachers of the medical school, whose instruction students of dentistry attend.

Until the year 1812 the college government and students had united in public worship with the first parish in Cambridge, but in that year the opinion was expressed by the overseers that religious instruction should be given on the Sabbath within the walls of the university. The discussions thus begun led in a few years to the founding of a

the logical school. The organization of this school has suffered many material changes during the sixty years of its existence, but the peculiar feature insisted upon by its founders, "that no assent to the peculiarities of any denomination of Christians shall be required either of the instructors or students," has not been altered. The school has a valuable library of nearly 16,000 volumes, which is kept in Divinity Hall. Instruction is given in all the subjects usually included in a system of theological education, and the full course occupies three years. Those students who complete the course and sustain the required examinations receive the degree of bachelor of divinity. There are now 5 professors and a librarian attached to the school.

The law school was established in 1817, but the number of students in law was small until after the reorganization of the school in 1829. Since that time the law school has been one of the most flourishing departments of the university, and there are now over 1700 names on the list of its graduates. The law library in Dane Hall is one of the most complete and extensive in America, containing about 15,000 volumes. There are now 5 professors, 1 assistant professor, and a librarian in the school.

The Lawrence Scientific School takes its name from Abbott Lawrence of Boston, who in 1847 made a gift of $50,000 to the corporation, with which to establish a school "for the purpose of teaching the practical sciences." The three professorships at first created were those of chemistry, engineering, and zoology and geology. This last professorship was held by Louis Agassiz from its foundation till the time of his death in 1873. Connected with this school is the School of Mining and Practical Geology, founded in 1865.

The Museum of Comparative Zoology, more popularly known as the Agassiz Museum, is not a constituent part of the university, although it is directed by a faculty appointed by the corporation. The property of the museum is held by an independent board of trustees. There is, however, such an intimate connection between the museum and the college that a large part of the college instruction in natural history is given at the museum. The institution was founded in 1859, and continued under the direction of Prof. Agassiz until his death. Its library now contains 12,000 volumes. The Botanic Garden of the university and the Herbarium afford facilities for the study of botany which are unsurpassed in America. Funds for a professorship of natural history were raised as early as 1805, and a site for the garden was selected shortly afterwards. Nearly opposite the Botanic Garden stands the Astronomical Observatory, erected in 1846, and equipped throughout with the best of instruments.

The Bussey Institution is a school of agriculture and horticulture, established as a department of the university according to the terms of the will of Benjamin Bussey, who left, at his death in 1842, a large bequest in money and land (Bussey Farm) for the purpose. The Peabody Museum of American Archæology and Ethnology possesses a rapidly accumulating collection of objects illustrating the habits and customs of the early races inhabiting this country, but the erection of a museum building will be deferred until the funds set aside for that object shall amount to $100,000.

Besides the libraries of the professional schools, there is the general library for the use of the whole university, kept in Gore Hall, and containing 150,000 volumes, exclusive of pamphlets (of which there are about 100,000) and unbound serial publications. WILLIAM H. PETTEE.

Harvest-Fly. See CICADA.

Harvest Moon, the full moon nearest the autumnal equinox. In Great Britain and Northern Europe, owing to the latitude, the harvest moon rises for several evenings in succession near the time of sunset; an irregularity which is less observable in the U. S., on account of our lower latitude. At the equator no such anomaly is observable. The southern hemisphere has a harvest moon in March. The name is given from the fact that it enables farmers to lengthen the day's work during the haste of the autumnal ingathering of the crops.

Har'vey, county of S. Central Kansas. Area, 468 square miles. It is a good agricultural region, and is traversed by the Atchison Topeka and Santa Fe R. R. Cap. Newton.

Harvey, tp. of Meeker co., Minn. Pop. 364.

Harvey (Sir JOHN), K. C. B., b. in 1778; entered the British army in 1794; served in the wars against Napoleon, and in South Africa, India, and Canada, and was distinguished at Stony Creek, Chrystler's Farm, Lundy's Lane, and Fort Erie, where he was severely wounded; was aide-de-camp to Wellington in the Waterloo campaign; was governor of New Brunswick 1837–41, of Newfoundland 1841–46, and of Nova Scotia 1846–52. D. at Halifax Mar. 22, 1852. He attained the rank of lieutenant-general, became a commander of the Legion of Honor, and married a daughter of Lord Lake.

Harvey (LOUIS P.), b. at East Haddam, Conn., July 22, 1820; removed at the age of eight with his parents to Ohio; educated at Western Reserve College; removed to Kenosha, Wis., in 1840, and devoted himself for a time as teacher, subsequently as editor of the Whig paper of that city. He was a member of the State senate from 1853 to 1857, when he was elected secretary of state, and governor Nov., 1861. After battle of Shiloh repaired to the field with supplies for relief of the wounded, and on his return from the battlefield, he was drowned at Savannah, Tenn., Apr. 19, 1862.

Harvey (MATTHEW), LL.D., b. at Sutton, N. H., June 21, 1781; graduated at Dartmouth in 1806; became a lawyer 1809; was a prominent State legislator; Speaker of the New Hampshire house 1818–20; president of New Hampshire senate 1824–28; State councillor 1828–30; in Congress 1821–25; governor 1830–31; a justice of the U. S. district court 1831–66. D. at Concord Apr. 7, 1866.

Harvey (WILLIAM), M. D., b. at Folkestone, Kent, Apr. 1, 1578, was the son of a substantial yeoman, and was educated at Caius College, Cambridge, and at Padua, where he studied under Fabricius and took his doctor's degree; returned to England in 1602; became physician to Bartholomew's Hospital, London; Lumleian lecturer on anatomy and surgery 1615; was physician to James I. and Charles I.; was attached to the court of the latter, followed his fortunes in the civil war, and became warden of Merton College, Oxford, probably in 1645. D. June 3, 1658. Harvey's great discovery of the circulation of the blood seems to have been suggested by him in 1616, announced in 1619, and published in the *Exercitatio de motu cordis et sanguinis* (1628). Other *Exercitationes* on the subject appeared in 1649. His later years were occupied in observations upon generation, upon which he published a treatise in 1651. Servetus, Paolo Sarpi, Cæsalpinus, and perhaps Fabricius, Harvey's tutor, would appear to have believed in the circulation of the blood, but Harvey first established the truth of the doctrine.

Har'veysburg, post-v. of Warren co., O., in Massie tp. Pop. 388.

Har'ville, tp. of Winston co., Ala. Pop. 365.

Har'wich, town of England, in the county of Essex, at the mouth of the Stour. Its harbor is safe, spacious, fortified, and one of the best on the E. coast of England, but its entrance is difficult. Harwich has manufactures of cement and artificial manure. Pop. 6107.

Harwich, post-v. and tp. of Barnstable co., Mass., on the S. side of Cape Cod, about 70 miles S. E. of Boston. It has 4 miles of sea-coast, but no good harbor. The Cape Cod R. R. passes through the town. The fishing and coasting business is carried on to some extent. It has a national bank, a newspaper and printing office, 8 churches, several large halls, etc. Pop. of tp. 3080.

JOSIAH PAINE, ED. "INDEPENDENT."

Har'winton, post-tp. of Litchfield co., Conn., 23 miles W. of Hartford. It has an insurance company and some manufacturing interests. Pop. 1044.

Har'wood, tp. of Champaign co., Ill. Pop. 779.

Harwood (EDWARD), D. D., b. in Lancashire, England, 1729; appointed master of Congleton school 1754; became Unitarian pastor at Bristol 1765; received the doctor's degree from Edinburgh 1768; went to London 1770 on account of injurious but false rumors about him, and engaged in teaching and authorship. D. there, very poor, Jan. 14, 1794. His principal works are a *Liberal Translation of the N. T.* (1768), which was severely criticised; *Introduction to the Study of the N. T.* (1767–71, 2 vols.); *View of Various Editions of Greek and Latin Classics* (1775), a learned and able work; *The N. T. Collated with the most approved MSS., with Select Notes* (1776); *Biographia Classica* (2d ed. 1778).

Has'drubal, or **As'drubal** ("Baal is his help"), the name of many famous Carthaginians, among whom we may notice—(1) a son-in-law of Hamilcar Barca, went to Spain and there founded New Carthage (212 B. C.), and by shrewd diplomacy brought nearly all Spain under the rule of Carthage; was murdered by a slave 221 B. C. (2) Son of Hamilcar Barca and brother of Hannibal, was defeated by the Scipios in a great battle on the Iberus, 216 B. C.; reduced the Numidians to quietness, 213 B. C.; defeated and slew Cn. Scipio in battle, in Spain, 212 B. C.; was defeated by P. Scipio the Younger at Baecula, 209; invaded Italy through Gaul, and was defeated and slain on the Metaurus by Livius and Nero, 207 B. C. (3) A son of Gisco, who served in Spain in the second Punic war; was totally defeated by Scipio at Silpia, 206 B. C.; was twice

defeated before Carthage by Scipio, 204 B. C., and committed suicide by poison. (4) A general in the last Punic war; was defeated by Masinissa and forced to capitulate 150 B. C.; served against the Romans before Carthage 149–147; commanded against Scipio in the defence of Carthage (147–146 B. C.), and after the destruction of that town lived a captive in Italy.

Ha'se (KARL AUGUST), b. at Steinbach, Saxony, Aug. 25, 1800; was imprisoned in 1819 for belonging to the Burschenschaft; was made a private tutor in divinity at Tübingen 1823; graduated at Leipsic 1828; became in 1829 professor of philosophy there; professor of theology at Jena 1830; has long been a prominent rationalist, and in 1844 became an editor of the *Protestantische Kirchenzeitung*. Author of *Evangelische Dogmatik* (1826), *Gnosis* (3 vols., 1826–28), *Hutterus Redivivus* (1829), *Leben Jesu* (1829; in English by J. F. Clarke, 1859), *Kirchengeschichte* (1834; English trans. by Blumenthal and Wing, 1856), *Neue Propheten* (1851), *Das geistliche Schauspiel* (1858), *Handbuch der Polemik gegen die römisch-katholische Kirche* (1862), *Franz von Assisi* (1856), *Katharina von Siena* (1862), *Wormser Lutherbuch* (2d ed. 1868), *Ideale und Irrthümer* (1872), and many other works.

Hase (KARL BENEDICT), b. May 11, 1780, at Sulza, in Saxony; went in 1801 to Paris, was appointed 1805 to a place in the Royal Library in the MS. department; in 1816 professor of modern Greek and of palæography in the School of Oriental Languages; afterwards director of the same; member of the Academy of Inscriptions 1824; professor of the German language and literature in the Polytechnic 1830; professor of comparative grammar at the Sorbonne 1852; besides other honorable appointments. Contributed many valuable articles on philology to the *Journal des Savants*, *Journal Asiatique*, *Revue Archéologique*, etc. Edited *Laurentius Lydus de Ostentis*, Paris, 1823; wrote an introduction (*commentarius*) to the edition of *Lydus de Magist. Rom.* by Fuss; edited *Leo Diaconus* (in *Byz. Script.*), Bonn., 1828; was principal editor of the new edition of *Stephani Thesaurus Linguæ Græcæ*, aided by De Sinner and Fix, afterwards by W. and L. Dindorf, who continued the work after his death. D. Mar. 21, 1864. (See GUIGNIAUT, *Notice historique sur la vie et les travaux de C. B. Hase*, Paris, 1867.) H. DRISLER.

Hashish' [Arabic], a variety of *Cannabis sativa* (hemp), is cultivated in districts N. of Calcutta for the production of (1) *bhang* (Hindostani), *hashish* (Arabic), the dark-green stalks and green leaves used in smoking, or as a constituent of a sweetmeat (*majun*); (2) *ganja*, the flowering shoots brought into the London drug-market under the name of *guaza*; (3) *charas*, or *churrus*, the resin which exudes from the branches and leaves of the plant. It has been shown that an extract of the hemp grown in the U. S. shares the qualities of that of India, but doubtless in a less degree, for the hemp of hot countries has more of the active resin (*churrus*) than the hemp of temperate climates. Hashish has long been employed in medicine in Asia. Arabs, Persians, Indians, Chinese, and South Africans esteem it for its intoxicating powers; but there are many people of European race who are scarcely influenced by it; and upon those who are intoxicated by its use the effects are extremely varied. This uncertainty of effect greatly limits its use in medicine. Upon some persons its influences as an anodyne and hypnotic in certain diseases are very happy.

Has'kell, county in the N. W. of Texas. Area, 1275 square miles. It is unorganized, and consists chiefly of a high, level table-land, reported to afford good pasturage and abundance of game.

Has'kins, post-v. of Middletown tp., Wood co., O. on the Dayton and Michigan R. R. Pop. 243.

Has'lett's, tp. of Gates co., N. C. Pop. 946.

Has'lingden, town of England, in the county of Lancaster. It is situated in a mountainous region rich in coal-mines and stone-quarries, and carries on extensive manufactures of woollen and cotton. Pop. 12,201.

Has'san, post-tp. of Hennepin co., Minn. Pop. 551.

Has'sard (JOHN R. G.), b. in New York City in 1836; graduated at St. John's College, Fordham, N. Y., in 1855. He assisted in preparing the *New American Encyclopædia;* was editor of the *Catholic World* in 1865, and was engaged on the *Chicago Republican* in 1865–66. Since 1866 he has been on the editorial staff of the New York *Tribune*, of which, since the death of Horace Greeley in 1872, he has been assistant editor. He published a *Life of Archbishop Hughes* in 1866. J. B. BISHOP.

Has'saurek (FRIEDRICH), b. at Vienna Oct. 9, 1832; served in the student legion in the revolution of 1848, and was twice wounded; came in 1849 to the U. S., and became a journalist, lawyer, and politician of Cincinnati; was U. S. minister to Ecuador 1861–65, and in the latter year became editor of the Cincinnati *Volksblatt*. Author of *Four Years among the Spanish Americans* (1868).

Has'sell's, tp. of Tuscaloosa co., Ala. Pop. 355.

Has'selt, town of Belgium, the capital of the province of Limbourg, on the Demer. It has large distilleries, salt-refineries, and manufactures of linen and lace. Pop. 10,448.

Hass'ler (FERDINAND AUGUSTUS), M. D., b. at Norfolk, Va., Mar. 6, 1844; took his medical degree at the University of Pennsylvania 1866; professor of materia medica in Lincoln University. One of the authors of the *Medical Register and Directory of the U. S.*; has published various papers upon natural science and on professional subjects.

Hassler (FERDINAND RUDOLPH), b. at Aarau, Switzerland, Oct. 6, 1770; was brought to notice in the U. S. by Albert Gallatin; professor of mathematics at West Point Military Academy 1807–10; was sent as scientific ambassador to Europe, with the salary of a foreign minister; was the first superintendent of the U. S. Coast Survey, which he conducted 1816–18 and 1832–43 (for an account of his work in this great enterprise, see art. COAST SURVEY); was for years chief of the bureau of weights and measures. D. at Philadelphia Nov. 20, 1843. Author of textbooks on mathematics; of a *System of the Universe*, in 2 vols.; and of many valuable scientific reports, including *Report to the U. S. Senate on Weights and Measures* (1832), and another to the secretary of the treasury on the same subject (1842).

Hassler Expedition. The U. S. Coast Survey having found it necessary to provide a new steamer for hydrographic purposes on the Pacific coast, the Hassler (so named from the first superintendent of the Coast Survey) was built in Philadelphia, and sent out by way of the Straits of Magellan. To render the voyage profitable to science, Prof. Peirce, the superintendent, offered to Prof. Agassiz the privilege of making the voyage in her with a limited number of assistants, which he gladly accepted. The steamer, an iron screw vessel of about 350 tons, was placed under the orders of Com. P. C. Johnson, U. S. N. Mr. L. F. Pourtalès of the Coast Survey was assigned to take charge of the dredging operations. The rest of the scientific corps consisted of Dr. F. Steindachner of Vienna, ichthyologist; Dr. Th. Hill of Cambridge, as botanist and photographer; Dr. White of Philadelphia, as chemist and photographer; Mr. J. H. Blake of Cambridge, as draughtsman and collector. Mrs. Agassiz accompanied her husband, as usual, in his travels. The steamer sailed from Boston Dec. 4, 1871, after considerable delay, which somewhat curtailed the time which would otherwise have been devoted to deep-sea dredging in the Atlantic. Therefore, only surface observations were made on the passage to St. Thomas. The next stopping-place was Barbadoes, where very rich dredgings were made in 100 to 120 fathoms. The rough sea caused by the trade-winds prevented any work being done from that port to Pernambuco, but along the coast of Brazil the dredge was used with success whenever the weather permitted. Rio Janeiro was reached Jan. 23, 1872, where three weeks were spent for various repairs to the vessel. Montevideo was next visited for coaling, but the ship was placed under quarantine; only a short visit to the mount was allowed, where Prof. Agassiz found unmistakable proofs of glacial action. The next halting-place was San Matias Bay, Patagonia, where the bluffs showed fine sections of the strata underlying the Patagonian plains. In the Straits of Magellan stoppages were made every night, and occasionally a day or two spent in interesting localities. Thus, at Possession Bay an excursion inland was made by some members of the party as far as Mount Aymon, which was found to be an extinct volcano, and the easternmost of a chain of similar ones extending in a westerly direction. Elizabeth and Magdalen islands, great breeding-places of birds; Sandy Point, a Chilian penal settlement, with a promising coal-mine; Glacier Bay, with a very interesting glacier reaching nearly to the sea-level; and Sholl Bay, were other stopping-places, where abundant collections were made and interesting observations on the former and present state of the glaciers recorded by Prof. Agassiz. The channels of internal navigation were followed through Smyth's Channel to the Gulf of Penas. On the coast of Chili, San Carlos, Lota, and Talcahuano were visited. The steamer went from the latter place to Juan Fernandez, while Prof. Agassiz went by land to Valparaiso. Some deep soundings were taken in the neighborhood of that island, but the dredging-rope having been injured by dampness in the hold, failed to give the results which were expected from it. Valparaiso, Caldera, Pisco, Callao, Payta, and the Galápagos Islands were next visited, and finally San Francisco was reached in Aug., 1872, after touching at Panama, Acapulco, Magdalena Bay, and San Diego. Some of the zoological results of the expedition have been published by Messrs. A. Agassiz, Lyman, and

Pourtalès, but the death of Prof. Agassiz has prevented the publication of his numerous observations, except in the preliminary form of letters to Prof. Peirce.

L. F. Pourtalès.

Hass'loch, town of Rhenish Bavaria, which carries on considerable coal mining and trade in grain. Pop. 4090.

Has'tings, town of England, in the county of Sussex, on the English Channel. Here William the Conqueror landed, and the decisive battle was fought in 1066 in the vicinity. The excellent harbor was ruined in the time of Elizabeth by a storm, and Hastings is now best known as an elegant and much frequented bathing-place. Pop. 29,289.

Hastings, county of Ontario, Canada, extending N. by W. from the Bay of Quinte, Lake Ontario. It contains many lakes and streams, and much fertile land. It has 3 ridings. Cap. Belleville. Pop. 48,664.

Hastings, post-v. of Peterborough and Northumberland cos., Ontario, Canada, on the river Trent, has a good water-power, and cotton, woollen, and flour mills.

Hastings, city and tp., cap. of Barry co., Mich., on the Thornapple River, 30 miles from its junction with Grand River and 32 miles S. E. of Grand Rapids. It has a national bank, a union school house that cost \$50,000, 2 newspapers, 4 churches, 33 stores, 2 hotels, 2 large flouring-mills, a large foundry, 2 sash, blind, and door manufactories, 3 saw-mills, and several smaller manufacturing establishments. Pop. of city, 1793; of tp. 2919.

Geo. M. Dewey, Ed. "Republican Banner."

Hastings, city, cap. of Dakota co., Minn., on the W. bank of the Mississippi River, opposite the mouth of St. Croix Lake, 20 miles below St. Paul. It is on the Milwaukee and St. Paul R. R., river division, and the Hastings and Dakota R. R. It is noted as a wheat and lumber market, having 4 large flouring-mills, 3 saw-mills, 9 grain-elevators, carriage-shops, furniture-factories, foundry, machine-shop, 9 churches, 2 national and 1 private bank, 2 weekly newspapers, 12 hotels, a public library, an academy for ladies, and a well-conducted public school. Pop. 3458. Irving Todd, Ed. "Hastings Gazette."

Hastings, city of Adams co., Neb., on the Burlington and Missouri River R. R. and the St. Joseph and Denver City R. R. It is incorporated as a city of the second class. The region about Hastings is well adapted to agriculture. Pop. about 700. It has 1 weekly newspaper.

A. L. Wigton, Ed. "Journal."

Hastings, tp. and post-v. of Oswego co., N. Y., on the Syracuse Northern R. R., 24 miles N. of Syracuse. The township is also traversed by the New York and Oswego Midland R. R., and contains 5 churches and several villages. Pop. 3058.

Hastings (Thomas), Mus. Dr., b. in Washington, Conn., in 1784; removed to Clinton, N. Y., with his father when twelve years of age; was editor of a religious journal of Utica, N. Y., 1824–32; became a musical instructor and composer of sacred music in New York City. Author of *Spiritual Songs* (1832), *Christian Psalmist* (1836), of several volumes of poems, hymns, etc., and compiler of many collections of church music. Many of his compositions are widely known, and have attained enduring popularity.

Hastings (Warren), LL.D., b. at Daylesford, Worcestershire, Dec. 6, 1732; was educated at Westminster, and went to Bengal in 1750; was taken prisoner by Surajah Dowlah 1756; served under Clive 1757; was resident at the court of Meer Jaffier 1757–61; became a member of the council at Calcutta 1761; returned to England in 1764, and expended the considerable fortune he had acquired for the relief of his poor relatives; returned in 1769 to India, where he had hitherto been a general favorite, but more remarkable for industry and studious habits than for ability; was second in the Madras council 1769; became president of the supreme council of Bengal 1772; assisted the nabob of Oude against the Rohillas 1773–74; was the first governor-general of India 1774–85; quarrelled with the councillors 1774; procured the execution of his enemy Nuncomar 1776, in which year the government attempted unsuccessfully to displace him; received notice in 1778 that his resignation was accepted, but disavowed the resignation and refused to give up the office; married as his second wife the divorced baroness Imhoff 1778, to whom he had for nine years been avowedly attached; sent an expedition against the French in 1778; fought a duel with Philip Francis 1780; accepted bribes from the rajah of Benares 1780; made Sir Elijah Impey judge of the court of appeal 1781; compelled the Madras government to give up the revenues of the Carnatic to the nabob 1783, in disobedience of the orders of the directors; made the conquest of Benares 1784, and concluded the treaty of Chunar; resigned and went to England 1785. Articles of impeachment for high crimes and misdemeanors were presented by Burke against Mr. Hastings in Feb., 1786. In his famous trial, which began Feb. 13, 1788, and ended Apr. 23, 1795, the ability and eloquence of Burke, Sheridan, and Fox failed to convict him, it having been conclusively shown that India had improved greatly under his rule, and that Hastings was extremely popular with the natives and with the majority of the Europeans of his government. Hastings' faults were those of the English system in India. Personally, he was a kindly man, who made warm friends everywhere. As a ruler he was one of the ablest India ever had; but being a man of positive character, he could not fail to make enemies, and there is no doubt that his quarrel with Francis in India made the latter his bitter opponent. Hastings expended his fortune in defending himself in the great trial, and was afterwards supported by a large yearly allowance from the East India Company. D. at Daylesford Aug. 22, 1818.

Hastings-upon-Hudson, post-v. of Greenburg tp., Westchester co., N. Y., on the Hudson River and the Hudson River R. R., 19 miles N. of New York. It has a sugar-refinery and other manufactures.

Hat. See Hat-Making, by C. G. Leland.

Hat'boro', post-v. of Montgomery co., Pa., 15 miles N. E. of Philadelphia, on the North Pennsylvania R. R. It has 3 educational institutions, a public library of 9009 vols. founded 1755, 2 churches, 1 bank, 2 hotels, 10 grist-mills, and 1 newspaper.

Dr. W. T. Robinson, Ed. "Public Spirit."

Hatch (Edward), b. in Maine; removed to Iowa, and became captain 2d Iowa Cavalry Sept., 1861, rising to be colonel of the regiment June, 1862, and in command at New Madrid, Island No. 10, and Corinth; commanded a brigade at Iuka, and subsequently a division of cavalry in Army of the Tennessee. Appointed brigadier-general of volunteers May 30, 1864, and commanded a cavalry division at the battles of Franklin and Nashville and the subsequent pursuit of Hood's army. Brevet brigadier and major-general for the last two battles. In July, 1866, was appointed colonel of the 9th U. S. Cavalry, which command he still holds (1875).

Hatch (Horace), M. D., b. at Trowbridge, Vt., 1788; graduated at Dartmouth College 1815; practised medicine at Norwich, Vt., until 1837, and for twenty years thereafter practised at Burlington, Vt.; was employed in the U. S. treasury department, Washington, D. C., 1861–65, and then removed to New York; was distinguished for benevolent and generous disposition, and occupied a high place as a practitioner. D. in New York Oct. 28, 1873.

Hatch (John P.), b. in New York in 1822; graduated from the U. S. Military Academy, and appointed brevet second lieutenant of infantry July 1, 1845, rising through successive grades to be lieutenant-colonel of cavalry, 1873; in the Mexican war he took part in various engagements from Palo Alto to the final capture of the city of Mexico, and brevetted first lieutenant and captain for gallantry in battle; subsequently in garrison and on frontier duty; engaged on frequent expeditions against hostile Indians up to 1861. In the civil war he was appointed brigadier-general of volunteers Sept., 1861, and commanded a cavalry brigade in the Shenandoah Valley and Northern Virginia; engaged at second battle of Bull Run and Chantilly; at the battle of South Mountain Sept. 14, 1862, commanded a division and was severely wounded; subsequently commanded various districts in the South; brevetted from major to major-general for gallant services; at present (1875) serving with his regiment (4th cavalry) on the S. W. frontier.

G. C. Simmons.

Hatch'ie River rises in the N. E. of Mississippi, flows N. into Tennessee, and then W. N. W. to the Mississippi River. Its mouth is 25 miles N. of Memphis. Small steamboats can run for half the year as far up as Bolivar, Tenn., 150 miles from its mouth. Its valley is very fertile. Its lower portion is often called the *Big Hatchie.*

Hatch'ing, the development of the young of an oviparous animal from the egg. In a narrower sense the term is applied to this development as a result of the process of incubation, or the sitting of the mother bird upon her eggs. A few fishes and reptiles perform a kind of incubation, but they probably do this only to guard their eggs. A few birds, like the ostrich, leave the eggs in the hot sand during the heat of the day, the heat of the mother's body not being necessary. Other birds, like the Megapodidæ, place their eggs in heaps of rotting organic matter, the heat of which hatches out the young. In Egypt and China millions of eggs are hatched by artificial heat, and a machine called Eccaleobion (which see) has been employed for the same purpose.

Hatch'ment, or **Atchievement,** a funeral tablet set-

ting forth the arms, and sometimes the descent, of a deceased person. The construction of the hatchment is based upon nice heraldic rules, by a knowledge of which the observer can tell whether the deceased was male or female; married, single, or widowed; what was his or her rank; whether heirs survive; if a wife, whether she were an heiress or not, etc. In different countries there are varying rules for the decoration of hatchments, every circumstance of which is significant of some fact with regard to the deceased. It is very commonly placed upon the house-front for a season. (See HERALDRY, by REV. B. R. BETTS, A. M.)

Hat'field, tp. and post-v. of Hampshire co., Mass., on the W. bank of the Connecticut River, and on the Connecticut River R. R., 5 miles N. of Northampton. Hatfield village is one of the most thriving and beautiful places in the State. The greater part of the soil is very fertile, producing fine tobacco, broom-corn, grain, and hay. Hatfield has considerable manufactures of lumber, etc., and is the seat of an academy. It was during colonial times much exposed to Indian attacks, and spirited fights occurred here May 30 and Oct. 19, 1675. On Sept. 19, 1677, the Indians made a bloody assault upon the settlement. Pop. 1594.

Hatfield, tp. of Montgomery co., Pa. Pop. 1512.

Hatfield (CHESTER M.), U. S. N., b. Feb. 21, 1837, in Massachusetts; graduated at the Naval Academy in 1856; became a master in 1859, a lieutenant in 1860, a lieutenant-commander in 1862, a commander in 1870; served as executive officer of the Owasco, one of the vessels of Porter's mortar flotilla, during the bombardment of Forts Jackson and St. Philip in Apr., 1862, and is thus spoken of in the report of his commanding officer: "Lieut. Chester Hatfield, in action, and in the very heavy duties which have devolved upon him for weeks past, has proved himself a brave and capable officer." D. Dec. 15, 1879. FOXHALL A. PARKER.

Hatfield (EDWIN FRANCIS), D.D., b. in Elizabethtown, N. J., Jan. 9, 1807; graduated at Middlebury College, Vt., in 1829; spent two years (1829–31) in Andover Theological Seminary; was ordained by the third Presbytery of New York May 14, 1832; was pastor of the Second Presbyterian church of St. Louis, Mo., 1832–35; of the Seventh Presbyterian church of New York City 1835–56; and of the North Presbyterian church 1856–63, when he was compelled by loss of health to give up the pastoral work. After resting a year he became special agent of the Union Theological Seminary in New York 1864–66, and again 1870–73, raising a large sum of money for its endowment. Since 1846 he has been stated clerk of the General Assembly. In 1850 he received the degree of D.D. from Marietta College, O. While pastor of the Seventh church in New York 1556 persons were admitted to the fellowship of the church on profession of their faith. Dr. Hatfield has also done a large amount of literary work. He has published *Universalism as it Is* (1841), *Memoir of Elihu W. Baldwin, D.D.* (1843), *St. Helena and the Cape of Good Hope* (1852), *The History of Elizabeth, N. J.* (1868), *The Church Hymn-Book, with Tunes* (1872), *The Chapel Hymn-Book* (1873). He also edited *The New York Observer Year-Book* for 1871, 1872, and 1873. R. D. HITCHCOCK.

Hat-Making. The hats in general use at the present day among all civilized people are of two kinds only—those made entirely of *felt*, and the so-called *covered* hats, of silk or cotton, which are coated with a long nap or plush resembling the fur which it was originally intended to imitate. Felt, which was known to the Romans, is formed on the principle that hairs of any kind when subjected to constant motion and pressure have a tendency to closely fasten together until a compact mass is formed. This is due to the fact that every hair, although it may appear smooth under the strongest microscope, is made up of *lamellæ* or extremely fine plates or scales. If a hair of any kind be taken between the thumb and finger, and the two are gently pressed and rubbed together, the larger or root-end of the hair will always work away, until it escapes, owing to the gradually diminishing size of the protecting lamellæ. If two or more hairs of a single kind are worked or beaten together, the lamellæ will of course, acting like barbs, cause them to adhere closely. St. Clement, whose day occurs on the 23d of November, is the patron saint of hat-makers, because it is narrated that he accidentally discovered felt. Having gone on a pilgrimage, he put some wool between the soles of his feet and his sandals, to make his journey easier. The wool in time was converted into felt. Felt was really known long before it was rediscovered by St. Clement, but the legend illustrates the simple manner in which this material may be made; as it indeed is, even by cows when they swallow their own hair licked from their bodies, forming the well-known *ægagropila*, or felt balls, so often found in their stomachs. Ordinary felt hats are made either of wool or wool and hair, thickened with size. A better quality are the so-called *plated* hats (or *plates*), which are covered with a coating of finer material; and superior to these are the *short naps*, in which different qualities of fur—*e. g.* of rabbits or hares, muskrat, and nutria—are mixed in the wool. This kind of hat is invariably waterproof and stiffened. The old-fashioned apparatus for making felt hats by hand embraced the *bow*, a stick formerly of ash, but sometimes of other wood, with a very strong catgut cord; a *hurdle*, or a flat surface of wood or a table with three enclosed sides to keep in the light material; a *basket*, of straight wicker rods from 20 to 25 inches in length; and the *battery*, which consists of a *kettle* and the *plank*, half of lead and half of mahogany. The different kinds of fur and wool being combined, the first step by this process is to intimately mix them; and this is effected by *bowing*, or by causing the bowstring "to strike and play upon the fur, so as to scatter the fibres in all directions," while the dust and lumps in the fur fall through the *grids*, or holes between the woodwork or wires of the hurdle. The object of the workman now is to mould this material or felt as if it were putty, first into one piece which is to make half a *cap*, then make another, and unite the two. The fur, driven about by the bowstring, forms a lump, enough for one side or half of the hat. This is shaped partly by the bow and partly with the *basket*, by a process called *gathering*, into a conical form called a *bat*. With the aid of a piece of leather called a *hardening skin* and a wet cloth this is worked more and more into *felt*. Another conically-shaped piece, precisely similar, is now prepared. These are made into shape by folding and joining the edges over a stiff piece of triangular or conically-folded paper, which serves as a guide. The first bat is laid upon a second, so that the joining of the one rests upon the other, and the two by a process of wetting and manipulation are worked into one between folds of linen cloth. After being folded it is taken to the *battery*, where it is immersed in a liquor of sulphuric acid diluted with water, and worked with a roller or with the hands during four hours. If thin places are detected in the body of the hat, they are supplied with fresh felt, while lumps are picked out. If beaver is used, it is applied at the end, and in this case beer is added to the liquor. With this the hat is again brushed and worked with a roller till it is firm and no longer sticky. When dry a waterproofing varnish is applied, more to the inside than the outer surface, while the brim is specially thickened. If the hat is to be covered or napped, a coat of beaver or other fur is laid upon it, and patted on with a brush; moistened with the hot liquor until it gets incorporated, the *cut* ends of the hairs towards their roots being those which spontaneously fasten themselves into the felt. These ends are firmly worked in by wetting the hat with the liquor and squeezing it in a haircloth. *Napping*, it should be observed, depends entirely upon the curious tendency of the *cut* ends, and not the *points* of hairs, to root themselves into the felt. This working the beaver in is called *rolling off* and *ruffing*, or roughing. A brim is prepared and napped by the same process, and united to the whole. In this rough shape the hat is called a *hood* (Ger. *Hut*—*i. e.* "hat"). It is now cut to the proper size, and the crown is shaped by rewetting and working on a block, the brim being for the present neglected. Great care is taken to reduce the conical top to a flat surface. A *suit* or six dozen hats are now put, on *blocks*, into the dye-kettle, which contains a mixture of copperas and verdigris. They are alternately steeped in this and dried, and then washed clean. The nap is now raised, or caused to rise, by being carefully combed with a card, and further improved with pumice-stone and soft rubbing. The hat receives its final shape by being steamed and pressed on a block or mould with hot irons. By means of a knife fixed in a gauge which presses against the crown the brim is cut so as to correspond to the latter. The brim, in order to turn it, is cut through the stiff part, leaving the outer fur untouched. Many variations are made both as regards materials and manipulation, especially for silk hats, but the processes here described, although they have been generally superseded, especially in America, by machinery, set forth the principles of hat-making as usually practised till within a few years. At present the hat-maker generally obtains the bodies of the hats of some large manufacturer, and shapes and finishes them to suit his customers. By machinery the processes of mixing and cleaning the fur is effected with much greater rapidity than by the old method. The fur, being passed into a picking machine, is tossed and separated on revolving teeth, which, acting with great rapidity, cause a current of air which aids in agitating the material. It is then carried on an endless band to another similar machine, where it undergoes the same process, and is now considered as *mixed*, the different kinds of fur, wool, or cotton being thoroughly amalgamated. Lumps, long hairs, and other extraneous matters are, however, still to be removed, and this is effected by the process of *blowing*. Being passed upon rollers, it is now conveyed to a

cylindrical picker which revolves with incredible rapidity, retaining only the finest hairs and rejecting all impurities and coarse matter. This process is repeated until the fur is perfectly cleaned and reduced to a proper fineness. The felt from which the body is to be shaped is now formed by a very simple and ingenious process. A cone of thin plate copper, perforated with so many holes that it resembles wire gauze, turns slowly around, while within it a fan which revolves with great rapidity exhausts the air which is drawn into it through the perforations. The fur having been fed into a cylindrical case, passes through an opening or slit the exact height of the revolving cone, and about one inch wide at the top, and three at the bottom, in order that the lower part, or brim, may receive more stuff. This is of course *sucked* towards, and upon, the revolving copper cone. The *cap* is thus made of felt almost immediately, great care being, however, taken to remove any lumps or superfluous felt. The cone is now removed, the cap is wrapped up in a wet felt or cloth, and covered with a brass case and set in hot water. It is then *sized* and made up. By machinery 100 hats are made in the time which was formerly taken for one, and the price has accordingly been much reduced, though, as it would appear, not in the retail trade in proportion to the saving which has been effected for the manufacturer.

Silk hats of cylindrical shape are made by finishing the body with various applications of shellac, glue, and seedlac. A covering of fine silk plush, the best of which comes from Paris, carefully cut and sewn, is exactly fitted to the body, and the whole is pressed with a heated iron, which by softening the varnish causes the plush to adhere. Those from the best makers in Paris are very light and elegant in shape, but are not durable; the London-made are very strong, as the climate demands, and last well. The American hats combine lightness and durability to a remarkable extent, but are expensive in due proportion to their excellence. Of late years simple felt hats have again become, if not fashionable, at least very general for ordinary wear in all countries. The *chapeau mécanique*, invented about thirty-five years ago by a Paris hat maker named Gibus, is made of thin cloth or strong crape upon a body consisting simply of a wire coil, and may be pressed quite flat and retained in this shape by means of a spring. The etiquette which demands that a hat shall be carried in crowded assemblies has kept this singular combination of machinery and head-covering in fashion. In England many hats are made of such light materials as felt, cork, and white linen for India.

Straw hats were known to the Romans and probably to many wild races since the earliest times. The most elegant have always been made in Italy; those of Leghorn, being the best, have given the name to all from the whole kingdom. The single straws for this manufacture are split by a fine iron comb, steeped in water, braided, and flattened between rollers. The plait is then sewn into shape on a block. Coarse hats made of whole straw are often worn. Very pretty hats for both men and women are made, especially in the Southern States, of the inner husk of the maize. Palm-leaf hats of the split leaf of the date and other palms are imported from China and Manila, and extensively made by machinery in the U. S. The *jipi japa*, otherwise known as the Panama, is, however, the best of all these hats woven from vegetable fibres. One of the best quality costs from $50 to even $100. A coarse imitation of these South American hats, from the China Straits, is sold in London as Panama. The writer has seen a plain cigar-case, made from the finest quality of Panama reed, the cost of which was £7. Hats for sailors, cabmen, and others much exposed to the weather are made of oiled and glazed cloth or glazed leather.

Hat-making in France is at present principally confined to Anduze, Lyons, and Paris. Few persons are aware of the extent to which old hats are remade for the colonies, and in Paris it is common for street-dealers to cry, "A new hat for four francs and your old one." In the old days of beaver hats, when La Rochelle was at the head of this industry in France, it was shown (1692) by a M. de Guénégand that beaver skins passed from Canada to La Rochelle, and thence to Russia, where much of the fur was removed. Passing again to La Rochelle, the skins became hats of a new pattern, and when worn out in France were remade for Spain, where, hardened, gummed, and without fur—as the Spanish fashion required—they were again renewed and worn out. They then went to Portugal, where the same process of remaking and exhausting was again experienced, and then passed to Brazil, as of the latest style. Full of holes, the hats at last were forwarded to Guinea, and thence passed along the coast until, as thorough veterans, they were thrown away in Sofula and Mozambique. The last that is seen of a London hat at the present day is when, after sundry transitions, it passes to Ireland, and is finally thrown into New York harbor by the newly-arrived emigrant at the end of his voyage.

CHARLES G. LELAND.

Hato'ka, tp. of Nottoway co., Va. Pop. [illegible].

Hatras', town of the N. W. Provinces, British India, 90 miles S. E. of Delhi. It has a fort and a large cotton trade. Pop. 2[illegible],000.

Hat'temists, the followers of one Pontianus van Hattem, a Dutch minister of the eighteenth century who was excommunicated for Spinozism. They were fatalists and Antinomians, and taught that the whole duty of the elect was to be patient and to maintain tranquillity of mind. They denied the existence of moral evil and the corruption of the nature of man.

Hat'teras, tp. of Dare co., N. C. Pop. 673. (See CAPE HATTERAS.)

Hatz'feld, town of Hungary, in the Temesvar banat, has 6889 inhabitants, mostly engaged in raising wheat and breeding horses.

Hau'berk, a coat of mail covering the body, and often the neck, arms, and even the hands, and frequently covering also the head, except the face. It was of ring-mail or of true chain-mail.

Hauch (JOHAN CARSTEN) was b. at Frederikshald, Norway, May 12, 1790, and studied at the University of Copenhagen, where in 1821 he took the degree of Ph. D.; 1821–27 travelled through Germany, France, and Italy, studying zoology and botany; 1827–46 lectured on physics at the Academy of Sorö; 1846–48 held the professorship of Scandinavian literature and language at the University of Kiel, but on the outbreak of the rebellion he returned to Denmark, and became (1851) Oehlenshlager's successor as professor of æsthetics at the University of Copenhagen. He d. Mar. 4, 1872. His lyrical poems are comparatively few, and not very prominent, though some of his ballads and elegies are beautiful. Of his dramas several have been represented in the Scandinavian theatres and in Germany with great success, such as *The Two Sisters from Kinnacliff* (1849); *Honor Lost and Regained* (1851); *The Youth of Tycho Brahe* (1851); *The King's Favorite* (1858), etc.; but the largest and most interesting of his dramatic works—his tragedies *Tiberius* (18[illegible]); *Svend Grathe* (1841); *Marsk Stig* (1850), and others—were not intended, and are hardly fit, for theatrical representation. He attracted most attention, however, by his excellent novels, *Wilhelm Zabern* (1834); *The Alchymist* (1836); *A Polish Family* (1839); *The Castle on the Rhine* (1845); *Robert Fulton* (18[illegible]); *Charles de la Bussière* (1860), etc. As a poet, Hauch was a disciple of Oehlenshlager, though with individual character and independent development. His genius was of slow growth and inclined to mysticism. But he possessed considerable power of reflection, and has drawn many very intricate characters with great precision and clearness, and depicted many very complex social states with great vividness and impressiveness. In his old age his tendency to mysticism turned into a sublime pathos, which sometimes became monotonous, but which often was allied with a crushing satire.

CLEMENS PETERSEN.

Hauff (WILHELM), b. in Stuttgart, Germany, Nov. 29, 1802; studied divinity at Tübingen 1820–24; became editor of *Das Morgenblatt* (Stuttgart, 1827), and d. there Nov. 18, 1827. He was a writer of romances and poems in the manner of Hoffmann, whose inferior he was in imaginative power, although his style is more finished. Among his works are *Lichtenstein* (1826); *Die Bettlerin vom Pont des Arts*; *Das Bild des Kaisers*; *Märchen* (1832); *Mittheilungen aus den Memoiren des Satan* (1827); *Der Mann im Monde*, a satire on Clauren (1827); *Phantasien im Bremer Rathskeller* (1827), etc.

Hau'gians, the followers of Hans Nielsen Hauge (1771–1824), a reformer, b. in Norway. He opposed the Creeds, advocated the idea that all should share in the work of the ministry, believing that ordination and clerical education are not necessary, and laid great stress upon faith and upon strict church discipline. His labors led to a great religious revival, but he was imprisoned, heavily fined, and compelled to cease from his labors. At present the Haugeans are a large and influential evangelical party in the Norwegian Church, but in Denmark Hauge's preaching was without success.

Haupt (HERMAN), A. M., b. in Philadelphia Mar. 26, 1817; graduated at the U. S. Military Academy, and entered the army as brevet second lieutenant of infantry July 1, 1835. In September following he resigned from the army and adopted the profession of civil engineering. After serving as assistant engineer on railroads in Pennsylvania, he was in 1844 appointed professor of civil engineering and mathematics in Pennsylvania College, which position he held till 1847, when he was appointed principal assistant engineer of the Pennsylvania Railroad. From 1849 to 18[illegible]

he was general superintendent, and subsequently became chief engineer and director of that company. For many years he was engaged upon the Hoosac Tunnel, Mass., as chief engineer and contractor. During the civil war in America he was aide to Gen. McDowell, with the rank of colonel, and chief of bureau of U. S. military railroads in charge of construction and operation. In Sept., 1862, he was promoted to be brigadier-general U. S. volunteers, which appointment he declined. He is at present (1875) general manager of the Piedmont Air-Line Railway from Richmond, Va., to Atlanta, Ga.

Haupt (MORITZ), a distinguished philologist, b. in Zittau July 27, 1808; pursued his university course at Leipsic 1826–30, under Hermann; privat-docent 1837; appointed professor extraordinary 1838, and professor of the German language and literature 1843; in consequence of his participation in the political movements of 1848–49 was removed; called, however, in 1853 to take Lachmann's place in the University of Berlin as professor of classical literature; in 1861 secretary of the Academy of Sciences. Like his predecessor, Lachmann, he devoted himself to both classical philology and the Old German. He edited with Hoffmann *Altdeutsche Blätter* (1836–40, 2 vols.); founded in 1841 *Zeitschrift für deutsches Alterthum* (Leipsic); published a new edition of Lachmann's *Nibelungen* (Berlin, 1852); in same year poems of *Walther von der Vogelweide*; *Armen Heinrich* (1842), and other old German works; his classical publications were editions of *Catullus Tibullus* and *Propertius*, Ovid's *Halieutica* and *Metamorphoses*, the *Cynegetica* of Gratius and Nemesianus Olympius; also from Hermann's unpublished remains, *Bion and Moschus* (1849), and *Æschyli Tragœdiæ cum Commentariis* (2 vols., Leipsic, 1852; 2d ed. 1859). He contributed largely to the principal critical journals. D. in 1874. H. DRISLER.

Hauran [Heb. *Hauran*, from *hur*, "cave"], the present Arabic, as well as English name of a district in Syria S. of Damascus and E. of the Jordan, mentioned by Ezekiel (xlvii. 16, 18), and nowhere else in the Old Testament, as the appointed N. E. boundary of the Holy Land after the captivity in Babylon. Its dimensions are not indicated. In the Greek and Roman period, Hauran (Gr. Ἀυρανῖτις) was one of the four provinces of BASHAN (which see). The Arabian geographers make it embrace the greater part of ancient Bashan; and so do some modern travellers, who say the natives regard it as consisting of three parts—*en-Nŭkrah*, *el Lejah*, and *Jebel Hauran*. This whole region is volcanic, very fertile, and contains hundreds of deserted or ruined towns, with many Greek inscriptions, referred mostly to the Roman period. Druses, Bedouin, and a few Christians now inhabit the region. Others restrict the application of the name to the more level part of the district (the ancient *Auranitis*), which has a gently undulating surface and slopes strongly westward. It yields great crops of grain. (See ROBINSON, PORTER, and WETZSTEIN.)
R. D. HITCHCOCK.

Hauréau (JEAN BARTHÉLEMY), b. in Paris Nov. 9, 1812; began as a journalist in the provinces, and was sent by the department of La Sarthe as representative to the constituent assembly of 1848. Under the empire he resigned his functions of keeper of the manuscripts at the National Library, but was chosen librarian for the lawyers' corporation of Paris. He was elected member of the Academy of Inscriptions and Belles-Lettres. Hauréau published many works of erudition, the elements of which he nearly monopolized on account of his being the librarian of the National and other large libraries of France, and contributed largely, in Louis Philippe's reign, to *Le Droit*, a judicial paper, to *Le Journal du Peuple*, *Le National*, and other opposition papers. He has written a *History of Poland*, *Criticism of Palasgus's Metaphysical Hypothesis*, the 14th,. 15th, and 16th vols. of the great compilation *Gallia Christiana*, *Francis I. and his Court*, *Charlemagne and his Court*, etc. FÉLIX AUCAIGNE.

Hau'ser (KASPAR), b. Oct. 7, 1812, at some unknown place, and kept for sixteen years in some other place in a dark cellar, fed upon bread and water, and learning nothing, not even to walk. On May 26, 1828, he was found in the streets of Nuremberg. His helplessness—he could at that time walk a little, speak a little, and write his name—excited sympathy, the more so as he was a fine-looking youth; and the mystery which surrounded him made him and his history the subject of intense curiosity. He was placed under good circumstances, and his education began, but different attempts to assassinate him were made in a most mysterious manner, and at last he was actually stabbed in the royal garden at Anspach, and d. Dec. 17, 1833. Very different views have been propounded in explanation of this story. Julius Meyer (*Authentische Mittheilungen über Kaspar Hauser*, 1872) considers him an impostor. Prof. Daumer (*Kaspar Hauser, sein Wesen, seine Unschuld, seine Erduldungen und sein Ursprung*, 1873) considers him a son of the grand duke Charles of Baden and his wife Stephanie, pushed aside in some criminal way in order to secure the succession to the children of the grand duke Charles Frederick and the countess of Hochberg. This part of the story has comparatively little interest, however, but his education presented many curious psychological observations, which have been much and variously expounded by modern philosophers.

Haussmann (Baron GEORGES EUGÈNE), b. at Paris Mar. 27, 1809; educated at Paris; studied law, and became an advocate; was sub-prefect of various departments, and prefect under the presidency of Louis Napoleon. In 1853 the latter appointed him prefect of the Seine, and under his administration the various beautiful and costly improvements were conducted. Much opposition was made to his enormous expenditures, and charges of mismanagement were freely made against him. In 1870 he was relieved by the Ollivier administration. He was made officer of the Legion of Honor 1856, and in 1862 received the grand cross.

Hautboy. See OBOE.

Haute-Garonne, department of France, on the frontiers of Spain. Area, 2529 square miles. Pop. 479,362. The southern part is high, occupied by the Pyrenees, and rich in minerals; lead, copper, iron, and zinc are mined; excellent marble is quarried. In the northern part much wine and corn are raised. The transit-trade with Spain is very considerable. Cap. Toulouse.

Haute-Loire, department of Central France, on the upper part of the Loire. Area, 1900 square miles. Pop. 308,732. It is mountainous, mostly occupied by the Margerides, which connect the Cevennes with the mountains of Auvergne, and whose lofty peaks are covered with snow half the year. Wheat and wine are raised, cattle and silkworms reared, and coal mined. Cap. Le Puy.

Haute-Marne, department of North-eastern France, on the upper part of the Marne. Area, 2385 square miles. Pop. 251,196. It is hilly and mountainous, rich in vines and forests. Its chief product is iron; numerous mines and furnaces are worked throughout the whole department. Cap. Chaumont.

Haute-Saône, department of North-eastern France, on the upper part of the Saône. Area, 2028 square miles. Pop. 303,088. It is mountainous, traversed by numerous branches of the Vosges Mountains, which here are covered with splendid forests, and are rich in coal and iron. Besides agriculture and the timber-trade, a considerable industry is carried on in mining and in the manufacture of glass and china. Cap. Vésoul.

Haute-Savoie, department of France, separated in part from Switzerland by the Lake of Geneva, which extends along the N. border. It is also bounded E. by Switzerland. Area, 1667 square miles. It contains Mont Blanc, and its surface is elevated and not very productive. Forest products, cattle, wool, and cheese are the leading articles exported. Cap. Annecy. Pop. 273,027.

Hautes-Alpes, department of South-eastern France. Area, 2114 square miles. Pop. 118,898. It is entirely covered by the Alps, whose lofty summit, Des Écrines, is situated here, and rises 13,442 feet above the level of the sea. Numerous sheep are reared, and some mining industry is carried on. Cap. Gap.

Hautes-Pyrénées, department of France, on the frontier of Spain. Area, 1730 square miles. Pop. 235,156. Branches of the Pyrenees traverse it, and form beautiful valleys watered by the Adour, the Arros, and the Gave-de-Pau. The mineral springs, especially those of Bagnères, Barèges, and Cauterets, are celebrated and much frequented. The well-known woollen stuff called barège is made here. Cap. Tarbes.

Haute-Vienne, department of North-western France. Area, 2118 square miles. Pop. 323,447. It is covered with low mountains, the highest point of which is Le Puy de Vieux, 3200 feet high, and which are rich in minerals—copper, lead, tin, and porcelain clay. The soil is not very fertile. Horses, cattle, and sheep are reared in great numbers. Cap. Limoges.

Hautpoul, the name of an ancient family of Languedoc, which since the eighth century has produced many eminent men. JEAN JOSEPH D'HAUTPOUL SALETTE (1754–1807) was a brilliant general of cavalry, who fell at Eylau at the head of the cuirassiers.—MARIE CONSTANT FIDÈLE HENRI AMAND, MARQUIS D'HAUTPOUL (1780–1854), a distinguished officer of Napoleon's horse-artillery and cavalry; refused to serve the emperor during the Hundred Days; was made a field-marshal in 1819, and governor to the young duke of Bordeaux.—ALPHONSE HENRI, MARQUIS

D', brother of the preceding, b. at Versailles Jan. 4, 1789; entered the military school of Fontainebleau 1805; officer of the 59th infantry 1806; was badly wounded at Arapiles 1812; colonel 1815; brevet field marshal 1829; minister of war 1830; lieutenant general 1841; peer of France 1846; commander-in-chief of the army at Rome and minister to the Holy See, and, later, minister of war 1849; governor-general of Algeria 1850; senator 1852; became marquis in 1854. D. July 28, 1865.

Hau'vers, tp. of Frederick co., Md. Pop. 1381.

Haüy (René Just), Abbé, b. of humble parents at St. Just, Picardy, Feb. 28, 1743; became a church singer at Paris, and a teacher in the College of Navarre 1764; laid before the Academy of Sciences in 1781 his new and brilliant discovery of the geometrical law of crystallization; was chosen to the Academy 1783; took orders in the Church; was imprisoned in 1792, and escaped death at the hands of the revolutionists through the exertions of Geoffroy St.-Hilaire, his pupil; became keeper of the cabinet in the School of Mines 1794, a member of the Institute 1795, professor of mineralogy in the Museum of Natural History in 1802, officer of the Legion of Honor in 1815. D. at Paris June 3, 1822. His principal works are an *Exposition de la théorie de l'électricité et du magnétisme* (1787); *Traité de minéralogie* (1801); *Traité élémentaire de physique* (1803); *Traité de crystallographie* (1822).

Haüy (Valentin), Abbé, a brother of the mineralogist Haüy, b. at St. Just Nov. 13, 1745. Becoming acquainted with Mlle. Paradis, a blind pianist, he resolved to devote his time to the instruction of the blind, and invented the art of printing with raised letters for the blind. The schools of this philanthropist were everywhere failures, owing to his lack of judgment, yet he is universally recognized as the "apostle of the blind." Though a cleric of the Roman Catholic Church, he was twice married, the second time to an ignorant market-woman. He was also for a time, it appears, a sub-priest of the Theophilanthropists. He had, says Dr. Howe, "genius, generosity, and zeal, but lacked common sense." D. at Paris Mar. 19, 1822. Was author of *Essai sur l'éducation des aveugles* (1786) and *Mémoire historique sur les télégraphes* (1810).

Hava'na (Sp. *La Habana*), cap. of the island of Cuba, the most important city of the West Indies, and one of the principal commercial marts of the world, is situated on the northern shore of the island, on an inlet of the Gulf of Mexico, in lat. 23° 8' N., lon. 82° 22' W. Its harbor is one of the finest in the world, entered through a narrow, strongly fortified channel, three-eighths of a mile long, and then opening into a large basin, capable of accommodating 1000 vessels of any size, lined with commodious, mostly covered wharves, and provided with a capacious dry dock. In the older part of the city the streets are generally very narrow, and not remarkable for cleanliness, but the more modern portion contains many spacious and beautiful avenues, with a broad macadamized drive in the centre and lined with palm trees. The architecture of the city is mostly that of Southern Spain—the houses low, one or two stories, massive, with flat roofs, the large windows provided with iron shutters and wooden blinds, but not glazed, and the walls gayly painted with red, blue, and yellow. The most prominent among the public buildings are—the opera-house, one of the largest in the world; the cathedral, built in 1724, and containing the ashes of Christopher Columbus, transferred hither from St. Domingo in 1796; the palace of the governor-general, with apartments for the different government officers, etc. None of these buildings, however, are very remarkable, but with respect to its public parks and promenades, Havana perhaps surpasses all other cities in the world. The Plaza de Armas, in front of the governor's palace; the Alameda de Paula, along the bay; the Parque de Isabel; the Paseo de Tacon, a magnificent drive with double rows of trees; and other promenades traverse and surround the city, charming the visitor not less with their liveliness and gayety than with their trees, flowers, fountains, and statues. The city is well provided with water from the Chorrera by an aqueduct about 7 miles long, and has about 50 public fountains. It has a university, an excellent botanical garden, many scientific, educational, and benevolent institutions, and is the seat of the government of Cuba and of a Roman Catholic bishop. Its manufactures are not important, with the exception of those of tobacco; in 1872 the exportation of this one article amounted to 18,210,800 pounds of leaf tobacco, 229,087,515 cigars, and 19,341,707 packages of cigarettes. But its commerce is very extensive. Besides tobacco, one of the principal items of exportation is sugar; in 1872 were exported 252,271 tons of sugar, 2,606,125 gallons of rum, 12,000 gallons of molasses; also, honey, wax, oranges, pineapples, preserved fruits, etc. are largely exported. Havana communicates by weekly lines of steamers with Spain, France, England, and the U. S.; by telegraph with Key West, Kingston, and Aspinwall; and by rail with all the most important points of the island. Pop. 205,676—138,895 white, 66,781 colored, 29,013 of the latter being slaves.

Havana, tp. of Hale co., Ala. Pop. 1440.

Havana, post-v. and tp., cap. of Mason co., Ill., on the E. bank of the Illinois River, opposite the mouth of Spoon River, and on the Peoria Pekin and Jacksonville, the Indianapolis Bloomington and Western, and the Springfield and North-western R. Rs. It has a public park, 4 churches, 2 newspapers, 8 dry-goods and 7 grocery stores, 1 plough and wagon factory, 3 hotels, and 1 bank. A toll wagon-bridge spans the Illinois River, and a railroad bridge is in course of construction. Pop. of v. 1785; of tp. 2953. S. Wheadon, Ed. "Democratic Clarion."

Havana, post-v. of Schuyler co., N. Y., is beautifully situated 3 miles from the head of Seneca Lake, 18 miles from Elmira, on the Northern Central R. R. and the Chemung Canal. It has 1 national and 1 State bank, 2 newspapers, 3 foundries and machine-shops, 2 flouring mills, 5 churches, 2 hotels, 2 woollen-mills, 2 plaster-mills, 1 pottery, a sash and blind factory, and the usual number of dry-goods and grocery stores. It is in close proximity to Havana Glen, and about 2½ miles from Watkins Glen. Pop. 1273. A. G. Ball, Ed. "Havana Journal."

Havan'na, tp. of Steele co., Minn. Pop. 636.

Havelock (Hargrave P. O.), a v., cap. of Pontiac co., Quebec, Canada, 8 miles from the river Ottawa, and 70 miles W. N. W. of Ottawa. It has manufactures of lumber, sash, doors, etc. Pop. about 200.

Havelock (Sir Henry), Bart., K. C. B., b. at Bishop-Wearmouth, England, Apr. 5, 1795; studied at the Charterhouse, and read law in the Middle Temple and under Chitty; entered the army in 1815; went to India in 1823; met with a great change in his religious views on the voyage, after which he joined to his military duties the religious instruction of the men under him; became a preacher of the Baptist denomination; served with distinction in Burmah 1824–26, in Afghanistan 1839 *seq.*; became adjutant-general for the queen's troops in India 1851; served in Persia 1856–57; became a brigadier 1857; gained over Nana Sahib the brilliant victories of Cawnpore, Bithoor, etc.; relieved and reinforced Lucknow Sept. 25, 1857; was made K. C. B. and baronet, the patent for the latter title being sealed the day after his death, but the title was confirmed to his eldest son. D. at Alum Bagh Nov. 25, 1857.

Hav'emeyer (William F.), b. in New York City Feb. 12, 1804, the son of a German immigrant; graduated at Columbia College 1823; was successfully engaged as a sugar refiner 1828–42; presidential elector 1844; was chosen mayor of New York in 1845, and again in 1848; was the first president of the commissioners of emigration 1846–47, an office which with that of mayor he filled with great acceptance; president of the Bank of North America 1851–61; was again elected mayor by the Reform party in 1872, and d. Nov. 30, 1874, before the close of his official term of service. Mr. Havemeyer was a man of the highest personal integrity.

Ha'ven (Alice Bradley), b. in Hudson, N. Y., Sept. 13, 1828. Her name at first was Emily Bradley. While at school she sent many pleasing sketches signed "Alice G. Lee" to the *Saturday Gazette* of Philadelphia, to whose editor, Joseph C. Neal, she was married in 1846, assuming at his request the name of Alice. After his death (in 1847) she conducted the *Gazette*. In 1853 she was married to a Mr. Haven. She published numerous sketches, tales, and poems, mostly designed for the young, under the name of "Cousin Alice." These were highly popular and of admirable moral tone. She d. at Mamaroneck, N. Y., Aug. 23, 1863. (See *Cousin Alice, a Memoir of Alice B. Haven*, 1865.)

Haven (Erastus Otis), D. D., LL.D., b. at Boston, Mass., Nov. 1, 1820; graduated at Wesleyan University 1842; was for some years an instructor at Sudbury, Mass., and principal (1846–48) of the Amenia Seminary, N. Y.; entered the Methodist Episcopal ministry 1848, stationed in New York until 1853, when he became professor of Latin in the University of Michigan, and 1856 took the professorship of English language, literature, and history; editor of *Zion's Herald*, Boston, 1856–63, member of the Massachusetts board of education 1858–63, member of the State senate 1862–63, president of the University of Michigan 1863–69; president of North-western University, Evanston, Ill., 1869–72; corresponding secretary of the board of education of his Church 1872–74; became chancellor of the Syracuse University 1874. Has published *Young Man Advised* (1855); *Pillars of Truth* (1866); *Rhetoric* (1869).

Haven (Gilbert), D. D., b. in Malden, Mass., Sept. 21, 1821; graduated at Wesleyan University, Conn., in

1846; was appointed the same year professor of Greek and Latin in Amenia Seminary, N. Y., and principal of the same institution in 1848. In 1851 he joined the New England conference of the M. E. Church, and occupied several important pulpits. In the civil war he was the first commissioned chaplain (Apr. 18, 1861), and served in Butler's regiment. In 1862 he travelled in Europe. In 1865 he was appointed to special service in Mississippi; was afterwards editor of *Zion's Herald*, Boston, and in 1872 was elected bishop. Author of the *Pilgrim's Wallet*, a sketch of his travels in Europe, and of a volume of sermons, chiefly relating to slavery and the war. D. Jan. 3, 1880. ABEL STEVENS.

Haven (JOSEPH), D. D., LL.D., b. in Dennis, Mass., Jan. 4, 1816; graduated at Amherst College 1835; ordained pastor of the Congregational church in Ashland, Mass., 1840; pastor at Brookline, Mass., 1846–50; professor of mental and moral philosophy in Amherst College 1850–58; professor of systematic theology in the Chicago Theological Seminary 1858–70; resigned this place on account of ill-health in 1870, and after a tour in Europe and the East devoted himself to preaching and lecturing upon ancient and modern philosophy and the English classics. In 1873 he became acting professor of mental and moral philosophy in the Chicago University; and d. May 23, 1874. In addition to numerous sermons and articles in the religious journals and reviews, Dr. Haven published *Mental Philosophy* (1857), *Moral Philosophy* (1859), and a collection of essays entitled *Studies in Philosophy and Theology* (1869). J. H. SEELYE.

Haven (SOLOMON G.) was in a partnership in the practice of law with Millard Fillmore at Buffalo, N. Y., when the latter was elected to the Vice-Presidency in 1848. Mr. Haven was a leading member of Congress from 1851 to 1857. D. at Buffalo Dec. 24, 1861.

Ha′vens (JAMES) was b. in Mason co., Ky., Dec. 25, 1763; licensed to preach in 1781, and joined the itinerant ministry in 1820; was one of the founders of Methodism in the North-west, especially in Indiana. D. Nov., 1864.

Ha′vensport, a v. of Fairfield co., O. Pop. 83.

Hav′ercamp (SIEGEBERT), b. at Utrecht in 1683; studied theology, and was for several years a minister, but in 1721 was appointed to the chair of Greek in the University of Leyden, which he afterward changed for that of history in the same university. D. at Leyden Apr. 23, 1742. He published new editions of Josephus, Sallust, Tertullian, and Lucretius; wrote *Introductio in Antiquitates Romanas* (1730), *Introductio in Historiam Patriæ* (1739), etc.; but it was as a numismatist that he showed the greatest merit. His principal works in this line were—*De Numismatibus Alexandri Magni* (1722); *Thesaurus Morellianus, sive familiarum Romanarum numismata omnia* (1734); *Nummophylacium reginæ Christinæ* (1742), and other minor essays and criticisms.

Hav′erford, post-tp. of Delaware co., Pa., 10 miles W. of Philadelphia. Haverford College is situated in the N. W. part of the township. Pop. 1338.

Hav′erford Col′lege, in Delaware co., Pa., was founded in 1832, by members of the religious Society of Friends, under the name of "Haverford School," and was made a college, with authority to grant degrees, in 1856. It possesses a farm of over 100 acres, and besides the two chief college halls there are a well-furnished astronomical observatory, a laboratory, a gymnasium, and a commodious library and alumni hall, with a constantly increasing library. The plan of the institution limits the number of resident students to 60. Since 1849 others besides the sons of Friends have been admitted. The principals have been Samuel Hilles, John Gummere, Daniel B. Smith, and Joseph Harlan; the presidents, Samuel J. Gummere and Thomas Chase. Haverford College was the first collegiate institution founded and conducted entirely within the Society of Friends; and as it was founded in order to furnish an advanced and yet guarded collegiate education to young men belonging to that society, and as its reputation has always been high, especially for thoroughness in the instruction of all its students, and a balanced or many-sided training and culture, its influence in promoting intellectual culture among the members of the denomination has been important. HENRY HARTSHORNE.

Hav′erfordwest′, town, cap. of Pembrokeshire, Wales, picturesquely situated on the Cleddy, carries on some export trade in cattle, butter, cheese, and corn. Pop. 6622.

Hav′erhill, city of Essex co., Mass., pleasantly situated on the Merrimack at the head of tide-water and navigation, 18 miles from its mouth, and distant 32 miles from Boston by the Boston and Maine R. R. Operations are in progress to extend navigation to Lawrence. Settled in 1640, incorporated as a town 1645, and as a city 1870. For many years a frontier-town, suffering much from the incursions of the savages. Prominent in the Revolution, furnishing 74 of the 1000 men at Bunker Hill. The manufacture of fine boots and shoes is the principal industry, employing 6000 operatives, the city ranking third in the country in the production of this kind of goods; annual value, $10,500,000. There are 2 large hat-factories, 1 woollen-mill, and numerous collateral industries. Valuation (1877), $10,342,954. Estimated pop. 15,000. Haverhill has 31 graded public schools, 19 churches, a public library (24,000 volumes); 1 daily, 1 tri-weekly, 1 semi-weekly, and 2 weekly newspapers; 1 street railway; 4 national, 2 savings banks; 4 hotels. The noted buildings are the city-hall, Masonic temple, Odd Fellows' building, high-school house, public library, old ladies' home; also a fine soldiers' monument in marble. Ayer's and Rocks villages are within the city limits. Fine iron bridges connect Haverhill with the pleasant towns of Bradford and Groveland. Pop. in 1870, 13,092. JOHN CROWELL.

Haverhill, tp. of Olmsted co., Minn. Pop. 650.

Haverhill, post-v., one of the capitals of Grafton co., N. H., is on the E. bank of the Connecticut River, and on the Boston Concord and Montreal R. R., 84 miles N. N. W. of Concord. The township has several villages, and manufactures of leather, lumber, starch, paper, whetstones, boxes, etc. It has an academy, 3 churches, and a fine park, near which the public buildings stand. Pop. of tp. 2271.

Hav′ersack [Ger. *Habersack*, an "oat-sack"], a stout bag of canvas in which a soldier carries his rations on the march. Also, the leather bag in which ammunition is carried from a magazine to the guns.

Haver′sian Canals′ [named from *Clopton Havers*, their discoverer] are passages in the compact substance of bone for the blood-vessels upon which the nutrition of the bone depends. They are round, oval, or angular in section, and are from $\frac{1}{200}$ to $\frac{1}{2000}$ of an inch in diameter. The largest contain several vessels surrounded by marrow. All are lined by a delicate membrane continuous with the periosteum or endosteum. Each Haversian canal is surrounded by from eight to fifteen concentric rings of bone called *lamellæ*. Each canal with its surrounding lamellæ makes up an Haversian system or Haversian rod. The general direction of the canals is usually nearly parallel to the long axis of the bone.

Hav′erstraw, post-v. and tp. of Rockland co., N. Y., on the Hudson River, 38 miles from New York. It has 8 churches, good schools, 1 newspaper, a bank of deposit and a savings bank, 3 hotels, the usual number of stores, etc., a large print-works, employing about 1000 hands, a rolling-mill for copper, and a paper-mill for making paper bags. Principal business, brickmaking. Pop. of tp. 6412.
ROBERT SMITH, PROP. "ROCKLAND CO. MESSENGER."

Hav′ilah, post-v., cap. of Kern co., Cal., 100 miles N. of Los Angeles. It has 1 weekly newspaper.

Havre, or **Havre de Grâce,** town of France, in the department of Seine Inférieure, at the mouth of the Seine. It is beautifully situated at the foot of a range of hills whose tops are lined with elegant villas and present some beautiful views. But the city itself is not handsome, though the new city-hall and barracks are magnificent buildings. Its harbor, consisting of seven spacious basins, capable of accommodating 600 vessels, and well provided with wet and dry docks, is one of the best harbors of France, and, next to Marseilles, Havre is the most important commercial place of the country. One-fifth of the foreign commerce of France is transacted in this city. The total value of the imports and exports amounts to about $250,000,000 annually. In 1870, 8458 vessels, with a tonnage of 2,516,898, entered its harbor. The port itself possessed about 500 vessels. It communicates directly with New York, Havana, Rio Janeiro, Calcutta, and all the chief commercial places in Europe, exporting wine, brandy, oil, and different kinds of French manufactures, and importing cotton (464,985 bales in 1870), sugar, coffee, tea, and spices. Pop. 86,825.

Havre de Grace, post-v. and tp. of Harford co., Md., 36 miles N. E. of Baltimore, on the line of the Philadelphia Wilmington and Baltimore R. R., on the S. bank of the Susquehanna River, near where it empties into the Chesapeake Bay. It is located at the natural outlet to tide-water, through the Pennsylvania and Susquehanna Canal, for the anthracite coal of the Wyoming and Shamokin regions, and for the bituminous coal of the Juniata, as well as the lumber, minerals, manufactures, and agricultural products from the valleys of the Susquehanna and its tributaries. It has 1 weekly newspaper, churches, schools, stores, flour-mills, breweries, shipyards, saw and planing mills, fruit-canning establishments, etc. It has a fine harbor, and an extensive trade in coal and lumber; also extensive shad and alewive fisheries, and in this vicinity are secured, in large numbers, the celebrated canvas-back ducks. Pop. 2281. A. P. MCCOMBS, ED. "HAVRE REPUBLICAN."

Hawaiian Islands. *Origin of the Hawaiian Race.*—There are two theories of the origin of the Hawaiians—one pointing to the East, the other to the West. The former claims their relationship with the Toltec branch of the great Nahoa family of Mexico, and presents certain slight physiological and psychological similarities in proof thereof. This hypothesis makes the Hawaiians the oldest Polynesian colony, from which the other branches of the family originated. It is supported by the prevailing direction of the winds and ocean-currents. The other theory, carefully tracing the relationship of all the island-nations of Oceanica, supports the hypothesis, based mainly upon philological research and analogies in customs and implements, that all the Pacific archipelagoes and islands were colonized by successive migrations from Southern Asia; that the family which includes the Hawaiians, New Zealanders, Samoans, Marquesans, Tahitians, Tongans, the Austral islanders, and the natives of Madagascar, was an extremely ancient and primitive member of the great Malay race; and that the Malay Archipelago was the starting point of their distinct migration. This theory is consistent with the evidence from language, race, manners, and customs, and has the additional support of Hawaiian tradition. A junk from the W., with survivors on board, has drifted ashore at the Hawaiian Islands in recent times.

History. The Hawaiian Islands were discovered by Gaetano, a Spanish navigator, in 1542. Mendana, another Spanish discoverer, ascertained the correct position of the island of Kauai in 1567. Long before these dates (probably about 1527) one or two Spanish vessels were wrecked on the coast of Hawaii, and the few survivors intermarried with the natives. Their descendants are known at the present day by a light skin, which is liable to freckle, and by a Caucasian facial contour, and are designated as *Ehu*. Capt. Cook visited the Hawaiian Islands in 1778, sighting the islands of Oahu and Kauai on Jan. 18, and anchoring at Waimea, Kauai, on the 19th. After visiting the island of Nühau, he sailed for the American coast, and, returning, arrived at the island of Maui on Nov. 20, when he met Kamehameha I., then a young man. Capt. Cook afterwards spent some time with his vessels at the island of Hawaii, where, by his abuse of the unbounded hospitality and reverence of the natives, he lost their friendship, and was killed by them in a quarrel at Kealakekua Bay on Feb. 14, 1779.

The Hawaiians at this time supported an elaborate feudal system, closely analogous to that of Europe in the Middle Ages. Physical and religious forces were the controlling influences, each allying itself with the other as the necessary condition of its own permanence. From a collection of savage tribes, each led by its own chief, the movement from generation to generation, through incessant fighting, had been toward centralization, until, at the time of Capt. Cook's visit, under the sovereignty of five or six independent dukes or kings, they had reached a fair degree of barbaric civilization. The administration of these kings was absolute and their persons were sacred. High chiefs did fealty to the king, supplying food or forces for military service according to royal demands, while lower chiefs in like manner supported them, and were themselves served by the *konohikis*—middlemen between chiefs and people—who were the last representatives of kingly power, and who oppressed the common people with great severity. The status of the latter was that of vassals, tenants, and serfs, who, with all they possessed, belonged to the chiefs and were under their protection. In 1790, Kamehameha, then king of a portion of Hawaii, was attacked by Keoua, king of the other part, whom he defeated and captured, thus obtaining possession of the whole island. Inspired with this success, he invaded the neighboring islands, and after several years of hard fighting conquered them all except Kauai and Nühau, which were under the sway of Kaumualii, with whom Kamehameha, after one or two futile attempts at invasion, made a treaty, under which the possessions of Kaumualii were to vest in Kamehameha upon the death of the former.

In 1792 and the two following years Vancouver visited the Hawaiian Islands, and introduced cattle on May 8, 1819. Kamehameha died at Kailua, Hawaii, after a long and most successful reign, in which he had firmly established his kingdom over the whole group. His eldest son, Liholiho, succeeded him under the title of Kamehameha II., with Kaahumanu, widow of Kamehameha I., as premier, and who in influence and power was the real sovereign. Under her sagacious leadership, aided by the bold recklessness of the king, the mighty taboo system of centuries was overthrown, and the conservative party totally routed in a sanguinary battle which lasted for six hours. The universal destruction of the idols followed. Shortly after, on Apr. 1, 1820, the first American missionaries arrived—seven men, with their wives. They immediately began to reduce the language to writing, adopting an alphabet of twelve letters—*a*, *e*, *i*, *o*, *u*, *h*, *k*, *l*, *m*, *n*, *p*, *w*—the vowels pronounced as in Europe, and the consonants *hey*, *key*, *lah*, *mu*, *nu*, *pe*, *wey*. The first printing was done in 1822. In 1823 the king and Kamamalu, his queen, visited England, where they both died the year following; whereupon Kaahumanu, the premier, became regent, and governed until the majority of Kanikeaouli, brother of the late king, a period of nine years. In 1824, George, the son of Kaumualii, late king of Kauai and Nühau, headed a rebellion on Kauai, which after some successes was summarily crushed. In 1825 the Ten Commandments were adopted as laws by the government, and a few criminal laws were enacted in 1827 and 1829. The first Roman Catholic missionaries arrived July 7, 1827. The priests with their converts were from time to time exposed to severe persecutions by the government until 1839, when Commander Laplace of the French frigate L'Artemise obtained, under threats of war, civil and religious privileges for Roman Catholics. Kanikeaouli assumed the government in 1833 as Kamehameha III. In 1840, Kamehameha III. and the chiefs promulgated a constitution granting civil rights to the people. On Feb. 25, 1843, the provisional cession of the islands to England, in consequence of the harsh demands of Lord George Paulet, occurred; which arrangement was terminated and the Hawaiian flag restored by Admiral Thomas on July 31 in the same year. In 1846, Kamehameha III. approved of the famous Land Act, by which he released the royal right to a large portion of the lands of the kingdom and provided for their conveyance to the people. In 1849 the temporary occupation and embargo of the port of Honolulu by the French took place. In 1852 the constitution was revised by the king and legislature, by which free suffrage was established as a civil right. Kamehameha III. died on Dec. 15, 1854, and was succeeded by Alexander Liholiho (son of Kinau, the daughter of Kamehameha I.), who reigned as Kamehameha IV. The chief monument of his reign is the Queen's Hospital. In 1856 he married Emma Naea (adopted daughter of Dr. Rooke), who in 1858 gave birth to a boy who lived but little over four years. After a quiet and prosperous reign of nine years, he died on Nov. 30, 1863. In 1862 an English Reformed Catholic mission arrived. Lot Kamehameha, brother of the late king, succeeded him as Kamehameha V., and was noted for his forcible abrogation of the national constitution and promulgation of a new one limiting the right of suffrage by a property qualification. His reign was commercially prosperous, and Honolulu, the capital, was beautified with fine public buildings. He died Dec. 11, 1872, without issue, leaving the Kamehameha dynasty extinct. After a four weeks' interregnum under the regency of the cabinet, Lunalilo, a high chief, upon the unanimous nomination by the people, was elected king by the legislature. His short reign of one year was noted for the institution of measures for the restoration of the liberal principles of the old constitution, for the unpopular ministerial effort for commercial reciprocity with the U. S. on the basis of the cession of the Pearl River Lagoon, and for the bloodless mutiny of troops at the barracks in Honolulu. Lunalilo died Feb. 4, 1874, and left no issue. On Feb. 12, Kalakaua was elected king by the legislature, with the determined opposition of Queen-dowager Emma, which culminated at the election in a riot by her supporters, in which many of the representatives were severely injured and the legislative hall partially demolished. Order was restored by armed forces from American and English war-ships in the harbor.

The independence of the Hawaiian Islands was recognized by the U. S. in 1829, and more formally in 1843; by Belgium in 1844; and by England and France later in the same year.

Population. From the time of Captain Cook's visit to the arrival of the missionaries in 1820 the decrease of population through war and disease was immense; a pestilence in 1804, called *ahulau okuu*, the character of which is not known, decimated the nation fearfully. Cook's estimate of a population of 400,000 in his time was probably too great by 100,000. In 1823 the population was estimated at 142,000. In 1832 the first census was taken, making the number 130,313; the census of 1836 gave 108,579; that of 1850, 84,165; that of 1853, 73,137, the last interval including the smallpox year; the census of 1860 gave 69,700; that of 1866, 62,959; and that of 1872, 56,897. The last census shows 31,650 males and 25,247 females, of whom 13,077 males and 12,682 females are married. It also shows 889 resident Americans, of whom 240 are females; 619 English, of whom 178 are females; 224 Germans, of whom 47 are females; 88 French, of whom 19 are females; 395 Portuguese, of whom 28 are females; and 1938 Chinese, of whom 107 are females; besides 364 other foreigners, of whom 21 are females; and 849 Hawaiian born, but of foreign parentage, of whom 4?? are females, showing a total of 5,366 foreigners and their descendants, of

whom 1071 are females—showing an increase over the census of 1866 of 1172.

Geological and Geographical Features.—The Hawaiian Islands are situated in the North Pacific Ocean between lat. 18° 50′ and 22° 30′ N., and lon. 154° 50′ and 161° 40′ W. They are twelve in number, with a total area of about 6400 square miles: Hawaii, 4000 sq. m.; Maui, 800 sq. m.; Kahoolawe, 65 sq. m.; Lanai, 100 sq. m.; Molokai, 200 sq. m.; Oahu, 500 sq. m.; Kauai, 640 sq. m.; Niihau, 95 sq. m.—habitable; and Molokini, Lehua, Kaula, and Nihoa, barren rocks. The group extends in a N. N. W. direction from Hawaii. The islands are all high, increasing in size and altitude toward the S. E. The rock of the whole group is volcanic, with the exception of the ancient elevated coral reef and the resulting sandstone. No true fossiliferous rocks are found, although the tufa contains fossilized shells and corals of recent species. On the tops and in the interior of the mountains a variety of trachyte is found, and the bulk of the mountains seem to be composed of phonolites and graystones, forming a complete series from basalt to trachyte. The following are some of the minerals that have been noticed: sulphur, pyrites, common salt, sal-ammoniac, limonite, quartz, augite, chrysolite, garnet, labradorite, feldspar, gypsum, soda-alum, copperas, glauber salt, nitre, and calcite. There are two active volcanoes on Hawaii—viz. Kilauea and Mauna Loa. The following eruptions are known to history: (1) In 1789, from Kilauea, accompanied by earthquakes and the discharge of poisonous gases, by which nearly 100 persons were killed; (2) in 1801, from Mount Kualalai, the third in height on Hawaii; (3) in 1823, from Kilauea; (4) in 1832, from Kilauea and Mauna Loa; (5) in 1840, from Kilauea; (6) in 1843, from new craters and fissures near the summit of Mauna Loa; (7) in 1852, from a fissure on the N. side of Mauna Loa; (8) in 1855, from the same place, continuing thirteen months; (9) in 1859, from Mauna Loa; (10) in 1866, from Mauna Loa; (11) in 1868, from a new fissure, nearly three miles long, in the slope of Mauna Loa, ten miles from the sea, accompanied with violent earthquakes and irruption of great sea-waves upon the land, by which 200 houses and 79 persons were destroyed. The craters of Mokuaweoweo (on Mauna Loa) and Kilauea are now active. The altitude of Mauna Kea, the highest point on Hawaii, is 13,805 feet; of Kaleakala, the highest point on Maui, 10,030 feet. The extinct crater of Kaleakala is 7 miles long, 3 wide, and 19 in circumference, and is from 700 to 2000 feet deep. Kaala, the highest point on Oahu, is 3850 above the sea; the altitude of Kauai is about 6500 feet. The soil is fertile and well adapted to planting and grazing. It is estimated that there are nearly 2,000,000 acres of grazing land, besides 290,000 acres of arable land. The mountainsides abound in forests, in which there is a plenty of ship-timber and ornamental woods. Numerous streams, many of them large, flow down the mountains to the sea.

Agriculture.—Sugar is the principal product. There are between thirty and forty plantations which raise and manufacture an aggregate of about 10,000 tons of sugar per annum, besides molasses; wool, tallow, hides, rice, pulu, and bananas are exported in considerable quantities, their production being generally profitable. Nearly all the crops of temperate climates can be successfully grown, but are not profitable for want of markets.

Exports and Imports.—The total exports for 1873 were valued at $1,661,407.78, and the imports for the same period were estimated at $1,349,448.51.

Meteorology.—The climate is much affected by locality, and varies from cool, frosty weather to a high average of heat the year through. The N. E. trades blow the greater part of the year, and prevent the heat from becoming oppressive. Certain leeward portions of the islands are cut off from the trades by the mountains, and are consequently oppressed with sultry weather, which, however, is tempered by the sea-breezes which in such places almost invariably blow through the day. Showers are frequent in the summer, and in the winter severe southerly and westerly rainstorms, lasting for days and even weeks, are liable to occur. Thunderstorms are rare, but severe. At Honolulu the average height of the barometer is 30.054 inches. The thermometer at the same place ranges from 62° F. at sunrise to 89° at 3 P. M., with an average of 75.7°. At Waimea, Hawaii, at an elevation of 4500 feet, the average is 64°, the lowest 48°. The average rainfall at Waikiki, near Honolulu, is 48 inches per annum; on the hill, 1 mile back of the town, 56 inches; at Kalaea plantation, on the opposite side of the island, 61 inches. The rainfall in Honolulu for the year 1837 was 21.1 inches: for 1838, was 46.8 inches, 12 of which fell in October. The former year had 295 days of trade-winds, 44 of S. winds, and 26 variable; and 285 fine, 37 rainy, and 43 variable days; while the latter had 258 days of trade-winds, 71 of southerly winds, and 36 variable, and 275 fine days, 41 rainy, and 49 variable weather.

Fauna.—By far the greater proportion of animals peculiar to the Hawaiian Islands are birds, which number over 70 species, of which nearly 50 have been catalogued and partially described. The larger part of these consist of water-fowl, beach and sea birds. The difficulty with which the forest birds can be observed and procured has rendered progress in describing them necessarily slow. David Malo, the native historian, enumerates as native, hogs of several varieties, dogs, mice, the domestic hen, dragon-flies, two kinds of butterflies, millers, moths, flies, wasps, grasshoppers, cockroaches, winged ants, two kinds of spiders, and two kinds of lizards.

Plants.—The vegetable kingdom is rich in interesting forms. Many new species and varieties have been discovered, and much work has been done in their description and classification. S. B. Dole.

I endorse the above article by Mr. Dole,

Elisha H. Allen, *Chief-Justice of Hawaiian Islands.*

Haw Creek, tp. of Knox co., Ill. Pop. 1056.

Haw Creek, tp. of Bartholomew co., Ind. Pop. 2634.

Haw Creek, tp. of Morgan co., Mo. Pop. 1731.

Hawes (Joel), D. D., b. at Medway, Mass., Dec. 22, 1789; graduated at Brown University in 1813; studied theology at Andover, and in 1818 became pastor of the First Congregational church in Hartford, Conn. He won great fame as an author and preacher. Among his numerous works are *Lectures to Young Men* (1828), which had a great sale; *Memoir of Normand Smith* (1839); *The Religion of the East* (1845); and *An Offering to Home Missionaries* (1865). D. at Gilead, Conn., June 5, 1867.

Hawesville, post-v., cap. of Hancock co., Ky., 120 miles W. S. W. of Louisville, on the Ohio River. It is the centre of the Kentucky coal system, 8 mines being in successful operation in the vicinity. There are several good schools, 4 churches, 2 hotels, 1 furniture-factory, 1 hub and spoke factory, and 1 newspaper. Principal occupation, coal-mining and tobacco-raising. Pop. 855.

David R. Murray, Ed. "Plaindealer."

Haw′finch, the common grosbeak of Europe and Asia, *Coccothraustes vulgaris.* It is a shy forest bird, but is quite destructive of small fruits, seeds, and the like. It is variegated with black, white, brown, and gray of various tints, and is seven inches long.

Haw′ick, town of Scotland, in the county of Roxburgh, at the confluence of the Teviot and the Slitrig. It is the centre of the Scotch manufactures of stockings, plaids, shawls, and blankets. Pop. 11,355.

Hawk, a popular name for many birds of prey of the family Falconidæ, mostly smaller than those known as eagles, and having, as a rule, shorter wings than the true or noble falcons. The term is, however, a very vague one. For instance, the black hawk of the U. S., called also rough-legged falcon, is the *Archibuteo sancti-johannis;* others are of the genera *Poliornis, Geranospiza, Micrastur, Melierax,* and many other genera. The genus *Accipiter* is, however, regarded as the typical one. The more important species are described under their alphabetical heads.

Hawk′bit, the *Leontodon autumnale* of Linnæus, called also fall-dandelion, a composite perennial plant from Europe, naturalized in parts of the U. S. Its heads of yellow flowers resemble those of the dandelion, and in New England are very abundant from July to October.

Hawk Creek, tp. of Renville co., Minn. Pop. 353.

Hawkers. See Peddlers.

Hawkesbury, a river of East Australia, in New South Wales. It enters the Pacific at Broken Bay, 20 miles N. E. of Sidney. Its course is only 50 miles, but it is navigable up to Windsor. It is remarkable for its inundations, the water sometimes rising 20 feet in a few hours.

Hawkesbury, a v. of Prescott co., Ontario, Canada, on the river Ottawa, opposite Grenville, with which it is connected by ferry. It has manufactures of lumber. P. 1671.

Hawkesworth (John,) LL.D., b. in London 1715 or 1719; was a clockmaker's apprentice; read law, and in 1744 became compiler of parliamentary debates for the *Gentleman's Magazine,* for which periodical he was critic 1765–72; was the author of 70 of the 140 papers published in the *Adventurer* (1752–54), in consequence of which he received the doctorate from the archbishop of Canterbury. Author of *Zimri,* a good oratorio (1760); *Edgar and Emmeline,* a drama (1761); *Almoran and Hamet,* a tale (1761); prepared for the government an account of the first voyage of Cook, with some account of the voyages of Byron, Wallis, and Carteret (3 vols., 1773), a work which called forth severe criticisms; translated Fénelon's *Télémaque* (1768); prepared a good *Life of Swift,* etc. D. Nov. 17, 1773.

Hawking. See Falconry, by Prof. A. de Gubernatis.

Haw'kins, county of Tennessee, bounded on the N. by Virginia. Area, 500 square miles. It is mountainous, with wide fertile valleys. Cattle, grain, tobacco, and wool are staple products. Cap. Rogersville. Pop. 16,587.

Hawkins (BENJAMIN), b. in North Carolina Aug. 15, 1754; educated at Princeton; was an excellent French scholar; became Washington's interpreter in his intercourse with the French officers of his army; was with him at the battle of Monmouth. In 1780 was chosen commercial agent of North Carolina, and 1781–84 and 1786–87 was a delegate to Congress; 1789–95 was a Senator from the same State under the new Constitution. In the latter year he was appointed by Washington agent for superintending all the Indians S. of the Ohio; this office he retained until his death, making his head-quarters most of the time at a station in Georgia which is now known as the city of Hawkinsville, named in honor of his memory. To each successive President from Washington to Madison he tendered his resignation, which was not accepted. He was a man of superior abilities, great variety of learning, and of lofty character. He left some valuable writings on topography and the Indian character. D. June 6, 1816, universally lamented by both the white men and the red men from the Ohio to the Gulf, whose mutual interests and intercourse he had so humanely and beneficently conducted for upwards of a quarter of a century. (See CHAPPELL'S *Historical Miscellanies of Georgia.*) A. H. STEPHENS.

Hawkins (BENJAMIN WATERHOUSE), F. G. S., F. L. S., b. in London Feb. 8, 1807; was educated at St. Aloysius' College; studied art under William Behnes, the sculptor; began the pursuit of natural science in 1827, and in 1852 began the restoration of extinct animals in model, his previous labors (1842–47) in studying living forms of animal life at Knowsley Park having fitted him for the work. In 1868 he removed to the U. S. His lectures in the United Kingdom and the U. S. have done much to popularize science. His thirty-three restorations of fossil animals for the Crystal Palace Park, near London, are famous examples of his skill in modelling. Author of *Popular Comparative Anatomy* (1840); *Elements of Form* (1842); *Comparative View of the Human and Animal Frame* (1860); *Atlas of Comp. Osteology* (with Huxley, 1864); *Artistic Anatomy of the Horse, Cattle, and Sheep*, etc.

Hawkins (Sir JOHN), b. about 1520 at Plymouth, England; became a mariner, and in 1562, 1564, and 1567 took cargoes of slaves from Guinea to Spanish America; was attacked (1567) on the Mexican coast by a Spanish fleet, and lost several ships from the squadron in his command; was made treasurer of the English navy 1573; knight and rear-admiral 1588, and served with distinction against the Armada; went with Frobisher to cut off the plate fleet 1590, but failed to accomplish that result; led with Drake an expedition against the Spanish West Indies, and d. at sea Nov. 21, 1595.

Hawkins (Sir JOHN), b. in London Mar., 1719; was bred an attorney, but devoted much time to music and literature; joined the Madrigal Society 1741, and in 1749 became a member of Dr. Johnson's literary club; magistrate for Middlesex 1761; suppressed the riots at Brentford 1768, at Spitalfields 1769; was knighted 1772, and d. in London May 21, 1789. Chiefly remembered for his *General Hist. of Music* (1776), an important work; wrote also a *Life of Johnson* (1787), and published an edition of Walton's *Angler* (1760), and of Johnson's *Works*, besides several minor works of his own.

Hawkins (WILLIAM GEORGE), b. at Baltimore, Md., Oct. 22, 1823, a son of John H. W. Hawkins (1797–1858), the Washingtonian temperance lecturer. The son graduated at Wesleyan University, Middletown, Conn., 1848; studied divinity at Fairfax Seminary, Va., 1848–51; entered the Protestant Episcopal ministry 1851; has held rectorships in Maryland, Massachusetts, Pennsylvania, etc.; edited the *National Freedman*, etc., 1863–66, and has been much engaged in domestic missions; in 1874 became chaplain in the asylum at Binghamton, N. Y. Author of a *Life* of his father (1859); *Lunsford Lane* (1863); *History of the Freedman's Commission* (1866), etc.

Haw'kinsville, city, cap. of Pulaski co., Ga., 40 miles S. of Macon, on the Macon and Brunswick R. R. It has 4 good schools, 5 churches, 1 bank and trust company, 1 newspaper, 2 carriage and wagon factories, a large cotton-factory, 3 cotton warehouses, 1 steam grist-mill, a Masonic and an Odd Fellows lodge, and the usual number of stores. Pop. 813. JOHN H. MARTIN, *Mayor.*

Haw'kinsville, post-v. of Boonville tp., Oneida co., N. Y., has several manufactories. Pop. 150.

Hawk Moths, the Sphingidæ, a family of lepidopterous insects, of which there are more than 300 known species, quite largely from tropical America. Among them are some of the largest of the Lepidoptera. They have stout bodies and narrow, strong wings, which make their flight swift and powerful. They often stand poised in the air like humming-birds, and in general obtain their food from flowers after the manner of humming-birds. At rest, the wings usually form a roof or tent over the insect, and in flight the hind wing is attached by a hook to the forward wing. The larvæ have sixteen legs, and are remarkable for their large size and their habit of elevating the fore part in a manner fancied to resemble the position of the sphinx (hence the name *Sphinx* for the typical genus). The larvæ are mostly destructive plant-feeders. The U. S. have many species.

Hawks (CICERO STEPHEN), D. D., LL.D., Protestant Episcopal bishop of Missouri, was b. at New Berne, N. C., May 26, 1812, and graduated at the University of North Carolina in 1830; studied law; was ordained in 1834; rector of Trinity church, Buffalo, N. Y., 1837–43, of Christ church, St. Louis, 1843–44, and was consecrated bishop of Missouri in 1844. During the cholera season of 1849 he was conspicuous for his care for the physical and spiritual good of the sufferers. He was the author of several works, chiefly for the young. D. Apr. 19, 1868.

Hawks (FRANCIS LISTER), D. D., LL.D., b. at New Berne, N. C., June 10, 1798, and was an elder brother of Bishop C. S. Hawks. He graduated at the University of North Carolina in 1815, and became a successful lawyer, but in 1827 was ordained to the ministry of the Protestant Episcopal Church. Was for a time assistant minister in New Haven, Conn., and in Philadelphia; in 1830 was chosen professor of divinity in Washington—now Trinity—College, Hartford, Conn.; in 1831 was rector of St. Stephen's, New York City, and of St. Thomas's, 1832–43. In 1835 he declined the missionary bishopric of the South-west. In 1837 he became one of the founders of the *New York Review*, and in 1839 established St. Thomas's Hall, a school at Flushing, N. Y., by which he was heavily involved in debt. He was (1840–42) editor of the *Church Record*. In 1843–44 he resided in Mississippi, of which diocese he declined the bishopric. He was (1844–49) rector of Christ church, New Orleans, and was chosen first president of the University of Louisiana. He held (1849–61) rectorships in New York City, where $15,000 was presented to him for the relief of his pecuniary embarrassments. In 1854 he declined the bishopric of Rhode Island. Sympathizing with the South during the civil war, he held (1861–65) the rectorship of Christ church, Baltimore. In 1865 he accepted the ministry of the chapel of the Holy Saviour, N. Y. D. Sept. 27, 1866. When in the practice of law he published several volumes of legal reports and a digest, and afterwards *Contributions to the Ecclesiastical Hist. of the U. S.* (1836–41); *Narrative of Com. Perry's Expedition* (1856); *History of North Carolina* (1857–58); *Documentary Hist. of the Prot. Episcopal Church* (1863), and a large number of other works, among them the "Uncle Philip" series for the young. He was alike eminent for learning, piety, and eloquence.

Hawks'bee, or **Hauksbee** (FRANCIS), F. R. S., was chosen to the Royal Society in 1705; became curator of experiments, and in 1723 assistant secretary. Author of 43 papers in the *Philos. Transactions* between 1704 and 1713, and of *Physio-Mechanical Experiments* (1709). He was one of the founders of electrical science, and made improvements in electrical machines, air-pumps, and other apparatus. The times and places of his birth and death are not known.

Hawk'shaw (JOHN), F. R. S., b. at Leeds, England, in 1811, where he was educated; pupil under Mr. Chas. Fowler; engaged in the construction of turnpike roads; subsequently he became assistant to Mr. Alexander Nimmo, government engineer of public works. On the death of Mr. Nimmo, Mr. Hawkshaw went to South America and assumed charge of the Bolivar copper-mines. Returning to England, he became engineer of the Manchester and Bolton Canal and Railway, and subsequently constructed the Lancashire and Yorkshire Railway and several others in various parts of England. His name is intimately connected with many great engineering achievements throughout Europe. In Russia he constructed the Riga and Dunaborg and the Dunaborg and Witepsk railways; in Wales, the Penarth harbor and dock in Cardiff Roads; the Londonderry bridge in Ireland; the Charing Cross and Cannon Street railways, besides other public works in London; the new docks at Hull; the government railways in Mauritius; was engineer-in-chief of the great ship canal from Amsterdam to the North Sea, planning the North Sea harbor, the actual construction of which involves but slight deviation from his original designs; constructed the new West India docks in London, etc.; was consulting engineer to the Madras and Eastern Bengal railways; engineer of the magnificent harbor of refuge at Holyhead, and of the foundations of the new fortifications at Spit-

head; and is frequently called upon by the British government as consulting engineer on works of a professional character. On the failure of the great sluice at St. Germains, by which the tide-waters of the river Ouse poured into the *Middle Level* Drain, bursting its banks at various points and inundating 6000 acres of land, Mr. Hawkshaw's services were called upon to remedy the disaster, which he did successfully, substituting for the first time large siphons for the fallen sluice; was one of the metropolitan commissioners of sewers, and in 1860 was appointed royal commissioner to decide between the various schemes proposed for supplying the city of Dublin with water. In 1874 he sailed for Brazil, on invitation of the emperor, to examine and report on all the principal harbors of the 3000 miles of seacoast. Author of many professional papers and works, and has been president of the Institution of Civil Engineers. G. C. SIMMONS.

Hawks' Springs, tp. of Jackson co., Ala. Pop. 386.

Haw'ley, post-tp. of Franklin co., Mass. It is mountainous, but well adapted to grazing, and contains iron ore and a mineral spring. Pop. 672.

Hawley, post-v. of Palmyra tp., Wayne co., Pa., on the Honesdale branch of the Erie R. R., 8 miles S. E. of Honesdale, and on the Pennsylvania Coal Co.'s R. R.

Hawley (BOSTWICK), D. D., b. at Camillus, N. Y., Apr. 8, 1814; graduated in 1838 at Wesleyan University; taught in seminary, Cazenovia, N. Y., 1838–42; has held numerous pastorates in the Methodist Episcopal Church. Author of *Manual of Methodism*, and various reviews, tracts, etc.

Hawley (JOSEPH), b. at Northampton, Mass., 1724; graduated at Yale College 1742. Starting life in the ministry, he became a lawyer, in which profession he achieved a great reputation through many years of practice. From 1764 to 1776 he occupied a seat in the house of representatives, where his eloquence was exerted in the cause of American liberty, of which he was one of the ablest advocates during this eventful period. Owing to the condition of his health he retired from public life in 1776. Although for a time an active opponent of Jonathan Edwards, whose removal he attempted to effect, he yet in 1760, on becoming convinced of his error, in a characteristic letter to Mr. Edwards deplored his action in the matter. D. Mar. 10, 1788.

Hawley (Gen. JOSEPH ROSWELL), b. at Stewartsville, N. C., Oct. 31, 1826. His father was a native of Farmington, Conn., and to that State the family returned in 1837, and afterwards removed to Cazenovia, N. Y. Gen. Hawley received his early education in the schools of Farmington and Hartford, Conn., and Cazenovia, N. Y., and was graduated at Hamilton College, N. Y., in 1847. He studied law at Cazenovia and Farmington, and in Sept., 1850, commenced practice in Hartford, where he was for a time the law partner of John Hooker, Esq. He very early took a deep interest in the politics of the country, and was an active opponent of slavery, especially of its extension to the U. S. Territories. He was an earnest, forcible, and vigorous platform-speaker in the days of the Free-Soil agitation. In his law-office, and by his invitation, Hon. Gideon Welles, Hon. John M. Niles, and a few other prominent Hartford men met Feb. 4, 1856, and took steps which led to the organization of the Republican party in Connecticut. In Feb., 1857, he left the practice of the law and became editor of the Hartford *Evening Press*, a journal established in 1856 as the organ of the newly-formed Republican party, his associate being William Faxon, Esq., afterwards assistant secretary of the navy. As an editor and platform-speaker he was prominent in his State in the exciting political times from 1856 to 1861. Upon the outbreak of the war of 1861–65 he enlisted in the army (Apr. 15, 1861), being the first man in Connecticut to enroll his name for the volunteer service. He went to the field as captain in the 1st Regiment Connecticut Vols.; was in the battle of Bull Run, his company and regiment being among the forces which preserved their discipline through that rout, returning to Washington in good order, and saving much property that had been abandoned. At the close of the three months' campaign he immediately engaged in recruiting for the 7th Connecticut Vols., in which he was commissioned lieutenant-colonel. He served in a campaign before Charleston, S. C., aided in the bombardment of Fort Pulaski, his regiment being the first to occupy the fort after its surrender; was in the battles of Morris Island, Fort Wagner, James Island, Pocotaligo, and Olustee, commanding a brigade in the latter engagement. He was commissioned a colonel in 1862, and a brigadier-general in 1864, though he had commanded a brigade for a long time previous to this promotion. He served in the Army of the James before Richmond and Petersburg, and with his command participated in many of the hardest battles of that siege. He was military governor at Wilmington, N. C., on the occupation of that city by the Federal troops. He was brevetted major-general in 1865, was Gen. Terry's chief of staff at Richmond after the surrender of Lee, and was mustered out of service in Jan., 1866. He was elected governor of Connecticut in Apr., 1866, holding the office one year. He returned to journalism as editor of the Hartford *Courant*, with which the *Press* had been consolidated. He was president of the Republican national convention at Chicago in 1868, and his brief speech on taking the chair was an eloquent declaration of the high and pure ideas which have guided his political life. Such sentiments as the following in that speech furnished keynotes for the campaign in some degree: "For every dollar of the national debt the blood of a soldier is pledged. Every bond, in letter and in spirit, must be held as sacred as a soldier's grave." "The power of a nation of forty millions must be behind the just claims of the poorest workingman, of whatever race, to even a day's wages; its majesty must be felt wherever the humblest loyal man appeals against personal violence and oppression." He was elected to the 42d Congress from the First Connecticut district Nov. 5, 1872, to fill the vacancy caused by the death of Hon. Julius L. Strong, receiving the largest Republican vote ever cast in the district. He was re-elected to the 43d Congress Apr., 1873. On the organization of the Centennial commission to arrange for the celebration of the one hundredth anniversary of American Independence, he was chosen its president. Gen. Hawley is a good type of the self-made men of America. His progress in the army was due to a noble courage and constant devotion to his soldierly duties; his distinction in other fields has been worthily won—a sound integrity, high purposes, earnest advocacy of what he believed to be right, and fearless opposition to wrong everywhere, having been characteristics of his social, journalistic, and political life. S. A. HUBBARD.

Haw'leyville, post-v. of Newtown tp., Fairfield co., Conn., on the Housatonic R. R., at its junction with the Shepaug Valley R. R., 23 miles N. by W. from Bridgeport, Conn.

Hawleyville, post-v. of Page co., Ia. Pop. 200.

Hawthorn. See CRATÆGUS.

Haw'thorne (JULIAN), a son of Nathaniel Hawthorne, b. in Boston June 22, 1846; studied in Harvard College and Scientific School, and in Dresden, Germany, where he has resided since 1872. He was 1870–72 an engineer in New York. He has published the novels *Bressant* (1873) and *Idolatry* (1874), and many contributions to periodical literature.

Hawthorne (NATHANIEL), b. July 4, 1804, at Salem, Mass. In early youth he was sent, on account of feeble health, to live upon a farm at Raymond, Me. He graduated at Bowdoin College in 1825, in the same class with H. W. Longfellow and G. B. Cheever. He then returned to Salem, where resided his widowed mother, who had ever since 1808 been a constant mourner for the loss of her husband. While here he published occasional articles, mostly tales, in different periodicals. In 1828 he published *Fanshawe*, an unsuccessful romance. He went to Boston in 1836 and edited the *American Magazine*, an illustrated periodical, which was soon bankrupt. In 1837 appeared *Twice-told Tales*, which was made up from his previous contributions to periodicals. This work gradually drew the attention of cultivated persons to the wonderful powers of its author, and in 1842 another series appeared. He was (1838–41) employed in the Boston custom-house, in which the historian Bancroft was then collector. In 1842 he joined for a time in the Brook Farm experiment. In 1843 he married and went to Concord, Mass., where he lived in the old parsonage, afterwards immortalized by him in *Mosses from an Old Manse* (1846). While here he was the associate of Emerson, Thoreau, Ellery Channing, and other congenial friends. He was (1846–50) surveyor of the port of Salem. While here he wrote that powerful tale *The Scarlet Letter* (1850), his most successful romance. He lived (1850–52) in Lenox, Mass., and here he produced the *House of the Seven Gables* (1851), and *The Blithedale Romance* (1852), and in the latter year published a *Life of Franklin Pierce*, who was a college-friend to whom Hawthorne was warmly attached. He was U. S. consul at Liverpool 1853–57, and afterwards spent some years in Italy. He lived (1860–64) in Concord, Mass., and while journeying for his health with Mr. Pierce he d. at Plymouth, N. H., May 19, 1864. Besides the works mentioned above are *True Stories from History, etc.* (1851), *The Wonderbook* (1851), *The Snow Image, etc.* (1852), *Tanglewood Tales* (1853), *The Marble Faun* (1860, in some respects his best effort), and *Our Old Home* (1863). After his death appeared a series of *Notebooks* (1868–72), *Septimius Felton* (1872), and parts of the unfinished *Dolliver Romance*. In person he was tall, large, and imposing, but he was as

shy, sensitive, and impressible as any woman. In his peculiar vein of romance his genius is unapproachable. Mr. Hawthorne's wife, SOPHIA PEABODY (1810–71), a lady of artistic tastes, illustrated one of his stories before their acquaintance, and after his death edited the *Note-books*, and published a volume of *Notes* of her own (1868). His daughter UNA edited her father's *Septimius Felton*.

Haw Tree, tp. of Warren co., N. C. Pop. 1540.

Haxall (ROBERT WILLIAM), M. D., b. in Petersburg, Va., Aug. 1, 1802, d. in Richmond Mar. 26, 1872; graduated at Yale College 1823; attended his first course of medical lectures in the University of Pennsylvania, and received his degree from the University of Maryland in 1826. He volunteered to meet the cholera in New York City in 1832, enjoyed the advantages of the schools and hospitals of Europe, and returning thence settled in Richmond, where for years he enjoyed a large practice. He obtained two Boylston prizes—one for an essay on fistula lachrymalis, the other for exploration of the internal organs by external means. He was also a frequent contributor to a monthly medical journal called the *Stethoscope*. He was president of the Medical Society of Virginia in 1841, and again in 1850, and took a very active interest in the organization of the American Medical Association—was in fact one of its founders. PAUL F. EVE.

Haxo (FRANÇOIS BENOIT), BARON, b. June 24, 1774; a general of French engineers, and one of the most able military engineers of modern times. Distinguished himself at the siege of Lerida, Mequinenza, and Tarragona under Suchet; directed the construction of fortifications at Belfort, Sedan, Grenoble, and L'Ecluse; also the operations at the siege of Antwerp, 1830; published no system of fortification, but introduced new features and made important modifications. (See *Encyc. Brit.*, "Fortification.") Best known out of France by what is called the "Haxo casemate," formed *in* the parapet, and, though arched over, covered with earth, and open behind to the terreplein; the guns fire through embrasures formed in an extension of the parapet beyond its ordinarily retired position in his system, and are not only secured from the enemy's fire, but may be hidden by masking the embrasures. D. June 25, 1838.

Hay, forage-plants cut for fodder and cured for storage. The plants commonly used for making hay are many kinds of grasses, several leguminous plants, particularly the clovers, and a few plants of other natural families. As a rule, plants are in the best state to be cut for fodder when in blossom or just out of blossom, because during the development of the seeds great drafts are made upon the plant to supply phosphates and other valuable nutritive substances which are needed for their perfection. The seed is thus formed more or less at the expense of the haulm and leaves, and at the same time the stems become woody and stiff, preparatory to sustaining the weight of the heads. This woody fibre is formed at the expense of the starch, gum, sugar, and soluble cellulose contained in the cells and juices of the stem and leaves.

The manner of curing is no less important than the time of cutting. If exposed to the sun, turned often, and dried rapidly and thoroughly, grass and clover will be found to be harsh and brittle, the leaves will fall off, the sweet odor will be gone, and a great part of the value of the hay lost. The object sought is not to *dry* hay so that it will keep, but to *cure* it so that it will make the most nutritious fodder and be dry enough for storing. Slow drying, with sufficient exposure to the air to prevent fermentation, causes the juices of the plants to become thickened, and when such a degree of inspissation is reached that the hay will not heat and mould when placed in stacks or in the mow—a point not difficult to determine with sufficient accuracy—the process is complete. Such hay will be found green, fragrant, and tough, the leaves even of clover not breaking and falling off. A greater weight of hay will be obtained, and it will prove more nutritious and be better relished by animals. The cutting of grass for hay is done by hand scythes or by horse-power mowing machines. The swaths as cut are shaken out and turned to expose all to the action of the sun and air, either by hand or by machines called "spreaders" or "tedders." It is raked together when somewhat dry, either by hand or horse rakes, into long heaps, called "windrows," extending in parallel lines across the field. The hay in the windrows is divided by the eye, and formed into symmetrical, compact conical heaps called "cocks," which are of greater or less size according to convenience, and according to the condition of the hay, small cocks heating less readily than large ones. Hay-caps, which are pieces of cotton cloth four to six feet square, with loops of cord sewed in at the corners, whereby they are pinned with wooden pins or forks to the hay, are not unfrequently used to cover the tops of these cocks in threatening weather to prevent the hay getting wet. Thus protected, or indeed unprotected, hay will go on curing in the cock for several days. There is no hay superior to that cured in this way, but there is danger of overheating and mildewing. When sufficiently and freshly aired, hay will have a slightly harsh feel when grasped in the hands; no sensation of moisture will be perceived when a lock is wrung and hard twisted in the hands, and the stems will not feel cool or moist when pressed against the dry lips. It is stored either under cover in barns or barracks, or in stacks. It may be salted when mowed away, four quarts to a peck of salt being used to the ton. This gives it a fresher color, and it is more relished by the cattle. Salt is, moreover, a great preventive of injury from heating, in case hay is housed or stacked too green. In addition to the tools already mentioned, horse hay-forks of various kinds are an important aid. They are arranged so that by a system of ropes, blocks, and rods the hay is lifted from the load upon the fork, and delivered in any section of the barn.

Brown Hay.—In some parts of Europe the fermentation of hay housed in a half-cured state or only well wilted before housing is so regulated that the mass becomes both cured and *cooked* by the operation. The result is a very compact mass, in which the plants lose to a degree their individuality, and which is of a dark-brown color, and so compact that it may be cut with an axe, though it can be broken up by hand. This is fragrant, and highly relished by stock, possessing at the same time a higher nutritive value than the best common hay. The fermentation causes a considerable loss in weight from the dissipation of moisture, and from the consumption of a part of the carbonaceous matter. Coarse grass and plants hardly regarded as fit for fodder, if mingled with grass of a better quality, are thus made to contribute largely to the store of winter forage.

Hay varies greatly in composition and nutritive value according to the plants from which it is made, the growth and period of cutting, the method of, and the good or ill fortune attending, its curing. Exposure to a single heavy dew causes fermentations and decompositions within the substance of the moistened stems and leaves, both fragrance and flavor are lost, and the nutritious quality of the hay seriously injured. The average composition of meadow hay of medium quality, as given by Wolff and Knop (quoted by Johnson), is in 100 parts—water, 14.3; combustible matter, 79.5; ash, 6.2. The organic or combustible matter consists approximately of albumenoids (gluten, etc.), 8 parts; carbohydrates (starch, sugar, and gum), 40; fat, 2; and crude fibre, 30. Except for the amount of crude fibre which it contains, good hay compares favorably with the different kinds of grain as nutritious food, and it is its bulk, caused by the woody fibre, which particularly adapts it to the use of cattle and horses as a general diet. The money-value of the hay-crop in all countries where cattle cannot graze during the winter and spring is fully equal to any other farm-crop, as generally estimated. Its intrinsic value is really greater, for the value of farm-crops in money is fixed chiefly by the convenience and expense of marketing, and this places hay at a disadvantage. To be marketed at a distance it must be pressed into as small compass as possible by hay presses worked either by hand or power; and even in this form hay is a bulky article and expensive to transport and to market. Ordinary bales measure 2 feet to 2 feet 6 inches across the ends, and 4 to 5 feet in length, and usually weigh from 200 to 350 pounds; while those made by the most powerful presses, though of the same size, weigh 400 to 500 pounds.

The kinds of grasses and forage-plants most valued for hay, and which are generally cultivated for that purpose in this country, are the following: (1) Timothy (*Phleum pratense*), called Herd's grass in New England, a well-known grass growing to the height of 2 to 4 feet, flowers in July, yields abundantly for the first cutting—little for the aftermath. (2) Orchard grass (*Dactylis glomerata*), called also Cock's-foot, a rough, rather coarse, leafy grass, flowering in June, at the same time with red clover, yields a heavy crop of hay very early, escaping late droughts, which it endures well; makes afterwards a great growth of root leaves, useful for late pasturage. (3) Red top (*Agrostis vulgaris*), called Herd's grass in S. and West New York, a grass known under many names, and assuming different forms and colors in different soils. It usually matures rather late, but grows wiry before it fairly flowers in July; is most valuable with other grasses, which it is apt gradually to crowd out; makes good hay, but not so much as those previously named. (4) Fowl meadow (*Poa serotina*), an admirable grass for moist meadows, making an abundance of nutritious, fine, soft hay—better for consumption than for market—and good aftermath. (5) June grass or blue grass (*Poa pratensis*), is hardly worthy of being included among hay grasses, yet, as it finds its way into almost all permanent meadows, and makes good sweet hay.

excellent pasture, and a close sward, it is here named as one of our best grasses. Besides these, a long list of less valuable grasses might be named, but those who buy seed for hay-meadows will generally confine themselves to these and to the clovers. The rye-grasses are good, but not equal to timothy and orchard-grass for hay. Sweet-scented vernal-grass is present in almost all soils of the Northern and Eastern States. It gives the odor to new-mown hay so much admired, which is not noticed in Western hay, on account of the absence of this grass. In addition to these proper grasses, the clovers are most important, as already mentioned. The most valuable is the common red clover (*Trifolium pratense*), which we have in two principal varieties—the mammoth and medium. The latter is preferable for hay, and may be used alone, or, better, in connection with orchard-grass or timothy, or with timothy, orchard-grass, and red-top mixed. Alsike, or Swedish clover (*Trifolium hibridum*), is partially procumbent in its growth, but with grass to sustain it makes excellent hay. Lucerne, or alfalfa (*Medicago sativa*), is sowed by itself, and after becoming established, where it does well yields at least three heavy crops of hay or green fodder each year.

The great consumption of hay is of course in those parts of the country where the winter is long and severe. Grasses adapted to the soil throughout these colder portions of the temperate zone afford rich and abundant summer pasturage, but for winter fodder the chief dependence is hay, and in this country corn-fodder, which, though properly included in our general definition of hay, is never reckoned as such by the farmers. The amount of hay cured in the U. S., and its distribution, as given in the census for 1870, may be roughly stated as follows: The total is placed at 27,316,000 tons; of this, New York produced 5,614,000, Pennsylvania 2,848,000, Illinois 2,747,000, Ohio 2,289,000, Iowa 1,777,000, Michigan 1,290,000, Wisconsin 1,287,000, Indiana 1,076,000, Maine 1,053,000, Vermont 1,020,000, Minnesota 695,000, Missouri 615,000, New Hampshire 612,000, Massachusetts 597,000, Connecticut 563,000, California 551,770, and New Jersey 521,000. This embraces all those States the hay-crop of which is reported at more than 500,000 tons, and it will be observed that the great stock-growing sections of Kentucky, Virginia, Tennessee, Kansas, and Texas are not included, the winters being so mild as to make hay of secondary consideration, its place being supplied by corn-fodder and the straw of grain, peas, etc. M. C. WELD.

Hay (Sir JAMES DOUGLAS HAMILTON), BART., a Canadian statesman, b. Dec. 28, 1800, son of Sir Thomas, fifth baronet; succeeded to his title 1833; resided at Quebec and at Ottawa, where he was on duty at the adjutant-general's office, and where he d. July 30, 1873. The family was raised to the Scottish baronetage in 1703. His mother was Anna, daughter of Mr. Sheffield Howard of New York.—His son, the present baronet, Sir HECTOR MACLEAN HAY, was b. in 1821, and resides in Quebec.

Hay (JOHN), b. at Salem, Ind., Oct. 8, 1839; graduated at Brown University in 1858; studied law at Springfield, Ill., and was admitted to the bar in 1861. Immediately afterwards he went to Washington with Pres. Lincoln, serving him as assistant secretary, and subsequently as adjutant and aide-de-camp. During the war of 1861–65 he served for several months under Gens. Hunter and Gillmore, attaining the ranks of colonel and assistant adjutant-general. He was appointed secretary of legation at Paris in 1865, and remained in that position till 1867, when he became *chargé d'affaires* at Vienna by the withdrawal of Mr. Motley, remaining in the latter place till 1868. In 1869 he was appointed secretary of legation at Madrid, and held that position till 1870, when he returned to the U. S. and accepted a situation upon the editorial staff of the New York *Tribune*, where he still remains. Soon after this he became widely known by his dialect poems of "Little Breeches," "Jim Bludsoe," "Banty Tim," etc., which were afterwards published in book-form under the title of *Pike County Ballads*. He also published about the same time his most enduring work, *Castilian Days*, a series of brilliant sketches of Spanish life, character, and politics. J. B. BISHOP.

Hay (Sir JOHN CHARLES DALRYMPLE), BART., F. R. S., F. R. G. S., b. Feb. 11, 1821; educated at Rugby; entered the navy, and as midshipman served on the coast of Syria, and as flag-lieutenant off the coast of Borneo; senior officer of the Columbine in 1849 in China, and promoted for the destruction of pirate vessels; commanded the Hannibal during the Crimean war, participating in the capture of Kertch and Kinburn and the bombardment and capture of Sebastopol; in command of the Indus 1857–59; on Greenwich Hospital commission 1860–61; and 1861–64 chairman of the iron-plate committee; succeeded to the baronetcy on the death of his father in 1861; elected to Parliament 1862, and again in 1866, in which year he was promoted to be rear-admiral, and retired as such 1870; was a lord of the admiralty 1866–68. Author of the *Flag List and its Prospects*, *Our Naval Defences*, *Remarks on the Loss of the Captain*, etc.

Hay (THOMAS), M. D., b. Feb. 7, 1837, at York, Pa.; was educated at the Pennsylvania College, Gettysburg, Pa., and the College of New Jersey; in 1861 took his degree of M. D. from the University of Pennsylvania, commenced practice in Philadelphia, and very soon obtained a lucrative and extended business. Gynæcology attracted his especial attention, and among many successful operations he removed, in 1871, an inverted uterus, complicated with a large intramural fibrous tumor. Previous to this time the most eminent surgeons had held that this operation was not to be resorted to unless death were certain to take place without it. But since then Dr. Gross, in a new edition of his *System of Surgery*, as well as other distinguished writers, has accorded him due credit for this achievement. His operations have extended to almost every branch of surgery. In 1869 a paper of his upon the use of the long tube in intestinal obstruction was published in the medical journals, and in 1871 another upon the removal of an inverted uterus by écrasement. Various other contributions have been made by him to professional literature. In 1865 he became a member of the Philadelphia County Medical Society; in 1866 a permanent member of the American Medical Association and of the Medical Society of Pennsylvania; in 1872 a corresponding member of the Gynæcological Society of Boston; and in 1874 a member of the American Public Health Association.

Hay (WALTER), M. D., b. at Georgetown, D. C., June 13, 1830; was educated in the Georgetown College and in the medical department of Columbian College, D. C.; studied for an engineer, and for five years was employed in the U. S. Coast Survey; since 1857 has been a practitioner in Chicago; editor of the Chicago *Medical Journal* since 1868; adjunct professor of the theory and practice of medicine in Rush Medical College since 1870; in 1872 was for six months attached as surgeon to the staff of Gen. Sheridan.

Hay As'thma, Hay Fe'ver, or **Autum'nal Catarrh',** a disease recurring in certain individuals at certain seasons every year, as in June (rose cold), in the haymaking season (hay fever), or (in this country especially) in the autumn, whence the name autumnal catarrh. It is a catarrhal affection of the nasal (and sometimes of the bronchial) passages, often with some fever and more or less asthmatic spasm. Sometimes incessant sneezing and coryza are the only prominent symptoms. It is not observed in very hot or very cold countries, on the sea, or at considerable heights in some mountain-regions. It is very probably caused by pollen from some plants, but it is by no means certain of what species they are. Helmholtz has found vibriones in the nasal mucus in this affection, and recommends the topical employment of quinine, which seems to destroy the vibriones. Removal from districts where the disease prevails is the only means of cure, but the usual palliatives may be employed. (See MORRILL WYMAN, *Autumnal Catarrh*, 1872.) REV. BY WILLARD PARKER.

Hay'cock, tp. of Bucks co., Pa. Pop. 1250.

Hay Creek, tp. of Goodhue co., Minn. Pop. 901.

Hay'den (FERDINAND VANDEVEER), M. D., PH. D., LL.D., b. in Westfield, Mass., Sept. 7, 1829. When young he emigrated to Ohio; graduated at Oberlin in 1850, and took his degree as doctor of medicine at Albany, N. Y., in 1853. He did not practice medicine, but commenced his explorations of the Western Territories in 1853. He was a surgeon of volunteers during the civil war, and was brevetted lieutenant-colonel for meritorious services at its close; was appointed professor of mineralogy and geology in the University of Pennsylvania at Philadelphia in 1865, and resigned in 1872; commenced the geological survey of the Territories in 1867 under the auspices of the general government, with an appropriation of $5000; continued in 1868 with $5000; 1869, $10,000; 1870, $25,000; 1871, $40,000; 1872, $85,000; 1873, $115,000; 1874, $95,000. Seven annual reports have been published, with abundant illustrations; also some volumes of miscellaneous memoirs octavo, and a number of volumes quarto. Besides the reports of the survey, Dr. Hayden has written about 50 memoirs, some of them good-sized volumes. His reports of the explorations of the famous Yellowstone region in 1870 and 1871 induced Congress to set apart by law, as a national park, 3575 square miles of the public domain, containing within its limits most of the geysers, hot springs, and other wonders of that region. Dr. Hayden is a member of the National Academy of Sciences, and of nearly all the other scientific societies of America; honorary and corresponding member of a large number of scientific bodies in foreign

countries. Dr. Hayden has occupied more than twenty years in the exploration of our great West, and has extended his investigations over the greater portion of Kansas, Nebraska, Colorado, New Mexico, Dakota, Montana, Idaho, and Utah.

Hay'den (JOEL), a prominent manufacturer of Williamsburg, Mass., b. Apr. 7, 1798. He founded the village of Haydenville, where he was successfully engaged in cotton manufacturing and the making of gold pens, and where he afterwards established a large brass-foundry. He was (1861–62) a member of the governor's council, and (1863–65) lieutenant-governor of Massachusetts, besides holding other important offices. D. in New York Nov. 10, 1873.

Hay'denville, an important manufacturing post-v. of Williamsburg tp., Hampshire co., Mass., on the New Haven and Northampton R. R., 7 miles N. W. of Northampton. It has a savings bank and a good water-power, which is well improved. In 1874 it was nearly destroyed by the bursting of the Williamsburg reservoir, when the loss of life here was very great.

Haydenville, post-v. of Green tp., Hocking co., O., on the Columbus and Hocking Valley R. R., 57 miles from Columbus, has extensive mines of coal.

Haydn (FRANZ JOSEPH), b. in Rohrau, near Vienna, Mar. 31, 1732; d. in Vienna May 26, 1809, seventy-seven years of age. When a mere child he assisted the family music by playing on two sticks as violin and bow with so much expression that at five years of age a schoolmaster named Frank took him to Hamburg for education. During the three years spent with Frank he learned reading and writing, something of Latin, and the elements of music and of the art of singing. He also commenced to play on the violin and several other instruments, besides the drum, of which he was very fond. At eight years of age his fine voice and his intelligence attracted the attention of Reuter, who took him to Vienna as chorister for the cathedral of St. Stephen. There he diligently followed his art, learning what he could from his associates and from observations in the course of his work. At thirteen he made his first effort at composing by writing a mass, which was so crude that Reuter laughed him to shame. But not disheartened, Haydn set to work with characteristic patience and industry, teaching himself the art of composition from the dry and obscure works of the period. When by the natural change his fine soprano voice was lost, Reuter turned him into the street penniless. A poor barber named Keller gave him a bed in his garret. There, with a worm-eaten harpsichord, a few books, and some scores, he worked in tranquillity, occasionally having a bout down stairs with the wigs, or with Anne Keller, to whom, in an evil hour, he proposed marriage. After a while his lessons and playing on the violin and the organ gave him a support. In these early years he was so attracted by the sonatas of Karl Philipp Emanuel Bach as to study closely his style, and he mastered it so well that Bach recognized the complete success of his effort. Sammartini, a prolific Italian composer of clear and graceful style, exerted the only other influence which affected his early work. He was introduced to Porpora, one of the greatest masters of that day, and knowing what inestimable benefits might be derived from such a source, Haydn devoted himself to Porpora as valet, brushed his boots, dressed his wig to perfection, ran on his errands, and steadily labored to overcome that master's ill-humor and repulses. Finally, Porpora received him fully, made him his accompanyist, his companion, and gave him invaluable knowledge of the art of Italian singing and of correct, elegant composition. His productions improved much after this, and brought him some personal attention. But, although publishers issued many of his works, he derived little or no benefit from them, being either ignorant of their publication or too retiring to enforce his claims.

The precarious period of his life ended at twenty-eight years of age in 1760, when he became chapel-master to Prince Esterhazy and a member of his household, receiving a salary of 400 florins, which was later raised to 1000. Rarely do circumstances harmonize so completely with character as in Haydn's life from 1760 till 1790. He was the intimate friend of his beloved Prince Nicholas till death severed the bond. The prince played the violoncello, and fully appreciated Haydn's genius. What more charming offering of friendship than Haydn's fresh compositions, 150 of which were written for his patron's instrument? The monotony of the country life at the court of Eisenstadt was varied by the most healthful recreations—mountain rambles, hunting, fishing, occasional visits to Vienna, musical evenings, and friendly, affectionate intercourse with intelligent men and beautiful women. Haydn, the greatest figure in that little world, and unconsciously one of the greatest in the great world, lived in his calm retirement, contented, laborious, and unambitious. But one misfortune crossed his path. In his prosperity, remembering his gratitude to the barber, he married Anne Keller. Her exasperating nature was too much for even the serenity of Haydn. They lived together but a short time before he left her, sharing his means generously for her support. His affectionate but dispassionate heart found consolation in Mademoiselle Boselli, a singer of the court, as well as in the friendship of other congenial and appreciative people about him. By the death of the prince the tie was broken which made Haydn unwilling to travel. In 1790, at the age of sixty, he visited London, where his enthusiastic reception was a proof of his renown surprising to him. At this time his accumulated fortune was $5000. In 1795, after a second voyage to London and some of the continental cities, having amassed $100,000, he retired from the Esterhazy service, and bought a house and garden near Vienna. There he remained till his death, modestly receiving the greatest honors from all parts of Europe. The nobility of Vienna vied with one another in tendering him every affectionate attention to render his last years happy —a striking contrast to their treatment of Beethoven, who died in abject poverty but eighteen years afterward.

Haydn was small and slight in stature, and of so dark a complexion that he was nicknamed "the Moor." But his face was kind and unaffected, expressing a placid, healthy, genial nature. He was extremely generous in his recognition of other musicians. The love between young Mozart and his "papa Haydn" is one of the sweetest passages in the history of art. He was deeply devout, taking every accomplished work as from God. At the beginning of every MS. are the words "In nomine Domini" or "Soli Deo gloria;" at the end of each, "Laus Deo." When, in the midst of a composition, he was arrested by a difficulty or by the cooling of his imagination, he recited his rosary, which he said invariably brought him success. His character was a remarkable union of genius and industry. Early in life he worked sixteen, even eighteen, hours per day, and later never less than five. From the first he seems to have known his mission, and to have followed it, without error or hesitation, to full success.

Haydn is the father of symphony and of the stringed quartet. He did more to develop instrumental music than any hundred of his predecessors. The leading qualities of his compositions are—perfect lucidity of ideas, perfect symmetry in their development and treatment, and the perfect finish of every phrase and part. In his works are reflected, with surpassing truthfulness, the freshness, calmness, and purity of nature, which so filled his mind that there was no room for storm, passion, or romance. The works of his unceasing industry number about 800; of this extraordinary number, his most esteemed compositions are the twelve grand symphonies written for London, the fifty last quartets for stringed instruments, and the oratorios *The Seasons* and *The Creation*. Yet these were compositions of his later years. The master was already sixty when he turned his attention from instrumental music, in which he had wrought such wonders, to oratorio, in which he expressed the joyous fulness of his nature. Of the 118 symphonies and the 83 quartets that he composed, scarcely a fourth part are ever performed either at public or private concerts in Germany, but the oratorios lose none of their freshness with time. They have all the joyousness of piety. CHARLES H. FARNHAM.

Hay'don (BENJAMIN ROBERT), b. at Plymouth Jan. 25, 1786; d. in London, by his own hand, June 22, 1846; was a student at the Royal Academy 1804. His first work, *Joseph and Mary Reposing*, was exhibited in 1807, and immediately bought at a high price. Two years later his *Dentatus* gained a first prize from the Academy. In 1815 he opened a school of painting, where Eastlake and the Landseers studied, and delivered lectures on painting and design, which were published in 1844. At his instance the British government bought the Elgin Marbles in 1816. Haydon was a man of eccentric genius, inordinate sensibility, and boundless ambition. His life, as told by Tom Taylor (1853), was saddened by pecuniary want, thwarted ambition, crossed vanity, and defeated passion. His reputed insanity, it was found on examination, was due to cerebral disease. Haydon's pictures treated of grand themes: *Uriel and Satan*, *Curtius leaping into the Gulf*, *The Burning of Rome*, *The Judgment of Solomon*, *The* [illegible], *The Raising of Lazarus*, *Christ's Entry into Jerusalem*. The last is the property of the Roman Catholic cathedral in Cincinnati, O. Haydon's life and genius were the subject of much comment in the London magazines. See *London Quarterly* and the *Edinburgh Review*, Oct., 18[illegible]. His reputation as an artist has not increased since his death. His family were provided for by a subscription led by the queen. O. B. FROTHINGHAM.

Hayduk. See HAIDUK.

Hayes (Augustus Allen), M. D., b. at Windsor, Vt., Feb. 28, 1806; graduated at Norwich, Vt., 1823; was assistant professor of chemistry in New Hampshire Medical College; in 1828 removed to Boston; was long State assayer of Massachusetts, and in industrial chemistry has made useful inventions and published scientific papers.

Hayes (Isaac Israel), M. D., b. in Chester co., Pa., Mar. 5, 1832; graduated M. D. in 1853 at the University of Pennsylvania; was surgeon to the second Grinnell expedition, under Dr. Kane, 1853–55; commanded an expedition (1860–61) in the schooner United States, and with a small party in a boat and dog-sledges reached (*viâ* Smith's Sound) land in lat. 81° 37′ N.; was a medical officer in the U. S. service in the civil war; went in the steamer Panther to Greenland 1869; has received gold medals from the geographical societies of Paris and London; author of an *Arctic Boat-Journey* (1860); *The Open Polar Sea* (1867); *Cast away in the Cold* (1868); *The Land of Desolation* (1872).

Hayes (Rutherford Birchard), LL.D., b. in Delaware, Delaware co., O., Oct. 4, 1822; graduated at Kenyon College 1842, and at Harvard College Law School 1845; was major, colonel, and general in the civil war; resigned his seat in Congress; was elected governor of Ohio 1867, 1869, 1875; nominated by the Republicans at Cincinnati, O., for President of the U. S., June 16, 1876, with William A. Wheeler of New York for Vice-President. (See Appendix for a full and complete notice.)

Hayesville, post-v., county-seat of Clay co., N. C. Pop. of v. 35; of tp. 884.

Hayesville, tp. of Franklin co., N. C. Pop. 1630.

Hayesville, post-v. of Vermilion tp., Ashland co., O. It has a literary institute. Pop. 576.

Hay'field, tp. of Dodge co., Minn. Pop. 18.

Hayfield, post-tp. of Crawford co., Pa. Pop. 1824.

Hay Fork Val'ley, tp. of Trinity co., Cal. Pop. 172.

Hay'mond, tp. of Taylor co., West Va. Pop. 934.

Hay'nau, von (Julius Jakob), Baron, b. at Cassel, Germany, Oct. 14, 1786, son, by a morganatic marriage, of the elector of Hesse-Cassel; entered the Austrian service 1801; was wounded at Austerlitz and Wagram; became a major-general 1835; field-marshal-lieutenant 1844; commandant of Verona 1848; was distinguished for military skill and executive rigor in Italy 1848–49; took supreme command in Hungary 1849; gained the victories of Raab, Szöreg, Temesvár, etc.; was proclaimed governor of Hungary. In 1850 he was dismissed from the service for insubordination. D. at Vienna Mar. 24, 1853.

Hayne (Col. Arthur P.), b. at Charleston, S. C., Mar. 12, 1790, was a brother of Gov. R. Y. Hayne; entered the army, and served actively in the war of 1812–15 and in the Creek and Florida wars; was admitted to the Pennsylvania bar after the war with Great Britain, but returned to the army, which he voluntarily left in 1820. In 1828 he was a Presidential elector from South Carolina, and in 1858 was sent to the U. S. Senate. D. Jan. 7, 1867.

Hayne (Isaac), b. in South Carolina Sept. 23, 1745. He served in a cavalry regiment in the Revolution, but in 1780 was made prisoner and set free on parole. In 1781 he was ordered to bear arms as a British subject. His wife and children being dangerously sick with smallpox, he was carried to Charleston, and there compelled to acknowledge his allegiance to Great Britain, though under protest; permission being granted him to return to his suffering family, while at the same time he was exempted from bearing arms, he went to his home, and found his wife dying and one of his children already dead. Soon after he received orders to take up arms against his country. These orders being a plain violation of the agreement made with him, he considered himself free from his parole. He accordingly assumed command of a regiment of South Carolina militia, in which he distinguished himself for valor and energy, but was soon taken prisoner and mercilessly hanged, without a trial, Aug. 4, 1781. Col. Hayne was a wealthy planter and iron-manufacturer of Beaufort district, greatly honored and beloved by all. He was great-uncle to Gov. R. Y. Hayne.

Hayne (Paul Hamilton), son of Lieut. Hayne of the U. S. navy, and nephew of Gov. R. Y. Hayne, was b. at Charleston, S. C., Jan. 1, 1831. He has been editor of the *Southern Literary Messenger*, *Russell's Magazine*, and other periodicals, and has published four volumes of poems (1854, 1857, 1859, 1873). He resides near Augusta, Ga.

Hayne (Robert Young), b. Nov. 10, 1791, in Colleton district, S. C.; studied law with Langdon Cheves, and came to the bar in 1812; served for a time in the war of 1812; distinguished himself in the State legislature; was in 1818 Speaker of the House, and soon after attorney-general of South Carolina. During his U. S. Senatorship (1823–32) he displayed abilities of the first order. In 1824 he enunciated in an able speech the doctrine that a protective tariff is unconstitutional, and he was the first, at least in Congress, to propound the doctrine that a State has a right under the Constitution to arrest the operation of such Federal enactments as she considers unconstitutional. This led to the famous debate between Daniel Webster and himself. He was in 1822 chairman of a committee in the South Carolina State convention which reported the celebrated "Ordinance of nullification." In the same year he was chosen governor. To President Jackson's denunciation of the nullification acts, Gov. Hayne made a defiant reply, and prepared for resistance of the Federal authority. Meanwhile, Mr. Clay's compromise measure averted the threatened danger, and another State convention repealed the nullification ordinance. In 1834, Mr. Hayne became mayor of Charleston, and in 1837 a railroad president. D. at Asheville, N. C., Sept. 24, 1839.

Haynes, tp. of Etowah co., Ala. Pop. 522.

Haynes (John), b. in England, at Copford Hall, Essex; settled at Boston, Mass., in 1633; was assistant in 1634 and in 1636; governor of the Massachusetts Bay Colony 1635; removed in 1636 to the new colony of Connecticut; was its first governor 1639; and was chosen governor every alternate year till his death, Mar. 1, 1654. He was one of the authors of the first constitution of Connecticut (1638), a man of ability, wealth, and influence, greatly beloved by the people and highly honored for his learning and virtue.

Haynesville Plantation, a plantation and post-v. of Aroostook co., Me. Pop. 165.

Hayneville, post-v. and tp., cap. of Lowndes co., Ala., 23 miles W. S. W. of Montgomery and $6\frac{1}{2}$ miles from the Mobile and Montgomery R. R. It has 4 churches, an academy building, a newspaper, a steam-mill, 2 hotels, etc. Pop. of tp. 3484. Ed. of "Examiner."

Hay'nie (Isham Nicholas), b. near Dover, Tenn., Nov. 18, 1824, his parents removing to Marion co., Ill., when he was but six years of age; studied law, and commenced practice 1846, but left his profession to serve in the war with Mexico as first lieutenant 6th Illinois Vols.; returning at the close of the war, he settled at Salem, where he resumed his profession; was elected to the legislature in 1850; in 1853 graduated from the law school of the Louisville University, and in 1856 was appointed judge of the court of common pleas at Cairo, to which place he now removed. He was an active supporter of Douglas and a Presidential elector in 1860; at the outbreak of the civil war became an ardent supporter of the administration, vacated the bench, raised the 48th Illinois Vols., which he commanded at Forts Henry and Donelson, at the battle of Pittsburg Landing, where he was wounded, but in the field again before Corinth; appointed brigadier-general of volunteers Nov., 1862; his appointment expired Mar. 4, 1863, when he resumed his profession. In Dec., 1864, was appointed adjutant-general of Illinois. G. C. Simmons.

Hays, county of W. Central Texas. Area, 690 square miles. It has a fine rolling surface and a good soil. Live-stock, fruit, corn, and cotton are abundantly produced. The county is well timbered and has plenty of good building-stone. Cap. San Marcos. Pop. 4088.

Hays (Alexander), b. at Pittsburg, Pa., 1820; graduated at the West Point Military Academy, July 1, 1844, and entered the army as brevet second lieutenant of infantry; appointed second lieutenant June, 1846; served on frontier duty 1844–46, and in the Mexican war was engaged in the battles of Palo Alto and Resaca de la Palma, being brevetted first lieutenant for gallantry; ordered to Pennsylvania on recruiting duty, he quickly enlisted a large number of men, and returned with them to the seat of war, being engaged in various actions. On the 12th of Apr., 1848, he resigned from the army, and engaged in the manufacture of iron at Venango, Pa., subsequently adopting the profession of civil engineer, which he followed till the outbreak of civil war, in April, 1861, when he was apponted major 12th Pennsylvania Vols., and in the following month a captain in the 16th U. S. Infantry. In Aug., 1861, he was commissioned colonel of the 63d Pennsylvania Vols., and led his regiment in the Virginia Peninsular campaign of 1862, through most of the battles from Yorktown to Malvern Hill, receiving the brevets of major and lieutenant-colonel. In the second battle of Bull Run he was severely wounded and disabled till Sept. 29, 1862, when he was promoted to be brigadier-general of volunteers and assigned to duty in the defences of Washington. At the battle of Gettysburg he was in command of a division of the 2d corps, and subsequently led it at Auburn, Bristoe Station, and the Mine Run affair. In the Richmond campaign of 1864 he fell at the head of his command in the battle of the Wilderness, May 5, 1864. G. C. Simmons.

Hays (William), b. in Richmond, Va., 1819; gradua-

ted from the Military Academy at West Point, July 1, 1846, and entered the army as second lieutenant of artillery; promoted to be first lieutenant 1847, captain 1856, and major 1863; served through the Mexican war with the light artillery in the battles of Palo Alto, Resaca de la Palma, Monterey, Vera Cruz, Cerro Gordo, Churubusco, Chapultepec, Molino del Rey, and the city of Mexico; wounded at Molino del Rey and brevetted captain and major; served subsequently against the hostile Indians in the Everglades of Florida and in Dakota. During the civil war (1861–65) he commanded the brigade of horse artillery of the Army of the Potomac in the Virginia Peninsular campaign of 1862, and the reserve artillery in the battles of Antietam and Fredericksburg; appointed brigadier-general of volunteers Nov., 1862; at Chancellorsville, where he commanded a brigade of the 2d corps, he was wounded and taken prisoner; rejoined the army at Gettysburg, and upon the fall of Hancock, severely wounded, was assigned to temporary command of the 2d army corps. From Nov., 1863, to Feb., 1865, he was provost-marshal-general of the southern district of New York, at which latter date he joined the army before Petersburg, serving with the 2d corps and in command of the reserve artillery till close of the war. Brevetted colonel and brigadier-general U. S. A. for gallant services in battle. D. at Fort Independence, Boston harbor, Feb. 7, 1875.

G. C. Simmons.

Hays (William Jacob), b. in New York Aug. 8, 1830; travelled extensively on the American continent, studying nature and animal life at first hand. His pictures have the merit of entire fidelity, and are marked with a fine animation of feeling. Technically, too, they are admirable as works of art. D. in New York Mar. 13, 1875.

O. B. Frothingham.

Hays City, post-v., cap. of Ellis co., Kan., half a mile from Fort Hays, on the Kansas Pacific R. R., 289 miles W. of Kansas City. It has a large school-house, a weekly newspaper, and the county court-house. Pop. 320.

Wm. P. Montgomery, Ed. "Hays Sentinel."

Hay'ti, an island of the West Indies, next to Cuba the largest of the Antilles, is situated between the Atlantic Ocean and the Bahama Islands to the N., Cuba and Jamaica (from which it is separated by the Windward Passage) to the W., the Caribbean Sea to the S., and Porto Rico (from which it is separated by the Mona Passage) to the E. It extends between lat. 17° 36′ and 19° 58′ N., and lon. 68° 20′ and 74° 38′ W., and comprises an area of 28,000 square miles, including the islands of Tortue or Tortuga to the N., Gonaive to the W., and Saone, St. Catharine, Beata, Alta Vela, and others along the southern coast. Its greatest length from E. to W., from Cape Engano to Cape Tiburon, is 405 miles; its greatest breadth from N. to S., from Cape Isabella to Cape Beata, is 165 miles. The coasts of Hayti, much indented and presenting a line of about 1500 miles, form a great number of bays, safe and commodious for vessels seeking shelter. The great bay of Samana, on the eastern coast, is of paramount importance for the passage into the Mexican Gulf, whether the northern route is chosen through the dangerous Bahama Channel between Cuba and Florida, or the southern through the channel separating Cuba from Yucatan. The principal mountains are Cibao, Bahoruco, La Selle, and La Hotte. The range of Cibao, whose average height is only about 800 feet, but whose culminating point rises about 9000 feet, traverses the island from E. to W., and sends out numerous branches towards the sea which form a multitude of promontories and bays. The slopes, very rough to the N., descend gently to the S. and S. E., and disappear at last in large savannas. The ridge itself, generally cultivable to the very summit, is covered with immense virgin forests. The plains which skirt the mountains or fill the interval between them and the shore occupy the largest portion of the surface of the island; they slope from the mountains towards the sea more or less insensibly, some presenting the aspect of vast amphitheatres, others being seemingly perfectly level. The island is generally well watered by the numerous rivers which descend from the central part of the Cibao range. The principal of these streams are—the Yuna, whose rapid waters traverse the rich valley of Vega Real and enter into the Bay of Samana; the Great Yaque, which runs through the valley of St. Yague and falls into the Bay of Monte-Christi; the Artibonite, which, crowded with caymans, enters into the Bay of Gonaive to the N. of the city of St. Marc; the Ozoma, whose bed is very deep, and the Neyba, both of which, running from N. to S., send their waters into the Caribbean Sea. Other streams discharge their waters into the large salt-lake Euriguillo. On account of the variety of soil through which these streams flow, and the difference of substances which they meet on their passage, and on account of the rapidity of their course, their waters are too turbid for drinking purposes; in the mountain-regions, however, they are limpid and wholesome. From the very configuration of the island, one part of its surface being mountainous, another low and level, results a great variety of climate and temperature. Other causes of a more local character also produce a considerable effect, such as the situation of the island in the region of the trade-winds, the local abundance of water and forests, etc. In Hayti, as in all countries situated between the tropics, the year is divided into two seasons only—the wet and the dry—and the transition from the one to the other is sudden and often violent. The wet season is generally in its full force in the months of May and June. The rain pours down in torrents, and rivers which at other seasons are perfectly dry swell and inundate the country. In the months of June, July, and August the heat generally rises, during the day, to 104° in the plains, and from 63° to 77° on the mountains, and during the night from 59° to 62°. In the same months violent hurricanes reign in Hayti, especially in the southern part, and earthquakes, sometimes strong enough to destroy whole towns, are frequent. But the wet season does not set in at the same time in all parts of the island. Thus, abundant rains fall in the north-eastern districts in the latter part of November, while the northern and eastern districts suffer from an almost perpetual drought. In the western and southern, as well as in the interior districts, the winter—that is, the season of rain and tempests—reigns from May to October. The soil of Hayti is very fertile, and produces coffee, sugar, cacao, maize, rice, cotton, tobacco, fruits, vegetables, etc., besides an enormous quantity of different kinds of trees, shrubs, and plants which might be turned into inexhaustible sources of wealth. Of timber-trees for furniture and building purposes, may be mentioned oak, mahogany, cedar, walnut, ebony, satin-wood, fustic, wax-palm, etc.; of dyewoods, the campeachy, yielding a red dyestuff; the yaws tree, yielding a yellow; and others, besides the indigo-plant and the cochineal fig. The vanilla and the grapevine festoon the forests, the latter yielding an excellent muscatel wine. Of minerals, gold, platina, silver, copper, tin, iron, salt, coal, sulphur, mercury, rock-crystal, jasper, porphyry, and marble have been found on the island. Coal-deposits have recently been discovered and thoroughly explored in the neighborhood of St. Yaque, along the small river Ainbaji, and in the departments of the North, Artibonite, and the South in the republic of Hayti. Copper and iron mines are found on the peninsula of Samana and on the island of Gonaive. The native quadrupeds are few and small, but cattle, swine, horses, and dogs, introduced from Europe, live now in great herds on the savannas. Birds, lizards, insects, and snakes are numerous, and the surrounding seas abound in oysters, lobsters, crabs, and various kinds of fish. The population, numbering about 850,000 (of whom about 700,000 are in the French part of the island, and the rest in the Spanish), consists of whites, creoles, mulattoes, mestizoes, and creole negroes; a few of the aboriginal inhabitants are said to be still living in the Bahoraco Mountains.

The island is divided into two states—the republic of Santo Domingo (which see), comprising the eastern or Spanish part; and the republic of Hayti, comprising the western or French part. This division is old. Hayti (which in the original Caribbean language signifies "mountainous") was the second place which Columbus visited in the New World, and the first European colony was planted here in 1492, and called Isabella. The Spaniards named the whole island Hispaniola, and a new colony was founded in 1496—Santo Domingo. These colonies prospered prodigiously. In 1506 their number had increased to fifteen, and in 1511 Santo Domingo was made a bishopric. But the Spanish government was cruel and barbarous in the highest degree. The native inhabitants, numbering about 2,000,000 at the arrival of the Spaniards, were put to work in the mines, and had to toil like beasts for the advantage of their foreign masters. Rebellions ensued, but, although they were put down with unheard-of severity, in 1517 it was necessary to introduce negro slaves to the island in order to get the mines and the plantations worked. The first negro slaves arrived in 1522, and were kept on the plantations of the viceroy, Pedro Colombo, the son of Christopher. Meanwhile, the native population decreased so rapidly that in 1711 only 21,000 were left, and in our time it is a question whether any exist. The Spanish population also decreased. New and still more wonderful countries were discovered, and the first settlers or their descendants left for Mexico and Peru. The beautiful island became almost a waste. But a new period of its history began with the arrival of the French in 1630. They settled—a number of adventurers—on the island of Tortuga, whence they crossed over to the northern coast of the main island; and so rapid was the growth of this settlement that it was formed into an independent department in 1714. The Spaniards tried to drive the French from the island

but failed, and by the treaty of Ryswick (1697) Spain ceded the western part of the island to France; in 1777 the boundary was fixed as running from the mouth of the Daxabon or Massacre, on the northern side of the island, to the mouth of the Pederuales or Anses-à-Pitres, on the southern. The prosperity of the French colony was wonderful. The value of the importations from France to St. Domingue amounted in 1792 to 293,454,000 francs, and that of the exportations from the colony to France 279,000,000 francs — namely, of sugar, 190,000,000 francs; of coffee, 80,000,000; of indigo, 18,000,000; of cotton, 10,000,000, etc. 1400 vessels, with crews of 30,000 men, were engaged in this trade, and the total population of the colony amounted to about 780,000—namely, 40,000 white, 40,000 free colored, and 700,000 slaves. Of the free colored people, the mulattoes, many possessed large estates in the colony, and were men of education and refinement, but they had no political rights. Instigated by the revolutionary ideas and movements of the mother-country, they demanded in 1790 to be placed on an equal footing with the whites, and organized an army in order to support their demand by force. They were defeated by the whites, and their leaders were cruelly put to death. Nevertheless, in 1791 the national assembly granted their demand in spite of the remonstrances of the white population, and order seemed to return, when in the same year the negro slaves rose in insurrection. Civil war now raged for several years in the colony, and at the same time the Spaniards broke in from the E., and the English conquered and held the western coast districts. Under these circumstances the French commissioners declared (1793) all the inhabitants of the colony free and equal, and appointed Toussaint l'Ouverture commander of the army which the black people now formed. He succeeded in expelling the Spaniards and English, and restored order once more. By the treaty of Bâle (1795) Spain ceded her part of the island to France, and under the government of Toussaint l'Ouverture the prosperity of the island was revived. But in 1801, Napoleon determined to restore slavery in St. Domingue, and sent for that purpose an expedition under Gen. Leclerc to the island. Toussaint l'Ouverture was treacherously captured and sent to Paris, where he d. shortly after, but his successor in the leadership, Dessalines, was also a vigorous and sagacious man, and the French army became so reduced by ill-luck and yellow fever that it had to capitulate (Nov. 30, 1803) to the commander of an English squadron, and (Jan. 1, 1804) St. Domingue declared itself an independent republic. Dessalines was chosen governor for life, but on Oct. 8, 1804, he broke the constitution, assumed the title of emperor of Hayti, and plunged the island, by his ill-considered and fantastic attempt at royalty, into a long series of civil wars, which ended in almost complete social dissolution. Oct. 17, 1806, he was assassinated, and while the eastern part of the island returned to Spanish rule, the western (or Hayti) was for many years divided between several rival chiefs. In 1822, Boyer succeeded in uniting the whole island under his government, and in 1825 France acknowledged the independence of the republic. But in 1842, Boyer was expelled, the eastern part formed itself into an independent republic under the name of Santo Domingo, and Hayti was again divided into different portions and harassed with internal contests. In 1849, Soulouque, who had been elected president of the republic in 1847, assumed the imperial title, but in 1858 he was deposed and expelled, and a republic was again proclaimed. Its first president was Geffrard, who fled in 1867; the next was Salnave, who was expelled in 1870; then followed Nissage-Saget, who succeeded in establishing peace and order. The present president is Gen. Michel Domingue.

The republic of Hayti is divided into four departments: (1) South, cap. Les Cayes (7000 inhabitants); other towns, St. Louis, Arquin, Miragoane, and Jérémie; (2) West, Port-au-Prince, cap. of the republic (30,000 inhabitants); other towns, Leogane, Grand Goave, and Petit Goave; (3) Artibonite, cap. Gonaives (6000 inhabitants); other towns, St. Marc and Petite-Rivière; (4) North, cap. Cape Haytien (6000 inhabitants); other towns, Petite-Anse, Fort Liberté, and Port-de-Paix. The departments are subdivided into arrondissements and communes. According to the constitution of June 14, 1867, the legislative power is vested in a representative assembly consisting of two chambers, and the executive power in a president elected by the representative assembly for a term of four years. During the civil wars commerce and agriculture suffered very much, and the finances fell into an almost irremediable disorder. The annual revenue amounts to 12,000,000 francs, but the expenditures to 14,000,000; and as yet it has not been possible to bring a balance into the budget. In the last ten years, however, great progress has been made. The tonnage employed in the traffic of the country has risen from 60,000 to 150,000; the exportation of coffee from 40,000,000 pounds to 55,000,000; of cotton, from 1,000,000 to 3,000,000; and of cacao, from 1,000,000 to 1,500,000. The sugar cultivation is also progressing, but the raw sugar is generally distilled into rum, of which about 6,300,000 litres are annually produced. Nevertheless, the resources of the country are very far from being properly utilized. The cultivation of indigo, tobacco, and vanilla is nearly abandoned, and that of coffee, the principal source of the national wealth, is carried on somewhat carelessly. The inexhaustible wealth of timber is unavailable, on account of the total lack of roads and canals.

MELVIL BLONCOURT.

Hay'town, a v. of Cass co., Ind. Pop. 260.

Hay'ward, post-tp. of Freeborn co., Minn. Pop. 382.

Hayward (GEORGE), M. D., b. at Boston, Mass., Mar. 9, 1791; graduated at Harvard in 1809; took his medical degree at the University of Pennsylvania 1812; professor of clinical surgery in Harvard University 1835–49. Author of *Outlines of Physiology* (1834), *Surgical Reports*, etc. (1855). D. Oct. 7, 1863. He was one of the leaders of his profession in Boston.—His father, DR. LEMUEL HAYWARD, b. at Braintree, Mass., Mar. 22, 1749, graduated at Harvard 1768, was a surgeon in the Revolutionary war. D. Mar. 20, 1821.

Hayward (NATHANIEL), b. at Easton, Conn., in 1808, shares with Charles Goodyear the honor of inventing the process of vulcanizing India-rubber. He still later made several important improvements in the manufacture of rubber goods, and in 1847 established the Hayward Rubber Co. at Colchester, Conn. He was a man of active benevolence. D. at Colchester, Conn., July 18, 1865.

Hay'wood, county of North Carolina, bounded on the N. W. by Tennessee. Area, 750 square miles. It is mountainous, and has beds of marble, iron ore, and other valuable minerals. The soil is mostly good. Live-stock, wool, tobacco, and grain are staple products. Cap. Waynesville. Pop. 7921.

Haywood, county in the W. of Tennessee. Area, 650 square miles. It is level, fertile, and well cultivated. Cotton, cattle, wool, and corn are staple products. It is traversed by the Hatchie River and the Memphis and Ohio R. R. Cap. Brownsville. Pop. 25,094.

Haywood, post-v. of Alameda co., Cal., 19 miles S. from San Francisco, and 1 mile from the Western Pacific R. R. It has a large school-house, 3 churches, Odd Fellows' building, a regularly organized fire department, 1 weekly newspaper, and a temperance hall; is in a good agricultural district. Pop. 504. C. T. WARD, JR.

Haz'ard, a game of chance played with dice, not for amusement, but for money. The character of the game is such that a professional player, who knows all the possibilities and probabilities of the game, has a twofold advantage over another person.

Hazard, post-v., county-seat of Perry co., Ky.

Hazard (ROWLAND GIBSON), A. M., b. at South Kingston, R. I., Oct. 9, 1801. He is a large and successful manufacturer at Peacedale, R. I. In 1841–42 he succeeded with much difficulty in freeing large numbers of negroes from the North who were illegally held in confinement at New Orleans. He has been several times in the State legislature. Author of an *Essay on Language* (1834), *Freedom of the Mind in Willing* (1864), *Causation and Freedom* (1869), and several other works.

Hazard (THOMAS R.), a brother of R. G. Hazard, was b. at South Kingston, R. I., in 1784. Author of *Facts for the Laboring Man* (1840), *Capital Punishment* (1850), *Report on the Poor and Insane* (1850), *Appeal to the People of Rhode Island* (1857), and other works.

Haz'ardville, post-v. of Enfield tp., Hartford co., Conn., has manufactories of the Hazard brand of gunpowder, a large carpet-factory, etc.

Hazebrouck, town of France, in the department of the Nord, on the Bourre. It has considerable manufactures of linen and yarn. Pop. 8273.

Ha'zel, a genus (*Córylus*) of trees and shrubs of the order Cupuliferæ. Of these, the *C. Avellana* and *Colurna* of Europe and Asia produce the FILBERT (which see), as well as some of the varieties of nut called cobnut and hazelnut, which are used not only as food, but for their oil. The hazel-bush is extensively planted for copses in Europe, and yields material for hoops, hurdles, gunpowder, etc. The *C. Americana*, or wild hazel, and *C. rostrata*, or beaked hazel, yield nuts smaller and not so good as those of the European. There are still other foreign species.

Hazel, tp. in Luzerne co., Pa., contains the borough of HAZLETON (which see), and extensive mines of anthracite coal. Pop. 7110.

Hazel Green, post-tp. of Delaware co., Ia. Pop. 752.

Hazel Green, post-v. of Wolfe co., Ky. Pop. 77.

Hazel Green, post v., in a fertile township of the same name in Grant co., Wis., on the Illinois line. Pop. 725; of tp. 2161.

Ha'zelton, post-tp. of Buchanan co., Ia. Pop. 885.

Hazelton, post-tp. of Shiawassee co., Mich. Pop. 822.

Ha'zen (WILLIAM B.), b. in Hartford, Windsor co., Vt., Sept. 27, 1830; graduated at the U. S. Military Academy July 1, 1855, and entered the army as brevet second lieutenant of infantry, receiving his full appointment as second lieutenant in September following. Immediately on graduating he was assigned to frontier duty, and mostly engaged in scouting against hostile Indians to Nov., 1859, when severely wounded by the Camanches; appointed first lieutenant April, and captain May, 1861. During the civil war he recruited the 41st Ohio Vols., of which he was appointed colonel, and commanded it in defending the Ohio frontier and in operations in Kentucky. In the Tennessee campaign (1862) he commanded a brigade in the armies of the Ohio and of the Cumberland, being engaged at the battles of Shiloh, Perryville, and Stone River; appointed brigadier-general of volunteers Nov., 1862. In the campaign of 1863 he was engaged at Chickamauga, Chattanooga, Missionary Ridge, etc., and in East Tennessee against Gen. Longstreet. In the invasion of Georgia (1864) he was engaged in the various battles and actions up to and including the siege and capture of Atlanta, in command of a division from Aug., 1864, and with the army of Gen. Sherman in the march to the sea. Appointed major-general of volunteers Dec., 1864, and engaged in the march through the Carolinas up to the surrender of the army of Gen. J. E. Johnston, Apr., 1865. He commanded the 15th army corps from May to Aug., 1865; district of Middle Tennessee Oct., 1865, to Jan., 1866; mustered out of volunteer service Jan. 15, 1866. In July, 1866, he was appointed colonel 38th Infantry, transferred to 6th Infantry, 1869. During the Franco-German war (1870) Gen. Hazen visited the seat of war, and on his return prepared a work on school and army in Germany and France. For gallant services in battle during the civil war he received the successive brevets from major to that of major-general U. S. A. He was appointed chief signal-officer, with the rank of brigadier-general, Dec., 1880. G. C. SIMMONS.

Ha'zle Hill, tp. of Johnson co., Mo. Pop. 1904.

Ha'zlehurst, post-v. of Copiah co., Miss., on the New Orleans Jackson and Great Southern R. R. It has 2 weekly newspapers. Pop. 662.

Ha'zleton, post-v. of White River tp., Gibson co., Ind., on White River, 8 miles S. of Vincennes, and on the Evansville and Crawfordsville R. R. Pop. 356.

Hazleton, post-b. of Hazel tp., Luzerne co., Pa., on the Lehigh Valley and the Danville Hazleton and Wilkesbarre R. Rs., 80 miles N. N. W. of Philadelphia. It has important anthracite coal-mines; is the seat of a thriving trade; has varied manufactures, 1 daily and 2 weekly newspapers, 8 churches, 2 banks; and from its elevated position is becoming a very popular summer resort. Its population has largely increased since the U. S. census. Pop. 4317.

Ha'zlewood, post-tp. of Alexander co., Ill. Pop. 671.

Hazlewood, post-tp. of Webster co., Mo. Pop. 1267.

Hazlewood, post-tp. of Chester co., S. C. Pop. 1556.

Haz'litt (WILLIAM), b. at Maidstone, England, Apr. 10, 1778, the son of a Unitarian minister; studied at Hackney College, and for a time labored as an artist, but without high success; became noted as a contributor to journals, writing chiefly upon theatrical and literary topics. D. in London Sept. 18, 1830. Author of *Memoirs of Holcroft* (1809); *English Grammar* (1810); *The Round Table* (1817); *Characters of Shakspeare* (1817); *View of the English Stage* (1818); *Lectures on English Poets* (1818); *Lectures on English Comic Writers* (1819); *Lectures on the Literature of the Elizabethan Age* (1821); *Table Talk* (1821); *The Spirit of the Age* (1825); *Life of Napoleon* (1827); *Conversations with Northcote* (1830), etc.

Hazlitt (WILLIAM, JR.), b. in Wiltshire, England, Sept. 26, 1811; became a barrister of London 1811; a registrar of the London bankruptcy court 1854, of which court he is (1874) senior registrar; chiefly known as translator of historical works of Michelet, Thierry, and Guizot, and of Huc's *Travels;* with his colleague, H. P. Roche, has published some law-compilations, etc.

Hazlitt (WILLIAM CAREW), son of William Hazlitt, Jr., b. Aug. 22, 1834; was educated at Merchant Taylors' School and the Inner Temple; became a barrister 1861. Author of *British Columbia* (1858); *History of the Venetian Republic* (2 vols., 1858; enlarged to 4 vols. 1860); *Sophy Laurie* (1865); *Memoir of William Hazlitt* (1867); *Bibliography of Old English Literature* (1867); *English Proverbs* (1869); *Popular Antiquities of Great Britain*, and has performed much editorial and other literary work.

Head (Rt. Hon. Sir FRANCIS BOND), BART., P. C., K. C. H., and knight of the Prussian military order of Merit, b. near Rochester, England, Jan. 1, 1793; served with the royal engineers at Waterloo, at Fleurus under the Prussian general Ziethen; retired from the army and took charge of a gold and silver mining company in South America, riding over 6000 miles, a narrative of which he published in 1826, entitled *Rough Notes of a Journey across the Pampas;* in 1835 was appointed lieutenant-governor of Upper Canada, where he suppressed an insurrection, for which service he was created a baronet. The title of privy councillor was conferred on him in 1867. Among his many published works are *Bubbles from the Brunnen* (1833); *Life of Bruce* (1844); *The Defenceless State of Great Britain* (1850); *The Horse and his Rider* (1860); *The Royal Engineer* (1870). Wore the Waterloo medal, and was a major (retired list). D. in England July 20, 1875.

Head (Sir GEORGE), b. near Rochester, Eng., 1782; went to Portugal as commissariat clerk 1809; became assistant commissary-general 1811; was sent to Canada 1814, to Nova Scotia 1816; knighted 1831; d. in London May 2, 1855. Author of *Forest Scenes and Incidents in the Wilds of North America* (1829), *A Home Tour* (1836–37), *Rome* (1849), a translation of Cardinal Pacca's *Memoirs* (1850), a good translation of *The Golden Ass* of Apuleius (1851), etc.

Head'ache (*Cephalalgia*) is of many kinds. It is often the result of indigestion, of excess in eating or drinking, of malarial or other specific poison, of uterine disease, or of neuralgia. It is also a common symptom of many fevers and other acute diseases. If persistent headache be not relieved by a correction of the hygienic conditions as regards diet, clothing, exercise, etc., the case requires medical treatment, the character of which must depend upon the probable cause of the difficulty.

Head'ley (JOEL TYLER), b. at Walton, Delaware co., N. Y., Dec. 30, 1814; graduated at Union College 1839; studied theology at Auburn; for two years held a pastorate at Stockbridge, Mass.; was (1856–57) secretary of state for New York. He resides near Newburg, N. Y. Has published *Letters from Italy* (1845); *The Alps and the Rhine* (1845); *Napoleon and his Marshals* (1846); *Washington and his Generals* (1847); *Adirondack* (1849); *History of the Second War between England and the U. S.* (1853), and numerous other popular works.

Headley (Rev. PHINEAS CAMP), a brother of J. T. Headley, was b. at Walton, N. Y., June 24, 1819. Among his works are *Women of the Bible* (1850); *Life of Josephine* (1850); *Life of Mary Queen of Scots* (1856), and others.

Healds'burg, post-v. of Sonoma co., Cal., on the San Francisco and North Pacific R. R., 70 miles N. of San Francisco, the point at which tourists leave the cars for the Geysers. It has 1 academy, 1 seminary, 7 churches, 1 bank, 1 newspaper, Odd Fellows, Masonic, and Good Templars lodges, 2 hotels, 1 incorporated chair, basket, and wine manufactory. Principal business, farming, fruit-culture, stock raising, and quicksilver mining. Pop. 943.

JOHN G. HOWELL, ED. "RUSSIAN RIVER FLAG."

Heal'ing Springs, tp. of Independence co., Ark. Pop. 320.

Healing Springs, post-tp. of Davidson co., N. C. Pop. 675.

Healing Springs, post-v. of Bath co., Va., in Falling Spring Valley. It has three thermal mineral springs, whose waters are useful in a wide range of diseases.

Health [Ang. Sax. *hal*, "hale," "sound," "whole"], physiologically considered, is that condition of organized living bodies in which the blood and tissues are in the state of integrity and functional activity inherent in their normal constitution. All of the structures are necessarily undergoing change, owing to the waste and renewal of their ultimate elements, the cells. There is in the constitution of these elements a tendency to development and a tendency to decay or retrograde metamorphosis. Upon their development depends the growth and maintenance of the organism, while in their retrograde metamorphosis we have their destruction after they have performed their proper functions. This tendency to development and to retrograde metamorphosis of the elements of tissue is impressed upon the organism as a whole, but differs in intensity at different periods of life. In the young the tendency to development is greatest, and we have as a result growth; in the middle-aged these forces are balanced, and the structures are maintained in bulk and symmetry; in the later periods the tendency to retrograde metamorphosis predominates and the organism wastes, and at length

falls into inevitable decay and death. At all periods in the life of any organized body, therefore, molecular changes are in active progress in every tissue, and yet while these changes are in exact accordance with the normal constitution of their elements, a state of health is maintained. But, though this definition is strictly in accordance with the teachings of physiology, it is evident that such a condition of health can be affirmed only in the most general sense of any complex living organism like man. So infinitely numerous are the elementary parts, and so various and powerful the causes which impair their integrity and prevent their functions, that there must be abnormal conditions constantly occurring, which do not sufficiently impair structure and function to enable us to appreciate the deviation from the natural standard. It is only when changes in structure and function are so great as to be detected by the means which we employ for investigation that we can decide that a condition of health does not exist. The terms "good health," "poor health," are improper. STEPHEN SMITH.

Hea'ly GEORGE PETER ALEXANDER, b. in Boston 1808. The larger part of his life has been spent abroad, in Rome and Paris, whither he went at about the age of twenty-eight, and where he still resides. He is chiefly known by his portraits; twenty years ago he was the fashionable portrait-painter of Boston. The striking merit of his great historical picture, *Webster Delivering his Reply to Hayne*, is the portraiture of 130 persons. In twenty years of his art Healy executed 577 portraits, many of distinguished people—Cardinal McCloskey, W. H. Seward, M. Guizot, Marshal Soult, George Peabody, H. W. Longfellow, John A. Lowell, and others, as well American as foreign. His style is free, vigorous, effective, but marked rather by boldness than by carefulness. O. B. FROTHINGHAM.

Heard, county of Georgia, bounded on the W. by Alabama. It is hilly, but fertile. Corn and cotton are leading products. Gold, lead, and iron are found. Area, 286 square miles. Cap. Franklin. Pop. 7866.

Heard's Beat, tp. of Perry co., Ala. Pop. 615.

Heard's Island, an island in the Antarctic (South Indian) Ocean, lying S. E. of Kerguelen's Land, extending between 53° 2′ and 53° 14′ S. lat., and between 73° 50′ and 72° 30′ E. lon. It is about 24 nautical miles long and 9 broad, and its highest point (Kaiser Wilhelm Peak) about 6000 feet high. It was discovered by Capt. Heard Nov. 25, 1853. American and other vessels have here collected large amounts of the oil of sea-elephants and the smaller seals.

Hearing. See ACOUSTICS, by PROF. O. N. ROOD, A. M.; also EAR, ANATOMY OF THE, by PROF. H. HARTSHORNE, A. M., M. D.

Hearne, post-v. of Robertson co., Tex., at the junction of the International and Great Northern and the Houston and Texas Central R. Rs.

Hear'say Ev'idence, evidence which does not consist of a statement of facts within the personal knowledge of the witness by whom it is given, but which is a reproduction by him of statements or information derived from others, upon whose authority alone the credibility of the testimony depends. The term applies as well to written as to oral matter, though the mere name by itself would lead to a different inference. As a general rule, hearsay evidence is not admissible, on account of the little dependence which can be placed upon its accuracy, where the original author cannot be examined and the grounds of his declarations ascertained. But there are certain important classes of exceptions to this rule, which will be found, together with a fuller statement of the reasons for the rule itself, under the topic EVIDENCE. G. CHASE. REV. BY T. W. DWIGHT.

Hearse [Late Lat. *hercia*], the candelabrum in churches upon which candles are burned for ceremonial purposes. It was anciently the custom to place a hearse at the head of a new-made grave; and sometimes the framework which protected the effigy upon a tomb was called the hearse. From these uses of the word arose the modern signification, by which it designates either the funeral car or the catafalque employed in state funerals.

Heart, Human. This organ, as is generally known, is the great central power regulating and compelling the circulation of blood throughout the body. It is really two organs united in one, one-half governing the circulation through the lungs—the other half, that of all the rest of the body. Except for economy of space and synchronism of action, there might as well have been two hearts, placed in different parts of the body. Each of the halves is composed of a receptacle of blood and a propeller of the blood-current—*auricle* and *ventricle*. This heart, then, has four cavities—the right auricle and the right ventricle, and the left auricle and ventricle. The walls of these several cavities are composed essentially of muscular tissue, more or less abundant as the required force is greater or less. The walls of the left ventricle are more than half an inch in thickness, although much thinner at the apex, and those of the right ventricle only a little over two lines. Those of the left auricle are still thinner, and those of the right auricle the thinnest of all. The muscular fibres of the heart are of the variety called striated, having light-colored lines running in the direction of the length of the fibres, and others crossing these at right angles, so as to divide each fibre into little squares, altogether microscopic, called sarcous elements. This is one of two or three instances in which nature has departed from the rule of composing the voluntary muscles of striated fibres, and the involuntary of non-striated.

FIG. 1.

FIG. 1. External view of the heart, showing the beginning of the aorta and pulmonary artery and parts of the right and left auricles, reduced to one-third its natural size.

The right and left hearts are united by muscular fibres which pass in a broad layer from one to the other, and by the union of the fibres of each in the septum. The different layers run in different directions, thus crossing each other at various angles. A plane of muscular fibres runs from before backward obliquely to the left. This is common to the two hearts, acting as a part of each. It unites them into one organ, and at the same time effects the paradox of dividing them into two, hence called the *septum*. The septum ventriculorum is thick and strong; the septum auriculorum corresponds in thickness and strength with other portions of the auricular walls, and is thin.

The capacity of the four cavities of the heart is not equal. In the healthy circulation the two ventricles must receive and expel equal quantities of blood at each contraction, but the auricles may be and are of small size, because the dilatable veins emptying into each serve to supplement their capacity. The left auricle is smaller than the right. The ventricles, it was once generally held, discharge, with each contraction, two ounces, or four tablespoonfuls, each. Substances that can be quickly detected by chemical reaction have been injected into the venous blood, and have been found in the secretions one minute afterwards. Both the pulmonary and general or systemic circulations are completed, then, and secretion or excretion is effected, in one minute. Regarding either ventricle as a blood-meter, multiply 72, the average number of beats per minute in the adult man, by 2 (ounces), and we get 144 ounces, or nine pints, as the quantity of blood in all the vessels of the body. This falls a good deal below the physiologists' estimate. The ventricular working capacity is underrated, or the quantity of blood is over-estimated. This is certain, that after death either ventricle may be found holding fully twice two ounces.

If the blood entered the ventricle by an unguarded opening, there would be no reason why it would not flow back into the auricle and veins, as well as onward into the arteries in each ventricular contraction. To prevent this, on the left side there is a thin but strong membrane attached to the auriculo-ventricular opening, as a bag may be attached to a hoop. As this bag hangs downward into the ventricle, we will suppose the bottom to be cut off and the opposite sides slit up a little distance toward the opening or mouth. Now we have two open flaps below. Narrow them a little, and attach numerous little strings to the lower ends of the flaps; attach these to elastic straps fixed at the other end in such a manner that when the elastics contract the ends and edges of the flaps are brought together. This represents the principle on which the valve between the auricle and ventricle, one on each side, is constructed. That on the left side has two flaps, and has some resemblance in form to that of a bishop's mitre; so this is called the *mitral valve*. That on the right side has three slits, instead of two, and is called the *tricuspid valve*. The elastic straps in this comparison represent the *fleshy columns*, which are rather stout muscular bundles coming out of walls of the ventricles a little above the lower termination of their cavities. Standing upward in the cavity, and half an inch or more in length to the upper or free end of these columns,

[illegible] the two leaves of the mitral valve and the three of the tricuspid will be drawn together, and so the valves will be closed by the simultaneous contraction of the fleshy columns, and thus the muscles of the ventricles will make pressure on the blood as it is forced out into the arteries; and this pressure will cause a more complete coaptation of the valve-leaves, as it is admitted behind the posterior leaf, and is in front of the anterior. Thus, a valve is formed for each auriculo-ventricular opening, which is complete when it is first closed, but becomes more secure by the increase of the force that it is constructed to resist, unless that force becomes so great as to rupture the structures of which it is composed—an accident which is hardly compatible with a healthy state of these structures. Thus, the blood once received by the ventricles is forbidden a return to the vessels and parts from which it came.

But there is still another prevention or stoppage to be explained. The current of blood being forced into the aorta from the left ventricle, and into the pulmonary artery from the right, what is to prevent its return into the cavity from which it has just been expelled? At the very opening of these arteries a valve is provided, the like of which human ingenuity has never invented or imitated. Each is [illegible] artery itself, and the rest is formed of a delicate but strong membrane attached at its sides and bottom to the arterial wall. Thus are formed three cups, each of which is about half an inch deep. The membranous portion of each can fall inward, so as to fill just one-third of the arterial tube. When the blood goes out of the ventricle the membranous portion of these cups yields to the current and becomes closely applied to the wall of the artery, and so offers no obstacle to the flow. As soon as the ventricle ceases to contract, the elasticity of the now distended artery produces a reflux, as well as an onward current. This reflux causes a sudden filling [illegible] they each fall into the arterial tube, meeting in the centre, and form an obstacle to any return of the blood. The margins of these [illegible] are thicker and stronger than the other parts, and the evidence of design in their construction is completed in the production, at the [illegible] prominence of un[illegible] (fibro-cartilage) to fill the triangular space that would otherwise be left [illegible] meeting. This con[illegible] tic valve. In the pulmonary artery it [illegible] pulmonary valve. By this arrangement all the contractile [illegible] the [illegible]

Fig. 2.

Fig. 2. Position of the aortic, [illegible] vessel, when the valve is [illegible]

Fig. 3.

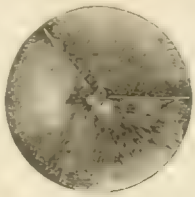


Fig. 3. Position of the [illegible] when [illegible]

[illegible]

[illegible] tendinous cords and fleshy columns.

The muscular structure of the heart is covered on the outside by a thin, diaphanous, attached membrane called the *serous pericardium*, while the name *pericardium* is also applied to the fibrous bag in which the heart moves (heart-sac). This latter is lined on the inside by a diaphanous membrane which is continuous with the visceral serous pericardium: it is "reflected off from the heart," so that the heart-sac has an outer and rather thick layer of fibrous tissue, and an inner delicate lining of serous membrane. This pericardium is attached to the heart only at its *base*, or upper extremity, and where the great vessels pass through it. It lies naturally in contact with the heart, but can in disease be distended and forced off a considerable distance from it. It is made fast below to the diaphragm at the cordiform tendon. Its serous lining secretes a little transparent fluid which serves to diminish friction as the heart contracts and expands.

Endocardium is the name given to the membrane which lines the cavities of the heart. It is a thin, diaphanous structure, resembling the serous pericardium. By the folding of this membrane on itself as it passes from one cavity to another, or from the ventricles into the aorta and the pulmonary artery, the several valves are formed. They are strengthened, however, by the addition of a little fibrous tissue between their folds.

[illegible] first vessels given off from the aorta. Their open mouths can be seen by depressing the membranes of the semilunar valves of the aorta. They descend on opposite sides of [illegible] capillary and countless. The venous blood of the heart is returned into the right auricle by several veins, which open into it through its outer wall.

[illegible] those of the voluntary system, yet it is reported that men have lived who could stop the heart's action at will. The [illegible] sends some of its fibres to the heart; so does the phrenic nerve, though chiefly distributed in the diaphragm. But the hearts of many of the inferior animals will beat after they are removed from the body. The heart of the bullock can be made to beat after such removal by a little irritation. It has been suggested that the muscle of the heart possesses the peculiar power of contracting, in and of itself, without nervous excitation. But since the discovery of nerve-centres of the kind called ganglia about the base of the organ, in the midst of its other structures, it has become probable, if not certain, that an essential part of its nervous supply is centred in itself.

Systole and *diastole* are the contraction and dilatation of the several cavities. The two ventricles contract simultaneously, as do the two auricles, but this action in the latter begins just perceptibly before the same action in the former. The repeated systole of the left ventricle, with what accessories and aids it may meet in its circuit, sends the blood into the right cavities with enough of ventricular force to open and occupy them. So the systole of the right ventricle sends the blood into the lungs with a force that is not wholly lost when it returns to the left chambers of the heart. Thus, diastole is passive, produced by the residual force of the systole of the opposite side.

The *sounds* produced by the action of the heart are two. Anybody can hear them by placing the ear on another person's chest in the region of the heart; indeed, one may hear the sounds produced in his own heart if, in the stillness of the night, in bed, he turn on his side and place the palm of his hand over the ear and rest his head on the pillow. The first begins with the first of the ventricular contraction, and continues till it is ended; the second has no more duration than the sound produced by the snapping of a handkerchief. Half a dozen theories have been proposed to explain the first, but the opinion of the writer is that its essential cause is the friction of the muscular fibres on each other. It has already been stated that in different layers they cross each other at various angles, and they all act together; but even in muscles of parallel fibres a similar [illegible] there is but little difference of opinion, for by experiment it has been proved to result from the collapse or striking together of the aortic and pulmonary valves at the close of the systole. The sound is one or single, because the closure on the two sides is simultaneous.

[illegible] mous, has been carefully studied in the inferior animals, and by inference it is assumed that the average human heart at the maturity of its strength would sustain a col[illegible] column of mercury of eight inches. This is equal to something less than one-third the pressure of the atmosphere—say, nearly five pounds to the square inch. This estimate relates to the strongest portion of the heart only—that is,

the left ventricle. But a material addition must be made to this reckoning. The atmospheric pressure must be overcome by the central force. When Humboldt and his party ascended the South American mountains they found at the high elevations an unexpected source of annoyance and weakness in a bleeding from the nose, gums, and lungs. The cause of this was twofold: the capillary vessels were not made strong enough to resist the power of the heart when the external pressure was considerably diminished, and their effort in climbing had increased the force, as well as the frequency, of the cardiac contraction. So that, really, the contractions of the left ventricle are effected with a force that can move about twenty pounds through the space of one foot in one second in the course of the vessels. The strength which the left ventricle *can* exert is by no means measured in these estimates, for they relate to the ordinary quiet action of the heart. Its possible power, it is fair to assume, is equal to that of a muscle of equal bulk—including, however, only one side of the ventricular walls—in any other part of the body; and that would much exceed the force of the ordinary heart-beats. The power of the right ventricle is assumed to be about one-half that of the left; but of its actual strength, and that of the two auricles, there are no means of accurate measurement.

The velocity of the blood-current in the larger arteries is assumed, from experiments made on the inferior animals, to be about twelve inches in a second of time. In dogs substances easily recognized, injected into one jugular vein, have been recognized in the jugular vein of the other side in from twenty to thirty seconds. In other words, the blood had completed the rounds of the double circulation in twenty to thirty seconds. It has already been said that such substances, similarly injected, appear in the secretions in one minute. There is but one source of error in these experiments. It is possible that a little of the chemical may pass, by endosmosis, through the thin septum of the auricles from the right to the left, and so shorten its course nearly one-half. It does not seem possible that the law of diffusion would cause the dissolved chemical to outrun the blood-current.

The position of the heart in the chest is easily described. In its shape the organ has an imperfect resemblance to a cone. The base of this cone is uppermost, the apex downward and to the left. The heart is very much imbedded in the left lung. Portions of the lung are behind the left half, to the left of it and in front of it, except about two superficial inches. Its base lies under the third rib of the left side, extending three inches from the middle (median) line of the body; the right auricle, when filled, extends half an inch to the right of the right border of the breastbone (sternum) in the second intercostal space, retreating under the sternum in its contraction. The apex is found in the fifth intercostal space, three and a half inches from the median line. Unite this point with the point three inches to the left of the median line on the third rib by a curve that will cross the fourth rib at a point four inches from the median line, and the left border of the heart is indicated. From the point indicating the apex carry a line to the right and a little upward, so that it will strike the right border of the sternum at the fourth rib, thence upward along this right border to the second intercostal space, and we have followed the external lines that represent the internal position of the heart. In the very rare instances of "transposition of the viscera," while the liver occupies the left upper part of the abdomen, the heart is found on the right side of the chest, filling the space on that side which corresponds with its natural position on the left.

The impulse of the heart, or "the heart-beat," as it is felt on the outside of the chest, has been a subject of much discussion, and each one of the many writers on the subject has proposed a new explanation; but Mr. Searle's studies of the course of the muscular layer in its walls have probably suggested the true explanation. Strong muscular bands are found starting from the base, passing over the anterior face of the heart, winding completely around the apex, some of them passing into the ventricles constituting and ending in the fleshy columns. These, it is evident, will draw the apex forward during contraction, directing it against the chest-wall. There is also a recoil of the whole organ at this moment, so far as the large vessels entering at the base will permit it, in obedience to the laws of action and reaction. If the heart exerts a power that can force ten pounds to move in one direction, there is a tendency to recoil in the opposite direction which is equal to the same number of pounds; and as there is some yielding in the great vessels (which under these circumstances act as ligaments), there is actually some recoil, a part of which is by these muscular bands directed against the wall of the chest. But there is a lifting of the whole precordial region in some cases of enlarged heart. This is probably due to the sudden hardening of the organ as its muscles become tense at the beginning of contraction, and to a real want of room for it in its enlarged state.

Weight of the Heart, and the Dimensions of its Orifices.—The size of this organ varies in the adult a little with the stature and weight of the body, but more with breadth of shoulders, and it is in advanced age a trifle larger than at forty. The average from twenty to ninety years, in the male, is ten ounces—in the female, eight to nine; but twelve ounces in man and eleven in woman would not be pronounced hypertrophy. The *left auriculo-ventricular opening* has, according to Bouillaud, an average circumference of 3 inches 6½ lines; the *aortic opening*, 2 inches 5½ lines; the *right auriculo-ventricular opening*, 3 inches 10 lines; the *pulmonary artery* has a circumference of 2 inches 7¾ lines. Thus, it will be seen that the orifice is smallest when the force propelling the blood is greatest, and everywhere, as that force diminishes, compensation is provided by opening a wider door.

The *fœtal heart*, when it begins to show itself as a beating organ, suggests nothing of the elaborate organization it is to become before independent breathing life can be possible. It is at first merely an enlargement of a beating blood-vessel. From this state it changes to such forms as are permanent in inferior types of animal life, passing from one to another, but always from a lower to a higher type, till it is completed. (See CIRCULATION OF THE BLOOD.) It grows, and gets a single partition through it, with an opening in this partition. This is a single heart of two cavities, an auricle and a ventricle. After a time a partition is developed in the lower of these cavities. It is then a heart with one auricle and two ventricles. Still later, a partition is formed in the upper cavity, with, however, an opening which allows free communication from right to left. This is a heart of four cavities, which, after closing the opening in the auricular partition, prepares the individual for life in "this breathing world." So long, however, as the lungs have to perform no function, they receive but little blood through the arteries which are to be enlarged into the right and left pulmonary; but most of the blood propelled by the right ventricle, instead of turning to right and left, goes directly forward into the aorta at the concavity of its arch, through a channel that will disappear soon after birth, called the *ductus arteriosus*. At the same time, the blood coming into the right auricle, or a part of it, passes freely into the left by the opening described above, which is called the *foramen ovale*. Thus, with the exception of the little blood sent for the nourishment of the lungs, this heart of four cavities acts as a single heart of two cavities. The first act of the new-born is to cry. This is the means appointed by nature to expand the chest and compel the opening of the lungs by the atmospheric pressure. No sooner are the lungs expanded than the blood of the right heart is literally drawn into the lungs, the right and left branches of the pulmonary artery expanding. The ductus arteriosus at the same time closes, and is soon to be obliterated. The blood in the right auricle is all directed into the right ventricle by the mechanical closing of a valve already provided on the left side of the foramen ovale. The valve soon grows into the septum, closing the foramen for ever, leaving, however, a little scar-like depression, which is called the *fossa ovalis*. ALONZO CLARK.

Heart Diseases. Every tissue entering into the organization of the heart is liable to morbid change, and some of them to many such changes. An enumeration of these diseases, and a brief synopsis of the nature and leading phenomena of each, are all that will be attempted in this article.

Hypertrophy of the Heart.—This is enlargement, and the term means nothing more, although there are usually other changes attending it. The heart naturally increases in size with advancing years, but the increase is not considerable, and is not regarded as a disease. Hypertrophy is simple when the muscular walls are increased in thickness and there is no other change in the organ. When at the same time there is expansion or enlargement of one or more of the cavities, whose walls are hypertrophied, it is *eccentric hypertrophy*, or hypertrophy with dilatation. Some of the medical authors recognize a concentric hypertrophy, or an increase in the thickness of the cardiac substance and a diminution of the corresponding cavity or cavities. But the better opinion is that this diminution is not the result of disease, but announces that natural contraction, more or less complete, was the last act of cardiac life. The internal cause of hypertrophy, as the studies of the writer of this article demonstrated twenty-five years ago, is an increase in the number of muscular fibres in the cardiac walls, and not an increase in the size of the original fibres. Cardiac hypertrophy is analogous to the enlargement of the blacksmith's arm or turner's leg; new demands made on its strength produce a multiplication of its muscular

fibres. The external cause of this hypertrophy is generally some obstacle to the circulation, requiring increased strength of muscle to overcome it, as a diseased valve, or a tumor pressing upon a large artery, or a large organ so diseased that the circulation through it is seriously obstructed. It is produced by the mental emotions, which increase the force and frequency of heart-beats, as frequent anger and the anxieties that excite the heart (some depress its action), and, it may be added, by causes that have not yet been discovered. Its subjective manifestations are a strong impulse of the heart-beats, which, however, may be very strong and never be noticed by the affected person, and shortness of breath on exertion, and very little else. The physician discovers it by many signs, the chief of which is the extension of dulness on percussion to the left of the line already given as the left boundary of the healthy heart. The heart, once enlarged, never returns again to its original size, and alone it rarely causes death. This usually is the result of secondary disorders, apoplexy or kidney disease, or it may wait for the intercurrence of other entirely distinct diseases. Indeed, if hypertrophy is produced by obstruction to the circulation, within certain limits it is compensatory and conservative.

Dilatation of the heart is an enlargement of its cavities. The left ventricle may be so dilated that its capacity is considerably greater than would be sufficient to contain the whole of a healthy heart. The dilatation may be in all of the four cavities, or may be confined to one. The ventricles are far more liable to dilatation than the auricles, and the left much more than the right. Dilatation and hypertrophy very commonly go together, so that eccentric hypertrophy or hypertrophy with dilatation, already explained, associated with and caused by morbid changes in the shape and function of the valves, is the most common form of heart disease. The conditions of the heart may be regarded as alternately active and passive—active in systole, passive in diastole. If in the passive state, while the blood is flowing naturally into a heart-cavity, there is at the same time a reflux of blood into the same cavity in consequence of a defective valve, dilatation of that cavity will be sure to occur. The extended wall of such a cavity may not be thicker than it is in health, yet as it bounds a greater space it will require more material, and is hypertrophied by multiplication of the muscular fibres. In this state the heart has been known to weigh sixty ounces, or six times its natural weight. There is one preserved at the College of Physicians and Surgeons in New York, which weighed, when first removed from the body, fifty-seven ounces. Hearts like these are *enormitas cordis*, or *cor bovinum and taurinum*. They are almost always found in persons who have had rheumatism and heart disease in childhood, and have grown to manhood with a damaged heart. It is noticeable that children bear these cardiac affections better than adults. The body, as it grows, seems to accept and tolerate an amount of such disease that would overwhelm a grown-up person. When it begins thus early, it is usually carried to manhood, and often to advanced manhood. It is the repetition of the attack which is fatal in childhood. Dilatation with hypertrophy is, after it reaches a certain stage of progress, attended by shortness of breath on exertion, sometimes palpitations, irregular heart-beating, and consequently irregular pulse. Its chief danger is, however, an induced or secondary Bright's disease, with dropsical swellings of the legs and body; without which the common forms of heart disease are not generally fatal. There is a form of dilatation of the heart in which there is not only no hypertrophy, but in which the walls of one or all the cavities gradually grow thinner and thinner by fatty degeneration and absorption of the muscular tissue, till this tissue is almost wholly removed, and the walls are stretched and expanded in the effort to expel the blood from their cavities. But this is a rare disease, and may be passed with the statement that it is possible.

Simple atrophy of the heart (diminished size and weight) occurs only with wasting diseases, in which the quantity of blood in the system is diminished also, and it should not be regarded as a disease.

Diseases of the Valves of the Heart.—Endocarditis, or inflammation of the lining membrane of the cavities of the heart, is a common attendant on acute rheumatic inflammation of the joints, but it may occur without rheumatism. This inflammation is one of the principal causes of derangement and imperfection in these essential appendages of the heart. Thus, endocarditis expends its force principally on those duplications of the endocardium which constitute the valves. It deposits a new material between their folds, and at first increases their thickness. A portion of this new material is converted into fibrous structure, and finally the fibres contract. The result is, that these valves become thick and unyielding, so that the semilunar cannot be applied to the arterial wall when the blood is forced into the aorta or pulmonary artery. The mitral and tricuspid grow stiff and hard, and do not fully give place to the blood passing from the auricle into the ventricle. Again, this new fibrous structure contracts and shortens the valves, so that their parts cannot meet properly and prevent the reflux of the blood. So blood from the ventricles sent into the great arteries will flow back again into the heart, to be forced out again by new contraction. This is *insufficiency*, or regurgitative disease of a valve. The stiff, unyielding state, when it obstructs the current, is called *obstructive disease of the valve* (*stenosis*). The valves are thickened also by the deposit between their folds of a yellowish substance, made up partly of small microscopic cells, and partly of fat-globules, called *atheroma*, one of the products, it is believed, of a slow or chronic inflammatory action. In time this atheromatous deposit is apt to be converted into, or rather is replaced by, a hard calcareous material, or even organized bone-structure. In the same way the least organizable portion of the deposit of acute inflammation (endocarditis) may slowly be replaced by the same material. This is the *ossification of the valves*. It is not a very frequent occurrence, and is limited usually to a small portion of a valve. But it does mischief, partly as an obstacle to the blood-current, but more by irritating these movable folds and keeping up chronic inflammation in them, and causing thickening, inflexibility, and shortening (just described), or increasing them if they have already occurred.

Rupture of the valves is possible. The aortic valve may yield in the bottom of one of its cups; or the marginal thread may separate from the deeper part of the cup; or the upper attachments of the cups to the aorta may give way; or the anterior leaf of the mitral valve may be perforated; or one or more of its tendinous cords may be broken. These accidents usually occur after the ruptured part has been weakened by the deposit in it of a plate of atheroma; yet they may yield without previous disease, but then always at the time of great exertion of muscular strength in lifting weights, running, jumping the rope, or the like. The reader may remember to have seen a few years ago a newspaper statement that a girl about twelve years old had been seriously injured by jumping the rope nearly 200 times without stopping. It was ascertained in that case that there was rupture at the mitral valve, probably of some of its tendinous cords.

Vegetations on the Valves.—This is another of the results of inflammation. They are minute hard warts that are formed on the free surface of the aortic valve just below its thickened margin. These are chiefly important as being the occasion of the deposit of masses of the fibrin of the blood upon the valves, so producing large granular-looking warts, which obstruct the outflow from the ventricle. Any roughening of a valve-surface by inflammatory or other disease, or by rupture, may cause the deposit of these *fibrinous concretions*. When they occur they not only obstruct the flow of the blood, and partially disable the valves, but portions of them may be washed off into the arterial current, and be carried into a distant organ, as the brain, spleen, or kidney; and one of these reaching an artery too small to receive it, it stops there, and cuts off the arterial blood from all portions of the organ usually supplied by the obstructed vessel. This mode of plugging up the arteries is called *embolism*; the plug itself is an *embolus*.

In the advanced stages of these diseases of the valves and muscular structure it is not difficult to arrive at the opinion that there is heart disease. Shortness of breath, induced by exercise, the strong heart-beating, beating of the vessels in the neck, and, when the kidneys become diseased, the dropsies, the distress produced by lying down, tell the truth but too certainly. But they do not designate the particular form or forms of disease. This can only be learned by listening to the sounds produced by the action of the heart, and by actual measurement by percussion. Thus, in addition to the two natural sounds remaining, from one to four new ones may be produced, called murmurs. If there is a murmur heard most distinctly under the breastbone, where the third ribs are joined to it, and while the ventricle is contracting (in systole), it is probable that there is obstructive valvular disease, either in the aorta or pulmonary artery, and the chances are thirty to one that it is in the former, for in this proportion at least is valvular disease found more frequently on the left than on the right side. Indeed, the grave valvular diseases of the right heart are almost always found to have occurred before birth. The aortic valve murmurs are heard somewhat more distinctly at the right border of the breast-bone, and those of the pulmonary valve at the left border. If there is a murmur with, and after the second, heard most distinctly at the same place, it indicates insufficiency—that is, regurgitation, as already explained. It will be remembered that the two hearts contract simultaneously, and that the two second sounds are

simultaneous. If, then, the second sound on one side is silenced by deformity of the valve, the valve on the other side is, in all probability, normal, and produces its own normal second sound strongly enough to be heard. A murmur heard most distinctly in the left and lower part of the heart-region (toward the apex) is referred to a diseased mitral valve. If it is in systole, the valve is insufficient, and there is regurgitation from the left ventricle into the left auricle. If it is in "the period of repose"—that is, the period between the second natural sound of the heart and the recurring first—it will indicate an obstruction, from the stiffness or other diseased change in the valve, to the flow from auricle to ventricle, for it is in this period that the auricle is emptying itself into the ventricle. There is nothing in the tone or other characters of these murmurs which indicates the character of the valve-change, except that a musical murmur is sometimes produced by the string left when the thicker border of an aortic cup is split off from the membrane below it, or a similar cord may be formed by rupture of the mitral valve. This must be learned, if it can be learned at all, from the general history and symptoms of each particular case.

With two exceptions, these murmurs are positive indications of change in the form, thickness, dimensions, or structure of these valves. There may be an *anæmic murmur* with the ventricular contraction at the aortic opening when the blood is thin, or does not contain its normal quantity of animalized elements—or, in other words, when it contains too much water (*hydroæmia* and *chlorosis*)—and there may be actual regurgitation, and the corresponding murmur at the mitral valve, caused by the irregular or imperfect contraction of fleshy columns of the left ventricle. The same rules are applicable to valvular diseases of the right heart, except that the murmurs of the tricuspid valve are heard at the junction of the sternum and fourth right rib, and those of the pulmonary artery, at the junction of the left third rib with the same bone.

These are the common forms of heart disease; and there will be in this article no better place than here to say that the popular opinion of their fatality is erroneous. Few persons can hear the announcement that they have disease of the heart, of whatever kind, without hearing in it the command, "Set thine house in order, for thou shalt surely die," and the general expectation is that the death will be sudden. It is true that there are sudden deaths from heart disease, even in persons who have not been ill enough to consult a physician. But these sudden deaths are exceptions. For one such, a quarter of a hundred live on till death comes through some disease which could not have been looked for, or the kidneys become involved in secondary Bright's disease, and perhaps become the chief actor in the concluding scene. The writer discovered in a young lady thirty-four years ago mitral regurgitation and decided hypertrophy of the heart. Now she is the mother of seven children, and, as far as her friends can judge, is in perfect health, except that she has shortness of breath at times. He examined a gentleman sixty-five years of age who had obstructive aortic disease and hypertrophy, in whom he traced the origin of the affection back to an attack of rheumatism when the patient was fifteen years old; yet this gentleman had had the energy to amass for himself a fortune of a million of dollars, and to build up the fortunes of two brothers; and that, too, in the good old times of honest industry. He knows physicians who carry considerable heart disease for indefinite years through an active practice. He knew one, an old gentleman, who had the disease nearly all his life, and continued his professional work till within a few days of his death. His heart weighed after death two pounds three ounces and two drams. The former possessor of the heart which weighed 57 ounces, referred to in this article, became diseased when he was six years old, and he died at twenty-eight, having been active as foreman in a large cotton-mill till four weeks before his death; and even then death was caused more by the kidneys than by the heart. These are not rare instances, but represent the important fact that these diseases, even when extreme, do not generally cause death without aid from another important organ; and when moderate in degree, if the avoidable causes of their increase are avoided, have till the age of sixty and upward but little influence in shortening life, except, again, with the concurrence of other and dangerous diseases.

Pericarditis.—As the lining membrane of the cavities is subject to inflammation, so is the external covering. This and the lining of the fibrous pericardium are alike liable. They are indeed but one membrane. Pericarditis and endocarditis often occur at the same time, being both produced by an extension or migration of articular rheumatism, or rather by that same state of the system which causes the articular disease. Either of these diseases may accompany Bright's disease. Beyond the concurrence with these affections the causes of pericarditis are not well defined. The disease itself, as well as endocarditis, has only been intelligently observed during the present century. The changes produced by pericarditis are, first, an increase in the quantity of blood in the vessels of the membrane; second, absorption of the fluid which in health diminishes the friction between the heart and pericardium; third, the discharge from the engorged blood-vessels of the fluid portion of the blood (*liquor sanguinis*) in condition to form new tissue, *false membrane*, or of the more watery parts, known as *serum*. Both of these products of this inflammation are commonly found, but the serum is usually much the most abundant and the most oppressive. When there is little serous fluid, the disease may run its course with but little general disturbance; but when the quantity is large, there is a rapid pulse, oppressed breathing, and a tendency to faint when sitting or standing. The pericardium is distended by its watery contents, sometimes even to tension; then the normal dilatation of the heart-cavities becomes difficult. But this fluid is absorbed usually in about a week, and the pericardium comes back to its contact with the heart. The common opinion regarding the fibrinous coating produced by inflammation is that it receives blood-vessels, and remains for a time the medium of the union which almost always takes place between the pericardium and the heart, after pericarditis; but according to some late German teachings it readily breaks up into granular and fatty matter, and is carried away by absorption; and they account for the adhesion by stating that the serous membrane is roughened during the inflammatory process by the production on its surface of many little granules or warts composed of fibrin, and that these mutually grow into the opposite surface, and so cause a blending. There is produced by the dry condition of the membrane, caused by the first engorgement of the vessels, a distinct creaking or rubbing noise as the heart moves in the pericardium. This sound is renewed when the fibrinous exudation takes place, heard first in systole, and soon after in both contraction and expansion of the heart. This may be interrupted when the serous effusion lifts the pericardium off from the heart, to be renewed again when the serum is absorbed and contact is renewed. The adhesion above spoken of takes place soon after the renewal of contact, so that in this recurrence the friction-sound does not commonly continue for more than a day. When the area of dulness on percussion is rapidly extended to the left of the heart and above the third rib, and this extension follows the friction-sound, it is produced by the serous effusion. The heart-sounds under these circumstances become a little less distinct as the heart is buried in water. This is the condition indicated by the phrase "water on the heart," popularly supposed to be a common malady, but it is not found to exist in one in twenty of the cases in which it is suspected. Pus is not often found in the pericardium after inflammation. In *chronic pericarditis*, implying chronic distension of the heart-sac, the fluid causing the distension is partly pus (sero-purulent). Chronic pericarditis is a grave disease; it is almost always fatal. In it the pericardium, in one case treated by the writer, was found to contain a gallon of sero-purulent fluid. Acute pericarditis is rarely fatal in the first attack. But in young persons subject to recurring rheumatism each return is more and more dangerous; even the third is not unfrequently fatal.

Pneumo-pericardium (air or gaseous matter in the pericardium).—A man amid the horrors of delirium tremens had a plate on which two teeth were set detached from his mouth, and he tried to swallow it, but it was stopped in the œsophagus (gullet) at a point just behind the heart. A projecting angle of the plate pierced the walls of the œsophagus and pericardium, and opened a passage by which the food and drink passed directly into the latter. Air also entered the pericardial sac. With each contraction of the heart there was a splashing noise, such as is produced by the agitation of a bottle containing air and water. Cancerous disease sometimes produces a similar opening. Gaseous matter of some sort—perhaps carbonic acid gas—is in rare instances liberated in this sac, and, so far as is known to the writer, there is always fluid in the cavity at the same time. The splashing in contraction of the heart is heard even a few inches from the body. The signs of this kind of pneumo-pericardium pass away as the signs of the pericarditis which it accompanies disappear. The perforation of the pericardium with admission of air is almost always fatal, while the elimination of gas in the cavity is not generally attended with serious consequences.

Carditis, or *myocarditis*, is an inflammation of the muscular structure of the heart. It is an occasional attendant of endocarditis or pericarditis, or may occur independently. The symptoms are vague and uncertain, so that it is difficult, and often impossible, to recognize it during life. It is, then, chiefly known by certain conditions found after death. In

limited portions of the left ventricle, or in the septum of the ventricles, the muscular fibres are broken up into fatty matter and fine granules, forming what is commonly called an abscess; indeed, real abscesses are seen when the cause of the carditis is septicæmia (poisoning of the blood by decomposing animal matter), as in gangrene of the lungs. But what is more frequently met with is a cicatrix, one or more, showing that while the muscular element is broken down, its fibrous covering (perimysium) has increased in quantity, and forms a depressed cicatrix, the pyoid matter having been absorbed and carried away. These cicatrices do not always restore the strength of the structure they replace. Hence, they sometimes yield gradually, producing aneurism of the heart. Such is the current view of myocarditis, but the writer gravely doubts whether this kind of fatty degeneration of the cardiac muscle is the result of full inflammatory action.

The muscular fibres of the heart sometimes undergo a *fatty degeneration*, in which, without change of size or change in the valves, little globules of oil have replaced the muscular substance. This degeneration weakens the heart, and causes it to act irregularly, changes its color from dark red to yellow, and materially diminishes its firmness. The disease is named after the English surgeon who first described it, *Quain's degeneration*, or, better, *Quain's disease*. The same gentleman has recently announced that there is an hypertrophy of the heart which is caused by an increase of the fibrous structures of the organ, while the muscular elements remain unchanged. The admission of the existence of such a disease awaits further investigation. Should the observation be verified, we shall have to admit into medical nomenclature *Quain's hypertrophy*.

Fatty degeneration has long had a significance very different from that of "Quain's disease." There is always on the outer surface of the heart a limited amount of what is called *adipose tissue*, or, in common language, "fat." This tissue is composed of layers of cells almost large enough to be seen by the unassisted eye, each having one or more capillary blood-vessels passing over and nearly around it. These cells contain oil, the quantity of which is large, when a person is said to be "fat," or they are empty and small, when he is pronounced to be "lean." This tissue is found under the skin in many parts of the body, but not in all, and in considerable quantity in the abdominal cavity. The portion of it that naturally belongs to the heart is small, and lies outside the muscular structure, and within its external serous investment (*serous pericardium*). The quantity of this is sometimes dangerously increased. It increases always at the expense of the muscle of the organ, so that the muscular wall becomes thin at certain places; and as the adipose tissue has not the strength of muscular, which it has displaced, the heart-wall is weakened where it is most increased. The undiminished strength of the other portions of the wall of the same cavity will sometimes cause this weaker part to give way.

Rupture of the heart occurs in the manner just described. It may occur also when the wall of either ventricle is weakened in one part only or principally. This may be the effect of a local development of Quain's disease, of an ulcer caused by the deposit of atheromatous matter on the outer surface, and its subsequent softening; of abscess and pseudo-abscess resulting from myocarditis, as above described; or from *aneurism* of the heart, in which an external tumor is formed by the internal pressure of the blood and the gradual yielding of a limited portion of the wall. There is then really a *ruptured heart*. When this rupture occurs, the blood pours through it, and soon fills the pericardial sac, and the heart-dilations are prevented. Such a sudden death is preceded by few symptoms, and sometimes by none. This occurrence is, however, rare. When it results from adipose degeneration, it is commonly found in the right ventricle; when from other causes of local weakness, it is usually found in the left.

Heart-Clot.—In rare instances the blood coagulates in the heart before death. This coagulation may be the cause of death, or the subject of it may survive for years. It may occur in the left ventricle, where it may be an inch or more in diameter, but being attached to the raised cross-muscles of this cavity, it does not obstruct the passage of the blood into the aorta. The fibrin which constitutes this mass is arranged in layers, and in most of the few instances that have been seen the central portion had already broken down into a yellowish fluid, which has been erroneously taken for pus. The late distinguished Dr. Cheesman presented to the New York Hospital Museum a ball fourteen lines in diameter, of a dull gray color, composed of several concentric layers of fibrin, having a cavity at its centre which held a teaspoonful of a black thick fluid. This was taken from the heart of a lady who had been subject to fainting, and died suddenly. It had long occupied the left auricle, resting unattached directly over the opening into the ventricle. The auricle was only moderately enlarged, but the irritation caused by this body had produced fibrous thickening in all the approaches to the opening. This was an evidence that the ball had been in that position for a long time. The collection of the coloring-matter in the central cavity, the laminated arrangement of its walls, and the dull opaque appearance of the fibrin, proved the same thing. It had all been produced in one coagulation, probably in one of the faintings. The opening had become elongated by the pressure of the blood-current, so that the blood passed on the right and left of the ball, till, at the last moment, a vigorous contraction of the auricle drove the ball so far into the opening that it acted as a ball-valve, and in this position it was found after death. Clots and fibrinous aggregations, then, can be formed in the heart-cavities during life, and may be the cause of death, either suddenly or remotely. The clots found after death usually fill one or more of the cavities, and are attached to the cavity-wall *in all its circuit*, or they are divided into two parts —one yellow or yellowish-white, glistening, and not wholly opaque; the other very dark, almost black. In hundreds of instances, such coagulations as these have been regarded as ante-mortem clots, and the immediate cause of death. If a clot is formed before death, the heart must contract upon it at least once. One such contraction is sure to separate it from its adhesion through a considerable portion of its circumference. The production of the light-yellow clot is only possible when the blood has been at rest long enough to allow its red corpuscles to sink in the fluid as far as this buffy portion extends; and the reason for its forming so considerable a portion of the whole coagulum is that the blood does not usually coagulate in the body till about six hours after death.

Embolism and Thrombosis of the Coronary Arteries of the Heart.—The first of these terms refers to the fact that clot or fibrinous concretion may form in the heart, as already explained, and that a part or the whole of it may be detached and carried forward till it reaches an arterial division too small to receive it; it cannot go back, but must remain there, preventing the circulation of arterial blood in the artery beyond it, till it is disintegrated and carried away. It is possible that a portion of a fibrinous concretion on the valves or wall of the left ventricle, so detached, may enter one of the coronary arteries, and so obstruct it. But a section of the aortic valve covers the mouth of each of these vessels during the contraction of the ventricle, and they receive their blood in the reflux, after the closure of the valve; and the force that propels it is the elasticity of the aorta. This protected condition must render such an accident very rare. What we are more familiar with is *thrombosis*, or the coagulation of blood in the artery. This cuts off half of the supply of blood to the heart; a pretty rapidly increasing feebleness of the heart-action follows, with a weak and slow pulse, great prostration of strength, extreme paleness of countenance, coldness of the feet and hands, and after these symptoms death occurs in ten to twenty hours in the majority of the cases.

Angina pectoris (breast-pang) is a suffocative pain felt in the position of the heart, shooting into the left shoulder and arm to the elbow or wrist; or it is a sensation such as the patient thinks would be produced if the heart were grasped in the hand of a strong man and crushed; or it is such as would be produced by a load of ice laid over the heart. It is attended by the dread of instant death. It is a neuralgia, and more than a neuralgia, and commonly occurs in those who have disease of the heart, although it has been known to depend on injury of the spinal cord near to the head. The particular conditions of disease that produce it have not been ascertained very accurately. Dr. Forbes, however, found that ossification of one or both of the coronary arteries was associated with it oftener than any other single change. It is produced in many persons having disease of the heart by walking. This form of it subsides with rest for a few minutes, but is immediately reproduced by the same cause. That which occurs when the patient is at rest or sleeping is more severe, and has often a duration of one to four hours. It is only rarely the immediate cause of death. The pulse is often entirely unaffected by it.

A[illegible] [illegible] been found [illegible] in the muscle of the heart, producing great disorder in the heart's action without change in its size. *A heap of similar matter* has been found [illegible] the organ between it and the heart-sac, in some places more than an inch wide and wholly [illegible]. *Tubercles*, such as produce consumption when they occur in the lungs, and cancer, are not unknown in the heart.

The *parasites* of the heart are the *[illegible]* and the *[illegible]*. The *[illegible]* [illegible]. It is like a [illegible] and has a retracted [illegible], or, by its etymology, tail. It is most frequently found in the

flesh of pork, and when introduced from that source into the human intestine it elongates by the growth of joints on its bottle extremity, and forms one of the varieties of tapeworm (*Tænia solium*). In the heart it lives out its life as a bottle and a neck, undergoing no transformation. It is large enough to be seen by the unassisted eye. The *Echinococcus* is again a bottle, a round bottle, and a neck, the extremity of which is armed with a double circle of hooklets. This neck is extended when the animal is, so to speak, confident of safety, but on any alarm it, with its hooklets, is drawn into the centre of the bottle. This little creature, when received into the intestines, like the *Cysticercus*, is produced by its lower portion growing into a succession of joints, resulting in a tapeworm different from the *Tænia solium;* found often in dogs and some other animals, not yet found in man.

Deformities and Defects.—The growth of the heart may be arrested in any of the imperfect stages referred to under the head of *Fœtal Heart.* It may have but two cavities, an auricle and ventricle, or two ventricles and one auricle, or two auricles and one ventricle; the pulmonary artery may be small or not developed; so also the aorta may be small or wholly obstructed at its origin; the foramen ovale may remain open after birth; there may be an opening in the septum of the ventricles which will permit free communication from one to the other; the ribs over the heart may be absent, so that the skin is its only chest-covering—indeed in certain rare instances the organ has been found beating and wholly outside the chest (*ectopia cordis*), suspended by its vessels, which were internal; in rare instances there is no heart: such a fœtus usually has no head or arms, but lumpy growths instead, and must always be one of twins, the circulation being produced by the twin heart through the placenta. The most common of these defects is an open foramen ovale, permitting venous blood from the right auricle to mingle with the arterial in the left. This is produced when the current through the pulmonary artery is obstructed. This state of the heart is known as *morbus cœruleus.* The name, however, applies equally to other congenital defects that permit venous blood to pass into the left heart or into the aorta to circulate in the arteries, producing blueness of the skin. This color is not constant, except in a few, but is produced by crying, a fit of coughing, excitement, or unusual physical exertion. It is not incompatible with a life of limited duration, but is likely to be attended by diminished growth of body, bodily and mental sluggishness, shortness of breath, palpitation at times, and occasional fainting. If the subject of any of these defects survive the first years of life, the defect alone will not probably be the immediate cause of death, but it will diminish the power of resisting a fever, a pneumonia, or any grave disease, and especially one that disturbs the balance of the two circulations. A woman died in Bellevue Hospital of pneumonia, aged forty years. While sick, *cyanosis* (blueness) was very marked, and finally extreme. She was attended by two grown-up daughters, who both assured the physician that they had never seen anything of that appearance before, and the patient informed us that she had been in perfect health till this attack of pneumonia. She had earned her living and supported her family by making the paper boxes in which matches are sold. After death the heart was found a little above the normal size, and a round hole, an inch in diameter, was discovered at the top of the ventricular septum, permitting a very free flux and reflux from one cavity to the other if the balancing force of the two ventricles was at any time lost. But it seemed that it had never been lost till the inflammation of the lung obstructed the pulmonary circulation, and turned the venous blood into the left heart. The heart of two cavities and obliteration of the pulmonary artery must be attended by an enlargement of the bronchial arteries if life can be maintained even for a short time. If there are two auricles and one ventricle, the foramen ovale must remain open; if there are two ventricles and one auricle, there is a permanent opening in the septum; if the aorta is obstructed, the ductus arteriosus remains, as well as the opening in the septum. In all these cases the action of the organ is practically the same as in a heart of one auricle and one ventricle.

The reader may say that in view of this long list of diseases it is a misfortune to possess a heart, and lose confidence in its physical integrity. But he should remember that less than $\frac{1}{25}$th (4 per cent.) of all the deaths in New York City are caused by all these agencies put together; that a very large proportion of the deaths so occurring are in persons of advanced age; that even when disease fastens on the heart, it does not, as a rule, preclude the hope and expectation of "length of days;" and that among the persons with whom he is in daily intercourse, counting from youth to age, not one in a hundred has any kind of disease or defect of the heart; and he may not only regain his confidence, but may come to the conclusion that the vital offices of this organ cannot be performed with less risk of morbid changes, since it must contribute its quota to the agencies which make death inevitable, and "the days of our age threescore years and ten." ALONZO CLARK.

Heart's Content, a v. on the S. E. side of Trinity Bay, N. F.; lat. 47° 50′ N., lon. 53° 20′ W. It is the landing-place of the Atlantic telegraph cables extending to Valentia, Ireland. Here is a fine telegraph-building. The harbor is good; most of the inhabitants are fishermen. P. 880.

Heartt (JONAS C.), b. in Troy, N. Y., in 1793, became a successful hardware-merchant, and was (1836–42) mayor of Troy, and in 1854 Speaker of the New York assembly. He was for many years a trustee of the Rensselaer Polytechnic Institute. D. in New York City Apr. 30, 1874. He was distinguished for business enterprise and benevolence.

Heat. It is difficult to give a *scientific* definition of the term *heat* in any other way than by the enunciation of the "dynamic theory," upon which all its manifestations depend. In its most common acceptation it refers to physical effects which bodies in nature, in certain conditions, produce upon others. A person exposed to the direct action of the sun or a fire experiences a feeling of comfort or discomfort, which is involuntarily attributed to some sort of emanation from these sources; and bodies in certain conditions are observed to produce effects on other bodies near them, or in contact with them, which are attributed to the same kind of influence. It was formerly supposed that a material agent passed from one body to another. Under this hypothesis it was conceivable that a body might "contain" heat, and that this substance might exist in greater "quantity" at one time than another in the same body; and although the term *heat* and the expressions "quantity of heat," "transfer of heat," and others having significations which involve the idea of quantity, are still retained, even in scientific explanations, the quantities referred to are not those of matter, but of dynamic effects.

The dynamic theory of heat—a theory which has revolutionized the physical sciences—is founded on the assumption that all substances in nature are composed of indefinitely small material molecules, which are maintained by the forces which act upon them in a constant state of vibration or oscillation. When a body, whether solid, liquid, or gaseous, becomes hotter in the popular sense of this term, the scientific condition involved is that the vibrations of the molecules become more rapid; and a decrease in the velocity of vibration of the molecules accompanies or produces the effect called cooling. The forces which act upon the molecules, and which determine the velocity of vibration, are presumed to be their own mutual attractions and opposing centrifugal forces, to which is added the external pressure of the atmosphere or other medium which surrounds the body. Each molecule in motion possesses a certain *vis viva*, or living force, corresponding to that which is manifested by *bodies* having visible or sensible motions; so that the living force due to the heat-vibrations may be said to represent generally the heat-condition of the body.

The dynamical process of heating or cooling may be effected in various ways. The most common and universal phenomena of this kind in nature take place through *radiation* of heat. If a heated body be placed near another which is cooler, a transfer takes place until an equilibrium is attained in their conditions. This equilibrium is assumed to be effected through the vibrations of an elastic medium which pervades all space, and which is composed of ponderable molecules so small that they penetrate the spaces between the molecules of other substances, and form, so to speak, an atmosphere around them. The ethereal atmosphere may be said to perform the same office in the transfer of heat that the common atmosphere performs in the phenomena of sound. The cooling of a body through radiation implies a loss of living force through the impact of its molecules with the atoms of the ethereal atmosphere, waves or vibrations being communicated to the latter, which are propagated in all directions. Another body within the influence of these waves will receive heat by the impulsion communicated to its molecules; or, in other words, an increased rate of vibration will be communicated to its molecules, its living force will be increased, and it will become hotter. In any system of bodies or particles, if no chemical action takes place, and no mechanical or dynamic influence is exerted upon the system from without, any change of heat in one of the bodies of the system is accompanied by a corresponding change of the same kind in an inverse sense in one or all of the other bodies: when, however, any external force is applied to the system, such as friction, pressure, or a shock, the effect of such external energy exerted is manifested by a change of heat in the whole system; and, according to the principles of conservation of energy, these opposite effects must be equivalent.

The variations of the heat of a body are thus known by common observation to be connected with the action of ordinary forms of dynamic energy.

The supposed motions of the separate molecules of bodies with which the phenomena of heat are connected cannot be made evident to the senses, and hence the dynamic theory was the result of inductive reasoning, and not of observation. It had its origin in the fundamental principle of the science of dynamics, connected with that force in nature which arises from the inertia of matter. The well-known law of dynamics, that when the velocity of a material particle or of a body is changed by the action of a force, the *work of the force* in a given time is equal to the *variation* of the *living force* of the particle or body, is a law which may be derived directly from the definition of the mass of a body and the principle of measuring forces by velocities. Applied to a system of bodies acted upon by a system of forces, this theorem of dynamics assumes the following general form of expression: *The aggregate work of the forces applied to a system in a given time is equal to the variation of the living force of the system in the same time.*

The discovery that this theorem of the transformation of energy, as applied to sensible finite velocities of bodies, is applicable to the insensible or indefinitely small vibrations of the molecules of a body which accompanies the changes of volume and the excitation of energy in the phenomena of heat was definitely demonstrated and received as a new theory about the year 1852. During many years previous to this the subject of the true theory of heat had been discussed, and the new theory was even announced in precise language by Lavoisier and Laplace as early as 1780, in the following language (VERDET, *Théorie Mécanique de la Chaleur*): "Other physicists think that heat is only the result of insensible vibrations of matter." . . . "In this system heat is the living force which results from the insensible movements of the molecules of a body;" "it is the sum of the products of the mass of each molecule by the square of its velocity." "We shall not decide between the two preceding hypotheses [referring to the material theory]. Many phenomena appear favorable to the latter. Such is, for example, that of the heat which is produced in the friction of two solid bodies; but there are others which are applied more simply in the first." "Perhaps they both have place at the same time." Laplace afterwards, however, in his discussions on heat, defended the material theory. The experiments of Rumford and of Davy in 1798 and 1799 upon the heat produced by friction served to demonstrate the failure of the *material* theory, and gave a new impetus to investigation.

The discoveries which led to the foundation of the science of thermodynamics were made between the years 1842 and 1849, and were due to the independent and separate investigations of Dr. Robert Mayer, a German physician, Mr. Colding, an engineer of Copenhagen, and Mr. Joule of Manchester, England. An approximate determination of the *dynamic equivalent* of a unit of heat was first published by Mayer; while Mr. Joule was the first to give by exact experiments the determinations which established the principle, and placed the value of the dynamic equivalent beyond doubt. The final development of the science into a definite form, immediately following the determinations of Mayer and Joule, was principally due to the labors of R. J. E. Clausius, Mr. M. Rankine, and Sir William Thomson, their most important researches having been published in the years 1849 to 1851. To these illustrious philosophers and mathematicians we are principally indebted for the establishment of the science of thermodynamics.

Heat being no longer regarded as a material substance, but its phenomena being those of force, motion, and work, it is proper to explain the meaning of the term "quantity of heat," which is retained even in scientific discussions. For this purpose it will be necessary first to explain the signification of the term *temperature*. The thermometer is so common an instrument that its construction need not be described. Degrees of temperature, as exhibited when the thermometer is brought in contact with a body, indicate, as is well known, various conditions of the body in regard to heat, and under the material theory it was rational to suppose that the lowering of the thermometer when in contact with a body would indicate the quantity of heat which passed out of the body; or, in other words, variations in the thermometer might be taken to represent variations of quantities of heat in a given mass. Under the dynamic theory, however, a change of heat in a body indicated by the thermometer involves three effects, an increase or decrease of the living force due to the heat-motions, the work of the force of attraction of the molecules, due to the change if the body expands or contracts; and also the work of the external pressure upon the bounding surfaces. The variation of heat in the body is the resultant of these effects. If the body heated or cooled retains its form and dimensions, then the only effect of an external modifying force is to produce a change of molecular movement, provided no visible or sensible motion is communicated to it; and this increment of living force, or "heat," will be indicated by the thermometer, or become *sensible* through the thermometer. The *dynamic equivalent* of a certain quantity of heat or living force will in such a case be the work of the exterior force which produces it. One mode of finding such an equivalent may be mentioned, especially, as that followed by Mr. Joule. He found by experiment the quantity of work expended in producing friction among particles of water, corresponding to the heating of one unit of weight, or one pound, one degree of the thermometer. The water was taken at its maximum density, so that the only effect of friction was the heating effect, no part of the external force being expended in producing expansion or in overcoming the attraction of the particles and the force of external pressure; or at least these effects were insensible. It was found that 772 foot-pounds of work correspond to an elevation of temperature in one pound of water one degree F. This quantity of heat being represented by 1, the dynamic equivalent of a unit of heat in English measures is said to be 772 foot-pounds. This operation being merely a transformation of the energy of a force exerted into another form of energy, the energy of motion in a mass, is necessarily invariable. To find the equivalent *thermal* effect in any other substance, it is only necessary to find experimentally the quantity in weight of such substance that will have its temperature changed one degree by the quantity of heat thus represented by unity. It is obvious that any other quantity of water might be taken, as, for instance, a kilogramme, and any other thermometer, the centigrade for instance. This would give a different unit of heat, which would correspond, however, to a different quantity of work of the modifying force, but the relations of the two units and the quantities of work would be invariable. Thus, a French unit of heat, a "calorie," is such a unit; it corresponds, nearly, to four British units, the exact ratio being 3.968, the quantity of work equivalent to a calorie being 423.55 kilogrammètres.

Various modes of determining the dynamic equivalent have been adopted, and laborious experiments and investigations have been made by eminent physicists with this view. These experiments include those in which heat is generated by friction of water, mercury, and iron; experiments with steam and air; the electro-magnetic machine; and the shock of bodies, all leading substantially to the same result, small differences only occurring in the determinations arising from causes of loss of heat or work which could not be always experimentally ascertained, the accepted result being that stated above.

The determinations by Joule in 1843–45, which first gave to the dynamic equivalent a value worthy of confidence, may be said to have been the starting-point of modern progress in the science of heat. We are thus led to the enunciation of the fundamental principle of the dynamic theory of heat, sometimes called the principle of equivalence of heat and work—viz. *Heat and dynamic energy are mutually convertible*; the law of this equivalence, stated with reference to British measures, being that *1 unit of heat corresponds to 772 foot pounds of dynamic energy exerted*. A quantity of heat expressed in British units of heat may therefore be expressed as work by multiplying the number of units of heat by 772, the result being work in foot-pounds.

The general conclusions to be deduced from what precedes are as follows: (1) The word *heat* implies a condition of bodies in nature which is a condition of energy, or capacity for producing changes. (2) This capacity is indicated by the thermometer; and one kind of change effected between two bodies in different conditions through the action of heat is the *transfer of heat*, by which bodies are brought to the same degree of temperature, as indicated by the thermometer, through radiation or actual contact. (3) The changes of heat in a body are accompanied by corresponding changes of the density and elasticity, or by changes in volume and in pressure, upon the medium which envelops the bounding surfaces of the body. (4) Among the changes produced by a change of heat also may be enumerated chemical, electric, and magnetic changes. (5) Heat, considered as a source of energy, is identical with the kind of energy called living force, and may be regarded as a quantity capable of being measured by its dynamic effects; and in this respect it is subject, like other forms of energy, to the law of conservation. This law, as applied to heat, gives rise to the principle of equivalence, and its proof is the determination experimentally of the *dynamic equivalent* of heat.

In a complete study of heat two very different systems of investigation are necessary. One consists in the determination of the quantities of heat which are absorbed or dis-

engaged by bodies when they pass from one condition of heat to another through intermediate states, in which the relation between the temperatures, volumes, and external pressures are considered. In this system of investigation the equivalence of heat and work is to be taken into account, and also the principles which form the basis of the science of thermodynamics. The phenomena of greatest interest to be considered are the changes of volume and of states of aggregation of bodies which accompany changes of heat; the performance of external work through the elastic force in the expansion of bodies; the applications of heat to electricity, magnetism, and chemistry. The investigations are prosecuted partly by experiment and observation, and partly by analytical investigation, the experimental investigations furnishing usually the constants or coefficients of the mathematical formulas.

The other class of investigations relates to the phenomena of heat as exhibited between bodies in which the interchange of temperatures is effected without any modifying external cause, and embraces the laws of the *propagation* or *transfer* of heat; the study of radiant heat in its relation to the wave-motions of the ethereal medium; and the action of bodies in reference to radiation and absorption. In these investigations the phenomena of heat and light are regarded as identical in character or as resulting from the same physical agencies.

The first system of investigation mentioned will be first discussed. Let it be supposed that the exterior forces which act on a body are uniform normal pressures, such, for instance, as the pressure of the atmosphere upon the surfaces of solids and liquids, or the pressure, equal and opposite to the elastic forces, of the sides of vessels upon the gases or vapors which the vessels contain, the temperatures of the bodies being uniform throughout their whole extent. Then the condition of any body will be completely determined by the relations which exist at any instant between the three quantities, p, the pressure, v, the volume, and t, the temperature—a relation usually expressed mathematically in the form of an equation, $f\ (p\ v\ t) = 0$, the expression $f\ (p\ v\ t) = 0$ being read *function* of $(p\ v\ t) = 0$. It is a common algebraic principle that in such an expression, *when the relations are known*, if any two of the quantities are known, the third can be determined. If the volume, and temperature, for instance, be taken as independent variables, the relation may be expressed $p = f\ (v\ t)$; and if the pressure and temperature be taken as independent variables, the volume would be expressed $v = f\ (p\ t)$. $t = f\ (p\ v)$ is another form of the same expression.

It is a matter of common observation that bodies assume different forms and conditions or states, which depend on their conditions in regard to heat. These states give rise to a classification of bodies under three general states, known as solid, liquid, and gaseous. A solid substance is one the molecules of which, though in a state of incessant vibration, nevertheless are retained in such a state of equilibrium between the attraction of the molecules for each other and the elastic force due to heat, that the body, as a whole, retains the state which is called solid. In the liquid state the molecules of the body move freely among themselves, but are not permanently attached to each other. In other words, a single molecule may transfer its contact from one set of molecules to another set, subject to the condition that the particles or aggregated molecules remain in mutual contact, like so many minute spheres or globules, rolling freely upon each other, but still retained in mass by the attractive forces which act through their point of contact. The term *gas* refers to that condition of substances in which the molecules are nearly or quite removed from the spheres of their mutual attractions. *A perfect gas* implies that this removal is complete. A gas will thus continue to expand indefinitely if it be not enclosed by an envelope. Nearly all substances in nature are known to assume all these states; and it is considered probable that all substances might be brought to these states under proper conditions of heat and pressure. Perfect gases do not probably exist, although some gaseous substances have never been reduced even to the liquid state; such are common air and its constituent elements, hydrogen, nitric oxide, carbonic oxide, and marsh-gas. These take the name of *permanent gases*. They approach so nearly to the conditions of perfect gases that in all technical applications they may be treated as perfect gases.

The effect of a transfer of heat to all substances is similar in all three states of aggregation. The transfer of heat to a solid not only causes an increase of molecular vibration, which is exhibited by an increase of temperature, but an expansion, which consists in the separation of the particles from each other, or an increase of volume; but this expansion involves the overcoming of the external pressure of the air or other enveloping medium. In the case of liquids, a transfer of heat to the liquid produces precisely the same effects as in the case of a solid—increase of molecular vibration, disintegration, involving expansion of volume and overcoming of the external pressure. In the case of perfect gases, the molecules having already become entirely separated, the effect of a transfer of heat is exhibited simply in increase of vibration of the particles, or increase of sensible heat (temperature), and capacity for overcoming the external pressure. When heat is abstracted from a body the effects described above are all reversed. The molecular oscillation is diminished, the volume contracts, and the external pressure, acting through the volume passed over by the contracting envelope, will perform work which appears in the heat abstracted.

These general laws may be illustrated or explained in a very simple manner, according to the fundamental theory of heat which has been enunciated, by the use of algebraic symbols. Suppose a definite quantity of any body, solid, liquid, and gaseous, to receive heat from some external source. Let the quantity of heat received, expressed in units of heat, be denoted by Q. The body will undergo the following changes: 1st, an increase of molecular movement involving an increase of actual energy or living force, which may be represented by W; 2d, a certain amount of expansion or change of position of the particles, which involves a certain amount of work in overcoming the attractive forces of the body, which may be represented by R; 3d, the change of volume involves the work of overcoming the external pressure to an amount which may be represented by S; and since Q is expressed in units of heat, and W, R, and S are supposed to be expressed in units of work—foot-pounds—we shall have, for the total effect of the heat transferred, $Q.E = W + R + S$; E representing the dynamic equivalent of a unit of heat. This expression is the enunciation, algebraically, of the principle of equivalence. The quantity W in the general expression represents a quantity of work equivalent to the change of *vis viva* of the mass of the body from the change of heat-motions of the molecules; the quantity R, the *work* of the forces of attraction of the molecules due to their change of position in reference to the centres of attraction; and S, the work of the external pressure. The two former are often combined in discussions under the head of *internal work*, while the latter is called *external work*, and the expression of equivalence then assumes the form $E.Q = U + S$; U designating the *internal*, and S, the *external* work, their sum being equivalent to the change of heat Q expressed in foot-pounds, or multiplied by E.

The principle of equivalence of heat and work is sometimes called the "first law of thermodynamics." Another law, called by some authors the "second law of thermodynamics," by others the "principle of Carnot," and by others, again, the principle of the "equivalence of transformations," depends upon the relation which exists between the quantity of work which a body can perform when undergoing an indefinitely small change of heat, and the temperature of the body at the time of the change. The principle, as enunciated by Clausius, is, that the capacity of a body for producing changes or performing such indefinitely small amount of work is proportional to the absolute temperature of the body, the *absolute temperature* being the temperature measured from a zero-point, at which any thermometer would stand if a substance to which it was applied were to be deprived of heat. This is a theoretical limit downward of all thermometers; and, although it cannot be realized in nature, yet its position on any scale may be determined. For Fahrenheit's scale it is at 459.4° below the ordinary zero, and for the centigrade scale 273° below. It follows from the principle above enunciated that if an indefinitely small quantity of work, represented by a change in the pressures, volume, and temperature of a body, be represented by $d\,z$, expressed in thermal units, then $d\,Q$, or the corresponding change in the heat of the body, will be represented by $d\,Q = T\,d\,z$; T being the absolute temperature. From this we get $\frac{dQ}{T} = d\,z$, $\frac{dQ}{T}$ being the transformation value of the work $d\,z$ at the temperature T. When a body passes through a series of changes in regard to heat, and finally returns to its original state, the process is called a cycle, and if the operations are all reversible—that is, if the body undergoes expansions and contractions which with the pressures involved are reversible—the total work performed, both internal and external, will be zero, and we shall have $\int \frac{dQ}{T} = 0$. The expressions $f\,(t, v, p) = 0$, $E\,Q = W + R + S$, or $E\,d\,Q = d\,W + d\,R + d\,S$, and $\int \frac{dQ}{T} = 0$, are three expressions on which the mathematical theory of heat are based, and which, when developed and combined for all changes of a body, constitute the science of thermodynamics.

It will be impracticable in this very general account to do more than refer to some of the problems relating to the expansive action of heat in fluids as illustrations of such applications. The relations between the temperature, pressure, and volume of unit of weight of any particular substance being given, the principles of thermodynamics serve to *compute* the quantity of heat which will be absorbed or rejected by unit of weight of that substance under given circumstances—the computation, for instance, of the *real and apparent specific heat*, the *heating and cooling of gases and vapors by compression and expansion*, the *free expansion of gases*, the *flow of gases and vapors*, the *latent and total heat of evaporation*, the *latent heat of fusion*, and the *efficiency of heat-engines*. Most of these subjects have been treated also by experimental methods. It is by experiment alone that the relations between the pressure, volume, and temperature are first determined. The specific heats of substances, or the numbers which are found in tables of specific heats, represent the quantity of heat required to change the temperature of 1 pound of the substance 1° of the thermometer under certain standard conditions as to pressure, volume, and temperature. The specific heat of water at the temperature of its maximum density, 39.1° F., is the *unit of heat*, represented in work by 772 foot pounds. It will readily be observed that since the quantity of heat required to raise the temperature of 1 pound of a substance 1° involves not only an increase of temperature, but a certain quantity of work if the body be allowed to expand, the specific heats will depend on the amount of expansion. The specific heats of solids and liquids, which are found in the ordinary tables of specific heats, are generally average values of the apparent specific heats, the true values increasing generally with the temperature.

It is difficult, if not quite impracticable in most cases, to determine the real specific heats of solids and liquids at constant volume experimentally, owing to the impossibility of retaining substances in these states at constant volume, except under very great pressures. For gases the specific heats are usually restricted to two particular cases—(1) those in which the volume is retained constant during a change of temperature, and (2) those in which the pressure maintained is constant. It is difficult also, in the case of gases and vapors, to determine the specific heat at constant volume, on account of the dissipation of heat through the sides of the vessel containing the substance. The specific heats at constant pressure are therefore determined experimentally, and the specific heat at constant volume computed. For a perfect gas the specific heat at constant pressure may be shown to be equal to the specific heat at constant volume, added to the thermal equivalent of the work performed by the gas in expending, at constant pressure, an amount corresponding to one degree of temperature.

Numerous problems arise in physical and mechanical investigations in which the intermediate changes between the initial and final states are not the object of examination, but the initial and final states alone, and the total quantities of heat involved in the changes.

The specific heats of substances have been referred to as the quantities of heat in thermal units required to cause a change of temperature in one unit of weight of the substance one degree. To find the quantity of heat corresponding to any given change of temperature in a given quantity of any substance requires, then, three factors—the *number of pounds*, the *change of temperature in degrees*, and the *specific heat*: this last factor for water (at 39.1°, or maximum density) being unity, and for other substances the specific heats may be found from the tables. A quantity of heat represented by Q—that is, a change of heat equivalent to Q expressed in heat units—may be expressed by symbols thus: $Q = W \times s \times t$, W being the weight of the body, s the specific heat, t the number of degrees of change of temperature. It is evident that if three of the above quantities are the known quantities in any problem, the fourth can be determined. This is a very simple but a very useful formula, which serves to solve a large class of problems which occur in every day life, and which requires only ordinary arithmetical or algebraic knowledge for its application. For instance, suppose we have a cubic foot of water, about 7½ gallons, at the temperature 60° F., in a wooden vessel, and we wish to heat the water to the boiling-point by putting in heated stones; required the number of pounds of stones heated just to redness that will produce this effect. The water being at 60°, and being heated to 212°, the change of temperature of the water will be 152°, and the quantity of heat to be taken up by the water will be $Q = 62.4 \text{lbs.} \times 1 \times 152 = 9484.8$ units of heat. Suppose W to be the weight of stones required; the specific heat of stones is about .22, and at a red heat the temperature of the stones may be estimated at 1000° F. The quantity of heat lost by the stones when immersed in the water, if both are brought to 212°, will be $Q = W \times .22 \times (1000° - 212°) = W\,173.36$; and since this quantity of heat must be equal to that gained by the water, we have $W \times 173.36 = 9484.8$.

$$W = \frac{9484.8}{173.36} = 60.5 \text{ lbs.}$$

Similar applications might be made for liquids mixed with liquids, for the quantity of heat abstracted from gases by contact with solids, and for any change of heat of a substance when the weight, specific heat, and change of temperature are known.

Coefficient of Expansion.—The rate of expansion of a body is the increase of volume which takes place for equal increments of temperature, the volumes being referred in each case to the volume of the same body at a standard temperature. When a body exists in the form of a rod or bar, the length of which is to be determined under different degrees of heat, the increase of length is called the linear expansion. Tables giving coefficients of expansion may be found in nearly all works on heat.

Liquefaction, Melting, or Fusion.—The continuous transfer of heat to a solid, causing a continuous rise of temperature and expansion of volume, produces ultimately a change of aggregation or change of state to the liquid form, called the fusion, melting, or liquefaction of the substance. This law is general for substances which do not change their composition in changing their state. For substances which do not change their composition the following phenomena occur: (1) "Each substance begins to melt at a certain temperature, which is constant for the same substance if the pressure be constant." (2) "The temperature of the solid remains at this constant point from the time when fusion commences till it is complete." (3) "If a substance expands in congelation, its melting-point is lowered by pressure; but if a substance contracts in congealing, its melting-point (or point of congelation) is raised by pressure." The laws which have been enunciated are subject to certain qualifications, such as slow process of cooling and variations of external pressure, which may lower the temperature of solidification, but under the same conditions they are invariable. The continuous application of heat to a solid at its melting-point does not raise its temperature as long as any portion remains solid; and, commonly, the abstraction of heat from a liquid at its point of solidification does not lower its temperature as long as any portion remains liquid. The change of state is also usually accompanied by a sudden change of volume. Some substances, however, pass from the solid to the liquid state without showing a definite melting-point, becoming plastic between these states. Glass and iron are examples, and instead of a definite melting-point a certain interval of temperature is required for the change.

Latent Heat of Fluidity.—The increase of the specific heat of a solid as it approaches its melting-point appears to be connected with the increase of the coefficient of expansion, which also increases simultaneously. At the melting-point the whole of the heat applied to a body is apparently required to overcome those molecular attractions which keep the molecules in the state of proximity belonging to the solid condition. The *work* of the heat applied is thus absorbed or expended without producing increased molecular vibrations. Heat which would have become sensible heat in the pure solid or liquid disappears or is transformed into the work of overcoming these molecular attractions, and is said to become *latent*. The latent heats of fusion of a few substances, estimated in units of heat, have been determined experimentally.

The total change of volume from the lowest to the highest temperature consistent with the solid or liquid condition of any substance is very small compared with the actual volume of the body which undergoes such a change, and hence the influence of the external pressure upon the bounding surfaces is very slight during the change. In other words, the work performed by heat in expanding liquids and solids may be regarded as chiefly expended in producing change of temperature and change of aggregation, the external work in all ordinary cases, especially when the solid or liquid is exposed only to atmospheric pressure, being so small that it may be disregarded. In the case of bodies in the gaseous condition, however, this is different. Gaseous bodies cannot exist in a fixed or determinate volume ordinarily, unless they are enclosed within bounding surfaces or envelopes. The force of cohesion among the particles of a gas no longer exists as in the solid and liquid states, and the heat condition of a perfect gas consists simply in the oscillation of the molecules (which is represented by the actual *temperature* of the gas), and the outward pressure or repellent action of these molecules, which must be resisted by the envelope. For a definite volume of a perfect gas thus confined there are thus but

two conditions involved in changes of heat—the temperature and the pressure which it exerts against the bounding surfaces of the envelope. If such an envelope is perfectly elastic, and heat be transferred to the gas (the external pressure, such as the pressure of the atmosphere, remaining constant), the effect will be an expansion of volume. This expansion will be much greater than the expansion of liquids and solids for the same increase of heat.

The coefficient of expansion or increase of *volume* of the permanent gases under such circumstances, for an increase of temperature of 1° F., has been determined, through the well-known experiments of Regnault and others, to be 0.002035, or $\frac{1}{491.4}$ of the volume of the gas at 32° F., and for 1° C., 0.00366, or $\frac{1}{273}$ of the volume of the gas at 0° C. Thus one volume of a perfect gas at 0° C. or 32° F. will become $1 + 0.00366$, or $1 + \frac{1}{273}$ volume at 1° C., or $1 + 0.002035$, or $1 + \frac{1}{491.4}$ volume at 32° + 1° F. A slight difference in the coefficients was found by Regnault for the different gases, and also a slight difference at different external pressures, but for purposes of ordinary calculation the coefficients of all *permanent gases* may be regarded as the same.

We may conceive, however, that when heat is transferred to a gas enclosed within an envelope (for instance, within a cylinder which is closed at one end by a movable piston), the *volume* and the *external pressure* may change simultaneously, and thus the three quantities which determine the condition of the gas—viz. the volume v, the pressure p, and the temperature t—may all be variable quantities. The relation between these quantities has been found, and is represented by what is well known as the law of Mariotte and Gay-Lussac. The following simple equation is the mathematical enunciation of this law: $PV = R(a + t)$ or $PV = RT$; R representing a constant for any particular gas, and T the absolute temperature; in which P is the external pressure upon unit of surface, V the volume of unit of weight, R a constant which depends on the specific gravity or density of the gas (the weight of this unit of volume), T the temperature, and A the number 273, Centigrade degrees being employed, and 459.4 if Fahrenheit degrees be employed. The quantity P, defined as the external pressure upon a unit of surface, is evidently also the outward pressure or elastic force of the gas.

It is well known, from common observation, that many liquids, such as water, alcohol, and ether, if not confined in close vessels, become transformed into a condition resembling the gaseous condition at ordinary temperatures, and disappear *as liquids*, being diffused in the atmosphere as vapors. This transformation takes place in nearly all liquids more or less rapidly at ordinary temperatures, though for some no such transformation takes place at very low temperatures. It is considered probable, however, that this quiet change takes place in all liquids above certain fixed temperatures. Many solids, also—*e. g.* ice and camphor—pass to the state of vapor without passing through the intermediate liquid state, under certain conditions. If a *closed* vessel be partly filled with a liquid, the space above the liquid will thus ordinarily become filled with the vapor of the liquid, and the *elastic force* of the vapor will depend on the nature or *kind* of liquid, the *volume* of the enclosed space, and the *temperature*. If heat be applied to the liquid in this condition, the formation of vapor will continue, the vapor exerting a certain additional elastic force depending on the *temperature alone*, as long as there remains any liquid. Evaporation will cease when the application of heat is suspended, and, if the liquid be cooled, *condensation* will occur; so that the relative quantities of liquid and vapor, and the elastic force of the latter in a given space and for a given liquid, are dependent on the condition of heat or *temperature* solely. Similar phenomena will follow if the extent of the enclosed space be enlarged or contracted, the *temperature remaining the same*. If the space be enlarged, an additional quantity of the liquid will pass into the state of vapor; and if the space be contracted, a certain amount of the vapor will be reconverted into liquid. For every liquid in an enclosed space there is thus a certain tension or elastic force depending on the temperature (whatever be the relative volumes of the liquid and the free space above it) which is the greatest elastic force that the vapor can have at each particular temperature. If the vapor be compressed, liquid is formed by condensation, and if the space be enlarged, or the external pressure which confines the vapor be diminished, additional vapor will be formed, and the elastic force will remain thus constant for each constant temperature. A vapor in this condition in presence of its liquid is said to be *saturated*.

This law of vapors—viz. that the elastic force in a given volume depends solely on the temperature—is approximately true whether the space in which the vapor is formed be vacuous, or whether it contain air or any other permanent gas, provided that the liquid exerts no solvent or chemical action on the gas. The combined elastic forces or the resultant pressure on the sides of the vessel, when a permanent gas is present which is not acted upon by the liquid, is nearly the sum of the elastic force of the gas and the maximum tension of the vapor at the given temperature. It was found by Regnault, in experiments on this subject, that liquids do not give off vapor of quite so great a tension in a space occupied by a permanent gas as they do in a vacuum, and that the difference increases as the temperature rises; but for technical applications under ordinary temperatures the law may be considered true. The only difference between evaporation in a vacuum and in a space occupied by a gas is, that the formation of vapor takes place more slowly if a gas be present—a fact of great importance in the economy of nature connected with the evaporation of water from the surface of the earth.

When heat is continuously applied to a liquid in a closed vessel, the space enclosed remaining constant, the temperature of the liquid and vapor will continually increase if there be no dissipation of heat through the sides of the vessel; the quantity of the liquid will diminish and the pressure will increase, the vapor remaining saturated as long as any liquid remains. After the last element of liquid shall have passed to the state of vapor, if heat be still applied the vapor begins to assume the properties of the permanent gases. Under this condition, if the temperature could be indefinitely raised, or the volume of the space indefinitely increased, under a constant temperature, the vapor would finally arrive at a state corresponding to that of perfect gas, and would then follow strictly the law of Mariotte and Gay-Lussac; and hence it may be said that the physical properties of vapors, when sufficiently expanded or at sufficiently high temperatures, and when they are not in contact with their liquids, are identical with those of perfect gases.

Complete Vaporization.—The temperature at which the complete evaporization of a liquid in a given space will occur depends on the relative volumes of the liquid and the space above it. With alcohol, the empty space being about equal to that occupied by the liquid, complete vaporization takes place at about 400° F. In the case of water, if the space occupied by the water be about one-fourth of the whole internal volume of the vessel, the liquid will be wholly converted into vapor, if the vessel be strong enough to resist the pressure, at about 680° F. (*Cagniard de la Tour*). The elastic force of the vapors of *mixed liquids*, as determined by Regnault, is the sum of the tensions of the two vapors taken separately if the liquids have no solvent action on each other. With water and ether the tension of the vapor of the mixture is less than that of the sum of the tensions of the two liquids taken separately, being hardly equal to that of ether alone. When two liquids dissolve each other in all proportions—*e. g.* water and alcohol—the resultant tension is intermediate between the tensions of the separate liquids.

Boiling-points.—The *boiling-point* of a liquid is an expression which usually refers to a fixed or standard pressure upon the exterior surface, the pressure of the atmosphere, and it indicates the temperature at which the elastic force of the vapor is equal to such standard pressure. *Ebullition* is a phenomenon which takes place when heat is applied to the lower part of the mass of a liquid which has been heated to the boiling-point, and arises from the formation of bubbles of vapor at the point at which the heat is applied, the bubbles rising through the liquid and escaping at the free surface. The formation of such bubbles may occur before the whole mass of the liquid has been heated to the boiling-point, but in this case the bubbles are usually condensed before they reach the surface.

"*Boiling-point due to the pressure*" is an expression sometimes employed to designate the *temperature* corresponding to the *pressure*, whether that temperature be above or below the standard temperature for which the boiling-points of the tables are determined. The boiling-point of a liquid under any pressure is, properly speaking, the lowest temperature at which ebullition *can* occur, since there may be circumstances under which ebullition, or the formation of vapor, does not take place until the liquid has been heated many degrees above its tabulated boiling-point. If the free surface of a liquid be covered or surrounded by another which has a higher boiling-point, the bubbles of vapor of the interior liquid having no escape, this liquid may attain a temperature higher than its ordinary boiling-point. The boiling-points of liquids are also influenced by the nature of the vessel. Water has generally a higher boiling-point by several degrees, under atmospheric pressure, in

glass vessels than in iron vessels. Liquids holding solid bodies in solution generally boil at higher temperatures than when the liquid is pure.

Nebulous or *vesicular* vapor is that which arises from the condensation of particles of a vapor in the atmosphere or in its own vapor, constituting cloud or mist. If heat be applied to vesicular vapor, the condensed globules evaporate and the vapor becomes transparent, though still saturated. If heat be abstracted, new particles are condensed; the globules coalesce and fall in drops.

Superheated Vapor.—When a vapor at the point of saturation is removed from contact with its liquid and heated, it is said to be *superheated.* A saturated vapor not in contact with its liquid may become superheated by the enlargement of the space which contains it, for it will then admit of compression without condensation, and will have a pressure, at the same temperature, inferior to that of saturated vapor, and also a temperature more elevated than that due to saturation for the same pressure.

Spheroidal State.—It is a matter of common observation that when water is sprinkled upon the horizontal flat surface of a hot stove, the drops are not immediately converted into steam, but roll about on the heated surface, and gradually evaporate, retaining all the time the spherical or spheroidal (flattened sphere) form. This condition is not peculiar to water, but may be experimentally demonstrated with all volatile liquids, and is usually described as the *spheroidal state.* It arises from the fact that the rapid formation of vapor makes a layer or bed of vapor on which the drop rests, and which prevents actual contact between the drop and the surface. The phenomenon may occur also whether the heated surface be liquid or metallic, the condition being that the surface shall be heated to a point considerably above the boiling-point of the liquid drop. Experiments by Boutigny showed that the *lowest* temperature at which a metallic vessel will cause the spheroidal state is 289° F. for water, 273° F. for alcohol, and 141° F. for ether. The spheroidal condition, sometimes called "Leidenfrost's phenomenon," illustrates an important fact in regard to the transfer of heat which will be treated of subsequently. It shows that for the rapid transfer of heat to a liquid there must be actual liquid contact with the heated surface—the interposition of a thin film of gas acting as an obstruction to the passage of heat.

Humid Vapor.—The vapor of water which is usually employed in industrial operations usually contains particles of water mechanically suspended in the vapor. The steam is then not only saturated, but *wet.* When in the simple condition of saturated vapor it is called *dry steam. Steam-gas* is a term applied by some writers to superheated steam, or steam in the condition of a perfect gas.

Expansion of Dry Saturated Steam.—If dry saturated steam be enclosed in a vessel, and the volume be enlarged by extending the space in such a manner that the elastic force of the steam performs no *work,* the steam will become superheated—*i. e.* its temperature will be, at the end of the expansion, higher than that due to the boiling-point corresponding to the pressure, and it will remain transparent. If, however, the expansion takes place against a pressure, so that there is work performed by the elastic force, condensation of a portion of the steam will take place, and the mass of steam will present a cloudy appearance. This fact was first determined theoretically by Rankine and by Clausius, and experimentally by Hirn. It is supposed that no heat is communicated to, or abstracted from, the vapor during the expansion. This condensation does not take place in steam sufficiently *superheated.* From the experiments of Fairbairn and Tate on superheated vapors it appears that for an interval of about 18° F. above the temperature due to the pressure the coefficient of expansion of a superheated vapor is greater than that of perfect gases, but above this temperature the relation between the volume and pressure follows closely the law of Mariotte and Gay-Lussac.

The elastic force of saturated vapors may be illustrated experimentally by taking several barometer-tubes, filling them with mercury, and inverting them in a trough of mercury. The surface of the mercury in each tube will drop about six inches, leaving a vacuous space at the top of the tube. If now a small quantity of liquid water be passed up into this vacuous space in one tube, alcohol into another, and ether into another, the quantity of liquid being more than can be evaporated in each space at ordinary temperatures, it will be found that a portion of each liquid will be instantly evaporated, and the mercurial column will be depressed in each tube, but by different amounts. If each tube be now heated by surrounding it with warm water, the elastic force of each vapor will be increased, the mercury will descend in the tubes, and will finally press the mercurial column down to the level of the reservoir. At this point it is evident that the elastic force of each vapor is equal to that of the atmosphere, or *1 atmosphere.* But the temperature of the liquid and vapor in each tube will be different from that in the others. The temperature of the watery vapor will be found to be 212° F., the temperature of the alcohol 173°, and the temperature of the ether 95°. These are the temperatures at which the elastic forces of these vapors are equal, respectively, to 1 atmosphere. At these temperatures the liquids will *boil* under the atmospheric pressure. If the temperatures be reduced below these points, the pressure remaining the same, a portion of the vapor in each tube will be liquefied; and, the temperatures remaining the same, if the pressure be increased above 1 atmosphere, a portion of each vapor will become liquefied. The tension or elastic force of 1 atmosphere is thus the *maximum tension* which the saturated vapors can bear at the temperatures given above. If the three tubes and the basin of mercury could be enclosed in a chamber in which, by compression of the air, different pressures can be obtained higher than 1 atmosphere, it would be found that, for each of the substances named, the temperatures at which the mercury will be forced down to the level of the reservoir under each additional atmosphere of pressure will be increased. The elastic force of saturated vapors is thus *independent of the volume and proportion of liquid mixed with the vapor, and depends only on the temperature.*

It has been found impossible to determine, *theoretically,* the relation which the temperatures bear to the pressures, and reliance is placed mainly on the celebrated experiments of Regnault. These tables show that no *simple* relation exists between the maximum tension and the temperature. Different empirical formulas have been proposed, however, to express this relation with certain degrees of approximation.

The effects which follow the transferring of heat to a body, solid, liquid, or gaseous, have been described by employing the simple algebraic expression, $QE = W + R + S$. The quantity W represents a change which is exhibited by a change of sensible heat or change of *temperature.* That part of the whole heat transferred which produces the work R and the work S is expended in producing a change in the relative positions of the particles and in *external* work; and disappears as *sensible heat*—*i. e.* it is not afterwards contained in the body or exhibited in the body as heat. These two quantities of heat, R and S, become *latent.* The term *latent heat* is a technical expression, designating a quantity of heat which has apparently disappeared, but which really has been employed in producing changes in the body, in the form of work, other than the change of velocity of molecular motion or change of *temperature.* By reversing the process by which heat is thus made to disappear, this latent heat may be reproduced.

The total heat necessary to transform 1 pound of water from the liquid condition at the melting-point of ice to the condition of saturated vapor or steam at the temperature t is called the *total heat of vaporization,* and represents the sum of the heat which is required to heat the water from the temperature 32° to the temperature t, and the heat which disappears as latent heat. By algebraic symbols this sum is evidently expressed as follows: $Q = c(t - 32°) + L = q + L$; c being the mean specific heat of water between the limits of temperature, and L the latent heat of vaporization at the higher temperature.

The results of Regnault's experiments, already referred to, led him to the discovery that *the total heat of the vapor of water from the temperature of melting ice increases at a uniform rate as the temperature rises.* Regnault's formula by which this law is expressed is as follows: $Q = 606.5 + 0.305\,t$, Q being the total heat in calories, and t being expressed in centigrade degrees. The equivalent English formula is $Q = 1091.7 + 0.305\,(t - 32°)$. The expression for the total heat of vaporization is $Q = q + L$, from which we have $L = Q - q$; that is, the latent heat of vaporization is equal to the total heat, diminished by the quantity of heat necessary to raise the temperature of the liquid from the melting-point of ice to the final temperature of evaporation.

Density of Gases and Vapors.—The term density refers to the degree of approximation of the particles of a body to each other. It is specific when it refers to the number of particles or quantity of matter in a unit of volume of a given substance, this unit being a standard for all bodies. In English measures, 1 cubic foot is the standard unit of volume, and the weight of a cubic foot of a substance in any condition is the *specific weight* of that substance in that condition. It is usual to express specific weight in terms of the weight of a unit of volume of a standard substance, the latter weight being taken as unity. Water is the general standard for specific weight, but for gases and vapors air is often taken as a standard, the weight of 1 cubic foot of air being taken as unity. The following table shows the relative

densities at 32° F. and one atmosphere pressure of some of the gases commonly met with:

Relative Densities.

Air	1.00000	Water	1.0000000
Nitrogen	0.97137	Air	0.0012932
Hydrogen	0.06926	Nitrogen	0.0012562
Oxygen	1.10563	Hydrogen	0.0000896
Carbonic acid	1.52901	Oxygen	0.0014298
		Carbonic acid	0.0019774

The following are the *weights* of 1 cubic foot of each of the same substances in pounds avoirdupois under the same conditions—viz. at 32° F. and one atmosphere pressure—except for water, which is taken at 39.1° F.:

Weight in Pounds Avoirdupois of 1 cubic foot.

Water	62.425
Air	0.08073
Nitrogen	0.07860
Hydrogen	0.00559
Oxygen	0.08926
Carbonic acid	0.12344
Steam	0.0502

The density of a perfect gas at any other pressure and temperature may be found from the law of Mariotte and Gay-Lussac, $PV = RT$, by substituting for V the volume of 1 pound, $\frac{1}{D}$, and for R its value for the gas under consideration. Fahrenheit's scale being used for T, the values of R are:

Air	$R = 53.35$
Nitrogen	$R = 54.93$
Oxygen	$R = 48.26$
Superheated steam	$R = 85.77$

The *specific volume* of a gas is the volume of unit of weight. In English measures *1 pound avoirdupois* is the unit of weight, and to obtain the specific volume we have $V = \frac{1}{D}$, the reciprocal of the *specific weight. Specific volumes*, or *volumes of 1 pound of each* of the *substances named, are given below* in cubic feet, for 32° F. and 1 atmosphere:

Air	12.3870
Nitrogen	12.7226
Hydrogen	178.8909
Oxygen	11.2032
Carbonic acid	8.1011
Steam, at 212°	26.4216
Steam theoretically, at 32°	19.9203

Chemical action, when accompanied by the development of light and heat, is usually called *combustion*. *Inflammation* denotes that kind of combustion in which the products are gaseous and flame is produced. *Ignition* is simply the incandescence of a body unattended by chemical change. The phenomena of heat being those of rapid molecular motions, the heat and light developed by combustion must indicate an increased molecular movement in the particles of bodies, when combustion takes place, proportional to the amount or force of the chemical attractions. The heat of combustion may therefore be rationally explained by saying that intense and violent increase of motion in the particles of the compound is produced by the chemical attractions. Ordinary combustion consists in the combination of oxygen with various substances, the temperature required being different for different substances, and varying for the same substance with the rapidity of the combustion. Phosphorus combines slowly with oxygen at 77° F.; charcoal burns *slowly*, but does not ignite below a red-heat; sulphur burns in air at 550°. But most elementary substances require to be heated to redness before combustion in oxygen or the air takes place. According to Peclet, solids emit light or become dull red at about 950° F. Most substances burn with great rapidity when in a finely divided state. Fine dust of many substances burns in this manner with a rapidity which in a closed space may give rise to such a degree of pressure from the expansion of the gases as to produce phenomena like explosions. A single spark may thus produce instantaneous combustion in a space filled with fine dust.

Porous substances often absorb and condense air within their pores; oxidation begins, accompanied by an elevation of temperature, which accelerates the oxidation until the process produces spontaneous combustion. Charcoal-powder, masses of tow, cotton, or rags, saturated with oil, sawdust mixed with oil, moist hay, and other substances in similar conditions, have thus been known to burst into flame. Wood does not take fire in oxygen gas, according to Thénard, at temperatures below about 600° F., but if it be long exposed to a high temperature, even longer than this, in air, it may become partially charred, and rendered so inflammable as to favor the conditions of spontaneous combustion. Under such conditions a single spark or accidental exposure of the substance to a higher degree of heat may cause it to take fire.

Ordinary combustion is accompanied usually by *incandescence* and flame. If a solid burns without flame, the heat evolved at the surface of contact of the air and the solid causes an elevation of temperature of the residual solid particles, which gives rise to a *glow* or *incandescence*, the color and intensity of the light being dependent on the temperature. Dull red indicates the lowest temperature at which light appears, and dazzling white the highest degrees of heat: between these extremes the light passes from dull red or cherry red to bright red, dull white, then to yellowish, and finally to a bluish white, and a full or dazzling white. If the combustible is gaseous, the combination with oxygen may be instantaneous, producing by the violent concussion of the air an explosion; or it may be gradual. In order that the phenomenon of explosion may take place, the combustible gas must be mixed uniformly with air or oxygen in the proper proportions, and then heated to the burning-point. A similar effect takes place when a solid combustible, such as sulphur or charcoal, is mixed with a *nitrate* or other solid which gives up its oxygen readily. In both cases it is only necessary that the temperature be raised to ignition at one point by friction, percussion, or the contact of a hot body, the action being then propagated instantaneously throughout the whole mass. When the combustion is gradual, the contact of the combustible gas with oxygen or the air takes place usually at the bounding surface of the gas; as, for instance, when a jet of gas issues from an orifice or when a column of gas rises from the wick of a candle. The inner mass of the combustible gas does not ignite at first, and the ignited surface assumes the form of a hollow cylinder or cone. The brightness and color of such a flame depend not only on the degree of temperature, but upon the presence of solid incandescent particles in the flame. These solid particles arise sometimes from the compound produced by the combination, but in ordinary forms of combustion of fuel they are particles of carbon. Hydrogen gas, carbonic oxide, alcohol, and sometimes coal-gas, burn thus with a dull flame. A bright flame is produced by compounds which contain carbon, from which a portion of the carbon becomes separated by the heat produced, the separated particles being first heated to incandescence, and afterwards burned by contact with the air. If the quantity of air supplied be not sufficient, these solid particles may become cooled and form soot. The visible part of smoke is this soot cooled below red heat. Marsh-gas, olefiant gas, ether, volatile oils, resins, fats, etc., when burned, give off carbon in this manner, and may form bright flames, or produce, if the separated particles are not all burned, soot or smoke. *A purely gaseous substance does not become luminous at any degree of temperature, however high, luminosity being caused by particles of incandescent solids in the gas.*

The combustible ingredients of ordinary fuel, and of the liquids and gases usually employed for the generation of heat, are *carbon* and *hydrogen*. These substances combine readily with oxygen, the former producing by the combination carbonic acid or carbonic oxide, and the latter water. The oxygen required is usually supplied by the atmosphere, which contains about one-fifth of its weight of this substance.

As a general rule, all chemical *combinations* produce heat, while chemical *decompositions* cause a disappearance of heat. In the combination of two simple isolated elements heat is evolved only, but where the combination is effected through the simultaneous decomposition of compound substances, the heat evolved is the resultant of that which is produced by the combination of the combustible elements and that which *disappears* through the decompositions. In compounds containing oxygen and hydrogen in the proper proportions to form water, the surplus hydrogen only contributes to the development of heat when combustion takes place.

An important consequence of the dynamic law of heat, and one which has been experimentally verified, is, that all chemical changes are accompanied by corresponding changes of heat. *Chemical action and heat are mutually convertible;* and although the quantity of *heat* evolved or annihilated in any chemical change can only be experimentally determined, yet it has been established that the *combination of any two bodies, chemically, is attended by the evolution of a quantity of heat equal to that which disappears in their separation.* The quantities of heat evolved or disengaged in chemical combinations are found experimentally by means of *calorimeters*. These measures of heat are employed in various forms, and operate, generally, in such a manner as to exhibit the effects of the heat evolved in acting on a given substance, such as the melting of ice or the raising of the temperature of a given quantity of

water, the quantities of heat being thus indirectly measured by being transferred to some body in which these effects can be estimated in units of heat. In this manner the heat evolved in the combination of both simple and compound bodies has been determined by many observers, especial authority being given to those of Favre and Silberman. In the chemical changes which compound bodies undergo it may be stated as a general law that the heat which appears or disappears is the resultant of the action of the simple elements; and where a compound consists of *combustible* elements only, like *carbon* and hydrogen, *the heat disengaged is the sum of the quantities of heat disengaged by the combustion of the elements separately.* This law, though not indisputably established, is considered sufficiently exact for all ordinary purposes. The *temperature* at which bodies combine, although affecting the rapidity or energy of chemical action, does not affect the *total* quantities of heat involved in the change.

The transfer of heat from a heated body to one that is at a lower temperature consists, according to the dynamic theory of heat, in the loss of living force, due to heat-motion, in the hotter body, and an equivalent gain of living force in the colder body. When the two bodies are quite distinct, or separated, and do not form part of one and the same body, this transfer takes place generally, as has been stated, through the intervening ethereal medium by the process of radiation. Through this medium there is a tendency to equilibrium of temperature or of living force, the relative exchange of heat being inversely proportional to the masses of the bodies. It is probable that the transfer of heat between two bodies is always thus accomplished by *radiation*, although, technically, a distinction is made between the transfer at appreciable distances, or *radiation*, and the transfer by actual *contact* of the two bodies. Heat may be transferred practically also by the actual change of position of the body in which it exists. In this mode of transfer, which is called *convection* or carrying, the transfer is a mechanical one, and is not in any way connected with the change of heat in the body carried. Although this mode of transferring heat is of great importance in the arts, and especially in connection with the generation of steam, involving as it does the question of circulation of heated fluids, yet after the convection of heat by the transfer of the body in which it exists, whether that body be solid, liquid, or gaseous, there still must take place the transfer from the heated body to another, by the process of radiation or contact, before the heat can be utilized *as heat*. Thus, a heated gas or liquid may be carried through pipes, or may be mingled mechanically with other gases or liquids for the purpose of conveying heat, but the final process by which that heat is actually transferred from the heated gas or liquid to another body, *as heat*, must depend on the dynamic laws of heat. In adopting, therefore, the usual designations of the modes by which heat is transferred—viz. radiation, contact, convection—it is to be understood that the latter is a mechanical mode, and need be discussed only in connection with the carrying of bodies to the places or points at which it is desirable or necessary for them to impart their heat to other bodies.

The experiments of Melloni are usually quoted as giving the first direct proofs that radiant heat like light consists in vibrations of the ethereal medium. It is now a matter of almost universal popular knowledge that the white light of the sun is composed of rays of various colors, which may be produced at will by means of a prism. The rays are deviated in the well-known order from red to violet, the number of vibrations for the red rays being 481 billions per second, and for the violet 764 billions. The greatest intensity of light, according to Fraunhofer, is in the yellow, and the least in the violet. This spectrum is also a *heat spectrum*, the heat spectrum extending over about four times the space occupied by the visible spectrum. In the heat spectrum the maximum of heating effect lies beyond the red, on the obscure part of the spectrum. The greatest calorific effect is thus produced by rays for which the ethereal vibrations present waves of greater length and greater duration than those of the red rays of the light spectrum. The heat-rays beyond the violet, although not visible, are known to influence chemical action, in certain bodies, in a remarkable manner. While the light spectrum is thus only a part of the total spectrum, the invisible rays possess the same general properties as the light rays, and it appears that the ethereal vibrations affect the eye only between certain limits. A heated particle of a substance communicates vibrations to the ethereal medium whether the particle be surrounded by air or whether it be in a vacuum. In ordinary language, the particle sends *rays* of heat in every direction; these rays or waves proceed indefinitely, without change in strength or character, and with the same velocity as light, until they are intercepted by some body in the paths of the rays. If such a particle be a *molecule* on the surface of a body, it is evident that it will send off rays of heat in every direction not intercepted by the body itself.

It is a common error to suppose that the intensity of *a ray* of heat diminishes as the distance between the body emitting and the body receiving the heat increases—*i. e.* inversely as the square of the distance. The law of the inverse squares of the distance is rather a geometrical than a physical law, and refers to the action of *one* body on *another*, whether the question be one of heat or gravitation. A body or collection of molecules possessing a certain amount of living force, due to heat, imparts this energy to the ethereal medium in all directions, and the quantity of energy *intercepted* by another body will depend on the distance between the two bodies—the quantity thus intercepted by the *same body* at *different distances* being inversely proportional to the squares of the distances.

The inclination of the surface which intercepts radiant heat determines, for similar reasons, the quantity of radiant heat received. Even if the rays be supposed parallel, as in the case of the radiant heat of the sun, it is apparent that all the heat conveyed by a beam of rays may be represented by the section of the beam perpendicular to its direction. If the beam falls upon a surface inclined to its direction, the amount of surface over which the beam will be distributed will be greater as the inclination of the surface is greater. If the surface be plane, when it becomes parallel to the axis of the beam, it will receive no heat. Hence in estimating the intensity of radiant heat by units of surface, the inclination of the receiving and absorbing surfaces must be considered. The regions of the earth's surface near the poles, from their approach to parallelism with the direction of the sun's beams, receive less heat on each square mile of surface than is received by a square mile at the tropics.

Attempts have been made to determine the quantity of heat in units of heat emitted by any given surface at a given temperature, supposing the temperature of the absorbing surfaces to remain at constant temperature. MM. Dulong and Petit, whose researches in this and other branches of physics are universally known, made numerous experiments on this subject, which resulted in the determination of certain general laws. The experiments were made to determine the rate of cooling of bodies in an enclosed space, the space being filled with different gases, and the enclosure being maintained at constant temperature. The results were enunciated as follows: (1) "The cooling of a body results from radiation and from contact of the fluid or gas which surrounds it. (2) The rate of cooling, from radiation alone, is the same for all bodies at the same temperature, but its absolute value depends on the nature of the surfaces." It is represented by the following formula: $Q = Ca^t(a^{t'} - 1)$, in which Q represents the number of French units of heat emitted by one unit of surface in a unit of time; C, a constant depending on the nature of the surface of the radiant body; a, the number 1.0077; t, the temperature of the enclosure or absorbent; and t' the *excess of temperature* of the radiating body over the absorbing body in degrees centigrade. (3) "The rate of cooling by *contact* of a fluid surrounding the heated body is also the same for all heated bodies, but its absolute value does not depend on the *nature of the surface*, and depends only on the form of the heated body."

For air under ordinary atmospheric pressure the law of cooling by contact is expressed by the formula $Q = C''.t^{1.233}$, in which Q represents the quantity of heat in calories abstracted from one unit of surface by the air in a unit of time; C'' a constant depending on the form of the surface; and t the excess of temperature of the body over that of the air surrounding it.

The *relative* radiating powers of different surfaces at 180° F., as determined by Leslie, are represented approximately in the following table:

Lampblack	100	Mica	80
Paper	98	Graphite	75
Resin	96	Tarnished lead	45
Sealing wax	95	Mercury	20
Crown-glass	90	Polished lead	19
India-ink	88	Polished iron	15
Ice	85	Tin plate	12
Red lead	80	Gold, silver, copper	12

It is stated by Magnus that the greater or lesser density of the surface has no influence on radiation from the surface. Platinum which has been strongly hammered possesses the same emissive power as platinum carefully annealed. But the same surface roughened with emery paper has its emissive power greatly increased. As far as quantities of heat are concerned, it is doubtful whether anything further than such *relative* determinations can, in the present state of

* Watts, *Dict. Chem.*

knowledge, be depended on, the actual or absolute quantities for different temperatures being still uncertain. The radiating powers of different bodies or different surfaces represent also their absorptive powers, and, as has been already stated, radiant heat does not affect the eye, or solids do not become luminous, until the temperature reaches about 950° F.

The radiation and absorption of gases, according to Prof. Tyndall, present very peculiar laws, and our knowledge of the action of gaseous bodies on radiant heat is still very slight. It has been demonstrated experimentally by Prof. Tyndall that a ray or beam of heat is wholly or almost wholly transmitted through moderate distances in air, oxygen, hydrogen, and nitrogen; and, conversely, no radiation takes place from the heated particles of these gases. The only mode, therefore, by which heat can be imparted to these gases, or by which they can impart heat to other bodies, is by actual contact. Some other gases possess remarkable powers in absorbing or intercepting *dark* radiant heat. The absorption of radiant heat by vapor of water diffused in air, under circumstances of average humidity, was shown by Prof. Tyndall to be seventy times greater than the absorption by dry air. As the quantity of watery vapor was increased, the amount of heat absorbed was increased.

Conduction of heat refers to the transmission of heat from one part of a continuous and homogeneous body to another part of the same body. When a body is heated at one point, the heat is transmitted with greater or less rapidity throughout the whole mass, depending on the nature of the body and the differences of temperature of the heated part and other parts of the body. If the body is terminated by two parallel surfaces which are each kept at a constant temperature, there will be a flow of heat, so to speak, at a constant rate from the hotter surface to the other by conduction. The *law of conduction* under these circumstances is, that the quantity transmitted for a unit of area perpendicular to the direction of transmission, and per unit of time, is directly proportional to the difference of temperatures of the parallel surfaces, and inversely proportional to the thickness or distance which separates the two surfaces. If t_1 and t represent the temperatures of the two surfaces, and e the distance separating them, the quantity of heat transmitted will be represented algebraically by the formula $Q = \frac{c\,(t_1 - t)}{e}$. The coefficient c depends on the nature of the body. When the quantities of heat thus transmitted for different bodies across an interval 1 unit of length in thickness, and for 1 unit of area and time, are determined, these quantities of heat represent the *relative* conductibilities of the substances, and the numbers thus found, when referred to 1 as a standard, may be called the *conductivities* of the different substances.

The relative conductivities of metals, determined by experiments on bars of a given cross-section, the transmission of heat being determined by thermometers placed at different distances in holes drilled in the bars, have been determined by different investigators. The following table of conductivities, from experiments made by MM. Wiedemann and Franz, the temperatures along the bars being determined by a thermo-electric arrangement, is given by Balfour Stewart:

Relative Conductivities.

Name of metal.	In air.	In vacuo.
Silver	100.	100.
Copper	73.6	74.8
Gold	53.2	54.8
Brass	23.6	24.
Tin	14.5	15.4
Iron	11.9	10.1
Steel	11.6	10.3
Lead	8.5	7.9
Platinum	8.4	7.4
Palladium	6.3	7.3
Bismuth	1.8	

The conducting power of liquids is greater at high temperatures than at low temperatures. And when there is no convection of heat in liquids, by which heated particles are carried from one point to another, the conducting power of liquids is very small, the conducting power of water being, according to Depretz, only about $\frac{1}{100}$th that of copper.

Conduction by Gases.—Gases possess such a feeble power of conduction that they have been regarded as having no conducting power. Experiments by Magnus and theoretical deductions by Clausius, however, demonstrate that there is a slight power of conduction in perfect gases. Clausius estimates the conducting power of air to be about $\frac{1}{1400}$th that of lead.

The calorific *intensity* of combustion, or degree of temperature of the products of combustion, and of the solid incandescent combustible, seems to depend on the rapidity of combustion, rather than the quantity of heat evolved. Nearly all writers on the subject have given a method for finding what may be called the theoretical temperature of combustion, by supposing that all the heat evolved is contained in the gaseous products, and calculating the temperature by means of the specific heats and the weights of the products of combustion and the heat evolved. Making use of formulas corresponding to that which has already been given, $Q = W.\ C.\ t$; Q representing, in units of heat, the heat evolved; W the weight; C the specific heat of the gaseous products of combustion; and t the number of degrees rise of temperature. From this formula we have $t = \frac{Q}{C \times W}$. Such determinations, however, have but little practical value for solid combustibles, because the residual incandescent solid gives off rapidly, by radiation, heat which does not pass off with the gases.

The quantity of heat radiated from an incandescent combustible depends not only on the temperature of the combustible, but also on the temperature of the absorbent and the nature of the surfaces. On this account there does not appear to be sufficient ground for ascertaining the temperatures of furnaces or of the escaping gases by this process. It is well known from common observation that the temperature in ordinary furnaces is greatly increased by a more rapid supply of air; so that the quantity of heat evolved in a given time, and the temperature, are thus increased. Chemical action is promoted by high temperatures, and the conditions for increase of temperature, increase of heat evolved in a given time, and rapidity of chemical action, are coincident.

Among the most important of the applications of the dynamic theory of heat in the physical sciences may be mentioned its applications to the constitution of bodies, to electrical phenomena, to chemistry, to physiology, to astronomy, and to geology. All of these sciences have felt the influence of the science of thermodynamics in a remarkable degree, the investigations of the present day in regard to heat being largely devoted to the development of these applications. In the practical sciences its applications to the theory of *heat-engines* is perhaps the most important; and these applications will be given in the articles STEAM-ENGINE and THERMODYNAMICS, to which the reader is referred.

W. P. TROWBRIDGE.

Heath, or **Heath'er** [Ger. *Heide*], small shrubs of the order Ericaceæ, found mostly in the Old World. The common ling or heather of Europe (*Calluna vulgaris*) grows also very sparingly in parts of New England and in Newfoundland. It is the only true heath known in America. In Europe it covers great tracts of waste land. Its spikes of rosy flowers are well known. It affords valuable bee-pasture. Its tops are used for oven-fuel, brooms, thatch, etc., and locally are brewed with ale and used for tanning leather. It is the only species of the genus. Most of the heaths are of the great genus *Erica*, nearly 500 species of which are known. A few of these are small trees. Most of the heaths are South African; none except *Calluna* are American; none are South American or Australian. Of the genus *Erica*, seven species are British, but only two are very common, *E. tetralix* and *cinerea*, the beautiful flowers of which are known to literature as heather-bells. A very large proportion of the heaths are richly beautiful when in flower. They are not much cultivated in the U. S., for the rearing of them in our climate is peculiarly difficult. They are best raised in special structures called heath-houses.

Heath, tp. and post-v. of Franklin co., Mass. It has 3 churches and some manufactures of lumber. Pop. 613.

Heath, tp. of Allegan co., Mich. Pop. 1000.

Heath, tp. of Jefferson co., Pa. Pop. 247.

Heath (ASA), b. at Hillsdale, N. Y., July 31, 1776; entered the Methodist Episcopal ministry in 1797; went to Maine in 1799, and until 1842 was one of the most active and influential ministers of his denomination in that State. D. Sept. 1, 1860.

Heath (BENJAMIN), recorder of Exeter, England, was author of an *Essay towards a Demonstrative Proof of the Divine Existence* (1740), *Nota sive Lectiones ad tragicorum Græcorum quæ supersunt dramata* (1792), a *Revisal of Shakspeare's Text* (1765), and other learned works. D. 1766.

Heath (CHARLES), b. in 1784; d. Nov. 18, 1848. He is chiefly distinguished as an engraver of plates for illustrated works. The *Shakspeare Gallery*, *Waverley Gallery*, and *Book of Beauty* were celebrated in their day. The modern engravers Doo and Watt were pupils of Heath.

Heath (WILLIAM), b. at Roxbury, Mass., Mar. 2, 1737; became captain of the Suffolk regiment; commandant of the Ancient and Honorable Artillery of Boston 1770; after-

wards a provincial colonel; was often in the legislature; was in the Provincial Congress 1774–75; a brigadier, and then major-general, 1775; brigadier-general of the Continental forces 1775; major-general 1776; was an exceedingly useful officer throughout the Revolutionary war; State senator 1791–92; became judge of probate for Norfolk co., Mass., 1793; was elected lieutenant-governor in 1806, but declined to serve. D. at Roxbury Jan. 24, 1814.

Heath'cote (Ralph), D. D., b. in Leicestershire, England, 1721; was educated at Jesus College, Cambridge; became vicar of Barkby 1748; assistant preacher of Lincoln's Inn 1753; vicar of Sileby 1765; rector of Sawtry-all-Saints 1766; a prebendary of Southwell 1768; vicar-general of Southwell church 1788. D. May 28, 1795. Author of *Historia astronomiæ* (1746–47), *The Use of Reason in Matters of Religion* (1755), *Discourse on the Being of God* (1763, a portion of his 24 Boyle sermons), besides a number of other works. He also assisted in the preparation of the *General Biographical Dictionary*.

Heath's Creek, tp. of Pettis co., Mo. Pop. 2523.

Heath'ville, post-v., county-seat of Northumberland co., Va., 92 miles N. E. of Richmond. Pop. of tp. 1996.

Heav'en. Among its names, the Ang. Sax. word *heaven* is that which is "heaved" up; *Cœlum* means that which is "hollowed;" *Olympus*, the Greek abode of the gods, was a high mountain on the Macedonian frontier of Thessaly; *Elysium* is of unknown derivation [Egyptian *elisont* (?); Gr. *luo*, to "loose" (?); *eleusis*, the "coming" (?)]; the Babylonian name *Albordsh* (*el burdj*) was the "mountain of meeting" in the North (Isa. xiv. 13). The Hindoo heaven for the ordinary righteous was on Meru, a mountain rising from the centre of the earth, 2,000,000 of miles high; that for those who had reached Brahmaship was *Nirwana*, or virtually "nothingness." The Hebrew words for heaven mean "height," "high places," the "rolling" (sky), "cloudy expanse," that which is "stretched or beaten out." The common New Testament word means "elevated."

The highest conception of heaven among the heathen is that of the Greeks—*e. g.* Plato, who describes it (*Phædo*) as it "may be," the home of the just who have led holy lives and purified themselves with philosophy. It is above the air, where all colors, trees, flowers, fruits, stones, minerals, animals, seasons, senses, etc. are immeasurably better than on earth. Poets—*e. g.* Virgil—describe it as the shadowy isles of the blest, Elysian Fields in the Atlantic, or in the sky or the under-world, where heroes were gathered. The Hindoo Vedas describe it as a continuation of this life, though under better conditions and overruled by the divine Yama, the progenitor of man. After the Vedas came the doctrines of the transmigration of souls and Nirwana. The Persian book *Avesta* taught of a paradise (Persian, "pleasure-ground") for the true and pure beyond the eastern mountains. The heaven of the Egyptians was in the course of the sun; of the Druzes, is in China; of the Druids, was in the sky, reached after transmigrations; of the Scandinavians, was *Walhalla*, the gathering-place of heroes, where they continued the earthly life and delights of feasting and fighting. The North American Indians look forward to a happy hunting-ground in the West. The Mohammedan paradise is mainly depicted with sensuous imagery of earthly delights. The Hebrew description is of a firmament between the upper and lower waters, through which rain, dew, etc. are poured, transparent like sapphire, hung with stars as lamps, and resting on the mountains. Above it is the throne of God. Some of the later Jews hold to two heavens, some to three, the aërial, sidereal, and divine (as appears in the New Testament), and some to seven. Amos speaks of the "stories of heaven." The seven were—(1) Velum, (2) Expansum, (3) Nubes, (4) Habitaculum, (5) Habitatio, (6) Sedes fixa, (7) Araboth, or treasury.

The New Testament speaks of heaven as a country, a city, a house, a kingdom, an assembly, etc., but emphasizes its spiritual and moral attractions. It is a place of rest, glory, holiness, of the manifestation of God and increase of all good. Mention is made rather of *what* it is than *where*. The inhabitants are God, Father, Son, and Spirit, angels, spirits of the just, martyrs, and all the redeemed. Among pagans the occupations of heaven were generally of the same character as the pleasures of life—feasting, fighting, the chase, social and intellectual pleasures, and rest. The Bible represents it as a place of delightful activity in learning, worship, ruling, honoring God, in spiritual intercourse, and enjoyment of divine favors.

Proof of the doctrine of the heavenly recognition rests on the almost universal consent of all ages and races; the Old Testament phrase being "gathered to one's fathers or people;" the expectation expressed by Jacob (Gen. xxxvii. 35), by David (2 Sam. xii. 23); the recognition of the king of Babylon (Isa. xiv. 9); the story of the rich man and Lazarus; accounts of the future gatherings with the patriarchs (Matt. viii. 11); the rebukes at the judgment given by the "men of Nineveh," the "queen of the South," etc.; the history of the transfiguration; the recognition of Christ's glorified body by the disciples, and by Stephen, Paul, and John; the social character of the delights of heaven; our continued personality and consciousness; and the descriptions of Christ's second coming. ISAAC RILEY.

Heaves. See BROKEN WIND.

Heavy Spar, a popular name for the natural sulphate of baryta or barytes, has reference to the high specific gravity of that mineral. (See BARYTA.)

Heb'bel (FRIEDRICH), b. at Wesselburen, in Holstein, Mar. 18, 1813. He was a peasant-boy, and twenty-two years old before he acquired any systematic education. He studied for several years at the University of Munich, and in 1841 he succeeded in attracting considerable attention by his tragedy of *Judith*. The king of Denmark gave him a stipend, and after travelling through France and Italy he settled at Vienna, where he married the actress Christine Enghaus, and resided there till his death, Dec. 13, 1863. As a dramatist he belongs to the school of Schiller. It is the idea, not the picture, which in a subject inspires him. His characters strike by the logic of their development, but they excite no sympathy. The most remarkable of his dramas are *Marie Magdalena* (1844), *Herodes und Mariamne* (1850), *Agnes Bernauer* (1855), and *Die Nibelungen* (1862).

He'be [Ἥβη], in the Greek mythology, the goddess of youth and the cupbearer and attendant of the Olympian gods. She was the daughter of Zeus and Hera, and the wife of Heracles.

He'bel (JOHANN PETER), "the German Burns," b. at Bâle May 11, 1760; was educated at Lörrach, Carlsruhe, and at Erlangen; became subdeacon and professor of ancient languages in the Carlsruhe gymnasium, and in 1798 professor of theology and Hebrew; church councillor 1805; director of the Lyceum 1808; in 1819 prelate of the Evangelical Church; was for some years editor of *Der Rheinländische Hausfreund*; author of *Biblischen Geschichten* (1824), but is chiefly remembered for his *Allemannische Gedichte* (1803), poems written in the Black Forest dialect. D. at Schwetzingen Sept. 22, 1826.

He'ber (REGINALD), D. D., b. of wealthy parents at Malpas, Cheshire, England, Apr. 21, 1783, and was a half-brother of Richard Heber; was educated at Brasenose College, Oxford, and wrote (1803) the prize poem, *Palestine;* became a fellow of All Souls; and in 1807 rector of Hodnet. In 1812 published a volume of hymns; was Bampton lecturer 1815; a prebendary of St. Asaph 1817; became (1822) preacher of Lincoln's Inn; and in 1823 was consecrated bishop of Calcutta, and labored in India with zeal and wisdom until Apr. 3, 1826, when he was found dead in his bath at Trichinopoli. His works, besides those mentioned above, are *Narrative of a Journey in Northern India* (1828), a *Life*, etc. of Jeremy Taylor (1822), and some volumes of poetry. Heber was a man of saintly character, polished and dignified manners, and kindly and humble spirit. He belonged to the High Church and Tory parties, was Arminian in his theology, and possessed the profoundest convictions of the adaptation of Christianity to human needs. His hymn "From Greenland's icy mountains" (1819) is the most popular missionary hymn in the English language.

Heber (Sir RICHARD), b. in London in 1773; was educated at Brasenose, Oxford, and when nineteen published the text of Silius Italicus (1792); his edition of the songs of Claudian was printed privately in 1793; he was M. P. for Oxford University 1821–26; is chiefly known as the most indefatigable of book-collectors. He possessed, according to Allibone, no less than 146,827 volumes, besides bound and unbound pamphlets, which cost him some £180,000. D. in London Oct. 4, 1833.

Heber City, post-v., county-seat of Wasatch co., Ut., about 45 miles S. E. of Salt Lake City. Pop. 658.

Hébert (ANTOINE AUGUSTE ERNEST), b. at Grenoble, France, Nov. 3, 1817; went to Paris in 1835; studied painting under Paul Delaroche and David d'Angers; won in 1839 the grand prize, and was made director of the French Academy in Rome in 1866. His most celebrated pictures are *La Malaria* (1850) and *Le Baiser de Judas* (1853), besides a number of excellent portraits.

Hébert (JACQUES RENÉ), nicknamed the "Père Duchêne," from the ultra-radical paper published by him during the French Revolution, which paper was imitated in Paris under the late Commune, was b. at Alençon in 1755, and guillotined Mar. 24, 1794, in Paris. Previous to the Revolution, as he was uneducated, he led a miserable life as lackey and ticket-seller at the doors of the theatres. Immediately after the capture of the Bastile in 1789 he started his journal, *Le Père Duchêne*, the real patriotism,

but also the extreme opinions, of which soon made Hébert extensively known, and carried him to be attorney-general of the then Paris Commune, and afterwards a member of the National Convention. Hébert wielded a tremendous influence, but Robespierre understood that the exaggerations of the Hébertist or ultra-radical party founded by Hébert discredited the cause of the Revolution, and the committee of public safety sent to the guillotine the "Père Duchêne" and his partisans. FÉLIX AUCAIGNE.

Hébert (PAUL O.), b. in Louisiana in 1819; graduated at the U. S. Military Academy in 1840, and entered the army as second lieutenant of engineers; engaged as professor of engineering at the Military Academy, and in constructing defences in Louisiana till 1845, when he resigned and was appointed chief engineer of the State of Louisiana. On the outbreak of the war with Mexico he was reappointed in the army, lieutenant-colonel 14th Infantry, being engaged in the battles of Contreras, Churubusco, Molino del Rey, Chapultepec, and at the final assault and capture of the city of Mexico, and was brevetted colonel for gallant conduct. Returned to private life at the close of the war, and engaged as planter in Louisiana until 1853, when he was chosen governor of the State. During the civil war he served as a brigadier-general in the Confederate army.

Hebrew Language. The Hebrew belongs to the Semitic family of languages, and shares their general peculiarities. (See SEMITIC.) It is the medium of the Old Testament revelation, and, next to the Greek, in which the New Testament was written, the most important for the biblical student. The name is usually derived from עֵבֶר (*Eber* or *Heber*), the ancestor of Abraham (Gen. xiv. 13). In the Old Testament it is called "the language of Canaan" (Isa. xix. 18), and, with reference to the dialect of the kingdom of Judah, "the Jews' language" (Isa. xxxvi. 11, 13; 2 Kings xviii. 26, 28). In the New Testament it is designated γλῶσσα τῶν Ἑβραίων and Ἑβραϊστί (John v. 2; xix. 13, 17). The latter term, however, embraces the Aramaic then current. (See JOSEPHUS, *Antiq. Jud.*, i. 1, 2, γλῶττα τῶν Ἑβραίων.) It was the language of the Jewish people during the time of their national independence, and, with some modification, down to the destruction of Jerusalem (A. D. 70). It has continued to be their sacred language, and is used in the synagogue to this day. Prior to the immigration of Abraham, who originally spoke Aramaic (comp. Gen. xxxi. 47), it was probably the language of the Canaanites, the Phœnicians, and the Punic race. The Phœnician and the Punic, whose character is determined by the remains found in the lapidary and numismatic inscriptions, numbering more than 100, agree closely with the Hebrew. Jacob and his family carried it with them to Egypt, and their descendants preserved it as the medium of communication among themselves (as the colonies of Greeks maintained their mother-tongue in foreign lands), and after a sojourn of 400 years carried it back again to its original home in Canaan. It was the universal belief among the rabbins, the Christian fathers, and the older theologians that the Hebrew was the language of Adam and Eve, and that it prevailed among all mankind till the dispersion of Babel; many of them even held that it was the medium of communication between God and the angels. They called it *lingua Dei, lingua angelorum, lingua prophetarum*. The elder Buxtorf advised all Christians to learn Hebrew, that they might carry on their devotional services in it.

Owing to the greater stability of the Eastern nations and the Semitic languages as compared with the Indo-European or Aryan, the firm character of the Mosaic institutions, its confinement to sacred literature, the isolation of Palestine, and the exclusive spirit of the Jews, the Hebrew remained substantially unmodified, either by accretions from other languages or by growth and development within itself, during the period of its literary activity. Its literature may be properly divided into three periods: (1) the Mosaic, (2) the Davidic or Solomonic, (3) the post-Babylonian. Gesenius and other writers who deny the Mosaic origin of the Pentateuch assume only the two latter periods, but the Mosaic writings (as Hengstenberg, Hävernick, and others have well shown) have some marked linguistic peculiarities. They contain archaic and poetic words and forms either peculiar to themselves or seldom found elsewhere. (For examples see KEIL'S *Introduction to the O. T.*, Eng. trans., vol. i. p. 46 *seq.*) Many Egyptian words are peculiar to the Pentateuch. (See CANON COOK'S second excursus to his *Commentary on Exodus*, in the *Speaker's Commentary*, vol. i. p. 476 *seq.*) The second or golden age extends from Samuel to Hezekiah (B. C. 1100–700), and attained its most glorious height during the reigns of David and Solomon. Here belong the older prophetic and poetic writings and all the Davidic Psalms. This period includes the lives and writings of David, Solomon, Isaiah, Micah, Nahum, Habakkuk, Obadiah, Jonah, Amos, and Hosea. The third period includes the interval between the Babylonian exile and the times of the Maccabees (about 600–160 B. C.). Its marked feature is the approximation of the Hebrew to the kindred Aramaic and Chaldee. It may be seen to a greater or less extent in Ezra, Nehemiah, Chronicles, Esther, Haggai, Zachariah, Malachi, Jeremiah, Ezekiel, Daniel, and the later Psalms.

Gradually the Aramaic (Chaldee) superseded the Hebrew as the spoken language of the people. It was the mother-tongue of Christ and the apostles. When the New Testament speaks of Hebrew as the then current language in Palestine, we must understand it to mean the Aramaic dialect. The evidence for this assertion is derived from such words as Βηθεσδά, ῥαββί, μεσσιας, μαμωνᾶς, Γολγοθά, βὰρ Ἰωνᾶ, ταλιθά κοῦμι, ἐφφαθα, κηφᾶς, Ἀκελδαμά, and others, which are Aramaic. Josephus also not infrequently uses *Hebrew* in the sense of *Aramaic* (*Antiq.*, iii. 1, 1; iii. 7, 2; iii. 10, 6). Christ is reported by Mark to have spoken Aramaic on three occasions: when he raised the daughter of Jairus (Mark v. 41, *ταλιθὰ κοῦμι*, טְלִיתָא קוּמִי, *puella surge*, "Damsel, arise," cf. BUXTORF, *Lex. Talm.*, p. 875); when he opened the ears of the deaf man (Mark vii. 34, ἐφφαθά, imper. Ethpael, διανοίχθητι, "Be thou opened"); and upon the cross, when he exclaimed ἐλωΐ (the Syriac form for ἠλί, אֵלִי, given by Matt. (xxvii. 46), ἐλωΐ, λαμᾶ σαβαχθανι (Mark xv. 35). It is characteristic that Mark, in keeping with the dramatic vivacity of his narrative, should introduce these instances of the original words used by our Lord. When Christ appeared to Paul on the way to Damascus he addressed him in Hebrew (Acts xxvi. 14), and Paul addressed the excited crowd at Jerusalem in Hebrew when he wished to appease their wrath and awake their sympathy (Acts xxi. 40; xxii. 2).

After the dispersion the Jews used for ordinary conversation the language of the countries in which they resided. This was especially the case with the Greek. The Jews who spoke this language were known by the appellation of *Hellenists*. This term distinguished them from the *Hebrews*, who lived in Palestine, and used, as a general rule, the Aramaic.

The history of the critical study of the Hebrew begins with the Jewish grammarians and scribes, the Talmudists and Masoretes, who carefully collected all that pertains to the text of the Hebrew Scriptures. The Christian fathers, with the exception of Origen, Epiphanius, and especially Jerome (who learned the language from a Jewish rabbi and utilized it for his translation of the Vulgate), were ignorant of the Hebrew language, and derived their knowledge of the Old Testament from the Greek Septuagint and the Latin Vulgate. During the Middle Ages the Hebrew was almost exclusively cultivated by learned Jews, especially in Spain during the Moorish rule, such as Eben Ezra († 1170), David Kimchi, Moses Maimonides († 1204). Even the greatest scholastic divines knew nothing of Hebrew. After the revival of letters some Christians began to learn it from Jewish rabbis. Reuchlin († 1522), the uncle of Melanchthon, is the father of modern Hebrew learning in the Christian Church. He wrote a Hebrew grammar (1505), coined most of the technical terms which have since been in use in Hebrew grammars (*status absolutus, affixum, verba quiescentia*, etc.), and introduced the pronunciation that prevails in Germany. The Reformers cultivated and highly recommended the study of Hebrew, and the Protestant translations of the Bible were made directly from the original languages, and not from the Vulgate. During the seventeenth century Buxtorf, father and son, of Bâle, Louis Cappel of Saumur, and Salomon Glassius of Jena were the most prominent Hebrew and Talmudic scholars. In the present century, Wilhelm Gesenius, professor in Halle (1786–1842), and Heinrich Ewald, professor in Göttingen (1803–73), created a new epoch in the study of Hebrew. Rödiger, Hupfeld, Hitzig, Fürst, Delitzsch, and others are prominent in this department of learning. In our own country, Moses Stuart of Andover (d. 1852), Edward Robinson of Union Seminary, N. Y. (d. 1863), James Addison Alexander of Princeton (d. 1859), Bush, and Conant deserve special mention as Hebrew scholars.

Literature.—Hebrew grammars by GESENIUS (20th ed. by Rödiger, 1866; transl. by Conant, Stuart, Davies), EWALD (7th ed. 1863), BÖTTCHER (1868), SEFFER (4th ed. 1864), NORDHEIMER (New York, 1842), and W. H. GREEN (New York, 1861). Hebrew dictionaries by BUXTORF (1639), SIMONIS (new ed. by Winer, 1828), GESENIUS (the manual edition, trans. by ROBINSON, and also by TREGELLES; the *Thesaurus* in Latin, finished by RÖDIGER, Leipsic, 1829–58, in 3 vols.), and FÜRST (1863, 2 vols., trans. by SAM. DAVIDSON, 4th ed. 1871). Hebrew concordances by FÜRST (1840, pp. 1428, fol.); *The Englishman's Hebrew and Chaldee Concordance of the Old Testament* (3d ed., London, 1868, 2 vols.). The latter gives the passages

from the authorized English version, but in the order of the Hebrew words. Also W. WILSON, *An English, Hebrew, and Chaldee Lexicon and Concordance*, 3d ed., London, 1866. PHILIP SCHAFF.

Hebrew Literature. See JEWISH LITERATURE, by PROF. FELIX ADLER.

Hebrews. See JEWS, by PROF. FELIX ADLER.

He'brews, Epistle to the, an anonymous Epistle of the New Testament, written by St. Paul, or, what is more probable, by one of his disciples and companions under his inspiration (Luke, or Barnabas, or Apollos), is addressed to the Christians of Hebrew descent in the East. Its object is to show the infinite superiority of Christ over Moses, and of Christianity over Judaism, and to warn its readers against apostasy. The writer makes the Old Testament itself prove the New, to which it pointed as its fulfilment. He sets forth especially the eternal priesthood and sacrifice of Christ, of which the Levitical worship was a significant symbol and type. The ninth chapter furnishes the key to the understanding of the tabernacle and the temple. The doctrinal expositions are interwoven with solemn warnings and rich consolations in view of the heavy persecutions to which the readers were exposed from the unconverted Jews. The eleventh chapter contains a most eloquent sketch of the ancient heroes of faith for the encouragement of timid believers, and forms a parallel to the seraphic description of love in the thirteenth chapter of First Corinthians. The Epistle belongs to the Pauline type of doctrine, and mediates between it and the Christology of St. John. It was written before the destruction of Jerusalem, when the temple worship was still in existence, probably in Italy during the first imprisonment of Paul in Rome, A. D. 63 or 64. See commentaries on the *Hebrews* by Bleek (in 3 vols.), Tholuck, Delitzsch, De Wette, Ebrard, Turner, Stuart, Alford, Lünemann (in Meyer's *Com.*), Moll (in Lange's *Com.*, Am. ed., with valuable additions by Kendrick), William Lindsay; also the able work of Riehm on the *Lehrbegriff des Hebräerbriefs* (1859, 2 vols.), and the relevant sections in critical introductions to the N. T. PHILIP SCHAFF.

Heb'rides, or **Western Islands,** is the common name given to the large group of islands which stretches along the western coast of Scotland, numbering about 490, of which, however, only 120 are inhabited. They are divided into the Outer Hebrides, among which the most remarkable are St. Kilda, Lewis, Harris, North and South Uist, Benbecula, and Barra; and the Inner Hebrides, the principal of which are Skye, Eigg, Mull, Iona, Staffa, Ulva, Lismore, and Kerrera. Their area is estimated at 3000 square miles. Pop. 100,000. Most of these islands, of which the remarkable ones will be described in separate articles, are rocky and unproductive, but their mild and moist climate, due to the presence of the Gulf Stream, produces excellent pastures, and cattle and sheep are reared in great numbers. In the ninth century these islands were colonized by emigrants from Norway, who largely replaced the original Celtic population, but the Gaelic language even now is in general use. The islands in the following centuries were alternately under Norwegian and Scotch authority, or under "Lords of the Isles," who were often virtually independent, until in 1540 they were finally annexed to the Scotch crown by James V.

He'bron [Heb. *Hebron*], a place in Palestine, about 20 (17½ geographical) miles a little W. of S. from Jerusalem, one of the oldest existing cities in the world. Its original name (Gen. xiii. 18), displaced for a time by *Kirjath-arba*, "city of Arba" (Josh. xxi. 11), was restored by Caleb. The Arabs now call it *El Khalil*, "the friend" (*i. e.* of God, meaning Abraham, whose home it was for many years). It was one of the cities of refuge. David reigned there seven and a half years before getting possession of the whole kingdom of Israel. The Maccabees recovered it from the Edomites, who had taken it after the Captivity. It was burned by an officer of Vespasian just before the destruction of Jerusalem. It was taken by the Arabs in 637, by the Crusaders about 1100; became the seat of a Latin bishopric in 1167; and ever since 1187 has been in the hands of its present masters, the Mohammedans. It is situated in a valley, generally supposed to be the "Eshcol" of the Mosaic period, about 3000 (Schubert says 2664, Russegger 2842, Tristram 3029) feet above the level of the sea. This valley is exceedingly fertile, abounding in grapes, olives, figs, pomegranates, and the like. The great mosque of Hebron, on rising ground, is over the cave of Machpelah, in which Abraham, Isaac, and Jacob, with their wives, are buried. The cave itself no one is permitted to enter; and until 1862, when the prince of Wales was the guest of the government, no Christian was permitted to enter even the area of the mosque. The population is some 8000 or 10,000, of whom some 400 or 500 are Jews, and the rest Mohammedans, noted for their bigotry and fanaticism. (See Appendix I. to *Sermons in the East*, by DEAN STANLEY, who accompanied the prince of Wales, 1863.) R. D. HITCHCOCK.

Hebron, tp. and post-v. of Tolland co., Conn., on the New Haven Middletown and Willimantic R. R. It has several cotton-mills and other manufactories. Pop. 1279.

Hebron, tp. and post-v. of McHenry co., Ill., 90 miles N. W. of Chicago, and on the Chicago and North-western R. R. Pop. 930.

Hebron, post-v. of Porter co., Ind., on the Columbus Chicago and Indiana Central R. R., 51 miles by rail S. E. of Chicago. It has a weekly newspaper.

Hebron, tp. and post-v. of Oxford co., Me., on the Portland and Oxford Central R. R., 45 miles N. of Portland. It has an academy. Pop. 744.

Hebron, post-v., cap. of Thayer co., Neb., on the Little Blue River, 65 miles S. W. of Lincoln, the capital of the State. It has a fine school-building, a religious organization, 1 grist-mill, 1 newspaper, 2 hotels, and 8 stores. The soil in the vicinity is well watered and fertile. Pop. about 250.
RALPH K. HILL, PUB. AND PROP. "HEBRON JOURNAL."

Hebron, tp. and post-v. of Grafton co., N. H., 40 miles N. W. of Concord. Pop. 582.

Hebron, post-tp. of Washington co., N. Y., 55 miles N. E. of Albany, has valuable slate quarries. Pop. 2399.

Hebron, post-v. of Union tp., Licking co., O., 27 miles E. of Columbus, on the Ohio Canal and National Road. Pop. 478.

Hebron, post-tp. in Potter co., Pa. Pop. 754.

Hebron, tp. of Marlboro' co., S. C. Pop. 1581.

Hebron, tp. of Orangeburg co., S. C. Pop. 311.

Hebron, post-tp. of Jefferson co., Wis. Pop. 1372.

He'brus [Ἕβρος, now called *Maritza*], a river of European Turkey, anciently in Thrace, and celebrated in Greek mythology and history. It drains nearly all of Roumelia. It is boatable as high as Philippopolis; vessels of 200 tons ascend to Adrianople, except in low water, when they stop at Demotica, 25 miles below. The river is 240 miles long and flows into the Ægean Sea.

Hecatæ'us, of Miletus, one of the earliest and most important of the chroniclers (*logographi*), was the son of Hegesander, and lived about B. C. 549 to 479. He is referred to in terms of respect by Herodotus, and would seem to have been of noble birth, from the prominent part he took in the affairs of his native city. He opposed at the outset the attempt of Aristagoras to arouse the Ionians of Asia to free themselves from the Persian dominion; was instrumental subsequently in procuring more lenient treatment for his countrymen from the Persian satrap; visited many countries, and published the results of his travels in a work entitled Περίοδος γῆς or Περιήγησις, in two books, of which the first was devoted to Europe, the second to Asia, including Egypt; wrote also Γενεαλογίαι or Ἱστορίαι, containing the mythological histories of the Greeks, in four books. His geographical work is the more important, as he described what he himself saw; wrote in the Ionic dialect. Some fragments remain, and are collected in *Hecatæi Fragmenta*, ed. Klausen (Berlin, 1831), *Fragm. Hist. Græc.*, ed. Müller, vol. i. pp. 1–31. (See MURE's *Hist. of Greek Lit.*, vol. iv. p. 140.) H. DRISLER.

Hec'ate [Ἑκάτη], a mysterious Greek goddess, whose mythus is variously given. The old traditions make her one of the Titans, honored by the Olympian gods, whom she assisted against the giants. She is oftenest reckoned as one of the infernal divinities, of a most mysterious and terrible character. She was worshipped with gloomy sacrifices and magical rites.

Hec'atomb [Gr. ἑκατόμβη] strictly signifies the offering of a "hundred bullocks" (ἑκατόν, βοῦς) in a sacrifice to the gods; but most commonly it designates the slaughter of a considerable number of animals of any kind. Sometimes the whole hecatomb, but more often the thighs, legs, and hides, were burned as a part of the ceremony, the flesh of the beasts being eaten by the worshippers.

Heck (BARBARA), "the foundress of American Methodism," was born in Ireland in a settlement of German emigrants from the Palatinate on the Rhine. These people came early under the influence of Wesley and his Irish itinerants, and formed some of the strongest Methodist societies of the island. In 1760, Philip Embury, Paul Heck, and Barbara his wife, with others of the settlement, sailed for New York. There the little company lapsed from their faith, or at least from their Wesleyan usages, but in 1766, Barbara Heck recalled Embury to his duty as a Methodist local preacher (in which capacity he had labored in Ireland); she gathered a little congregation at his house, and rested not till she saw the famous "Old John street

chapel" completed. Methodism was thus effectively introduced into the U. S. When Wesley's preachers arrived to take charge of the John street society she removed with her family and that of Embury to Northern New York, where they founded Methodist societies. They finally settled in Upper Canada, and became the founders of their denomination there. Barbara Heck d. there at the residence of her son, Samuel Heck, in front of Augusta, in 1804, aged seventy years. A. STEVENS.

Heck'er (Very Rev. ISAAC THOMAS), the founder of the congregation of Paulists, was b. in New York Dec. 18, 1819. In 1843 joined in the Brook Farm experiment, and afterwards spent some time in a socialistic community at Fruitlands, Worcester co., Mass., and also lived with H. D. Thoreau in his hermitage for a while. In 1845 he became a Roman Catholic; joined the Redemptorists in Belgium in 1847; was ordained a priest in 1849 by Cardinal Wiseman; returned to the U. S. in 1851; was released from the order of Redemptorists at Rome by the pope in 1857, and founded the congregation of St. Paul the Apostle in 1858. In 1865 established a periodical called the *Catholic World*. In 1869 was Bishop Rosecrans's procurator at the Vatican Council. Author of *Questions of the Soul* (1855), *Aspirations of Nature* (1857).

Hecker (JOHN), a merchant of New York and brother of Rev. I. T. Hecker, was b. in New York July 25, 1812. In 1835 established a large bakery; in 1840, with his brother, George V., engaged in an extensive flour manufacture. In 1850 started *The Mint*, a periodical, and in 1854–56 served as an alderman from the 7th ward. Was (1857–61) editor of the *Churchman*, and (1864–74) was a public school inspector. Was a strong friend of the ritualistic movement in the Protestant Episcopal Church, and was much interested in popular education. He published a work on *The Scientific Basis of Education*. D. May 7, 1874.

Heck'ewelder (JOHN GOTTLIEB ERNEST), b. at Bedford, England, Mar. 12, 1743, of Moravian parents, with whom he came in 1754 to America; became in 1762 an Indian missionary, laboring in Ohio, Pennsylvania, and Michigan; became in 1788 missionary agent for the Moravians, serving at times as U. S. peace commissioner with the Indians; residing 1801–10 at Gnadenhütten, O., and after that at Bethlehem, Pa., where he d. Jan. 21, 1823. His chief works are *An Account of the History, etc. of the Indian Nations* (1818) and a *Narrative of the Mission of the United Brethren* (1820). Heckewelder's love and admiration for some traits of the Indian character exposed his books to severe criticism. (See RONDTHALER, *Life*, 1847.)

Hec'la, or **Hek'la,** a famous volcano of Iceland, is in the south-western part of the island, 20 miles from the coast. It is conical in shape, 5110 feet high, covered with snow, and presents a dreary, desolate aspect. Since 1104 A. D. eighteen eruptions of this volcano are on record, of which five have been simultaneous with those of Vesuvius, and four with those of Ætna. The last and most tremendous eruption was that of 1845, lasting seven months, pouring out a stream of lava 1 mile broad and 50 feet deep, and sending its clouds of dust 400 miles over the ocean, as far as the Orkney Islands.

Hecla (HECLA WORKS P. O.), a v. of Westmoreland tp., Oneida co., N. Y., has a large manufactory of iron goods and hardware. Pop. 125.

Hec'tic Fe'ver [Gr. ἑκτικός, from ἕξις, "habit"], a fever which is so continued as to constitute a *habit* (ἕξις) of the body. Such fevers are probably always symptomatic of some local or extended irritation. Thus, hectic attends pulmonary consumption, chronic pleurisy with extensive exudations, peripheral caries of the bones, etc. Hectic, as it occurs in pulmonary consumption, is sometimes intermittent, with evening exacerbations; sometimes almost constant. The latter kind generally affords a bad augury, and it cannot in general be much relieved by treatment; but intermittent hectic may often be palliated, greatly to the patient's relief.

Hec'tor, one of the central characters of the *Iliad*, a valiant Trojan prince, son of Priam by Hecuba, husband of Andromache, and father of Astyanax. He is the principal champion of the Trojans, the slayer of Patroclus, and is himself slain by Achilles, aided by Pallas Athena.

Hector, post-tp. of Schuyler co., N. Y. It lies on the E. shore of Seneca Lake, and has numerous small manufacturing villages, 9 churches, and manufactures of leather, lumber, woollen goods, castings, agricultural implements, etc. Pop. 4905.

Hector, tp. of Potter co., Pa. Pop. 651.

Hec'uba, wife of Priam, the king of Troy, and mother of nineteen of his children, including Paris, Hector, Polydorus, Cassandra, Creusa, and Polyxena. She became a slave among the Greeks after the fall of Troy, but the narratives of the residue of her life are various.

Hed'ding (ELIJAH), D. D., b. at Pine Plains, N. Y., June 7, 1780; entered the Methodist ministry 1800; labored for many years with distinguished zeal and success, mainly in New York and New England; was elected a bishop in 1824, after which time his usefulness and ability were even more conspicuous than before. D. at Poughkeepsie, N. Y., Apr. 9, 1852. (See his *Life* by D. W. CLARK, 1855.)

Hed'dle, or **Heald,** in weaving cloth, is the vertical thread or wire which raises or depresses a certain part of the threads or every alternate thread of the warp preparatory to the passage of the shuttle. There is a heald attached to each warp-thread; and in every loom there are at least two, often several more sets of heddles, according to the kind of weaving. Many improved styles have been introduced for special kinds of looms.

Hedge, a fence of growing shrubs set closely together. The setting of hedges is a matter of great importance in regions where timber and stone are scarce or expensive, as in Great Britain and many parts of the U. S. The thorns (*Cratægus*) are extensively employed in England, but in the U. S. they are peculiarly liable to the attacks of borers, and are therefore not much used. Buckthorn, barberry, beech, hornbeam, Japan quince, privet, arborvitæ, holly, honey-locust, the Cherokee rose, and especially the Osage orange or bois d'arc (*Maclura aurantiaca*), are used successfully in the U. S. Much depends upon the proper setting of the hedge-plants, and still more upon subsequent care and proper clipping.

Hedge (FREDERIC HENRY), D. D., a clergyman of the Unitarian faith, b. in Cambridge, Mass., Dec. 12, 1805. At the age of thirteen he went to Germany, and studied there for several years; returned in 1823, and entered Harvard College in the class of 1825; studied theology three years at the Cambridge Divinity School; was settled in West Cambridge 1835; in Bangor, Me.; spent the year 1847–48 in Europe; took charge on his return (1850) of the Westminster church in Providence, R. I.; accepted a call to Brookline, Mass., 1856, and in 1872 took the office of instructor in German at Harvard College, where previously he had lectured on church history. Dr. Hedge has a powerful mind, and wields a powerful pen. His greatest work, *Prose-Writers of Germany* (1 vol. 8vo, Philadelphia, 1848), has a standard reputation. Other volumes are *Reason in Religion* (Boston, 1865), *The Primæval World of Hebrew Tradition* (Boston, 1870). He is known as the author of remarkable papers on Augustine, Leibnitz, Schopenhauer, and Coleridge, in magazines. He has been a valued contributor to popular literature, a lecturer and orator besides; from 1857 to 1860 he edited the *Christian Examiner;* was part compiler of a book of hymns; composed hymns; translated poems from the German; prepared a brief form of liturgy for the Unitarian Church; and was at one time (1857) president of the Unitarian Association. All his work indicates the scholar and the man of culture. He is eminent outside of his sect as a preacher and writer, for the vigor of his thought, the dignity of his presence, and the noble purity of his English style. Dr. Hedge is a Christian rationalist, combining intellectual independence with fidelity to ecclesiastical tradition, and might easily have been a leader had he been able to surrender his mind to any single school of thought. O. B. FROTHINGHAM.

Hedge (LEVI), LL.D., b. at Warwick, Mass., Apr. 19, 1766; graduated at Harvard 1792; a college tutor 1805–11; professor of Latin in Harvard College 1811–17; of natural theology, political economy, and moral philosophy 1817–22 and 1827–32; of logic and metaphysics 1810–27. Author of a treatise on logic (1816); editor of an abridgment of Brown's *Philosophy* (1827). D. at Cambridge, Mass., Jan. 3, 1844. Father of F. H. Hedge.

Hedgehog, properly the name of the insectivorous animals of the genus ERINACEUS (which see). In parts of the U. S. the name is incorrectly given to various species of PORCUPINE (which see).

Hedge-Sparrow. See ACCENTOR.

Hedgesville, tp. of Berkeley co., West Va. Pop. 2499.

Hedjaz, El ("the land of pilgrimage"), is the name of a partly sandy, partly stony region of Arabia, extending along the coast of the Red Sea from Yemen to the Syrian desert. As both Mecca and Medina, the two holy cities of the Mohammedans, are situated in this region, it is annually traversed by thousands of pilgrims. It is divided into a lowland (Tehama) and a highland region (Nejd); constitutes with Yemen a vilayet of the Turkish empire. Pop. of Hedjaz (*Gotha Almanac* 1874) is given as 518,750.

Hedj'rah, or **Heg'irah** [Arab., the "separation;" more fully *Hedjrat-al-Nebi*, the "prophet's departure"], the es-

cape of Mohammed in secret from Mecca, where the Koreish were determined to kill him. He fled to Medina, where he found many followers. This event, regarded as the true origin of Mohammedanism, occurred Sept. 13, 622, but it was not until 639 that Omar the caliph established the Hedjrah as the beginning of the Mohammedan era. As the Arabic year is nearly 11 days shorter than ours, it is very difficult to transfer dates accurately from one to the other year. If 3 per cent. be taken from the number of the year of the Hedjrah, and 622 be added to the remainder, the sum is usually, not always, the year of the Christian era.

Hee'ren (ARNOLD HERMANN LUDWIG) was b. at Arbergen, near Bremen, Oct. 25, 1760, and studied at the University of Göttingen, at which he was afterwards appointed professor—1787 in philosophy, 1801 in history. D. at Gottingen Mar. 7, 1842. His first works were critical editions of Menander, *De Encomiis* (1785), and Stobæus, *Eclogæ physicæ et ethicæ* (1792-1801); but the study of Polybius attracted his attention to the influence which trade and commerce had exercised on the foundation and development of the ancient states, and between 1793 and 1796 published his excellent work, *Ideen über Politik, den Verkehr und den Handel der vornehmsten Völker der Alten Welt;* also his *Geschichte des europäischen Staatensystems und seiner Colonien* (1809), and many of his minor historical essays were well received by the German public, and his *Untersuchungen über die Kreuzzüge* received a prize from the French Academy.

Hefele, von (KARL JOSEPH), D. D., Roman Catholic bishop of Rottenburg, Würtemberg, was b. at Unterkochen Mar. 15, 1809; studied at Tübingen; became a *privat docent*, and in 1840 professor of church history, archæology, and patrology in the Roman Catholic faculty of Tübingen. In 1869 he was made bishop. His edition of the *Apostolic Fathers* (1839), *Review of Wessenberg's Church Councils* (1841), *History of the Christian Councils* (1855–74, 6 vols.), *Pope Honorius, Cardinal Ximenes* (1851), *Contributions to Church History*, etc., have given him a wide fame as a profound scholar. He was a member of the Vatican Council, and voted with the minority against papal infallibility, but afterwards submitted.

Heg (HANS C.), b. in Norway in 1829; came to America with his father in 1840, and settled in Wisconsin. During the gold excitement in 1849 young Heg went to California, returning at the end of two years to Wisconsin, settling near Milwaukee, and devoting himself to agricultural and mercantile pursuits till 1859, when he was chosen commissioner of State prisons. On the outbreak of the civil war in 1861 he entered the volunteer service as major 4th Wisconsin, and in September following was promoted to be colonel 15th Wisconsin Vols., participating in the affair of Island No. 10 and the battles of Perryville, Stone River, and Murfreesboro'. From Apr. 29, 1863, commanded a brigade in the 20th army corps, leading it in all the actions of that corps and in the battle of Chickamauga, where he was killed, Sept. 19, 1863.

He'gel (GEORG WILHELM FRIEDRICH), b. at Stuttgart Aug. 27, 1770. He was descended from an old Suabian family which had migrated into Würtemberg from Carinthia shortly after the Lutheran Reformation, in order to secure religious freedom. His father was an officer under the ducal government. Hegel began to attend a Latin school in his native town when five years of age, and at seven entered the gymnasium. At the age of eight he read Shakspeare in Wieland's translation, and before thirteen he had studied geometry, surveying, Latin, Greek, and Hebrew. He translated the whole of Longinus on the *Sublime* at seventeen, and at eighteen the *Antigone* of Sophocles, which remained his favorite work of art through life. His efforts at declamation while at the gymnasium were unsuccessful. He stammered, and was very awkward in his manners. His French was good, chirography distinct. He early began the practice of entering in his commonplace book whatever interested him, and his extracts became voluminous. He entered the University of Tübingen in the autumn of 1788 as student of theology; heard lectures on metaphysics and natural theology by Flatt, and attended numerous other courses by different professors on various parts of the Bible, particularly the Psalms and New Testament; studied anatomy and botany, and reviewed his beloved Greek tragedies; was delighted with the book of Job. He received the degree of master of philosophy in 1790, and on the occasion wrote a dissertation, *De limite officiorum humanorum seposita animorum immortalitate*, evincing the fact that he had begun to ponder the question of the Kantian dualism. He had made some acquaintance with the Wolffian philosophy as early as his fifteenth year. In his personal demeanor towards his fellow-students he was honest and jovial. He appeared older than he was, and received from his mates the familiar name of *Alter*, or "the old man." In 1790, Schelling, then in his sixteenth year, came to the university, and his precocious intellect seems to have awakened in Hegel a new activity. Hegel had read Rousseau at an early age, and was influenced by him quite strongly, as, indeed, were Kant and most other German thinkers. The philosophy of Kant and his successors may be regarded as a speculative reaction against the tendencies that led to the French Revolution. Goethe's *Faust* portrays the same reaction in literature. In 1790, Young Germany looked for the social regeneration of Europe. "Liberty, equality, and fraternity" were the magic words of the time. Hegel took part in a political club formed for the dissemination of French ideas. In 1793 he left the university, and became a private tutor in a family in Berne. Fichte shortly before, and Herbart about the same time, held similar positions in Switzerland. He passed this epoch of his life in a quiet and studious manner, gradually departing from the ideas he had received at Tübingen, and beginning seriously to grapple with the problem of human responsibility, and to feel distinctly the want of a fundamental principle that should subordinate both the theoretical and practical phases of life. He wrote a life of Christ; studied Kant more thoroughly; was charmed by the theories of Benjamin Constant; finally bent all his strength upon the mastery of Fichte's *Science of Knowledge*, which just then appeared. His characteristic stubbornness and patience were put to a severe test. His correspondence with Schelling at this time assisted him in gaining an insight into the subtle psychological analysis of Fichte. Schelling's fiery nature was thoroughly aroused by the *Science of Knowledge*, and he stormed, Titan-like, the subjective limits which Fichte in the spirit of Kant placed to the validity of his theoretical principles. The universal and necessary truths which, according to the critical system, demonstrated the subjectivity of all our knowledge, seemed to Schelling to establish its objectivity; for they were not universal and necessary unless they were the necessary condition of the existence of objects in time and space. With this view he hastened to construe the world of nature *a priori* by means of transcendental ideas. Self-consciousness revealed the hidden laws and principles implicit in the ordinary knowing, and these laws and principles, drawn out of the unconscious activity of the mind, were identified with the moving forces of nature, and thus came to be attributed to an impersonal Reason, a Soul of the World. Schelling departed further and further in this direction during his first career, and developed a system in strong contrast to that of Fichte, which laid all stress on the conscious Ego and the free moral will. There was no necessary incongruity in the two systems, except what arose from one-sidedness, due to the intense emphasis given to the opposite poles of this philosophy: Fichte emphasizing the self-conscious Ego and the moral will, and subordinating all else as merely phenomenal and scarcely worthy of human investigation; while Schelling turned to nature and history as the unconscious realizations of spirit in time and space, and hence worthy of all study, as though charged with the fulness of divine incarnation. Fichte slighted time and space, and hence everything real and conventional — institutions, beliefs, systems; the world in short. He was ascetic, subordinated the world to the soul, somewhat as did George Herbert or Thomas à Kempis. Schelling looked upon the world as the revelation of the Absolute, and held it sacred, while subjectivity became less and less important in his eyes, and as a consequence morality and practical aims and endeavors lost their interest for him.

Through the assistance of his friend Hölderlin, Hegel obtained a situation in 1797 as tutor in Frankfort, the birthplace of Goethe. His interest in philosophical studies increased. He studied Plato and Sextus Empiricus, and began to seize the objective dialectic into which he could translate the psychological process of Fichte. In 1799 his father died, leaving him some property, and in 1801 he removed to Jena, the centre of literary activity at that time. Fichte had recently gone to Berlin, having been dismissed from Jena on account of complications arising from the charge of atheism made against him. Schelling was there as professor extraordinarius. Hegel lectured on logic and metaphysics, the philosophy of nature, and the philosophy of spirit. In 1805 he lectured on the history of philosophy, pure mathematics, and natural rights; in 1806, on the unity of philosophical systems and the phenomenology of spirit. Up to this time he had been a follower of Schelling, with whom he had edited the *Critical Journal of Philosophy* four years before. His own system begins to reveal its outlines at this period: I. Logic or science of pure thought or Reason—universal ideas applying to nature and mind alike; II. philosophy of nature, treating of the realization of Reason in time and space; III. philosophy of man as finite spirit; rising through Ro-

ligion to the Absolute or Pure Reason again, and thus completing the circle of philosophy. During this period his style evinced improvement, and his use of illustrations from Greek mythology gave to his abstractions a popular hold. He studied Goethe's philosophy of colors, and followed out the experiments indicated; reviewed Homer, and began to see the outlines of the process which includes the evolution of the world and as Providence guides human history. Schelling had removed to Wurzburg in 1803. Hegel had for four years been clearing up in his mind the relation of his own results to the presuppositions of Schelling. The relation of Fichte, as subjective idealist, to Schelling, as objective idealist, he had already defined in the *Critical Journal of Philosophy*. He now was ready to define his own relation toward Schelling. In the *Phenomenology of Spirit*, published in 1807—a work which he called his "voyage of discovery"—he undertakes to trace the history of consciousness in its growth from the first stages of culture up to the theoretical and practical conviction which underlies modern civilization. In the preface to this work he attacks the "immediate intuition" of Schelling, and shows that thought or knowledge without mediation is entirely empty. He employs in this "voyage of discovery" a dialectic method as strict as that of Fichte, but used objectively—as the necessity of the object under consideration, rather than as a mere subjective necessity of thought. Consciousness in the stage of simple sensuous knowing is proved to know nothing immediately. Its first preception is shown to be a mediated one, depending upon inference, which is made implicitly or unawares. Further analysis reveals the presupposition upon which the inference involved in perception is based: this inference is found to be not subjective alone, but to correspond to an objective activity of mediation, which is seen to be the necessity of the objective world, and is named *Force* by the consciousness. Herewith the reflective stage of Consciousness begins, or the realm of understanding. The presupposition underlying Force is investigated: it is a unity in multiplicity, self-united in its utterance; force in expending itself manifests its unity in all its effects. This dualism (force and manifestation) involves further the dualism of each of its sides, and thus we have the internal duality as Law on the one hand, and the external duality as Phenomenon on the other hand, containing force and manifestation. In natural law Consciousness perceives an ideal type or form, which as internal and ideal measures and shapes the phenomenal world. Law is not abstract unity, but it includes in itself difference, multiplicity. The difference in the law is ideal and posited through the unity, which, again, is unity only as revealing itself in self-opposition—in other words, the ultimate presupposition of law is self-determination. Beyond self-determination analysis does not proceed, for the former presupposes no higher principle; all its determinations (characteristics, properties, and attributes) are products of its own activity. Herein consciousness recognizes the image of itself; it has traced up the external world to its internal truth, self-determination (or "subject-objectivity," as Fichte named the Ego), an internal, essentially active, and self-opposed being; the Ego is such an activity as exists in self-opposition or as subject and object at the same time. Thus, the objective has been traced back to an Ego or spiritual personality (God) as its necessary essence, and in the contemplation of this essence of the world Consciousness finds itself contemplating its own prototype, and becomes self-consciousness. It must be understood that the mind makes all this experience in its pre-historic stages of culture, contemporaneous with its formation of language, but in a naïve, unconscious manner, having no philosophic knowledge of its method. It comes to a scientific knowledge of the course it has trodden only after thousands of years. The result of human experience, wherein it arrives at self-consciousness, is only a conviction, not a scientific idea. Hegel proceeds in the remaining part of the *Phenomenology* to trace out the necessary stadia of history by which man realizes this conviction in institutions, commencing with the patriarchal one of slavery. In the subtlest manner he shows how the mind reflects upon an institution as soon as realized, and elevates itself to a new realization, making at each step its unconscious conviction more and more a conventional, universally recognized conscious principle, enunciated in its revealed religion, portrayed in its art and poetry, organized in its state, civil society, and family, and finally generalized in its science. Hegel's philosophy is all contained *in nuce* in the *Phenomenology*, and in some respects this work is the best example of his method of dialectical procedure. His entire system may be regarded as the philosophy of Civilization, or as the demonstration of the personality of the Absolute and an exhibition of His revelation in the world of time and space.

The *Philosophy of Nature* attempts to exhibit the return from pure empty externality—time and space, or the pure form of God's Not me—through the mechanical and dynamical phases of matter, up to organized life as a phenomenal appearance of self-determined being. The *Philosophy of Spirit* attempts to show the development from mere consciousness (which is *real* self-determining being, instead of the phenomenal appearance of it in the animal, which is nature's highest being) up to the realization of this subjective consciousness (which exists in the savage only as a mere possibility) in objective institutions, family, society, state, and Church, with codes of laws and morals, ceremonials and conventionalities, as well as in theoretical presentations in art, literature, and science.

To this vast undertaking he devoted the rest of his life. Closing his lectures at Jena Sept. 18, 1806, on occasion of the approach of the French, he repaired early in 1807 to Bamberg, where he edited a political newspaper until the autumn of 1808, when he took charge of a gymnasium at Nuremberg. Here he remained eight years; he was married Sept. 16, 1811, to Marie von Lucher, of one of the oldest patrician families in Nuremberg. He elaborated and expounded his *Science of Logic* (1812–16) in three volumes, presenting in it the science of pure thought or the fundamental basis of his entire system. Its divisions are three: I. Being, or Immediateness; II. Essence, or Mediation; III. Idea, or Notion ("*Begriff*" and "*Idee*"), or Absolute Mediation. It may be called a search for the true first principle by an examination of abstract ideas, commencing with the simplest and most empty—to wit, pure being, which is so abstract and inadequate as to be the same as nothing—and proceeding by the method of discovering presuppositions up to the highest idea, which he names *The Idea, par excellence*, as it is the thought of a self-subsistent personality, a self-object, a Creator who creates nature or the world as his Image. The outline of the philosophy of nature he presented in the *Encyclopædia of Philosophical Sciences* in 1817, at Heidelberg, whither he had gone in Oct., 1816, to assume a professorship in the university. The principle of evolution in nature is the inadequateness of externality to manifest personality. Each lower phase of nature presents us the phenomena of a struggle to reach the realization of the three constituent phases involved in personality. Each higher phase achieves what the next lower one was most deficient in. The vertebrate animal is the summit of nature. The generic appears in him *ideally* as instinct (but not as Ego), and *really* as the process of reproduction. But no individual animal, as such, is more than half a personality, so to speak, being either male or female, and becoming whole only in the generic act. With consciousness appears personality, as incarnated in the world, and a new world, that of spirit, begins. In the world of spirit each individual soul is a monad—the generic entering it as Ego, and thereby constituting an immortal individual. Where the generic is only instinct, as in the animal, there is born as yet no *self*. The species lives, but the individual dies. Human beings are, as animals, sexual (dis-*sected*), and only half-persons, hence mortal. But as conscious Egos each is a totality and the possibility of the entire race. Hence, the human being proceeds to realize this possibility through the creation of symbols and language, science and institutions—family, society, state, and Church—in each of which he portrays for himself his generic nature, some phase or phases of the Absolute, so as to make it possible for the mere individual to participate in the life of the race, of the generic, of the Absolute. Culture or education is the name of the process of initiation of the individual into this heritage. The whole race is thus made to live vicariously for each man, and by theoretical participation each one avails himself of the life of the whole, without being obliged actually to suffer the penalties of living experience. This point is of the greatest importance as the transition from nature to spirit, and has been overlooked by countless students of Hegel, who have for this reason interpreted his doctrines pantheistically as a genial naturalism.

The *Philosophy of Spirit*, which is the third part of Hegel's system, attempts to trace out in its details this self-emancipation from nature and history, and is the labor of his Berlin period, which began in 1818, Oct. 22. He was called to the chair of Fichte by the minister Von Altenstein. In 1821 he published his *Philosophy of Rights*, containing the science of jurisprudence, morals, and politics. The constitutional monarchy is held by him to be the highest form of government. In the following years he wrote his *Æsthetics*, published after his death, in three volumes, treating of the three epochs of art—symbolic (Oriental), classic (Greek and Roman), and romantic (Christian)—as well as of the special arts, architecture, sculpture, painting, music, and poetry. The lectures on the philosophy of history were written in 1822–23, and delivered with modifications five times. According to Hegel, the history of the

world narrates the progress of humanity into a consciousness of freedom. A series of lectures on the proof of the being of God were delivered by him in 1830. While engaged on a new edition of his complete *Logic*, having finished the revision of the first volume, he died of cholera, Nov. 14, 1831.

His complete works were edited, and in some cases compiled, from notes taken at his lectures, by his disciples Marheineke Schulze, Gans, Von Henning, Hotho, Michelet, Forster, and Boumann. They included the writings of the Schelling period (1 vol.), the *Phenomenology of Spirit* (1 vol.), *Science of Logic* (3 vols.), *Outlines of the Philosophy of Rights* (1 vol.), *Philosophy of History* (1 vol.), *Æsthetics* (3 vols.), *Philosophy of Religion* (2 vols.), *History of Philosophy* (3 vols.), miscellaneous writings (2 vols.). To these should be added the *Life* of Hegel by ROSENKRANZ. Access to Hegel's system through English translations and original expositions is becoming quite ample. A partial analysis and paraphrase of the first chapters of the third volume of the *Science of Logic* was published in London (1855), under the title of *The Subjective Logic of Hegel*, translated by H. SLOMAN, DR., and J. WALLON; *Lectures on the Philosophy of History*, translated from the 3d Ger. ed. by J. SIBREE (*Bohn's Library*, London, 1857); *The Logic of Hegel*, with prolegomena, by WM. WALLACE, Oxford, 1874 (containing vol. i. of the *Encyc. Phil. Sci.*); *The Secret of Hegel, being the Hegelian System in Origin, Principle, Form, and Matter*, by JAMES HUTCHISON STIRLING, 2 vols., London, 1865 (contains a translation of a portion of the first volume of the *Logic*, with full commentary); *General Principles of the Philosophy of Nature, with an Outline of some of its Recent Developments among the Germans, embracing the Philosophical Systems of Schelling and Hegel, and Oken's System of Nature*, by J. B. STALLO, Boston, 1848 (contains a concise but genial exposition of Hegel's entire system); *The Science of Thought, a System of Logic*, by CHARLES CARROLL EVERETT, Boston, 1869 (contains an original exposition and justification of a system substantially identical with Hegel's *Logic*); *The Nation; the Foundations of Civil Order and Political Life in the U. S.*, by E. MULFORD, New York, 1870 (contains an original exposition and discussion of positions substantially agreeing with Hegel's *Philosophy of Rights*). In the *Journal of Speculative Philosophy* (St. Louis, 1867–75) have appeared translations of Bénard's *Analysis of Hegel's Æsthetics*; of chapters from the *Phenomenology of Spirit*, with analysis and commentary; of the *Philosophical Propædeutic* (written at Nuremberg) *on Rights, Morals, and Religion*, the outlines of *Logic* and the *Phenomenology*; of the chapters in the *History of Philosophy* on Plato and Aristotle; of the chapter on Chivalry from the *Æsthetics*; of the greater part of Rosenkranz's *Hegel as the National Philosopher of Germany* (written in 1869 for the centennial anniversary of Hegel's birthday); of Trendelenburg *On the Logical Question in Hegel's System*; of Michelet and Von Hartmann on *Hegel's Dialectic*; besides original articles on different phases of Hegel's system, and in particular an extended *Introduction to Speculative Philosophy and Logic*, by A. Vera (an attempt at popular presentation of Hegel's point of view). German works on various phases of Hegel's system exceed a thousand. Scarcely a new book in science or literature appears in Germany but exhibits some trace of the influence of Hegel. Perhaps Karl Rosenkranz is to be named as the foremost defender of the Hegelian system, and its most genial interpreter: R. Haym is its most bitter opponent. A. Vera is the leading expounder of Hegel in French and Italian. He has expanded the *Encyclopædia* into 7 volumes in French by his copious commentary. He is now (1875) publishing a French translation of the *Philosophy of Religion*. Charles Bénard has published 5 volumes in French, giving a translation of nearly all of the *Æsthetics*.

Hegel's school is so widespreading, and includes such a variety of thinkers, that it is not easy to give an account of it. The most distinguished names in it are Göschel, Hinrichs, Gabler, Erdmann, Marheineke, Daub, Rosenkranz, Gans, Vatke, Michelet, Conradi, Kuno Fischer, Hotho, Carrière, Vischer, Bruno Bauer. The best history of the Hegelian school is to be found in ERDMANN'S *Grundriss der Geschichte der Philosophie*. (See articles on GERMAN PHILOSOPHY, FICHTE, SCHELLING, KANT.)

WM. T. HARRIS.

Hegesip'pus, a contemporary of Demosthenes and Æschines, acted with great energy against Philip of Macedon, advocating the Phocian alliance and the declaration of war against Macedon. Two of the orations which have come down to us under the name of Demosthenes are ascribed to Hegesippus by the ancient grammarians—namely, that on Halonesus and that on the treaty with Alexander.

Hegirah. See HEJIRAH.

He'gins, post-tp. of Schuylkill co., Pa. Pop. 1154.

Hei'berg (ANDREAS PETER) was b. at Vordingborg, in the island of Sealand, Nov. 16, 1758; studied at the University of Copenhagen, in which city he afterward lived as a translator. He played a very conspicuous part in the literary, social, and political life, but his liberal ideas were blended with a kind of revolutionary passion, and the scourging satire with which he attacked any kind of abuse was often mixed with scandal. In 1799 was exiled, and went to Paris; received a position in the ministry of foreign affairs, and was frequently employed by Talleyrand in diplomatic negotiations. In 1817 was pensioned, and spent the last years of his life in lonesome retirement; he was blind, and his beautiful and accomplished wife had not followed him in his banishment. D. in Paris Apr. 30, 1841. His comedies, of which one, *Heckingborn*, has been translated into English and has had quite a run on the English stage, were much appreciated in their time, but are now entirely out of date. But some of his songs and prose-writings, as, for instance, *The Life of a Dollar-bill*, are still interesting.

Heiberg (JOHAN LUDWIG), son of the preceding, was b. at Copenhagen Dec. 14, 1791. Remained with the mother when the father was exiled. In 1817 took a degree as doctor in philosophy at the University of Copenhagen. From 1819 to 1822 lived in Paris with his father. From 1822 to 1825 occupied a chair as professor at the University of Kiel. After 1825 resided in Copenhagen, closely connected with the Royal Theatre as poet and translator, as director from 1849 to 1856, and as censor. D. Aug. 25, 1860. He was a highly accomplished man, at once broad and acute, and always elegant, especially when he had to tell people that they were stupid. His prose writings comprise 11 vols. of criticisms on Danish literature. The tendency of his criticism was to educate the public, and make it capable of appreciating literature and art; and in this tendency the critic was eminently successful. His poetical works comprise 9 vols., and consist mostly of dramas, of which one, *Elverhöi* ("Elves' hill"), has become the national drama of the Danes, in spite of Holberg's comedies and Oehlenshlager's tragedies. His chief work, however, is a comedy not destined for the stage, *A Soul after Death*. A shopkeeper of Copenhagen dies. From the sky he witnesses his burial and hears the minister's speech. He then strolls along; knocks at the gates of heaven, but is rejected; tries to get into Elysium, but is rejected again: and settles down at last in a comfortable place, where he finds newspapers, beer, tobacco, and slander, exactly as in Copenhagen. He has only one objection to the place: its name is hell.

CLEMENS PETERSEN.

Hei'de, or **Heyde,** town of Germany, in the former duchy of Holstein, in North Ditmarsch, near the North Sea. It carries on a lively trade in cattle and grain. Pop. 6280.

Hei'delberg, town of Germany, in the grand duchy of Baden, on the Neckar, has one of the oldest and most celebrated universities of Germany; in 1862 it numbered 88 professors and 785 students. It has a library of 200,000 volumes. A zoological museum, a botanical garden, a laboratory, and an observatory are connected with it. The old castle, built in the twelfth century, enlarged in the fourteenth and fifteenth, much injured by the French in 1688, and nearly destroyed by fire in 1764, forms a very interesting and picturesque ruin. The manufactures of Heidelberg are very varied, comprising tobacco, madder, ultramarine, and other dyestuffs, optical, surgical, and musical instruments, paper, and leather; and its trade, especially in wine, is extensive. Pop. 19,983.

Heidelberg, tp. in Berks co., Pa., on the Lebanon Valley R. R. It has manufactures of iron. Pop. 1193.

Heidelberg, tp. in Lebanon co., Pa. Pop. 2256.

Heidelberg, tp. in Lehigh co., Pa. Pop. 1141.

Heidelburg, tp. in York co., Pa. Pop. 2266.

Hei'denheim, town of Würtemberg, Germany, connected by rail with Aalen, Stuttgart (45 miles to the W. N. W.), and Nordlingen. It has varied and important manufactures. Pop. 5167.

Heights (Measurement). See HYPSOMETRY, by C. A. SCHOTT, U. S. C. S.

Heil'bronn, town of Germany, in the kingdom of Würtemberg, on the Neckar, is a curious old place, with narrow and crooked streets, and high, quaintly ornamented houses. Among its public buildings the church of St. Kilian, built from 1013 to 1529, the city hall, and the tower in which Götz von Berlichingen was imprisoned in 1529, are the most remarkable. Its trade is very lively, and its manufactures extensive and varied, comprising white lead, soap, chemicals, woollen cloth, gold and silver ware, cutlery, and musical and scientific instruments. Pop. 18,955.

Heim'dall, or **Heimdallr,** the watchman of the Æsir, or Scandinavian gods, son of Odin by a mother of the Jotun race. He has golden teeth, rides a horse with a golden mane, can see by night as well as by day, and beholds everything within a hundred leagues. He can hear the growing of the grass, and even that of the wool. He dwells in the bright Himinbjörg, at the place where the rainbow-bridge enters heaven. When danger approaches he blows the great trumpet Gjallar-horn so loudly that the whole universe can hear.

Hei'ne (Heinrich), b. at Düsseldorf of Jewish parentage Dec. 12, 1799, was early sent to Hamburg to his uncle, the well-known banker, Salomon Heine, to prepare himself for commercial pursuits; but as he utterly disliked business, he went in 1819, with his uncle's consent and support, to Bonn to study law. After a short stay in that city, during which he became quite intimately acquainted with A. W. Schlegel, he proceeded to Berlin, where Schlegel's letters introduced him to the celebrated literary circle which gathered around Rahel Levin, and which was frequented by Hegel, Chamisso, Grabbe, and others. Here he studied literature and philosophy, and published his first book, a volume of poems, in 1822. The poems were hardly noticed, however, and the young poet, disappointed and disgusted, left Berlin for Göttingen, where, after two years' unwearied study, he took his degree in law in 1825. Once more he returned to Berlin, and published his two tragedies, *Almanzor* and *Radcliff*, but this second attempt was still more unsuccessful than the first had been. It was his *Reisebilder*, published in Hamburg in 4 vols., from 1826 to 1831, which first attracted public attention. They made quite a sensation at their first appearance. The audacity with which the author ridiculed every idea and institution for which people felt veneration, the recklessness with which he slandered every person who had an established name in literature, the malice, wickedness, and deviltry of the book, amazed people, at the same time that they were charmed by its vivacity, sprightliness, elegance, and brilliant wit. Next year he published his *Buch der Lieder*, in which he inserted the greatest part of his earlier poems from 1822; and this book made him at once the most widely read author in Germany. There was a new sense of beauty in these poems. Everything they sung of, from the greatest in historical remembrances to the most insignificant traits of every-day life, became wonderfully living and fresh, and whether they moved in a strain of melancholy or mockery they were always original and impressive. People became almost intoxicated. From 1827 to 1831, Heine resided partly in Munich, where he edited *Politische Annalen* together with Lindner; partly in Berlin, where he fell out with Platen and enriched the German literature with a piece of polemics to which no other literature has an equal, either in scandal or in wit; and partly in Hamburg. The revolution of July put him in a sort of democratic frenzy; and as it perhaps was not very safe for him to live in Germany after the publication of *Kahldorf über den Adel, in Briefen an den Grafen M. von Moltke* (Hamburg, 1831), he removed in that year to Paris, where he resided with some short interruptions for the rest of his life; he d. there Feb. 17, 1856. From 1836 to the fall of the cabinet of Guizot in 1848 he received an annual pension from the French government of 4000 francs. From 1847 he was for the most time bedridden, suffering from a disease of the spine, which also affected his eyes. During the first part of his residence in Paris he developed a great literary activity. But all that he wrote was only a repetition of the two original types with which he began—*Buch der Lieder* and *Reisebilder*—and he who knows those two books knows Heine. His prose style improved, but his ideas did not improve, and his poetical genius weakened. The freshness became artificial, the intensity forced. A lack of true nobleness and elevation became apparent, and his influence was reduced to a mere dissolving process. The principal books written in Paris were *Neue Gedichte* (1844), *Atta Troll* (1847), *Romanzero* (1854), *Beiträge zur Geschichte der neuern schönen Litteratur in Deutschland* (1833), *Französische Zustände* (1833), *Der Salon* (1834–40), *Die Romantische Schule* (1835), *Ueber Börne* (1840), *Vermischte Schriften* (1854). Clemens Petersen.

Hein'sius (Antonius), b. about 1641, and d. at The Hague Aug. 13, 1720. When William of Orange ascended the English throne, Heinsius became the real governor of Holland, and he acted in this position with great success and in perfect harmony with his royal master. He was, if not the creator, a most energetic promoter, of the grand alliance between England, Holland, Hanover, Denmark, Prussia, Austria, and Savoy against Louis XIV., and it was to him, as the real soul of the alliance, that Louis XIV. made overtures of peace in 1708, 1709, and 1710. But the negotiations were every time broken off on account of the enormous and humiliating sacrifices which Heinsius demanded of France, and which he clung most doggedly to. A caprice of Queen Anne, however, changed the whole situation (see Spanish Succession, War of the), and as at the same time the French became successful once more in the field, the Peace of Utrecht was concluded Apr. 11, 1713. Heinsius signed it, but he was the last to do it.

Heinsius (Daniel), a disciple of Joseph Scaliger, b. June 9, 1580, at Ghent, wrote Latin elegies in his tenth year; became professor at the University of Leyden in his twenty-fifth year; charmed the whole world by his Latin tragedies, *Herodes Infanticida*, *Auriacus*, etc.; received great honors from Gustavus Adolphus, Urban VIII., and other monarchs; and d. Feb. 25, 1655. Published critical editions of many Greek and Latin authors, and some of these editions have great value.—His son, Niklaas Heinsius (b. July 20, 1620; d. Oct. 7, 1681), also acquired a great name for his critical editions, especially of Latin poets. He was not a poet himself, nor did he fill the office of a professor. He was a statesman, and was for some years in the service of Christina of Sweden.

Heint'zelman (Samuel P.), b. in Manheim, Lancaster co., Pa., Sept. 30, 1805; graduated at West Point, and entered the army as second lieutenant of infantry July, 1826. For twenty years he served principally on the Northern frontier and in the Florida war. In 1847–48, being now a captain, he served in the Mexican war, and was brevetted major Oct. 9, 1847, for gallantry at Huamantla. From 1849 to 1855 he served in California against the Coyote and Uma Indians, and subsequently to the breaking out of the civil war was mostly employed on frontier duty in Texas, commanding operations on the Rio Grande against Cortinas' marauders, etc. He attained a majority in the army in 1855, and in May, 1861, was commissioned colonel of the 17th Infantry, and assigned to duty in Washington as acting inspector-general of that department; appointed brigadier-general of volunteers May 17, 1861, he commanded the forces which captured Alexandria, Va., May 24, and commanded at that place till July following. He took part in the first battle of Bull Run, July 21, 1861, where he was wounded. In the Virginia Peninsular campaign of 1862 he commanded the 3d army corps before Yorktown, Apr.–May, and at the battle of Williamsburg, May 5. Promoted to be major-general of volunteers from the date of the latter battle, he commanded the 3d and 4th corps at Fair Oaks, May 31, June 1, and in the "Seven Days'" fight. At the second battle of Bull Run (Aug., 1862) he was engaged; also present at Chantilly, Sept 1. On Feb. 2, 1863, he was placed in command of the defences of Washington and the 22d army corps, which command he held till Oct., 1863; and from Jan. to Oct., 1864, commanded the northern department, embracing the States of Ohio, Michigan, Indiana, and Illinois; subsequently on court-martial duty till Aug., 1865, when he was mustered out of the volunteer service. Brevet brigadier-general and major-general U. S. A. for gallant conduct in battle. Resumed command of the 17th Infantry in Sept., 1865, and commanded in New York harbor and in Texas. In Feb., 1869, he was retired from active service upon the full rank of major-general. G. C. Simmons.

Heir [Lat. *hæres*], one who is entitled by law to succeed to the real estate of a deceased person who dies without a will or who leaves property undisposed of by his will. The name is only strictly applicable after the ancestor's death, since it is a maxim of the law that "no one can be the heir of a living person;" still, it is sometimes used in a secondary sense, to designate specified persons, during the ancestor's life. Personal estate does not pass primarily to an heir, but is received by the administrator, to be distributed among the next of kin, according to definite rules of apportionment, after the satisfaction of debts and other proper charges. (See Administrator.) But the rights of heirs appertain to all forms of real estate, tangible or intangible, in possession or in expectancy, and are vested in them immediately upon the occurrence of death, without any formality of transfer or acceptance. Hence it is a legal principle that no man can make another his heir, since heirship exists independently of any individual creation, and depends solely upon the ties of nature and established rules of law. Property passing to an heir is said to be acquired by descent, while all other modes of obtaining title to land are denominated, in law, acquisitions by purchase. An ancestor is under no obligation to refrain from disposing of his real estate in order that his heir may not be deprived of his prospective interest therein, but may, if he desires, devise it entirely to third persons in his will. This rule is sometimes modified by statute, as in New York, where a testator cannot devise, in certain cases of nearly related heirs, more than half of his estate to charitable corporations. When the heir is vested with the real estate, he does not take

it absolutely, discharged of all the claims of creditors, but subject to their right to levy upon it, as if the ancestor were living, in case the avails of the personal property are not sufficient for the payment of debts. The question as to what relatives shall constitute the heirs of an intestate is determined upon different principles in England and the U. S. It is the policy of the English law to keep landed estates undivided, and inheritance is therefore governed by the law of PRIMOGENITURE (which see). The eldest son and his descendants have the superior claim to the property, and in default of these the second son and his descendants receive the title, and so on with the other sons if there be any in the family. If there be only daughters, they all inherit equally by virtue of the doctrine of coparcenary. In the U. S. no preferential claim is given to any one of the children above the others, and all share the inheritance equally, being generally considered tenants in common. If there be no children living or their descendants, the other blood relatives who are nearest in degree inherit the property according to rules prescribed by statute. They will be found considered more at length under the title DESCENT. When there are no heirs of the deceased the property escheats to the State.

An *heir-apparent* is one whose right of succession is indefeasible in case he survive his ancestor; as, for example, the eldest son under the English law of inheritance. An *heir-presumptive* is one who would succeed if the ancestor were to die immediately, but whose right may be displaced, if the ancestor live, by the coming into existence of another as heir. Thus, in England an only daughter would be heir-presumptive until a son were born. So a brother would be an heir-presumptive until the birth of a child.

(The necessity of using the word "heirs" in conveyances of land is considered under the topic FEE. For the difference between *heir* at common law and *hæres* in the civil law, see HÆRES.) G. CHASE. REV. BY T. W. DWIGHT.

Heir-Apparent and **Heir-Presumptive.** See HEIR.

Heir'looms, such personal chattels as go, by force of a special custom, to the heir, along with the inheritance, and not to the executor or administrator of the former owner, as the usual laws for the disposition of personal property would require. The term "heirloom" is frequently employed in English law at the present day as applying to pictures, plate, or other articles of property which have been directed by deed of settlement or conveyance in trust to pass, with the mansion-house in which they are placed, into whosesoever hands the house may come. The ancient jewels of the Crown are also heirlooms. Charters and deeds evidencing the title to the land, together with the receptacles in which they are deposited, pass likewise to the heir with the inheritance. Ancient authorities define heirlooms as consisting chiefly of such articles as are firmly attached to the freehold, but these are now considered to pass with the land as fixtures. (See FIXTURE.) The owner of heirlooms cannot dispose of them by will if the land is left to descend to the heir; they are considered as constituting too essential a portion of the real estate to be thus dissevered. The law concerning heirlooms is confined to English jurisprudence, and is of no importance in the U. S., unless title-deeds to land are considered as passing to the heir under this designation in this country. This, however, is not definitely determined.

GEORGE CHASE. REVISED BY T. W. DWIGHT.

Hel [related to the word *hell*], the Norse goddess of the dead, was the daughter of Loki and Augurboda, and dwelt in Niflheim, under one of the roots of Yggdrasil, the mystic ash tree, where she had been hurled by the All-Father. Her awful abode was the home of monstrous evils of every kind, and from it there was no escape.

Hel'amys [Gr. ἕλος, "meadow," and μῦς, "mouse"], a name sometimes given to *Pedetes Capensis*, a South African rodent of the family Pedetidæ, also called jumping hare and grand jerboa. It is over a foot long, and can leap like a kangaroo—over 30 feet. Is nocturnal, and can rapidly hide itself in the ground. It is exceedingly timid.

Hel'der, The, town of the Netherlands, in the province of North Holland, on the Marsdiep, which separates the mainland from the island of Texel. The natural barrier against the sea to the lowlands is the coast-range of "dunes" or *downs*—hillocks of sand thrown up by the waves and drifted inward with the winds—which has a width in some places exceeding 2 miles. Towards the southern extremity of the peninsula of North Holland the barrier becomes much enfeebled, and the very extremity, the Helder, has required works of extraordinary magnitude. The great dyke of the Helder, built of Norwegian granite and Belgian limestone, forms for 6 miles an artificial coast-barrier. The Helder, previously little more than a fishing-village, was strongly fortified and made a naval station by Napoleon I., who called it his northern Gibraltar. The government of Holland maintains here a naval establishment, with dry docks, etc. The difficulties of navigation of the Zuyder-Zee caused the construction in 1820 of the "North Holland Canal," from the Y at Amsterdam to the Helder, by which the latter place became the real *seaport* of Amsterdam. In this capacity, however, it will be in great degree superseded by the "North Sea Canal" port now in construction. Pop. 17,296.

Hel'en [Ἑλένη], wife of Menelaus, and the most beautiful woman among the Greeks, was a daughter of Leda, born at the same time with Castor and Pollux. Her seduction by Paris (with whom she fled to Troy) was the cause of the Trojan war. Her story is variously given by different Greek poets.

Helen, post-tp. of McLeod co., Minn. Pop. 476.

Hel'ena, city, cap. of Phillips co., Ark., on the Mississippi River, 80 miles below Memphis, Tenn. It is the terminus of the Arkansas Central R. R., has 2 banking-houses, 6 churches for white and 2 for colored people, 2 daily and 1 weekly newspaper, public schools, 2 oil-mills, gasworks, 2 fire-engines, a hook-and-ladder company, a city-hall, and a theatre building. Pop. 2249.

Q. K. UNDERWOOD & CO., PUBS. "SOUTHERN SHIELD."

Helena, tp. of Antrim co., Mich. Pop. 483.

Helena, post-tp. of Scott co., Minn. Pop. 1089.

Helena, post-v., cap. of the Territory and of Lewis and Clarke co., Mont., in the heart of the gold and silver mining district of Montana, 150 miles S. of Fort Benton, has 2 national and 1 private bank, silver-smelting works, foundry and machine-shops, 2 carriage-shops, 2 door, blind, and sash factories, 5 quartz and 3 lumber mills, and 2 daily and weekly journals. It is the chief town of Montana. Pop. 3106.

R. E. FISK, ED. "HELENA HERALD."

Helena, post-tp. of Johnson co., Neb. Pop. 333.

Helena, post-v. of Brasher tp., St. Lawrence co., N. Y. It has water-power. Pop. 150.

Helena, a v. of Newberry co., S. C., 1 mile W. of Newberry Court-house, at the junction of the Greenville and Columbia and the Laurens R. Rs.

Helena, post-v., county-seat of Karnes co., Tex., 56 miles S. E. of San Antonio, on San Antonio River.

Helena, SAINT, mother of Constantine the Great, b. at Drepanum in Bithynia in 247 (or, as some say, at Gloucester in Britain). She was married to the emperor Constantius Chlorus, who for reasons of state divorced her in 292; but her son, Constantine the Great, on succeeding to the throne in 306, treated her with great honor, and conferred upon her the title of Augusta. After her conversion to the Christian faith she made a pilgrimage to Jerusalem, where, with almost miraculous success, if the legend is credible, she succeeded in identifying all the remarkable objects and places connected with our Saviour's history; more especially his sepulchre and the real wood of the cross on which he suffered. She also, as we are told, discovered the burial place of the "Magi" or Wise Men of the East (the "Three Kings"), removed their bodies to Constantinople, whence they were transferred to Milan, and thence (1164) to Cologne, where they constitute one of the chief wonders and sights of the noble cathedral. D. about 328. For her many virtues and charities she was subsequently canonized by the Church.

Hel'enus, a son of Pyrrhus, king of Epirus, accompanied his father on his expedition to Italy in 280 B. C. After the defeat at Beneventum, in 275 B. C., and the return of Pyrrhus to Epirus, Helenus was left in Tarentum with a small garrison of Epirotes. He was soon recalled, however, and took part in the attack on Argos, in which Pyrrhus was killed. He was taken prisoner himself, but Antigonus Gonatas treated him with great regard, and allowed him to return to Epirus with the remains of his father.

Héliade (JEAN), b. in 1801 at Turgowitz, was brought up at Bucharest, then capital of Wallachia, in a college, where he made such remarkable progress that at twenty years of age he was chosen one of its professors. As a literary man he introduced French literature into Roumania by translating the *Meditations* of Lamartine, the works of Voltaire, and other authors of the seventeenth century. He published also [illegible], and another poem, *Michael the Brave*, which is the national poem, the *Iliad* of Roumania. Héliade in 1821 founded the *Wallachian Courier*, a paper which was soon suppressed by the Wallachian government, then under the influence of Russia. In 1848, Héliade was a member of the revolutionary government, and in September he was exiled. He went to Paris, then to the island of Chios, where he finished his poem of *Michael the Brave*, and since 1860 he has lived in Roumania. FÉLIX AUCAIGNE.

Helianthus. See SUNFLOWER.

Hel'icoid [Gr. ἕλιξ, a "scroll," and εἶδος, "form"], a warped surface that may be generated by a straight line moving so that each of its points shall advance uniformly in the direction of a given straight line, and at the same time have a uniform angular motion around it. The fixed line is called the *axis* of the surface, the moving line is called the *directrix*, and any position of the directrix is called an *element*. The conditions imposed require that the same point of the generatrix shall remain continually on the axis, and that the angle between the directrix and axis shall be constant. When this angle is a right angle, the helicoid is *right*; otherwise it is *oblique*. The curve generated by any point of the directrix is called a *helix*. The right helicoid, which is a particular case of the helicoid, is also a particular case of the right conoid. The under surface, or soffit, of the spiral stairway is an example of the right helicoid; also the upper, or lower surface of the thread of the rectangular-threaded screw. The upper and lower surfaces of the thread of a triangular-threaded screw are examples of the oblique helicoid. Since the helicoid is a warped surface, every plane passing through an element is tangent to the surface at some point of the element. To construct a plane that shall be tangent to a helicoid at a given point, draw the element of the surface through the given point; also a tangent line to the helix that passes through the same point; the plane of these lines is the required plane. A plane through the point of contact, perpendicular to the axis, intersects the surface in a curve called the spiral of Archimedes, and the tangent plane in a line tangent to this spiral. If tangents are drawn to any helix at every one of its points, these tangents form a surface called the *developable helicoid*, from the fact that it can be developed, or rolled out, on a plane. W. G. PECK.

Hel'icon [Gr. Ἑλικών], **Mount,** a mountain of Greece, in Bœotia, between the Gulf of Corinth and Lake Copais. It is strictly a range of mountains, a continuation eastward of Parnassus. Its highest point is a cone 5000 feet high. Its eastern side is fertile and abounds in springs. Helicon was sacred to the Muses, probably because Hesiod the poet lived at Ascra, near its eastern foot. Near Ascra was the fountain Aganippe. Higher up was the grove of the Muses. Still higher up was the well Hippocrene. These points are well identified in modern times.

Hel'igoland, or **Hel'goland** ("holy land"), a small island in the North Sea, captured by England from Denmark in 1807, opposite to and about 40 miles from the mouth of the Elbe, in lat. 54° 11′ N. and lon. 7° 53′ E. Including Sandy Island, it is about 1 mile long from N. to S., one-third of a mile wide, and about 3 miles in circumference. The inhabitants are mainly of Frisian descent, and engaged in fishing and piloting, though of late years they have turned their attention to accommodating visitors who resort here for the fine sea-bathing. The island is divided into two parts—the low ground and the rock; the latter, a red sandstone, rises to a height of 200 feet above the sea. There are several excellent roadsteads. Although much has been said of the gradual washing away of the island by the sea, the probable rate is but very small; and by the best authorities it is stated that the island has suffered a diminution of but three miles in circumference for a century. The government is vested in a governor appointed by the Crown, aided by an executive council. The island is fortified, and has a lighthouse. In ancient times it was inhabited by Frisii, and it is said that on this island the temple of the Frisic god Fosete stood, before the introduction of Christianity in the eighth century, when it was destroyed. Pop. 1912.

Heliodo'rus [Ἡλιόδωρος], classed among the *scriptores erotici Græci*, b. at Emesa in Syria, and flourished towards the end of the fourth century A. D.; wrote, probably in early life, a romance entitled *Æthiopica* in 10 books, describing the loves of Theagenes, a Thessalian youth, and Chariclea, daughter of a king of Æthiopia. Heliodorus became in later life bishop of Tricca. The best editions are by Mitscherlich in the *Scriptores Erotici Græci* (the 2d vol. in 2 parts, Strasburg, 1798), by Coraës (Paris, 1805, 2 vols.), and in Didot's *Scriptorum Græcorum Bibliotheca* (Paris). H. DRISLER.

Heliogabalus. See ELAGABALUS.

Heliom'eter [Gr. ἥλιος, the "sun," and μέτρον, a "measure"], an instrument first invented to measure the diameter of the sun in seconds and parts of seconds, but now employed to measure small arcs generally upon the celestial sphere. There are several remarkably ingenious forms.

Heliop'olis, one of the most famous cities of ancient Egypt, situated near the delta of the Nile, on the canal which connected that river with the Red Sea. It was the chief seat of the worship of the sun and the cradle of the legends of the sacred bull Mnevis and the wonderful bird Phœnix. It was celebrated for the magnificence of its temples and for the learning and wisdom of its priests. Many of the Greek philosophers spent some time in Heliopolis to study; Plato lived there for thirteen years. In the fifth century it began to decline, and when Strabo visited it at the beginning of the Christian era, he found it a city of magnificent ruins, of which now only a few fragments are left. Its site is occupied by a small village, Matareeyeh.

Heliopolis of Syria. See BAALBEC.

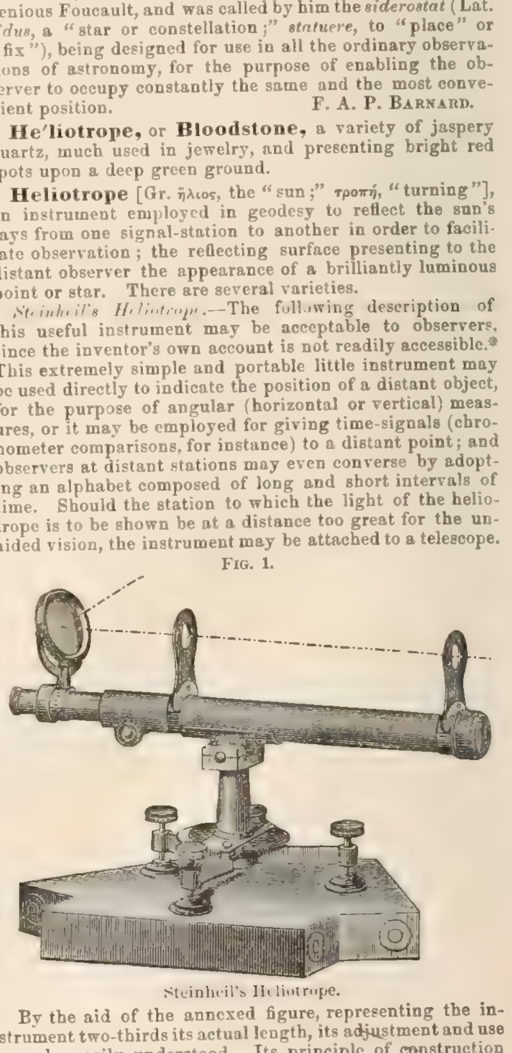
He'liostat [Gr. ἥλιος, the "sun;" στατός, "placed," from ἱστάναι, to "place"], a mirror carried by a clockwork mechanism, so contrived as to reflect a beam of solar light in an unvarying direction, notwithstanding the apparent change of place of the sun in its diurnal motion. The heliostat has long been in use in physical investigations and experiments, without possessing a high degree of precision. More recently it has been employed in aid of astronomical observation, for which purpose it has been greatly improved. The American expeditions sent out to observe the transit of Venus of 1874 (and also the French) made use of the heliostat in photographing the successive aspects of that phenomenon by means of telescopes of long focus (40 feet), instruments which without it could not have been employed at all. A nearly or quite perfect form of heliostatic apparatus, as it respects precision of movement, was one of the latest inventions of the very ingenious Foucault, and was called by him the *siderostat* (Lat. *sidus*, a "star or constellation;" *statuere*, to "place" or "fix"), being designed for use in all the ordinary observations of astronomy, for the purpose of enabling the observer to occupy constantly the same and the most convenient position. F. A. P. BARNARD.

He'liotrope, or **Bloodstone,** a variety of jaspery quartz, much used in jewelry, and presenting bright red spots upon a deep green ground.

Heliotrope [Gr. ἥλιος, the "sun;" τροπή, "turning"], an instrument employed in geodesy to reflect the sun's rays from one signal-station to another in order to facilitate observation; the reflecting surface presenting to the distant observer the appearance of a brilliantly luminous point or star. There are several varieties.

Steinheil's Heliotrope.—The following description of this useful instrument may be acceptable to observers, since the inventor's own account is not readily accessible.* This extremely simple and portable little instrument may be used directly to indicate the position of a distant object, for the purpose of angular (horizontal or vertical) measures, or it may be employed for giving time-signals (chronometer comparisons, for instance) to a distant point; and observers at distant stations may even converse by adopting an alphabet composed of long and short intervals of time. Should the station to which the light of the heliotrope is to be shown be at a distance too great for the unaided vision, the instrument may be attached to a telescope.

FIG. 1.



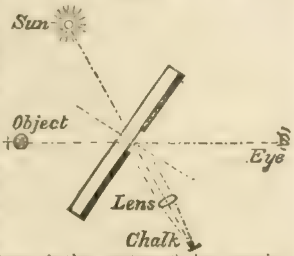
Steinheil's Heliotrope.

By the aid of the annexed figure, representing the instrument two-thirds its actual length, its adjustment and use may be easily understood. Its principle of construction involves the formation of an image of the sun 180° distant from the direction of the reflected rays, by means of which the eye may perceive the distant area over which the solar light, reflected by the mirror, is diffused. This is effected as follows: The reflecting surface of the mirror is perforated in the centre, and that axis of the instrument which is directed to it carries a small lens, in the focus of which is

* Schumacher's *Jahrbuch* for 1844, p. 12.

placed a surface of white chalk or plaster of Paris. If the solar rays, admitted through the hole, are made to fall upon the lens, they are united on the white surface, and are returned back through the lens and reflected by the lower surface of the glass where the metallic surface had been removed, and in a direction, according to the laws of optics, exactly opposite to that in which the [illegible] *lower* surface of the mirror reflects the sun towards the distant object. (See Fig. 2.) To use the instrument adjust as follows: Imagine a plane to pass through the vertical axis of the supporting screw and the optical axis of the lens (and consequently also through the centre of the opening in the reflecting surface of the mirror), and direct the latter to the sun. F. A. P. BARNARD.

FIG. 2.



Heliotrope [Gr. ἡλιος, "sun," and τρεπω, to "turn:" the flowers were once believed to turn with the sun], a genus (*Heliotropium*) of herbs and shrubs of the order Boraginaceæ. The *H. Peruvianum* and its hybrids are green-house shrubs, having flowers of delightful fragrance. They are extensively cultivated for their flowers, which are used by perfumers. *H. curassavicum* and *myosotoides* are natives of the U. S., where also the common heliotrope (*H. Europæum*) is naturalized. The Indian heliotropes (*Heliophytum*) have a few representatives in the flora of the U. S.

Helix. See PULMONATA.

Helix [Gr. ἑλιξ, a "winding"], a curve described by any point of the generatrix of a helicoid. (See HELICOID.) If a screw is turned around in a fixed nut, every point of the screw describes a helix. From the method of its generation it follows that every point of a helix is equally distant from the axis; hence, if we suppose the axis vertical, the horizontal projection of a helix is the circumference of a circle; further, every tangent to a helix makes a constant angle with the horizontal plane. If the projecting cylinder of a helix on the horizontal plane is developed, or rolled out, on a tangent plane, the helix will develop into a right line, which makes with the development of the base an angle equal to the angle that the helix makes with the horizontal plane. The tangent of this angle is equal to the vertical distance through which the generatrix ascends in one revolution, divided by the horizontal projection of the same portion of the helix. The different helices that make up an oblique helicoid are differently inclined to the horizontal plane, the limits of this varying inclination being 90° and 0°. The nearer a helix is to the axis, the greater is its inclination. If tangents are drawn to a given helix at every point, and produced to meet a plane perpendicular to the axis, they will intersect that plane in a curve which is an involute of that circle which is the horizontal projection of the given helix. W. G. PECK.

Hell. Hell is originally that which is "covered" [Ang. Sax. *helan*], the invisible world; the Hebrew *Sheol* (to "ask," or "to be hollow") is the *under world;* the Greek *Hades* is the *unseen* place; *Gehenna* means the valley of Hinnom. The Old Testament uses Sheol, and the New Testament uses Hades, for the place of the dead; sometimes the words may be restricted to the grave, at others to the place of the spirit without regard to character, though there are acknowledged distinctions and divisions there. The Jews after the exile divided Sheol into Paradise and Gehenna. (On *Hades* see Dr. E. R. CRAVEN'S *Excursus*, Lange's *Comment. on Revelation*, p. 364.)

The place of punishment (the present meaning of "hell") is described in the Bible as a place of torment or everlasting punishment. It is figuratively spoken of as under the earth, as Gehenna (the valley of Hinnom, where the rites of Moloch were celebrated), as Tartarus, as silence, the prison house, the pit of destruction, outer (or blackness of) darkness, where the worm dieth not, etc. The condemned suffer (1) the punishments which *naturally* follow sin—loss of happiness, pain, propensities to sin, the company of the evil, etc.; and (2) God's *positive* judgments. Sufferings vary with degrees of guilt. Between hell and heaven the scholastic divines placed Purgatory, with various compartments.

The Church has almost always and universally held to the future, eternal punishment of the wicked. Here and there some have taught (1) no future punishment; (2) a partial, (3) or complete restoration. Almost every nation and tribe has believed in the existence of hell as a place of punishment. Descriptions have depended largely on the power and character of men's imaginations. (See the accounts of the Scandinavian Niflheim and the minute and boundless extravagance of the later Hindoo doctrine.) The pagan accounts vary according to the peculiar views of each people as to the character of evil and that which constitutes the horrible. The Bible is very reticent as to particulars; heathen writings are generally very minute, sensuous, and revolting. (See art. "Gehenna" and the literature by Prof. Ezra Abbot in the Appendix to Alger's *History of the Doctrine of a Future Life.*) ISAAC RILEY.

Hell (MAXIMILIAN), b. at Schemnitz May 15, 1720. In 1738 he entered the Society of Jesus, and in 1751 took holy orders. From early youth he evinced great interest in astronomy and natural science, and while in Vienna studied at the observatory belonging to the society. Later, he held the chair of mathematics at the University of Klausenburg, Transylvania, for a couple of years, but from 1756 filled the position of director of the observatory in Vienna to his death, Apr. 14, 1792. His principal works are *Ephemerides Astronomicæ ad meridianum Vindobonensem* (1757–86), and *Observatio transitus Veneris ante discum Solis die 3 junii, anno 1769* (1770); which observation was made at Vardöhuus, the northernmost town on the mainland of Europe. On this northern journey he was said to have made most important observations, but they were never published, though announced.

Helladotheri'idæ [Ἑλλάς, "Greece," and θηρίον, "wild beast"], a family established for an extinct form whose remains have been found in the Miocene deposit of Pikermi, near Athens. The animal in its external appearance had some resemblance on the one hand to the giraffe, and on the other to the antelopes or deer, the body in front being upraised higher than behind, as in the giraffe, but the legs being relatively shorter, and the neck not prolonged, thus rather resembling the antelopes. It excelled in bulk any of the living ruminants. The skull was distinguished by the extension of the supra-occipital and parietal far backward, and by its contraction forward in front of the molars, the facial portion being normally produced. The molars (M. $\frac{3}{3}$, P.M. $\frac{3}{3}$) were broad, and the inner crescentic plates of enamel described a simple curve. No horns appear to have been developed. The generic name is *Helladotherium.* (See GAUDRY, *Animaux fossiles de l'Attique*, pp. 252, 264, pl. 41–44.) THEODORE GILL.

Hel'lam, post-tp. of York co., Pa. Pop. 1639.

Hellani'cus [Ἑλλάνικος], the most distinguished of the old λογογραφοι, preceding Herodotus, was a native of Mitylene in Lesbos, b., according to Pamphila, B. C. 496, and d. about 411; but these dates are much questioned. Like Herodotus and Hecatæus, he visited the countries he describes, though scarcely any particulars of his life are known. He wrote a number of works (some state 30), but probably parts of works are quoted by distinct titles. They related chiefly to the early Greek and Persian history. His principal writings are *Deucalionea*, in two books; *Phoronis*, in 2 books; *Atlantis*, in 2 books; *Troica*, in 2 books; *Atthis*, in 4 books; *Æolica*, in 2 books; *Persica*, in two books; and a chronological work, ἱερειαι τῆς Ἥρας (a list of the priestesses of Juno at Argos), in 3 books. Of his writings, fragments are left, collected by Sturz, *Hellanici Lesbii Fragm.* (1826), and by Müller, *Hist. Græc. Fragm.*, vol. i., pp. 45–69. (See MURE'S *Hist. Greek Lit.*, vol. iv.) H. DRISLER.

Hellas. See GREECE, by PROF. H. C. CAMERON, PH. D.

Hell-bender, the *Menopoma alleghaniensis* or *Protonopsis horrida*, called also **Mud Devil, Ground Puppy,** and **Young Alligator,** a tailed batrachian found throughout a large part of the U. S. It lives at the bottom of streams, is one or two feet long, and is incorrectly believed by fishermen to be poisonous. It is very greedy, and often bites a fish-hook, to the angler's great annoyance.

Hel'le [Ἑλλη], in Greek mythology, a daughter of Athamas and Nephele. When Phrixus, Helle's brother, was to be put to death, Nephele placed her children on the back of Chrysomallus, the ram with the golden fleece, who went with them through the air; but Helle fell off, and was drowned in the Hellespont, which was named from her.

Hel'lebore [Gr. ἐλλέβορος], a famous remedy used especially by the ancients in cases of insanity. The best grew at ANTICYRA (which see). It was the root of *Helleborus orientalis*, an herb of the order Ranunculaceæ. The "black hellebore" of modern pharmacy is chiefly the product of *H. niger* (which produces the flower called Christmas rose). Its properties are shared by *H. viridis* and *fœtidus*. These are all Old World species, and have violent cathartic properties. In overdoses they are active irritant poisons. Hellebore is at present not much used in medicine, except as an emmenagogue. (For white hellebore, so called, see VERATRUM.)

Hel'len, according to the Greek mythology, was a son of Deucalion and Pyrrha, and the progenitor of the whole Hellenic nation. He had three sons—Dorus, Æolus, and

Xuthus. From the two former, and from the two sons of Xuthus, Ion and Achæus, descended the four different branches of the Greek nation—the Dorian, Æolian, Ionian, and Achæan peoples.

Hel'lenist [Gr. Ἑλληνιστής], among the Jews of Palestine and other countries in the Roman period, and among the Jewish Christians of the same times, a name applied to those persons who yielded themselves to the influence of Gentile, and especially Grecian, civilization, letters, language, and habits, probably including also Judaized Greeks. It is a disputed point whether there were or were not distinct Hellenistic sects among Jews or Judaizing Christians, but the weight of the evidence seems to indicate that there were not. The Hellenistic spirit did much in preparing the way for the spread of Christianity.

Hellenis'tic Greek, the Greek language as it appears in the LXX., the New Testament, the writings of Josephus and Philo, and those of some of the early Christians. It abounds in Hebrew and Aramaic forms, idioms, and even words.

Hellenop'olis [originally *Drepanum* or *Drepane*], a Bithynian city on the Propontis (Sea of Marmora), near the river Draco. It was named Hellenopolis by the emperor Constantine the Great, probably because it was the birthplace of Helena, his mother. Constantine did much to build up the town, and so did Justinian in later days, but the place seems never to have been very important. Constantine lived much in this place, on account of its mineral springs. It is now called *Hersek*.

Hel'ler's, tp. of Newberry co., S. C. Pop. 2061.

Hel'lertown, post-v. of Lower Saucon tp., Northampton co., Pa., on the North Pennsylvania R. R., 50 miles from Philadelphia and 4 miles S. of Bethlehem, has extensive iron and zinc mines.

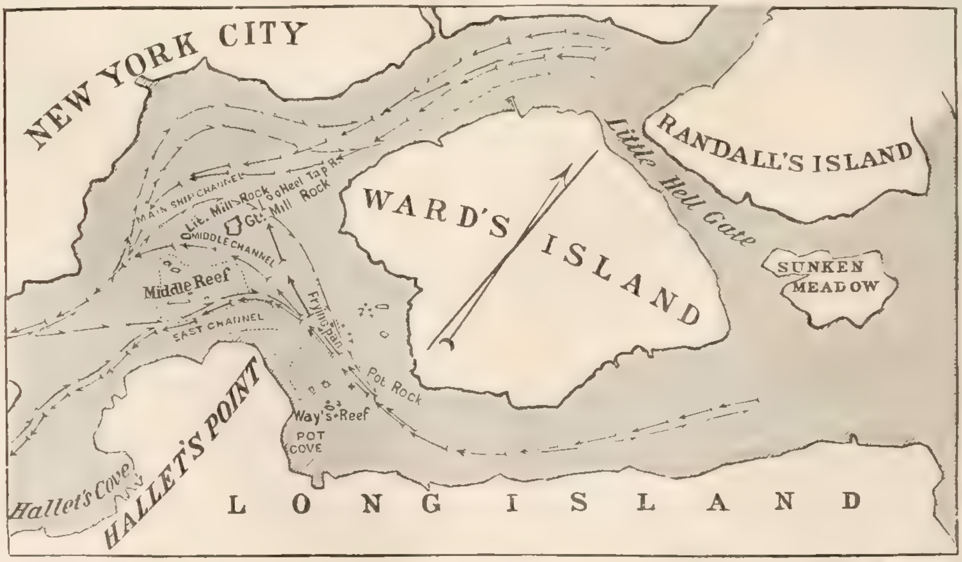
Hel'lespont [Ἑλλήσποντος], the ancient name of the DARDANELLES (which see), the strait which connects the Propontis and the Ægæan; named from the old legend of HELLE (which see), according to the ancients. It was the scene of many events conspicuous in the history and mythology of antiquity.

Hell Gate. The important relation which the East River holds to the commercial prosperity of the city of New York has always been so evident, that every effort which promised to remove the obstructions to its navigation, has promptly received public attention and appreciation. This stream receives the tide at its two extremities—at the eastern, the Sound tide, and at the western, the Sandy Hook tide. The times as well as heights of these tides are different, and by such want of uniformity, velocities are imparted to the currents sufficient to keep the channel dredged to depths suitable for the largest class of vessels now employed in commerce, or that it is possible to conceive in the future, will ever be so employed. This magnificent stream has, fortunately, been so endowed with capacities for self-preservation that the mistakes of man have hitherto been effective only in increasing the natural velocities at certain points of its course, between the cities of New York and Brooklyn, to such degree as at certain periods of the tide to prove a delay and embarrassment to navigation. When the risks are considered to which this river has been in the past, and in the future probably will be subjected, arising from the cupidity of riparian owners, corrupt legislation, and, it may be added, the general lack of knowledge appropriate to the treatment of rivers, it should be a matter of congratulation that the bountiful provisions of nature, though they may not be effective against injury, will nevertheless, as it is confidently believed, prevent the destruction of this thoroughfare.

The facts of the East River connecting the waters of the Hudson and of Long Island Sound, and of forming at the same time a large portion of the wharf-front of the cities of New York and of Brooklyn, constitute the causes of the interest manifested in the projects for its improvement. It has been assumed that the difference in the length of the voyage to Europe by way of the Sound, and that by way of Sandy Hook, would determine in favor of the former the course of Transatlantic steam-navigation; but this difference is too little to effect the result claimed or to influence it greatly. On the other hand, it has been asserted that the rock-bound shores of the Sound, its fogs, and comparatively intricate channel, will cause a discrimination against it, and compel the preference to be given to the outlet at Sandy Hook. The true conclusion would seem to be, that railroad lines having their natural termini upon the East River, must draw steamers to load at such points; and this, taken in connection with the superior depth of water, will determine the course of a considerable portion of the foreign commerce through the Sound. The position here taken is enhanced in probability by existing tendencies in the carrying-trade to consolidation, which have of late years caused a great increase in the size and draught of ocean-steamers, the largest of which, even now, test to the utmost the depth upon the bar at Sandy Hook—a depth which it is practically impossible to improve.

All of the obstructions of moment existing in the East River are to be found in that portion which passes under the name of Hell Gate, and are due to numerous reefs of rocks encroaching upon the channels, and to the violent currents caused by them. A survey was made in 1848 by Lieutenants-commanding Charles H. Davis and David Porter, U. S. navy, and from the results obtained, a very clear idea of the dangers and obstructions to navigation to be encountered may be formed. Lieutenant-commanding Davis writes: "The strength of the current is such that sailing vessels can only stem its force or escape from it by a commanding breeze; but as the main course of the flood tide keeps the middle of the eastern channel, it is most secure for vessels which are coming from the westward with the tide to place themselves in the middle of the stream and follow its direction. They are thus carried through safely. This plan, however, is inadmissible for any but small vessels, on account of two rocks, the Pot and Frying Pan, which lie in or very near the mid-channel, are in the way, both going to the eastward and westward, and have but

Fig. 1



Ebb current. Map of Hell Gate. Flood current.
Scale 1 : 25,000.

little water on them at low tide. There is also a reef, called Way's Reef, which lies in the course followed by steamboats principally when coming from the eastward against a strong flood. It is their custom to keep close round Pot Cove, and run up under Hallet's Point, by which they avoid the strength of the flood. In this part they find an eddy current in their favor. But on the ebb the greatest danger arises from the divergence of the current where the ebb branches off into three directions to take the course of the three channels—the main S. channel, the middle channel, and the eastern channel. The safe navigation depends here upon deciding sufficiently soon, at the point of separation, which channel shall be taken, and the neglect to do this, or a loss of control over the vessel for any reason, frequently results in being carried on the Gridiron. When a vessel that has attempted the eastern channel finds herself carried toward the Gridiron, her only chance for safety is to run for the middle channel, which is narrow and made precarious by the middle reef, the outer rock of which is the Negro Head. The Gridiron is, owing to the strong set of the tide on it, the most dangerous reef in the passage. The reef known as the Bread and Cheese, on the eastern end of Blackwell's Island, is also very dangerous. Vessels are liable to go on it in the flood, when it is covered, by getting into the eddy near it with a light wind. The chief danger is on the ebb, and from the same reason that makes the Gridiron dangerous—*i. e.* the strong set of the tide in that direction."

The obstructions in the East River necessary to be removed lie within the corporate limits of New York and neighboring cities, and in a few years, when this portion shall have become a busy harbor, the existence of the present obstacles would prove to be an intolerable nuisance. The large water-commerce with the East, all of which tends to this river, demands the improvement, as the crowded state of the thoroughfare at Hell Gate daily demonstrates to the most casual observer. The removal of obstructions, by which the harbor of New York would have two outlets into the ocean instead of one, will much increase the capability of a naval defence, while the difficulty and risk of blockading the port would be at the least doubled. Existing obstructions, while forbidding the use of this thoroughfare to large vessels of deep draught, are far from permitting a safe navigation to those of the smallest class, as the record of the large number lost or damaged sufficiently demonstrates.

To distinguish more clearly the positions and designations of the reefs, the Gridiron, Flood Rock, Hen-and-Chickens, and Negro Head, all of which constitute parts of one reef, will hereafter be known by the name of the Middle Reef, between which and the reef whose visible projections are called Great and Little Mill Rocks, the Middle Channel is situated. The Eastern Channel is included between the Middle Reef and Hallet's Point. The main South or Ship Channel lies to the W. of Great and Little Mill Rocks, and between them and New York Island.

Lieut.-commd'g Davis recommended "that Pot Rock, the Frying Pan, and Way's Reef be blasted and scattered. The two former are single rocks of a pointed shape, the latter is long, and has the character of a ledge;" and also that the Middle Channel be improved by blasting, so as to make a clear channel of sufficient depth for common vessels and steamboats. He further says: "Something has been said of removing and scattering all the rocks in Hell Gate, those out of the water as well as those under water. But it appears to me that this proposition is best answered by asking where the materials are to go. Unless carried off, they must obstruct the neighboring channels, and the process of blasting would never be completed." The large reefs he proposed to face with sea-walls or piers, showing above the surface of the water at high tide at least four feet, and "that these piers be faced with wood, and be provided with the spring-fenders used at the steamboat ferries, and that their forms should correspond to the natural shape of the reef; by which means vessels coming in contact with them would be guided into the channel-ways." Certain small rocks of less importance, situated near the shores, were likewise indicated by Lieut.-commanding Davis in this report for removal.

On the subject of an improved naval defence of Long Island Sound and of the harbor of New York he writes: "But a still more serious consideration is that of the increased facilities for naval defence which this improvement would afford." In the event of a rupture with a superior naval power, Long Island Sound and its shores would not, as before, be at the mercy of the enemy. "During the war with Great Britain our frigates were blockaded in the harbor of New York, which would not have been the case if the Hell Gate passage had been open. Com. Decatur ventured to carry his squadron through, but with such risk that the attempt with a frigate was only made once afterward, notwithstanding the constantly recurring necessity. The removal, therefore, of the obstructions to the safe navigation of Hell Gate is recommended by a regard to the future naval defences of the country." The substitution of iron-clad ships for the wooden walls of a former period, while endowing the naval defence of these waters with more certainty as well as with more power, will be deprived of much of its advantage by a failure to remove these obstructions. Lieut.-commd'g David Porter, while agreeing with the views of his brother officer, did not think it feasible to attempt the deepening of the Middle Channel, but rather that it be entirely filled in with docks. He recommended the removal of a part of the reef at Hallet's Point, on account of the eddies which it creates at flood and ebb tide respectively in Pot Cove and in the East Channel, and the dangers resulting therefrom to navigation.

Valuable as the reports of these officers were in pointing out the dangers to navigation, and specifying the particular obstructions to be removed or otherwise treated, they do not enter into the question of how the removal of the rocks should be effected, except by the general term *blasting*. The art of blasting under water at that period, was incompetent to deal with even the small rocks, which alone were selected for removal; and it may be said that their recommendations, limited as they are, were practically impossible of execution. Under such circumstances the idea of removing the large reefs was not so much as entertained, and consequently the diminution of velocities in the currents could form no part of their project.

The necessity of doing something to diminish the dangers to navigation was a continual pressure upon the public mind, for according to the first of these reports, one sailing vessel out of every fifty sustained more or less damage from being forced by the violent currents upon the rocks and shoals; while, according to the second, fifty vessels went on shore during the time occupied, two months, by the survey. Notwithstanding, nothing was attempted until 1851, when the process of surface-blasting, introduced by M. Maillefert, was applied by him. This process was very simple, and consisted in placing upon the rock a charge of gunpowder, usually 125 pounds, contained in a tin canister, and exploding it by means of the voltaic current. The weight of the water resting upon the charge served to tamp it and to increase the effects of the explosion. The services of divers were not called into requisition to examine the rock and to place the charges where, from the configuration of the bottom, they might be most effectual, but the charges were simply let down from a boat by means of an iron rod. No means were provided of removing the broken rock after the blasts, it having been taken for granted that the force of the explosion would be sufficient to project the débris into deep water. This assumption was a manifest error, and the consequence was, that in default of mechanical means of removing the broken rock, it was broken fine and powdered by the successive charges until it was small enough to be carried away into deep water by the tidal currents.

The rock in Hell Gate, so far as it has been examined, is a gneiss, stratified in thin layers, the direction being about N. 52° E., and the dip a few degrees from the perpendicular. From Hallet's Point the direction of the stratification is continuous across the channel, and can be verified upon the rocks on Ward's Island opposite. The different layers, differing in composition, hardness, and durability under exposure to abrading influences, would necessarily be unequally worn, whether exposed to the action of the air or to rapid currents of water, and this unequal action has been tested by observation. The surfaces of the reefs are consequently very uneven. Sheets of rock or clusters of sheets composed of the more durable materials, are continually found projecting many feet above the general surface. Pot Rock had 8 feet over it at low water, deepening quickly to 14 feet on two sides, and suddenly to 24 feet on the other two. Its form was quite pointed, and essentially that of a truncated pyramid, down to a depth of 18 feet, where the surface became flattened and of considerable development in every direction. Frying Pan on the top was 16 feet long and only 6 inches wide, and had over it a depth of 9 feet at low water. Way's Reef on the top was conical, and had a depth over it of 5 feet at low water. Bald-headed Billy was described as a single rock about 6 feet by 6, and capable of being easily blown into deep water.

The descriptions given of some of the rocks operated upon by Maillefert are important, as showing how readily their surfaces lent themselves to rupture and removal by an exploding agent, and are necessary in order to qualify in our minds any extravagant notions that might arise of the efficacy of his process. The citizens of New York raised by subscription about $15,000 to test Maillefert's process, disbursed under the direction of Mr. Meriam. M. Maillefert commenced operations Aug. 19, 1851, and operated with the result as shown in the following

Recapitulation.

Name.	Number of charges.	Pounds of powder.	Cost in gold.	Original depth, feet.	Depth at close of operations, feet.	Remarks.
Pot Rock	284	34,231	$6,837.50	8	18.3	
Frying Pan	105	12,387	2,116.81	9	16.	
Way's Reef	135	15,549	2,543.66	5	14.	
Shelldrake	6	750	110.34	8	16.	
Bald-headed Billy	1	125	500.00	...	......	Blown into deep water.
Hoyt's Rocks	8	1,000	250.00	...	.....	" " "
Diamond Reef	78	9,750	1,434.42	16	18.?	In 1869 the least depth was still 15.7 feet.
Hallet's Point	3	400	69.06	...	......	No effect.
Total	620	74,192	$13,861.59			

In 1852, Congress having made an appropriation of $20,000 for the removal of rocks at Hell Gate, this operation was assigned to the engineer department of the army, and Major Fraser was selected for that duty. He adopted the process already in use, and in this there was no alternative, as Maillefert's method was the only one known, and capable of application in Hell Gate. The sum of $18,000 was expended upon Pot Rock, the depth of which, being already 18.3 feet, Major Fraser succeeded in still further reducing to 20.6 feet. If we compare results, we find that at the commencement it required only $6837.30 to reduce the height 10.3 feet, but at the end the expenditure of $18,000 gained but a little more than two additional feet of depth; and the reason is obvious: the rock as the depth increased expanded both in width and length, and while the surface offered itself less readily to the action of the powder, the quantity to be removed for each foot of additional depth increased very largely in amount.

We are now in a position to estimate the value of Maillefert's process upon hard rock like gneiss. Whenever the rock was of small area, projecting above the general level of the bed-rock, of a conical or columnar shape, or when it presented itself in narrow sheets, the process became very effective, and was in fact generally cheaper than any other. On the contrary, when the rock was in large mass, with flattened surface—which is the condition to which the rocks are generally brought after the projecting parts have been broken off—then the process becomes very slow and inefficient. It is, however, often valuable as an auxiliary to better modes of blasting.

No further appropriations had been made, when in 1856 the advisory council to the commissioners relative to the encroachments and preservation of the harbor of New York made their report upon the necessity and mode of improving the navigation at Hell Gate. They advise the removal of Pot Rock, Frying Pan, and Way's Reef, and other smaller rocks near the shore, including a part of the reef at Hallet's Point, and the building of sea-walls or piers along the edge of the larger reefs; in fine, presenting very much the same project as that formerly advocated by Lieut.-commd'g Davis, and already given in the former part of this article. They state that the removal of Pot Rock and other small rocks by blasting could be easily effected—that, in fact, it had ceased to be matter of experiment; but they do not recommend the application of Maillefert's process, used in 1851 and 1852, upon these rocks, but rather the process by drilling.

It is difficult to account for the assertion that these rocks could be readily removed, since, Maillefert's process of surface-blasting laid aside as incompetent by itself to perform the task, the only other mode of blasting under water then practised was by drilling at the bottom from within a diving-bell, which in the rapid currents in Hell Gate would have proved unmanageable, even if it were not first knocked over by a colliding vessel. It is to be regretted that, as the advisory council believed drilling at the bottom to have been an easy operation, they did not indicate the mode of doing this, especially as the means then known of accomplishing this result were entirely inadequate to cope with the difficulties and dangers to be encountered. The council reported that it was not expected to reduce the velocity of the regular tidal currents in the channel, that the existing state of things could only be altered by a change in the capacity of the cross-section; and that such change was impracticable. It is evident, then, that the operations of blasting, after a thorough examination by the ablest men of that day, were limited to the smaller rocks lying in the channel, while the removal of the large reefs was expressly stated to be a practical impossibility.

The duty of an examination of Hell Gate was committed in 1866 to Brevet Major-Gen. J. Newton, U. S. Engineers, who was instructed by the engineer department to prepare a project with a view to its improvement for the purposes of navigation, and sufficiently in detail to present a plan and estimate for the necessary operations. This officer submitted his report in Jan., 1867, in which the estimate was based upon removing the reefs by blasting, after drilling the surface from a fixed platform above the water. This arrangement was described as follows: A platform of suitable size, with vertical sliding supports capable of being raised or lowered through a considerable height, is prepared and floated to its position, supported on the decks of two scows or other floats, one on each side. Arrived at the place, the floats are moored, the vertical supports of the platform let down to the bottom, securely fastened to the platform, and braced to each other if necessary. This operation being done at the top of the tide, the scows are floated away when the water falls. The supports to the platform may be placed within ten feet of each other, and the weight of the platform, to ensure steadiness and stability, fixed at any desirable standard. To avoid the interference of the currents with the drills, these were to be worked within iron tubes reaching from the platform to the rock. The engines to work the drills would be placed upon the platform. To remove the rock blasted, it was thought necessary to protect the divers from the force of the currents, and for this purpose a species of dam was described—viz. two cylindrical floats, of sufficient buoyancy, made of boiler iron, to be placed say thirty feet from centre to centre, towards their extremities to be inclined towards each other until they meet, forming one float, say 160 feet long and 40 wide. Curtains of iron, extending along the whole outer line of the floats, to be permanently fastened at their upper lines to these floats, and the lower end of the curtain to be attached by falls to small derricks or davits upon the floats, so as to be lowered or raised at will. The curtains to be flexible, made of plates of iron connected with each other by hinge-joints, and capable of reaching to the bottom at any height of the tide. An interior space of 160 feet by 40 to be thus protected, where the divers could fill the buckets, afterwards to be raised and emptied into scows lying alongside.

The particular machines above described were not relied upon as the sole or even the best means of effecting the object desired, one purpose for making such design being to show that no insuperable difficulties intervened to prevent a practical consummation of the work, and another to furnish data for the estimate. Two requisites of success were steadily kept in view: First, that the drills operated in drill-tubes should be attached to a platform or other framing kept absolutely fixed in position while the drilling was going on; and, second, that the divers, or the machinery necessary to handle and remove from the bottom the rock blasted, should be protected from violent currents. Another machine, which was arranged upon the same principles, combining in one both the platform and dam, was also proposed—viz. an iron caisson or cylinder, open at top and at bottom, having self-adjustable legs at the bottom to accommodate themselves to the inequalities of the rock and to support and level the machine. In plan the caisson was to be oval or pointed at both ends. The top was to be above the level of the highest tides, and to be framed across, so as to form a platform upon which the engines and the men directing the operations of drilling were to be placed. The sides, stiffened and strengthened with a sufficient framework, were to be covered with boiler iron, or with flat bars crossing each other, or with a meshwork of chains, it being supposed that the intervals so left would not permit the entrance of violent currents into the interior of the dam. The lower edge of the dam, though it might be in contact at one or two points with the bottom, would be held above it for the rest of its perimeter, owing to the legs which supported and levelled it, and therefore a strong current would force itself under the bottom through the intervals thus left. But a mesh of chains was to be arranged to cover these spaces, and protect the interior from the rush of water for any locality which would have demanded this additional precaution. The upper line of the chainwork was to be fastened to the sides of the dam near its bottom edge, and the lower line, triced up when not needed, would be lowered to rest on the rock when circumstances should have demanded it.

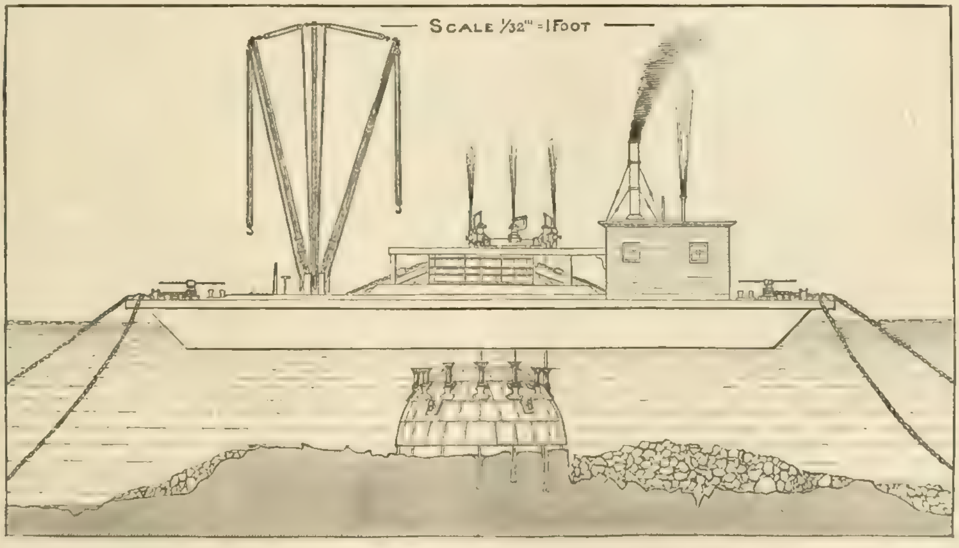
The dam was to be provided with pontoons or camels to float it, or, better still, with chambers to contain air or water as might be needed. When moored over the position intended the air was to be let out and the water introduced into the chambers, and as soon as the dam touched the rock, or was nearly touching, the legs, let go by the men, would support it in a horizontal position. The work of drilling was then to commence. After this was finished charges would be introduced into the holes, the chambers filled with air, the dam floated off, and the blasts fired. The dam was then to be brought back, moored over the same position, sunk to the bottom, when the work of removing the rock would commence within the sheltered area.

It would appear, after the principles had been settled, and even the mechanical mode of their application thus arranged, that there should have been no further difficulties to encounter, but that as soon as the money could be furnished the work of removal of the obstructions would have been commenced after either of the plans as stated. But, in reality, to construct a machine adapted to the peculiar requirements of the case demanded an arrangement in detail which was equivalent to a treatment *de novo* of the whole problem. The exposure of a platform, or of the caisson with upright sides, to the violent currents of Hell Gate might result in an overthrow unless the base of the machine should be large. But the varying sizes of the rocks to be operated upon, as well as the rugged inequalities of their surfaces, would make it inconvenient to apply a large machine in all cases, while the difficulty and risk of handling it would increase with the size. It was necessary, or at least very convenient, to design a machine which, although small, would nevertheless possess in itself the element of perfect stability against the action of the currents, and of applicability to the rocks in Hell Gate, irrespective of size or the nature of their surfaces. This was effected by adopting a caisson of a peculiar shape on the exterior, by which the resulting pressure of the currents of water on its surface would always be made to intersect the bottom within the area covered by the machine; and no overthrow could consequently take place.

But, after all, this consideration, important as it may appear to be, was really secondary to another; which was the mode of protecting the machine against the colliding of passing vessels. This is the most formidable danger to be encountered in Hell Gate. Platforms or caissons could be framed large and heavy enough to withstand the currents and to afford a stable and fixed support to the drills, but of what avail would all this have been when it was certain that in the crowded thoroughfare where the work was to be done, a week could not elapse before the machine would be crushed and overthrown by collisions, with a loss both of life and of a large amount of property? It was evident, therefore, that all idea of successful work was to be abandoned unless security against collisions could be attained. To moor hulks around the drilling-machine would not only have been very inconvenient, but even impracticable, from the room which would be thereby abstracted from the already contracted width of channel; hence, after much consideration, it was determined to surround the drilling apparatus with a structure, floating of course, which should be proof against collisions.

From the considerations which have been presented the construction and working features of the steam-drilling

Fig. 2.



Submarine Drilling Scow.

cupola scow resulted. This machine consists of two parts —a large float or scow, having a well-hole in it of a diameter of 32 feet. It is built very heavy and strong, and is provided with an overhang or guard around it, faced with iron, and has proved itself, up to this time, capable of withstanding violent collisions with other vessels. Besides affording this security, it serves also to transport the caisson or dome from place to place, and is a working platform from which the drilling-engines are operated. The caisson or dome is a hemisphere of the diameter of 30 feet, composed of a strong iron frame covered with boiler iron. The dome is open at bottom and at top, and is provided at the bottom with legs to support and level it, which are arranged to be let go all together after the dome is lowered. Owing to the hemispherical shape of the caisson, the pressures of the moving mass of water which are normal to the surface necessarily pass through the centre, and there is consequently no tendency to an overthrow by the action of horizontal currents, but, on the contrary, an additional downward pressure favorable to stability is produced. This would not necessarily be the result if the dome were of small diameter, for in this case, when on the bottom, it might lie entirely within the region of vertical eddies produced by the uneven character of the rock, and these forces acting within the interior of the dome would tend to an overthrow. When the dome is large, a small portion comparatively lies within the area of these abnormal currents, while the outer surface acted upon by the horizontal currents gives rise to normal forces which tend to an equilibrium.

The caisson or dome is simply a framework, affording a fixed support to 21 drill-tubes through which the drills operate. The dome is connected with the scow by four chains communicating with four hoisting-engines, by which it is lowered or raised. A framework is built upon the scow around the well hole, to support the carriage holding the drill-engines, which by these means may be placed directly over the drill-tubes. The engines simply raise the drill-rods, and allow them to fall by their weight upon the rock, the vertical play being 18 inches. The drill and drill rods together are about 10 feet long, and weigh from 600 to 700 pounds. The cutting edges are in the form of a cross, and are 5½ inches long.

The scow, having the dome swung by chains, is first anchored over the rock to be operated upon, so that the bow and aft moorings pull against the direct currents of the ebb and flood tides; but as these may vary somewhat in direction from one tide to another, as well as during the course of the same tide, it becomes necessary, in order to steady the scow, to have side anchors also. The diver descends to ascertain whether the location is well suited to placing the dome on the bottom, and, if not, to select a better. The required change in the position of the scow is made by lengthening and shortening the mooring chains with capstans, which are arranged to be worked, at will, with steam or man power. The dome is then lowered, and

when it touches or approaches near the bottom the legs are let go by the run, and, being held by self-acting cams, support the weight of the dome. The chains are now unslung from the dome, which is thereby without connection with the scow. The diver, if practicable, descends to ascertain which of the drill-tubes it is necessary to use to break up the rock within the dome, and how the surface offers itself to each particular drill. The drill-rods being introduced within the drill-tubes—which is easily effected during the most violent currents—a rope or other flexible connection is now made between the top of the drill-rod and the piston-rod of the drilling-engines. A flexible connection is necessary to the act of drilling, as in this machine, the dome remaining fixed upon the bottom in one position, while the scow holding the drill-engines swings for short distances from changes in the directions and strength of the currents, no rigid connection between the engines and drills would be practicable. The length of the rope attachment is regulated by a feed-gear for the rise and fall of the tides and continual changes of water-level.

The drilling being completed, preparations are made for charging the holes with nitro-glycerine. The chains are hooked on the dome, which is then raised from the bottom, and the scow swung off from the spot to a safe distance, without casting loose the moorings. This distance will depend upon the proposed amount of charge of nitro-glycerine, and will vary from 175 to 350 feet. The nitro-glycerine and tin cases, of different lengths to suit the varying depths of the drill-holes, are carried to the spot upon a small scow, from which the diver descends to the first hole to be charged. He is guided to this by a line. Withdrawing the plug, he introduces into the hole the tin cartridge, which has been filled by the men on the scow and passed down to him. Each cartridge is attached, before it is sent down, to the wires. The diver then passes on to the second hole, guided by the plug-line which connects the stoppers of the adjacent holes, and in this way the whole circuit of holes is visited and charged. The leading wires are connected with the battery when the small scow has been withdrawn, and the explosion is made. The batteries used are the friction and the wet batteries, and with the latter the underground connection, by which a long length of leading wire is saved. The fuzes, which have been much improved by the care devoted to the subject by Mr. J. H. Striedinger, C. E., who superintends the operations of the steam-drilling scow, never miss fire or fail to produce an explosion even with frozen nitro-glycerine. They contain, as detonator, about 25 grains of fulminate of mercury.

To break up the rock thoroughly the drill-holes should be from 6 to 8 feet apart, of the size of $5\frac{1}{2}$ inches at top, with the usual tapering towards the bottom, and charged with amounts varying with the depths of hole, which will average between 50 and 60 pounds for each. Under these conditions the depth to which the drill-hole reached, below the level to which it was desired to break the rock, was about 4 feet.

The dome would, in no sense of the term, be a dam without the attachment to the bottom part of the chain-netting before described, which might be replaced by one of rope, or by widths of canvas suitably loaded; for the reason, that there would be nothing to check the force of the currents penetrating between the lower rim of the dome, supported on legs and the uneven bottom. It must likewise be taken into consideration that the top of the dome, when drilling is going on, is many feet below the surface of the water, and there is no protection against the currents throughout this space. So far, in the operations of this machine, no occasion has made it necessary to convert the dome into a dam, though the manner of so doing has been prescribed should necessity ever arise to use the devices above indicated. The drill-rods are perfectly protected against currents by the tubes in which they work; they can be taken out and replaced without regard to these currents; while the diver has always been able to perform satisfactorily his functions during the times of slack water. So that for drilling and blasting the rock no necessity has existed for the use of a dam as protection against currents.

After the rock broken by the explosion covers the greater part of the reef, its removal is commenced. This is effected by means of Morris & Cuming's steam grapple. So far, it has not been necessary to protect this operation against the violence of the currents, but it is foreseen that such emergency may arise at some localities in Hell Gate. In such event it has been determined to use a network of chains, the lower part resting on the bottom, and weighted if necessary, or provided with a sufficient number of small grappling-hooks to catch the irregularities of the bottom; and the upper part attached to a boat or float of some description, so as to form in this way an enclosed space from which violent currents would be excluded. A steam-grapple mounted upon the boat could then operate regardless of the currents. The depth from the top line to the bottom of the chain-netting should be more than sufficient to reach the bed of the channel during the highest rise of the tide. The boat would be provided with the necessary apparatus connecting with the lower part of the chain-netting, to raise it off the bottom to a suitable height for the purpose of changing location, as the process of removing the broken rock might require.

Operations of the Steam-Drilling Scow.—The delay by Congress to appropriate money postponed the commencement of this machine until July, 1869. The necessary experiments upon the drilling-engines, upon the drills to ascertain their proper weights and size of cutting edges, and upon the effect of nitro-glycerine to determine the proper charge, prevented its practical application until May, 1871, upon *Diamond Reef*, near the mouth of East River. This reef was found covered, for the greater part, with sand, gravel, deposits of silt of various kinds, with ballast-stone, and with boulders, and before it can be removed by blasting its surface must be cleared by a dredging-machine. All the ledge-rock which was uncovered has been operated upon. The holes drilled were from 7 to 13 feet deep, the diameter $4\frac{1}{2}$ inches at top and $3\frac{1}{2}$ inches at bottom; the charges of nitro-glycerine 30 to 55 pounds per hole.

Coenties Reef was also operated upon in alternation with Diamond Reef during the working season of 1871. The number of holes drilled and blasted was 93, and of surface-blasts 17; nitro-glycerine consumed amounted to 5479 pounds. During the working season of 1873, 307 holes, $4\frac{1}{2}$ inches in diameter at top and $3\frac{1}{2}$ inches at bottom, were drilled. The nitro-glycerine consumed amounted to 17,127 pounds, and this included the charges, likewise, of 39 surface-blasts. The operations of this season left the reef thoroughly broken up, and a large portion of the débris was removed. Unfortunately, the next appropriation, by a blunder in its title, became inapplicable to the lower East River, in which this reef is situated, and it has perforce been left until this year (1875) to be finished. Its complete removal will require but a short period of time for the disposal of the stone already broken up. During the operations upon Diamond and Coenties reefs the scow was collided with many times.

Frying-Pan in Hell Gate.—The drilling-scow was moored upon this reef July 22, 1872; drilled 17 holes and made 11 surface-blasts.

Pot Rock in Hell Gate. The machine commenced work here Aug. 5, 1872, and remained upon this rock until Dec. 28, when running ice put an end to these operations. During this period it was collided with 16 times; four of the colliding vessels were sunk, and one of them, loaded with 200 tons of coal, was by the rapidity of the current drawn under the scow, and carried off the dome, which was recovered afterwards in 80 feet depth of water, having experienced great damage to the drill-pipes and supporting legs. Most of the collisions, while not injuring the scow, caused the mooring-chains to part, and great delays resulted therefrom, on account of having to search by divers for the other end of the chain remaining attached to the anchors. If it were possible to make use of buoys to the anchors, much valuable time in such searches would be saved, but their use is not practicable on account of fouling with passing vessels, and being carried off by this means. Forty holes were drilled and blasted; 60 seam-blasts and 24 surface-blasts were made; a large portion of stone was raked from the reef, of which no account could be kept. Owing to the rapidity of the current, it was impossible to use the steam-grapple to hoist up the rock, and to accomplish this buckets were let down to the bottom and filled by divers during the period of slack water, removing by this means 211 cubic yards. Work has not since been resumed upon these rocks, which lie in the channel and directly in the way of vessels, owing to the dangers which careless or inexperienced pilots entail upon the vessels they are navigating by colliding with the scow; and until certain regulations can be enforced upon the pilots it would be unwise to subject passengers on board steamers passing through, to risk of life. The exposure to damage, as experience has so far shown, lies with the colliding vessel, and not with the scow.

Way's Reef.—This rock was operated upon by M. Maillefert in 1851, who succeeded in knocking off a few of the most prominent projections; and again in 1869 by the same process, surface-blasting, he removed from the surface of this reef 1621 cubic yards, increasing its depth to $17\frac{1}{2}$ feet. The drilling-scow commenced work upon this reef Aug. 4, 1874, and on Jan. 20, 1875, it was wholly removed to a depth of 26 feet at mean low water. The size of the rock within the 26 feet curve was 235 feet long by a maximum width of 115 feet. The ebb currents, which are the strongest, run three knots per hour on the channel side, gradually diminishing in velocity as the shore is approached.

The average working force of the scow was thirty seven men.

Number of holes drilled 262
" " feet " 2150.4

Explosives used :
For 65 drill-blasts .... 15,2[illegible] lbs. } nitro-glycerine,
" 16 surface-blasts . . . . . 1,484 " }
and ... . . [illegible] " dynamite.

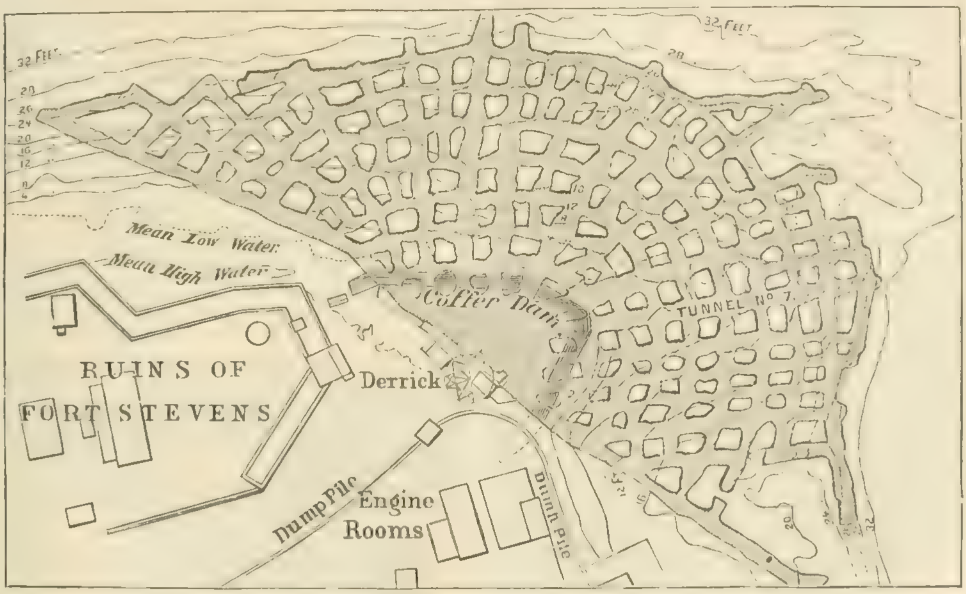
Cubic yards, exclusive of the operation of raking, removed by steam-grapple .... [illegible]
Total time of grappling . . .. [illegible] days.
" " " stone-raking . . [illegible]
Average No. of feet of drilled hole to each cubic yard [illegible]
" " pounds of nitro-glycerine " " [illegible]
" " feet drilled by each machine per shift of eight hours 6.5
" depth of holes, in feet 8.13
Average cost of linear foot of hole drilled, including placing of scow, lowering dome, expenses of drilling, sharpening drills, loss of steel, hoisting up dome, and heaving off scow $2.65
Average cost of sharpening a drill. $1.41
" No. of feet drilled to each sharpening................ 8.13
" expenditure of steel to each foot drilled, [illegible] 2.7
" cost of dredging and dumping 1 cubic yard of débris............... ....$1.29

The above data are from the report of Mr. J. H. Striedinger, assistant engineer superintending the operations of this machine, to Gen. Newton, and furnish a proof of the ability and skill with which the machine was directed by Mr. Striedinger. Upon the chart accompanying this report the position, depth, and charge of each drill-hole are recorded, so that the effects of blasts disposed at certain distances and charged with known quantities of nitro-glycerine are clearly revealed.

Having finished this description of the drilling-scow and of its operations, it remains only to say that its use has been, and will be, confined to the smaller reefs situated in the channel until these are all removed. These operations are necessarily the most costly. What it could accomplish, or at what cost upon the larger reefs, must remain a matter of conjecture until tried, though it is certain that it would be fully successful in such essay.

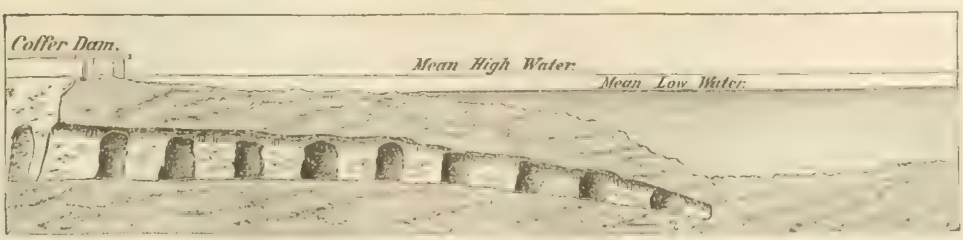
Hallet's Point Reef. This reef is in shape an irregular semi-ellipse, the longer axis, which lies next to the shore, being 720 feet in length, and the shorter semi-axis, projecting straight into the channel, about 300 feet. The cubic contents above the depth of 26 feet at mean low water

FIG. 3.



Plan of Excavations; scale, 1 : 1500.

FIG. 4



Longitudinal Section through Tunnel No. 7; scale, 1 : 750.

amount to 51,000 cubic yards. The shallowest portion of this reef is a ridge coincident with the line of stratification, and having a direction of N. [illegible]2 E. Besides the risk of striking the reef, it produces eddies on both sides of it according to the direction of the tidal currents, and is much in the way of vessels coming down with the ebb in the effort to hug the shore, and thus avoid being thrown upon the Middle Reef. It is in the way of small and large vessels equally, and its removal is an essential element in the improvement of the channel. The removal of this reef might have been undertaken in either of two methods—viz. that by drilling into the surface, blasting, and removing the debris by the steam grapple, or by means of tunnels and galleries used to explore the interior of the rock, and thus obtain places for blasting charges or mines to overthrow the whole mass of rock at once, the broken rock to be taken away by mechanical means.

The first time, so far as known, that tunneling was suggested as a means of removing rocky obstructions in a channel was in the spring of 1868 by Mr. G. C. Reitheimer, a gentleman who had formerly served as superintendent at the breakwater at Holyhead. His proposition was to remove the channel-rocks by the application of a circular iron shaft to reach to the rock, and after the bottom was secured against leakage to begin within this enclosure to sink into the rock, and after attaining the requisite depth, by a series of tunnels or galleries to explore the whole rock and place in it the mines for blowing it up. A letter dated Oct. 3, 1868, from Gen. Alexander, U. S. Engineers, gave the same project, except in the material of which the shaft is to be composed, for the removal of Blossom Rock in San Francisco harbor, Cal. Mr. A. W. von Schmidt, C. E., Nov. 20, 1868, gives his project for the removal of Blossom Rock, in which he proposes to reach to the surface by means of an iron shaft, then to sink into the rock to a suitable depth, and excavate such a cavity into its body that the débris of the explosion falling into this receptacle would leave the depth overhead required for purposes of navigation. The leading idea of this mode is identical with that of Mr. Reitheimer and of Gen. Alexander also.

Tunnelling under water was nothing novel, as shown by the coal-mines in England. Nothing could be done in the way of removing rocks in Hell Gate until a sufficient sum could be allotted to begin upon a competent scale; and it was consequently not until the month of July, 1869, that operations were undertaken at Hallet's Point with a view to the construction of a coffer-dam upon the reef, between high and low water levels. The dam was finished in October following, and the excavation of the shaft commenced. The form of the dam is that of an irregular polygon, being about 145 feet across on the shore-line, and about 90 feet out upon the rock. The form of the shaft conforms to that of the dam, and it has been excavated to a depth of 33 feet at mean low water. Ten principal tunnels, radiating through the rock, were commenced from the walls of the shaft. As the distance apart of the tunnels increased subsidiary tunnels were interpolated. Transverse galleries, averaging in distance 25 feet from centre to centre, were excavated as the work progressed. In all, there are 35 tunnels and 10 transverse galleries. The tunnels at the shaft vary from 22 to 17 feet in height, and from 12¾ to 9 feet in width; as they were advanced the height rapidly decreased, owing to the downward slope of the surface of the reef, and the width also decreased, so that the dimensions soon did not exceed those of a heading. The galleries vary likewise in size, from 12 feet high by 9 feet wide to much smaller dimensions. The number of feet in length of tunnels and galleries is 7400. The number of cubic yards removed from the tunnels and galleries is 45,000 to the end of Feb., 1875. At Blossom Rock the contractor, Mr. A. W. von Schmidt, commenced sinking an iron tube to serve as a shaft on Oct. 5, 1869, at the time when the dam at Hallet's Point was completed. The interior of the rock was excavated and the explosion made on Apr. 23, 1870, but the débris was not finally removed and the work completed until Dec. 6, 1870. Blossom Rock was of small dimensions, 180 feet by 100, within the limits to be removed, and the period of its removal occupied one year. The idea advanced by the contractor, of excavating a cavity within the rock sufficient to receive the entire débris of the explosion, was abandoned on account of the danger of the process, and the work, after being exploded in the ordinary way, was finished by removing the broken-up rock by mechanical means. Way's Reef in Hell Gate, 235 feet by 115 feet, was removed by the operation of the steam-drilling scow in about five months, while the cost was less than that of Blossom Rock.

The explosives used in tunnelling at Hallet's Point have been nitro-glycerine and its compounds, and gunpowder. The latter has been used only when the rock was weak and seamy. Reliance has been placed upon nitro-glycerine to drive the headings forward, and no accident has befallen the miners from its use, either at Hallet's Point or in the operations of the steam-drilling scow. To drive a heading, the drill-holes are made at an angle with the face, so that the charge may lift out the rock by its explosion. In this way, after a cavity is made, holes are drilled around it, and the surrounding rock blown into it. When large charges can be used, a square or rectangular portion of the face of the heading is marked out by drill-holes, inclining towards each other, and one or more perpendicular holes drilled within the boundary marked; the holes being drilled deep and well charged, the explosion would generally lift the rock according to the dimensions traced by the drills.

Owing to the risk from using large charges at Hallet's Point, the work of forming a cavity around which to excavate the heading was a piecemeal process. The charges of nitro-glycerine were usually only 8 ounces, and to avoid the vibration which would be caused from a simultaneous discharge of many blasts, the battery was not employed. Ignition was made with the Bickford fuze, and there was consequently no volley firing. The nitro-glycerine is contained within small paper cases, rendered proof against leaking by a composition. The cartridge is exploded by a cap containing fulminate of mercury, with which the fuze communicates. The necessity of using small charges and of avoiding volley-firing has been unfavorable to such rapid progress, as would have been possible on land under the same circumstances.

The average of twelve months' work with six Burleigh drills, was the excavation of 235 lineal feet of heading per month. Up to June 30, 1872, the work had been prosecuted by hand-drilling, with the exception of 20,160 lineal feet of drilling by the Burleigh drill and of 7000 feet by the diamond drill. That by the Burleigh drill was by contract at a certain rate per foot; and the diamond drill, purchased at the work for the purpose of exploring the rock ahead, was put in competition with it. The work of the Burleigh drill, though more satisfactory in the hard gneiss than that of the diamond drill, was still far from being perfectly so; and it was not until the former was tried by our own men that its advantages over hand-drilling became marked. Before this trial there was real doubt concerning its economical advantages for these works, owing to the small size of the headings, the limited depth of holes, and the minute charges which it was necessary to adopt. The Burleigh drill previously had made but 18 or 19 feet of holes per shift of 8 hours, and required one drill in the shop under repair for each one at work. The last fact indicated the necessity of extensive repairs and appliances for the same, the cost of which it was necessary to consider in the general problem. The cost of drilling, after a long trial with the Burleigh drill, is found to be between 36 and 37 cents per foot, including repairs and all items of expense except first cost and interest. The cost of hammer-drilling was found to be about 95 cents per foot. With nine Burleigh drills seven can be kept at work. The number of feet of holes drilled by each machine per shift of 8 hours was 30 feet. The diamond drill, owing to the encounter of frequent veins of pure quartz in the rock, did not answer well, but it should prove a valuable drill for rocks of inferior hardness. The Ingersoll rock-drill, which, like the Burleigh, is a percussion drill, was used experimentally at the works, and proved itself fully equal to the other.

A pump of the capacity of 1000 gallons proved itself capable of removing the leakage. As the floor of each tunnel declines in level from the shaft outward, it was necessary, in order to draw the water from the extremity of the tunnel by means of the pumps placed in the shaft, to lay down radial pipes in the tunnels communicating with the pumps. Owing to the restricted area of the tunnels and galleries, the work of excavation was almost exclusively that denominated the *heading*, without advantage of enlargement, and hence the following refers to the most costly and laborious part of the work of tunnelling:

Blasting One Cubic Yard in Headings.

10 feet of drilled hole.
1.22 pounds of nitro-glycerine.
.39 " " gunpowder.

The difference of cost between these operations by hand-drilling and by machine-drilling may be found at once by the substitution of the price per foot of these modes of drilling.

The rock, after being blasted, is lifted by hand into a box resting upon a truck-car, which is run down to the place upon a rail-track, and thence drawn by a mule to the shaft, where the box is hoisted by a derrick, and its contents emptied into the dump-cars to be rolled away and deposited in the pile.

Calling the cost of blasting and removing one cubic yard 1.00, the following gives the proportion of each item of expenditure:

Blasting	0.46
Transporting rock to shaft	0.17
Hoisting "	0.0328
Dumping "	0.0203
Pumping	0.1037
Incidental	0.2132
	1.00

The cost of plant and interest is not included in the proportion thus given. Repairs are included.

The tunnels and galleries are, it may be said, finished; but little remains to be done except to prepare for the final explosion, after which the débris will be removed by mechanical means. The means of explosion would appear to be simple: by destroying simultaneously—by cutting down with charges of nitro-glycerine or similar compounds of quick explosive character—the piers which support the roof of the excavation; at the same time, by introducing a sufficient number of charges in or under the roof, to break this up into pieces of convenient size. A simultaneous explosion can be effected by igniting with electric batteries a certain number of centres of explosion; and the connection of the charges of one pier with those of the adjacent piers will ensure the propagation of the explosion throughout the whole extent of the excavation.

The comparative cost of excavation between the system of tunnelling and that by means of drilling the surface of the rock, as performed by the steam-drilling scow, cannot be satisfactorily made until the removal of Hallet's Point be completed. Great credit is due to Capt. Wm. H. Heuer of the Corps of Engineers, who has been the resident engineer at Hallet's Point since June, 1872, for his careful and economical supervision of these operations. The chambers were successfully exploded Sept. 24, 1876. John Newton.

Hellin', town of Spain, in the province of Albacete, on the Menedo. In its vicinity are rich sulphur-mines and sulphurous springs used for bathing. Pop. 7632.

Hell'muth (Rt. Rev. Isaac), D.D., by birth a Polish Jew, became in 1856 an Anglican minister of Canada; founded Huron College (1863) and Hellmuth College (1865), London, Ont., and Hellmuth Ladies' College (1869); was successively

archdeacon and dean of Huron; became in 1870 suffragan bishop of Norfolk and coadjutor of Huron, and in 1871 succeeded Dr. Cronyn as lord bishop of Huron, Ont.

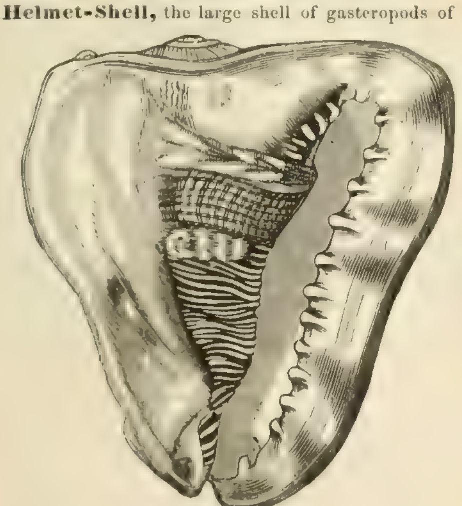
Helm, on shipboard, the steering apparatus, including wheel, tiller, and rudder. To *put down the helm* is to bring the ship's head to the wind; to *put up the helm* is the reverse. By means of the wheel the rudder is inclined to an angle varying from the ship's course, until by the action of the water upon the rudder the ship's direction is properly modified, when the rudder is returned to its normal position, in a line with the ship's course.

Helm (BEN. HARDIN), b. in Kentucky in 1831; graduated at West Point July 1, 1851, and entered the army as brevet second lieutenant of dragoons, resigning in Oct., 1852, his commission, and followed the practice of the law at Elizabethtown and Louisville till 1861, having been a member of the State legislature and commonwealth attorney. He joined the State guards under Gen. Buckner in 1861, and as a colonel in the Confederate army was engaged at the battle of Shiloh, being shortly after promoted to be brigadier-general. He took part in the battle of Perryville, and commanded a division at Stone River, and at Chickamauga (Sept. 19–20, 1863), where he was mortally wounded. D. Sept. 21, 1863.

Helm (JOHN L.), b. in Hardin co., Ky., in 1802; studied law under Duff Green, and attained a wide and early fame at the bar, and was several times Speaker of the house of representatives of Kentucky. In 1848 he was chosen lieutenant governor, and succeeded Mr. Crittenden as governor in 1850. During the civil war he strongly sympathized with the South, and his son, B. H. HELM, was a Confederate general of brigade. In 1865, Mr. J. L. Helm became a State senator, and in 1867 governor, but d. Sept. 8, only five days after his inauguration.

Hel'met, in ancient times the metallic or leathern head-dress worn by soldiers. Helmets of various forms are still employed to some extent in different nations. Helmets of forms varying according to the bearer's rank appear upon coat-armor beneath the crest. This is a comparatively recent innovation in heraldry. The forms of heraldic helmets are derived from the age of chivalry.

Helmet-Shell, the large shell of gasteropods of the



The Cassis tuberosa.

genus *Cassis*, of which there are some thirty-five living and as many fossil species. The living ones are found in all tropical seas, and are used in making shell cameos. *Cassis cornuta* gives a white figure on an orange ground; *C. tuberosa* and *madagascariensis*, white on claret color; *C. rufa*, a salmon color on orange.

Helm'holtz (HERMANN LUDWIG FERDINAND), physicist and physiologist, b. at Potsdam, Prussia, Aug. 31, 1821; studied medicine at Berlin, and became an army surgeon; was professor of anatomy at the Art Academy, Berlin, in 1848–49; professor of physiology at Königsberg 1849–58, and in 1858 was called to the chair of physiology at Heidelberg; went in the spring of 1871 as professor of physics to Berlin; is widely known as one of the ablest of students of the physiology of the organs of special sense. His principal works are *The Conservation of Force* (1847), *Handbook of Physiological Optics* (1856), *Theory of the Impressions of Sound* (1862), *Popular Scientific Lectures* (1865–71), and he has published numerous valuable scientific papers. He is the inventor of the ophthalmoscope, an instrument of the greatest value to the ophthalmic surgeon, and has made discoveries of the first importance in acoustics. He was chosen to the French Academy of Sciences in 1870.

Hel'mont, van (JAN BAPTISTA), b. at Brussels 1577, and studied at the University of Louvain. The mystical bent of his mind first assumed a religious character; he conferred all his property on his sister, studied medicine in order to serve Christ by curing the sick, and lectured in the seventeenth year of his age on medicine. But having met with a case which he could not cure, he gave up his science in despair, and strolled around for ten years, conversing with mountebanks and charlatans, and searching after the hidden knowledge,—the philosopher's stone, or panacea. Chemistry and alchemy became his favorite studies. He married a rich lady, settled down at Vilvoorden, and spent all his time in his laboratory and in curing people according to a new method. His fame soon grew great. His numerous mystical writings were much read; they contain real discoveries in chemistry, and, although he claimed to possess a means of prolonging human life, his system of physiology, anatomy, and medicine is clearer and more scientific than that of Paracelsus. Thousands of people gathered to his house, and many of his cures were so wonderfully successful that they attracted the attention of the Inquisition as probable works of the devil. Many brilliant offers were made him from kings and kaisers, but he declined them, and remained at Vilvoorden, where he d. Dec. 30, 1644.

Helm'städt, or **Helmstedt,** town of Germany, in the duchy of Brunswick. It has large alum and vitriol works, and carries on a lively trade. Pop. 7469.

Hel'mund, a river of Afghanistan, rises in the Hindoo-Koosh, flows with a course of 650 miles through a barren desert, and empties itself in the salt lake of Hamoon. Its banks, which are fertile, bear at many points traces of former cultivation.

Heloder'midæ [from ἧλος, a "nail," and δέρμα, "skin"], a family of pleurodont saurians belonging to the group of Diploglossæ, and distinguished therein by the skin being furnished with tuberculigerous or nail-bearing scales (whence the name); head also tuberculigerous; skull with the temporal fossa overarched by dermo-ossification; no premaxillary foramen; teeth with short dilated bases, obliquely ankylosed; and mesosternum longitudinal and without lateral limbs. This family has been established by Gray and Cope (*Proc. Acad. Nat. Sc.*, Philadelphia, 1864, p. 228; 1866, p. 322, for the reception of a large lizard (*Heloderma horridum*, Wiegmann) found in Northern Mexico and the contiguous U. S. territory. It is characteristic in its color, which is blackish, reticulated by yellow interspaces. The animal has a suspicious reputation, and is believed by the inhabitants of the country in which it is found to be poisonous, but no evidence of the fact has been obtained by Dr. Irwin, who experimented with it. In Southern Arizona, where it is common, it is known as the "scorpion." THEODORE GILL.

Héloise. See ABELARD, by PROF. J. H. SEELYE, S. T. D.

He'los, town of Laconia, near the mouth of the Eurotas, was founded by Helius, the youngest son of Perseus. It defended itself with great stubbornness against the Dorians, who after conquering it took revenge by making all its inhabitants slaves; hence perhaps the name *Helots* for the Spartan serfs. When Pausanias visited it in the second century of our era, he found it in ruins, and at present even its site is not precisely known.

Helostom'inæ, or **Helostom'idæ** [from ἧλος, "nail," and στόμα, "mouth"], a sub-family of the family Anabatidæ, or, according to others, a peculiar family of acanthopterygian fishes, with the upper joints of the branchial arches composed of thin laminæ for the reception of water, and all lined with a soft vascular membrane and without toothed tubercles. The head is unarmed; the mouth very small and transverse, and with movable teeth on the lips; the lateral line is interrupted. The representatives of this family are peculiar to the fresh waters of Java, Sumatra, and Borneo. THEODORE GILL.

He'lots [plu.; Gr. εἵλως, εἱλώτης, plu. εἵλωτες, meaning either "captives" or "inhabitants of Helos," a town of Laconia], the serfs of the ancient Spartans; a peasantry of Greek blood, owned by the state and compelled to do certain kinds of military duty. Their lot was a hard one, though they might not be sold. It was the custom of the Spartans to keep their numbers within bounds by the occasional slaughter of the strongest of the Helots, and young Lacedæmonians were from time to time sent out to slay numbers of them secretly.

Hel'per (HINTON ROWAN), b. in Davie co., N. C., Dec. 27, 1829; removed in 1851 to California, and was U. S. consul at Buenos Ayres 1861–67. Author of *The Land of*

Gold (1855), *Impending Crisis of the South* (1857), *Nojoque* (1867), *The Negroes in Negroland* (1868).

Helps (Sir Arthur), K. C. B., D. C. L., b. in England in 1817; graduated at Cambridge in 1838; became private secretary to the chancellor of the exchequer, and in 1859 became clerk of the privy council for England. Among his numerous works are *Thoughts in the Cloister and the Crowd* (1835), *Essays written in the Intervals of Business* (1841), several dramas: *The Claims of Labor* (1844), *Friends in Council* (1847; 2d series, 1859), *Companions of my Solitude* (1851), *Conquerors of the New World* (1852), *Spanish Conquest of America* (1855–61), *Life of Pizarro* (1869), *Brevia* and *Casimir Maremma* (1870), *The Life of Cortez*, and *Thoughts on Government* (1871), *Life of Brassey* (1872), *Ivan de Biron* (1874), *Social Pressure* (1874), etc. Helps' writings all have a noble moral purpose, and are written in a pure though not forcible style. He enjoyed the special favor and patronage of Queen Victoria for many years. D. in London Mar. 7, 1875.

Hel'singborg, town of the province of Malmö, Sweden, on the Sound, opposite to Elsinore, in Denmark. P. 7560.

Hel'singfors, the capital of the grand duchy of Finland, on the Gulf of Finland. It has an excellent harbor, and is strongly fortified. Its fortifications, of which Sweaborg and Gustavswärd are the two most important points, stretch over a row of seven rocky islands, and were in 1854 bombarded by the allied French and English fleet. (See Bombardment.) Helsingfors has a university attended by 600 students, a military academy, and a considerable trade. Pop. 32,113.

Helt, tp. of Vermilion co., Ind. Pop. 2794.

Hel'ton, post-tp. of Ashe co., N. C. Pop. 1004.

Helvel'lyn, a mountain of Cumberland, Eng., 3055 feet high, one of the highest points of land in England.

Helve'tia, post-tp. of Waupacca co., Wis. Pop. 148.

Helve'tii, the ancient Celtic inhabitants of Switzerland. Cæsar's *Commentaries* (*De Bello Gallico*) give a graphic account of their attempt to occupy more fertile parts of Gaul, and their terrible punishment and subjugation by the Romans (58 B. C.). They had previously (107 and 101 B. C.), in company with the Cimbri, experienced the power of the Roman armies. In 70 A. D., refusing to recognize Vitellius, and taking the part of Galba, the former fell upon them and put an end to their existence as a distinct people.

Helvétius (Claude Adrien) was b. at Paris in 1715, and educated in the College of Louis-le-Grand. After finishing his studies he was sent to Caen, to an uncle of his, who was a directeur des fermes, in order to make himself acquainted with the science and practice of a financier. In 1738 he obtained, through the influence of the queen, Marie Leczinska, a place as fermier-général, which gave him a yearly income of 100,000 francs. He grew rich, bought land, and after marrying the beautiful and talented countess de Ligniville, retired in 1751 to his estate, Voré, in Le Perche, where he spent the rest of his life. His famous book, *De l'Esprit*, appeared in 1758. He d. in 1771. Helvétius was a handsome man, with pleasant and elegant manners, kind-hearted, benevolent, full of sympathy with human sufferings, and always ready to help. But he was extremely vain, and although his vanity was ludicrous rather than offensive, the one aim of his life was to be noticed and applauded. He succeeded. After many years' labor the book was done and came out, and the sensation it made was so immense as to actually frighten the author. In thorough good faith, as if it did not contain anything extraordinary, or rather as if he himself did not understand what it contained, he sent copies to the queen, the dauphin, and all his friends at court, and he was entirely bewildered when suddenly the hurricane broke down on him. The court was scandalized and the clergy were in a fury. The doctors of the Sorbonne denounced the book, the Parliament of Paris condemned it to be burnt by the hangman, and the pope put it under ban. To all this the author answered by retracting. He wrote four retractions, each more sweeping than the preceding, but no one heard him. The book ran like wild-fire over all Europe, and when the storm was over Helvétius found himself one of the most famous authors of the time, the great revealer of *le secret de tout le monde*. Frederick the Great invited him to Berlin, and treated him like a prince; Catharine II. complimented him; France, England, the whole world applauded him. He had accomplished a great deed, and he was not going to outshine himself. He wrote no more books. After his death were found an unfinished poem, *Le Bonheur*, and an unfinished commentary on his book, *De l'Homme, de ses Facultés intellectuelles et de son education*. But they were watery; nobody read them; and as very few had noticed his passionate retractions, very few noticed the wicked whisper that Diderot had written all the good pages in his book.

De l'Esprit is the gospel of materialism. The principal ideas which it propounds are that all our mental faculties are reducible into physical sensibility, and the difference between man and animals is only a difference in exterior organization; that self-interest, guided by our love of pleasure and fear of pain, is the sole motive of our actions and affections, and the ideas of justice and injustice are nothing but reflections of habit; that mental inequalities do not depend on a more or less perfect organization, but merely on education, etc. But it was not these ideas which scandalized and enraged people. On the contrary, they were the charm of the book; they were the revelation of *le secret de tout le monde*. But Helvétius often employed some very clever illustrations; and when he, for instance, said, "Give the son of a carpenter smartness, courage, prudence, and energy, and in a republic he will become a Themistocles or a Marius, while in Paris he will become a Cartouche," such ideas were of course dangerous; people are generally more ridiculous in what they abhor than in what they admire.

Clemens Petersen.

He'mans (Felicia Dorothea), *née* Browne, b. at Liverpool, England, Sept. 25, 1794; married Capt. Hemans in 1812, and in 1818, after the birth of five sons, separated on account of the uncongenial character of the union. Mrs. Hemans from that time resided in Wales, Lancashire, and Ireland, engaged chiefly in literary production. D. near Dublin, May 12, 1835. Mrs. Hemans's best poetry is characterized by grace and tenderness, which is especially exhibited in her less ambitious pieces. But she wrote too much to write always well, and several of her tragedies and longer pieces were unsuccessful. Her works include *Early Blossoms* (1808), *The Domestic Affections* (1812), *The Forest Sanctuary* (1827), *Records of Women* (1828), *Songs of the Affections* (1830).

Hematine. See Hæmatine.

Hematite. See Hæmatite.

Hemibran'chii [from ἡμι-, "half," and βράγχια, "gills"], an order of Teleost fishes with the palatine bone directly articulated with the quadrate, without the intervention of the pterygoid; with jaws normally developed; the mouth being bounded above by the pre-maxillary, behind which is the super-maxillary; branchial apparatus imperfect, the superior branchihyals being rudimental, and at least the fourth wanting; anterior pharyngeal bones distinct; scapular arch connected directly with the post-temporal, no postero-temporal being developed; meso-coracoid absent; and ventral fins abdominal, the pubic bones having no connection with the scapular arch. To this order belong several families: the sticklebacks, (1) Gasterosteidæ and (2) Aulorhynchidæ; (3) the short pipe-fishes, or Aulostomidæ; (4) long pipe-fishes, or Fistulariidæ; and certain peculiar types with high bodies: (5) Centriscidæ, and (6) Amphisilidæ. The first four groups resemble each other, and are "gasterosteiform," and the last two "centrisciform." They differ from most fishes in the structure of the shoulder-girdle, and the union of the palatine arch directly with the quadrate bone, as well as by the imperfection of the branchial arches, to which the ordinal name refers.

Theodore Gill.

Hemiple'gia [from the Gr. ἡμι-, "half," and πλήγη, a "stroke"], that kind of paralysis which affects only one side of the body; or if both sides are affected, it is from the occurrence, a very rare one, of double hemiplegia—that is, of two concurrent paralytic strokes, one affecting each side. It manifests itself usually in the upper and lower extremities of one side, and in the parts of the head which are supplied by the fifth nerve. It may be the result of an apoplectic stroke, or of a slow effusion, or of the growth of a tumor within the brain. Owing to the decussation of the pyramids, the paralysis takes place usually on the side of the body opposite to the side of the brain in which the lesion has occurred. For example, if there be a tumor growing in the left hemisphere of the brain, the paralysis will, as a rule, be manifested in the right side of the body, because the nerve-fibres cross over from side to side near the base of the brain. But if the lesion occur below this crossing, there may be hemiplegia on the same side. Hemiplegia affects chiefly the nerves of motion, but affects more or less those of sensation also. Temporary attacks of hemiplegia are also observed in chorea, epilepsy, and hysteria. The treatment of hemiplegia varies with the condition of the patient and the cause of the stroke. Generally, time and rest are important to the relief of the patient.

Revised by Willard Parker.

Hem'ipode (*Hemipodius*, "half-foot," so named from the absence of the hind toe), a genus of gallinaceous birds, including the smallest birds of that group. *H. tachy-*

dromus, the Andalusian quail, ranges eastward from Spain to Australia. The fighting quail (*H. pugnax*) of Java is domesticated and trained to fight like a gamecock. Each of these birds is about five inches long.

Hemip'tera [Gr. ἡμι-, "half," and πτερόν, "wing"], an order of insects which have the mouth-parts formed into a slender horny beak or sheath of horny substance, enclosing three sharp bristle-shaped organs, the whole fitted for suction. Such are bugs, plant-lice, etc. They are named from the fact that such of these insects as have wings of typical form have the upper or basal portion of the wings thick, while the terminal portion is thin (Hemiptera heteroptera); but the cicadas, plant-lice, etc. have wings of uniform thickness (Hemiptera homoptera). Indeed, many forms have no wings at all. (See article ENTOMOLOGY, by PROF. SANBORN TENNEY, A. M., section *Hemiptera*.)

Hem'isphere [Gr. ἡμι-, "half," and σφαῖρα, "sphere"], one-half a sphere; applied particularly to the halves of the terrestrial globe. The distinction between the eastern and western hemispheres is an arbitrary one. The meridium of Ferro is assumed as the dividing line, and it serves the purpose, though but rather imperfectly, since a small part of North-eastern Asia is by this arrangement thrown into the western hemisphere. The equator gives a very natural division into a northern and southern hemisphere. As the land-surface of the earth is generally situated to the N. of the equator, and as the land-areas expand northward and taper to the S., the northern hemisphere contains nearly three times as much land as the southern, in which water correspondingly predominates. And as four continents are crowded together in the eastern hemisphere, it contains two-thirds, and the western only one-third, of the lands. The Old World is thus double the size of the New. As the lands are crowded on the N. and E. sides of our planet, the north-eastern hemisphere contains more land and the south-western hemisphere more water than any other we can devise. They are therefore contrasted by the celebrated Carl Ritter as the land and water hemispheres. In the land hemisphere are gathered together the largest parts of all the great continents, making over six-sevenths of all the land, and occupying only a little less than one-half of the surface. In the water hemisphere, Australia, the smallest of the continents, stands alone, with only the southern points of Asia and South America, making less than one-seventh of the land, and leaving twelve-thirteenths of the surface to the water. The centre of the land hemisphere is about London; that of the water hemisphere at some point in the ocean S. of New Zealand. (For cuts of Hemispheres see article EARTH in Vol. I. of this work.)

Areas in Square Miles.

	Land	Water	Total
The earth	52,900,000	144,000,000	196,900,000
Northern hemisphere	38,780,000	59,670,000	98,450,000
Southern hemisphere	13,960,000	84,480,000	98,450,000
Eastern hemisphere	36,100,000	62,350,000	98,450,000
Western hemisphere	15,900,000	82,550,000	98,450,000
Land hemisphere	44,000,000	54,450,000	98,450,000
Water hemisphere	7,000,000	91,450,000	98,450,000

ARNOLD GUYOT.

Hemitripter'idæ [from ἡμι, "half," τρεῖς, "three," and πτερόν, "fin"], a family of acanthopterygian fishes, with the vertebræ in greatly increased number (16 + 23), having an enlarged suborbital bone articulating with the preoperculum, and distinguished by the elongated spinous dorsal fin, combined with the characters of the true cottoid (the head not compressed, no true scales, and ventrals imperfect and enveloped in a thick skin). The family is represented on the coasts of the U. S. by a species known as the deep-water sculpin (*Hemitripterus acadianus*).

THEODORE GILL.

Hem'lock, or **Spot'ted Hem'lock** (*Conium maculatum*), a biennial plant, natural order Umbelliferæ, native in Europe, but naturalized and cultivated in the U. S. for medicinal purposes. It has an erect, round, branching stem from three to six feet high, marked with brownish-purple spots, whence the name "spotted hemlock." It bears large deep-green, decompound leaves, and small white flowers in compound terminal umbels. The plant, especially in summer, has a peculiar fetid, mousy smell. The leaves and fruit are used in medicine, the active principle being an alkaloid, *conia*, most abundant in the fruit. This is a yellowish oily fluid, volatile, of acrid taste, and strong mousy odor, slightly soluble in water, but freely in alcohol, ether, and oils. The action of hemlock has only of late years been carefully analyzed, and is simply to destroy the conducting power of the nerves of motion, producing thus muscular weakness and paralysis, the effect showing itself first in the muscles of the eyes and lids and of the legs. In poisonous doses it produces complete muscular paralysis, and thus death by paralysis of the muscles of respiration. It is not certain whether the hemlock used by the ancients as a state poison was this plant or the *Cicuta virosa*, a much more virulent herb. Hemlock has had a variety of medicinal virtues assigned to it, but its only rational use is to subdue abnormal motor activity or irritability. Many of the preparations of hemlock are apt to be inert, from loss of the volatile active principle. EDWARD CURTIS.

Hemlock, tp. of Columbia co., Pa. Pop. 1170.

Hemlock Lake, a manufacturing post-v. of Livonia tp., Livingston co., N. Y. Pop. 257.

Hemlock Tree, called also **Hemlock Spruce**, the *Abies Canadensis*, one of the most common of the coniferous trees of the Northern States and British America. It is a very large tree, and when young is very graceful. Though the timber is coarse and cheap, it is very serviceable, and immense quantities of it are employed in house-carpentry in the older and longer-settled parts of the North. The bark and its extract are very extensively employed in tanning leather in the U. S.—much more so than any other astringent substance. The wood is very inferior as fuel, burning up very quickly and with a loud crackling noise. "Hemlock oil" is distilled from its leaves and twigs, and "Canada pitch" is obtained from the old trees. Several very closely allied Asiatic trees are described.

Hemp, a fibre, the use of which in Persia and India antedates the period of accurate knowledge, and whose introduction into Europe was contemporaneous with civilization. This fibre is similar to that of flax, but coarser and stronger. The plant which produces it is also known as hemp, and is cultivated for its seed and for the oil which is expressed from the seed, and the hemp of warm countries, especially of India, possesses peculiar medical properties. (See HASHISH.) The plant is known botanically as *Cannabis sativa*, and is an annual belonging to the nettle family (Urticaceæ). It is a diœcious plant, having the fruit-bearing or female flowers, and the sterile or male flowers, upon different plants. Hemp grows four to twelve feet high, and makes its growth almost as rapidly as Indian corn. The stem is somewhat angular, rough, and hairy, branching freely when growing singly, but very little when crowded. The leaves are generally compound, five to seven leaflets being united upon the end of one leaf-stalk. The leaflets are three to five inches long, slender, and toothed at the edges. The staminate or male flowers are of a greenish-white color, and occur in loose clusters in the axils of the leaves near the top of the plant or the ends of the branches, while the pistillate or fruit-bearing flowers occur mostly in pairs close set in the axils of the upper leaves. As usually cultivated, it flowers in June, and ripens its seed in August.

The hemp-producing countries of the world are Russia, Turkey, India, Holland, Germany, Italy, and Great Britain. The Riga hemp of Russia combines fineness and strength, and is regarded as the best. There is, however, a kind produced in Italy called "garden hemp," raised with great care by hand-culture, which is the finest. The fibre is separated from the boon much as flax is, and is spun and woven in almost identically the same way. Excellent sheetings and shirtings, white and strong, are made from hemp, but towellings (huckaback), osnaburgs, tablecloths, napkins, floorcloths, sail-duck, and the like are manufactured on a large scale, and form articles of extensive commerce. By far the greatest consumption of the fibre is for rope, cordage, and twine.

Cultivation.—A large portion of the U. S. is well adapted to raising hemp, but it is principally raised in the following States, named in order of greatest production: Kentucky, Missouri, Tennessee, Ohio, Indiana, and New York. The cultivation for fibre is simple, the seed being sown as early as the ground is warm on well-prepared sward ground, which, if of a clayey nature, should be ploughed in the autumn and worked again in spring. It is not usual to manure directly for the crop. Four to six pecks of seed are used in this country to the acre, but the quantity varies according to the climate and to the strength of the soil, upon which also the vigor of the plants depends. In England they use two to three bushels of seed, but there the height of the plants is about four to six feet, while here it is frequently seven to nine. The seed is thoroughly harrowed in and rolled, and requires no attention until it is cut. Cutworms are often quite injurious to it, and crows and blackbirds on a hemp-field are the farmer's best friends. Hemp has no diseases that we know of. When the blossoms of the flowering (male) plants turn yellow and fall off, it is usual with us to cut the whole crop; but in Europe, as soon as the "blossom hemp" has fertilized the crop and the seed is set, the hands pass through, pull all the male plants, and binding them in bundles, dry and stack them for subsequent rotting. The female plants remain until the seed is ripe, when they are cradled, the tops, in which the seed is, cut off, and the stalks dried and stacked. Hemp

is generally cradled, but if over seven feet high this is hardly possible, and it should be cut with sharp bush-scythes. After two or three days' sunning the hemp is bound and stacked, either upon the ground if it is to be dew-rotted, or near the pools if it is to be water-rotted. The rotting is performed in the autumn at the commencement of cool weather, and requires in pools or vats ten to twenty days, according to the temperature. Vats under cover are preferred, each being about 20 by 40 feet, and 2 to 3 feet deep. The hemp is laid in crossways, and weighted down by stones laid upon planks. The water is changed by drawing off and refilling when required. The process is completed when the fibre separates readily from the stalk, or of its own accord springs off from it like a fiddle bow-string. It is dried and stacked, and "broken" in the winter. This operation is like that of breaking flax, but performed with heavier implements. The boon is scutched and beaten out of the fibre, which is twisted into hands or hanks and pressed into bales for market. In dew-rotting the hemp is exposed to the weather in thin layers, and turned occasionally until the gumminess of the stalks is gone and the fibre separates from the boon as before described.

When hemp is cultivated for the seed, it is planted upon good corn-ground, manured the fall before if the soil be not too light and sandy. It delights in moist rich soils. The culture is like corn, the hills being three and a half to four feet apart, according to the richness of the land. A dozen or more seeds are dropped in each hill, and at the first hoeing these are thinned to five or six plants. Cutworms may take two or three of these, and at the second hoeing they are reduced to four. When the blossom-hemp can be distinguished, these plants are removed, and two or three of the others left to each hill. One plant of the male or blossom-hemp is allowed to remain in the alternate hills each way, making one to each four hills, and as soon as the seed is set, the blossoms having ceased to shed their pollen (the yellow dust which falls when they are shaken), these plants too are removed, leaving only the seed-bearing plants in possession of the soil. The seed-hemp is cut before the seed will shell out of itself, stacked till dry, and the seed beaten out. This must be winnowed with care, and spread in thin layers in warm airy lofts, or otherwise, so that it shall not heat. The crop is 12 to 15 bushels per acre. Hemp-seed is largely consumed as food for cage-birds and fancy poultry. It contains about 25 per cent. of oil, which may be extracted, leaving a cake still rich in oil. The oil is of a greenish-yellow color, and is used in the manufacture of certain soaps and somewhat in paints and varnishes.

The name "hemp" is commercially applied to several coarse fibres which come chiefly from tropical or extreme southern countries. They resemble true hemp only in the fact that the fibre may be used for cordage and perhaps other purposes for which hemp is employed. M. C. Weld.

Hem'pel (Charles Julius), M. D., b. at Solingen, Germany, Sept. 5, 1811; studied in Paris and the University of New York, where he graduated, having come to the U. S. in 1835. He became in 1857 professor of materia medica and therapeutics in the Homœopathic Medical College of Philadelphia. He has published a German grammar (1842), *True Organization of the New Church* (1848), several translations of homœopathic medical works, *Homœopathic Theory and Practice* (1865), *The Science of Homœopathy* (1874).

Hemp'field, tp. of Mercer co., Pa. Pop. 1119.

Hempfield, tp. in Westmoreland co., Pa. It includes the borough of Greensburg (which see). Pop. 5819.

Hemp'hill, post-v., county-seat of Sabine co., Tex.

Hemp'stead, county in S. W. of Arkansas. Area, 790 square miles. It is a fertile rolling country, with fine timber. Cattle, maize, and cotton are staple products. Cap. Washington. Pop. 13,768.

Hempstead, post-v. and tp. of Queens co., N. Y., 21 miles E. of New York City, on the Long Island Central, the South Side, and the Long Island R. Rs. It has 4 churches, 2 fine public halls, 6 hotels, 30 business-houses, 1 flour-mill, 1 patent-leather factory, numerous mechanical shops, and many fine residences. It has 2 weekly newspapers. The township contains a large number of villages. Pop. of v. 2316; of tp. 13,999.

Henry M. Onderdonk, Prop. "Inquirer."

Hempstead, post-v., cap. of Waller co., Tex., 100 miles N. of Galveston, on the Texas Central R. R. at the junction of the Austin branch. It has 4 schools, 5 churches, 1 bank, 1 cotton-factory, 1 cotton-seed oil-mill, and 1 newspaper. The surrounding country is high, fertile, and healthy. Cotton and corn are the chief products. Pop. about 2500.

Riddell & Hieronymus, Eds. and Props. "Messenger."

Hems. See Homs.

Hem'sterhuys (Francis), son of the philologist, b. at Groningen in 1722, and d. at The Hague in 1790. He held a subordinate diplomatic position, studied art, literature, and philosophy, and wrote, in the French language, letters, *Sur la sculpture*, *Sur les désirs*, *Sur l'Homme et ses rapports*, etc., which were collected in 1792 in two volumes as *Œuvres Philosophiques*. He belongs to the sentimental school of the philosophy of the eighteenth century.

Hemsterhuys (Tiberius) was b. at Groningen Jan. 9, 1685; studied mathematics, philosophy, and philology in his native city and at Leyden; was appointed professor of mathematics at Amsterdam in 1704, of Greek at Franeker in 1717, and at Leyden in 1740, and d. in the last-named city Apr. 7, 1766. His principal works are critical editions of the *Onomasticon* of Pollux (1706), Lucian (1743), and the *Plutus* of Aristophanes (1744). He possessed a more intimate knowledge of the Greek language than any of his predecessors among modern scholars, having extended his study of Greek literature also to its mathematicians and astronomers; and he was the first who employed the study of Greek art as a means of better understanding the literature.

Hen'bane, *Hyoscyamus niger*, a plant, generally biennial, though sometimes annual, natural order Solanaceæ, native in Europe, but naturalized in the U. S., growing in waste places in the northern and eastern sections of the country. The root somewhat resembles that of parsley, and poisoning has resulted from eating it by mistake. The stem is erect, round, branching, from one to four feet high; the leaves numerous, large, deeply sinuate, sea-green, and both leaves and stem viscid and hairy. The flowers are yellow, beautifully veined with purple. The whole plant has a rank, offensive smell. The leaves and seeds are used in medicine, the active principle being an exceedingly poisonous alkaloid, *hyoscyamia*, which may be obtained in colorless needle-like crystals. The action of henbane on the system is almost identical with that of belladonna, causing increased pulse-rate, dryness of the throat, giddiness, staggering gait, dilatation of the pupils, delirium, and, in sufficient dose, death. It is considered to have more tendency to produce sleep than belladonna, though this is doubtful. Its uses in medicine are in the main similar to those of the latter drug. Edward Curtis.

Hendec'agon, less correctly **Endecagon** [Gr. ἕν, "one," δέκα, "ten," and γωνία, "angle"], a plane rectilineal figure of eleven sides. The area of a regular or equilateral endecagon is very nearly equal to 9.36564 times that of the square of one of its sides.

Hen'derson, county of Illinois, separated from Iowa by the Mississippi River. Area, 390 square miles. It is very fertile, containing both prairie and timber land. Cattle, grain, and wool are staple products. Carriages and wagons are leading articles of manufacture. It is intersected by branches of the Chicago Burlington and Quincy R. R. Cap. Oquawka. Pop. 12,582.

Henderson, county of Kentucky, separated from Indiana by the Ohio River. It is hilly, productive, and abounds in coal. Cattle, corn, and tobacco are staple products. The county is traversed by the Evansville Henderson and Nashville R. R. Area, 600 square miles. Cap. Henderson. Pop. 18,457.

Henderson, county in the W. of North Carolina, bounded on the S. by South Carolina. Area, 325 square miles. It is mountainous, but fertile, and has iron, limestone, slate, and other valuable mineral resources. Corn and tobacco are staple products. Cap. Hendersonville. Pop. 7706.

Henderson, county in the W. of Tennessee. Area, 620 square miles. It is level and fertile, producing livestock, tobacco, wool, corn, and cotton. Cap. Lexington. Pop. 14,217.

Henderson, county of N. E. Central Texas. Area, 934 square miles. It is mostly undulating prairie, with some timber. The soil is generally good. Cotton and corn are staple products. Cap. Athens. Pop. 6786.

Henderson, tp. and post-v. of Knox co., Ill. P. 1742.

Henderson, post-v., cap. of Henderson co., Ky., 212 miles W. S. W. of Louisville, on the St. Louis and Southeastern R. R. It has 5 schools, 8 churches, 2 banks, 2 newspapers, 5 hotels, 1 foundry, carworks, 2 carriage and 2 wagon factories, fair-grounds, etc. Pop. 4171.

J. G. Staples, Ed. "Reporter."

Henderson, post-v. and tp., cap. of Sibley co., Minn., 60 miles S. W. of St. Paul, on the St. Paul and Sioux City R. R. It has 2 mills, 3 hotels, 2 newspapers, and the usual number of stores. Principal business, farming. Pop. of v. 706; of tp. 1291. W. R. Colton, Ed. "Times."

Henderson, tp. of Jefferson co., N. Y., on Lake Ontario, from which Henderson Bay enters the town. It has

5 churches, and a lighthouse at Stony Point. The post-village of Henderson is on Stony Creek. Pop. of v. 339; of tp. 1926.

Henderson, post-v. and tp. of Granville co., N. C., 43 miles N. of Raleigh, on the Raleigh and Gaston R. R. It has 2 academies, 5 churches, 1 newspaper, 2 tobacco-factories, 2 warehouses for the sale of leaf tobacco, 2 hotels, and 16 stores. Pop. of v. 545; of tp. 3033.
S. J. Skinner, Ed. "Register."

Henderson, tp. of Huntingdon co., Pa. Pop. 661.

Henderson, tp. of Jefferson co., Pa. Pop. 884.

Henderson, post-v., cap. of Rusk co., Tex., 14 miles from Overton. It has 6 church buildings, an Odd Fellows hall and Masonic hall, with active lodges, a temperance council, a flourishing Sabbath-school, 25 or 30 business-houses, a weekly newspaper, a wagon and buggy manufactory, a hotel, a fine school, and is the seat of Henderson College. Pop. 918. W. W. Spivy, Ed. "Times."

Henderson (James Pinckney), b. in Lincoln co., N. C., Mar. 31, 1808, from whence he removed to Mississippi and engaged in the practice of law. In 1836 he was appointed a brigadier-general in the army of the republic of Texas; on its disbandment was chosen attorney-general, and subsequently (1837–39) secretary of state of Texas; minister from Texas to England to procure the recognition of the republic, and in 1844 to the U. S. to secure its annexation, which being accomplished he was chosen its first governor in the Union (1846–47). In the war with Mexico he commanded a division of Texan volunteers, with the rank of major-general, and for gallant conduct at Monterey was presented by Congress with a sword, accompanied by the thanks of that body. In 1857 he was elected U. S. Senator from Texas. D. at Washington, D. C., June 4, 1858. G. C. Simmons.

Hen'dersonville, post-v., county-seat of Henderson co., N. C., 255 miles W. by S. of Raleigh. Pop. 278; of tp. 1636.

Hen'dricken (Thomas Francis), D. D., b. at Kilkenny, Ireland, May 5, 1827, of partial Dutch descent; graduated at St. Kieran's College, Kilkenny, 1847; studied at Maynooth; was ordained at Dublin for the American mission 1853; occupied important Roman Catholic parishes at Providence, R. I., at Winsted and at Waterbury, Conn., where he remained seventeen years, built a costly church, and founded a flourishing academy for ladies; took an active interest in public and other schools; was theologian for the bishop of Hartford at the Plenary Council of Baltimore 1866; received the degree of D. D. from the pope 1868; was consecrated bishop of Providence Apr. 28, 1872, the first of that title; has founded numerous churches and schools, and published sermons, addresses, magazine articles, etc.

Hen'dricks, county of W. Central Indiana. Area, 400 square miles. It is level and fertile. Cattle, grain, and wool are staple products. Carriages, lumber, flour, bricks, harnesses, etc. are leading articles of manufacture. It is traversed by the Terre Haute and Indianapolis R. R. Cap. Danville. Pop. 20,277.

Hendricks, tp. of Shelby co., Ind. Pop. 1704.

Hendricks, tp. of Otoe co., Neb. Pop. 440.

Hendricks (Thomas Andrews), b. in Muskingum co., O., Sept. 7, 1819; removed with his father in 1822 to Shelby co., Ind.; graduated in 1841 at South Hanover College; was admitted to the bar in 1843. In 1850 he was an active member of the State constitutional convention; member of Congress 1851–55 from the Indianapolis district; commissioner of the general land-office of the U. S. 1855–59; U. S. Senator (Democratic) 1863–69. He was chosen governor in 1872 for the term of four years, and was nominated V.-P. of the U. S. by the Democratic party June 29, 1876.

Hendricks (William), b. in Westmoreland co., Pa., in 1783; settled in Madison, Ind., in 1814; held many important offices, and was a member of Congress from Indiana 1816–22, governor 1822–25, U. S. Senator 1825–37. D. May 16, 1850.

Hen'gist, a prince of the Jutes, who in 446, with Horsa his brother, landed with 300 followers at Ebbsfleet on the Isle of Thanet, and was employed by Vortigern, king of Britain, to repel the Picts and Scots. This the Jutes accomplished by aid of fresh reinforcements from the Continent, but soon turned their arms against the Britons, whom they overcame in a series of bloody wars. Horsa was slain at Eglesthrep 455; Hengist declared himself king of Kent 457, and repeatedly defeated the Britons in battle (465–473). D. 488. The very existence of Hengist and Horsa has been sharply questioned by modern critics, but Freeman believes that, after rejecting the obviously mythical parts of this story, a considerable portion of truth remains.

Heng'stenberg (Ernst Wilhelm), b. Oct. 20, 1802, at Fröndenberg, Westphalia, and studied (1819) at Bonn Oriental languages and theology. In 1826 he was appointed professor of theology at the University of Berlin. In 1827 he founded the *Evangelische Kirchenzeitung,* which soon became one of the most prominent religious periodicals in Germany; and after some years' labor as professor, journalist, and author he stood as the acknowledged head of the old Lutheran orthodox party. During the reign of the late king of Prussia he had great influence at court, and consequently great power at the university. But the exclusiveness of his theoretical views made him intolerant in practical life, and he raised a bitter opposition against himself. D. May 28, 1869. His best services were directed to the defence of the Old Testament against destructive criticism. His principal works are *Christologie des Alten Testaments* (3 vols., 1829–35; translated by Meyers, 1854); *Einleitung ins Alte Testament* (3 vols., 1831–39); *Commentar über die Psalmen* (4 vols., 1842–45); *Das Hohelied Salomons* (1853); *Das Evangelium des Johannes* (2 vols., 1861–62); *Die Offenbarung Johannis* (2 vols., 1849); and *History of the Kingdom of God in the Old Test.,* published after his death, and translated for Clark's *Foreign Theological Library.*

Henk'le (Rev. Moses Montgomery), D. D., b. in Virginia about 1799. He entered the itinerant ministry of the Methodist Episcopal Church at an early period in Ohio, and filled important stations in Ohio, Pennsylvania, Kentucky, Tennessee, and Alabama. He was for some time associated with Dr. McFerrin in editing the *Christian Advocate* at Nashville; he also edited the *Lady's Companion.* He wrote largely for the periodical press. He published several books, among which are the *Life of Bascom, Analysis of the Principles of Church Government, Platform of Methodism,* etc. He was connected with several literary institutions as professor or president. He was teaching in Baltimore during the war, and was sent within the Southern lines, and d. in Richmond, Va., 1864. T. O. Summers.

Hen'le (Friedrich Gustav Jakob), M. D., b. at Fürth, Bavaria, July 9, 1809; graduated M. D. at Bonn 1832; became an assistant in the anatomical museum at Berlin, and in 1834 prosector in the university, but was imprisoned for connection with the *Burschenschaft;* became in 1837 a private tutor of histology and pathological anatomy; was 1840–44 professor of anatomy at Zürich; held a similar professorship at Heidelberg 1844–52, and in the latter year took the chair of anatomy at Göttingen; has done much for microscopic anatomy, pathology, physiology, anthropology, etc., and has a world-wide fame in these departments of science. Among his works are *Ueber Schleim und Eiterbildung* (1838), *Vergleichende Anatomie des Kehlkopfes* (1839), *Pathologische Untersuchungen* (1840), *Handbuch der allgemeinen Anatomie* (1841), *Handbuch der rationellen Pathologie, Handbuch der Systematischen Anatomie* (3 vols., 1855–68).

Hen'ley (John), known as **Orator Henley,** b. at Melton-Mowbray, Eng., Aug. 3, 1692; was educated at St. John's College, Cambridge, where he wrote two numbers of the *Spectator* (396, 518); took orders in the Church; received appointments in London and elsewhere; became incumbent of Chelmondiston 1723, but soon gave up that living in consequence of reports affecting his character; opened the Oratory in London 1726, where he declaimed twice a week upon religion, fashion, and other subjects, and where he attempted to found a sect of Henleyarians and to establish a system of popular education. In 1746 he was arrested for treasonable speeches by order of Lord Chesterfield. D. Oct. 4, 1756. Among his somewhat numerous works are the *Complete Linguist, or a Universal Grammar; Oratory Transactions* (1728 seq.); *Esther, a Poem; History of Sweden,* and *Primitive Liturgy,* for the service in his Oratory, etc.; and for a time he edited the *Hyp-Doctor,* a stupid weekly comic paper, subsidized by Walpole.

Hen'na, or **Al'kan'na** [Arab.], a paste made from the leaves of *Lawsonia inermis* or of *L. spinosa,* mixed with catechu, and used in the East to stain the nails, the finger-tips, and the edges of the eyelids of women and the beards of men. It primarily gives an orange color, which, if desired, may be changed to black by adding other stains. Some species of *Hibiscus* are in Eastern Asia put to the same use. The Lawsonias are shrubs of the order Lythraceæ. Their leaves are used in Europe for dyeing leather.

Hen'nepin, county in the E. of Minnesota, bounded on the E. by the Mississippi River. Area, 600 square miles. It has a varied surface, partly covered with forests, and a good soil. Grain is a leading product. Lumber, furniture, flour, carriages, clothing, etc. are manufactured. The county is traversed by the St. Paul and Pacific R. R. Cap. Minneapolis. Pop. 31,566.

Hennepin, post-v. and tp., cap. of Putnam co., Ill., 48 miles N. of Peoria and 114 S. W. of Chicago, on the E. bank of the Illinois River, 4 miles from the Chicago Rock Island and Pacific R. R. It is connected with Chicago by the Illinois River and the Illinois and Michigan Canal. It has a fine courthouse, 2 churches, a public-school building, 3 dry-goods houses, 3 groceries, 3 drug stores, 1 newspaper, 2 hotels, a flouring-mill, and a planing-mill. Pop. of tp. 2144. I. H. Cook, Ed. "Record."

Hennepin (Louis), a Reformed Franciscan missionary and explorer, b. about 1640 at Ath, in Flanders. In 1675 he became a missionary to Canada. He was (1679–80) a member of La Salle's memorable band of explorers, who traversed the great lakes and the Upper Mississippi and its tributaries. He returned to Europe in 1697. He published *Description de la Louisiane* (1683), a valuable work, though full of exaggerations, and *Nouvelle découverte d'un très grand pays* (1697), which contains his previous work, enlarged by a narrative of a pretended voyage down the Mississippi to its mouth. In later life Hennepin abandoned the habit and the obedient life of his order, though still claiming the title of Recollet missionary. D. at Utrecht about 1706.

Hen'niker, post-tp. of Merrimack co., N. H., 15 miles S. W. of Concord, on the Contoocook River R. R. It has manufactures of lumber, furniture, paper, wooden wares, cooperage, etc. Pop. 1288.

Hénon (Jacques Louis), b. in 1802; author of two memoirs on botany and diseases of the horse, but better known as mayor of Lyons, France, after the revolution of Sept. 4, 1870, and as a prominent member of the Left in the Corps Législatif under the empire, and of the present national assembly. Hénon is not a political leader, and his best speeches were especially devoted to supporting the interests of Lyons, where his popularity has notwithstanding been overshadowed lately by that of more radical politicians. Félix Aucaigne.

Henri'co, county in the E. of Virginia, bounded on S. W. by the James River. Area, 280 square miles. The soil is generally light, but easily tilled. Triassic coal of good quality is mined. Tobacco and grain are staple products. Tobacco, furniture, clothing, metallic wares, cigars, saddlery, carriages, etc. are among the articles manufactured, chiefly at Richmond, the capital of the county and State. The water-power and the commerce of the county are extensive. It is traversed by the railroads which centre at Richmond. Pop. 66,179.

Henriet'ta, post-tp. of Jackson co., Mich. Pop. 976.

Henrietta, post-tp. of Monroe co., N. Y., traversed by the Rochester branch of the Erie R. R. It has 3 churches, an academy, and some manufactures. Pop. 2280.

Henrietta, post-tp. of Lorain co., O. Pop. 927.

Henrietta, post-tp. of Richland co., Wis. Pop. 754.

Henriville, post-v. of Iberville co., Quebec, Canada, 40 miles S. E. of Montreal, has a convent of nuns of the Presentation. Pop. of sub-district, 1918.

Hen'ry, the south-easternmost county of Alabama, having Georgia on the E. and Florida on the S. Area, 930 square miles. The navigable Chattahoochee is on the E. border. This county is in the great pine-region, but produces good crops of corn and cotton. Cattle are bred extensively. Cap. Abbeville. Pop. 14,191.

Henry, county of N. W. Central Georgia. Area, 400 square miles. The surface is in part heavily timbered. Iron and gold are found. Cotton and corn are leading products. The Macon and Western R. R. traverses the S. W. part. Cap. McDonough. Pop. 10,102.

Henry, county in the N. W. of Illinois. Area, 830 square miles. It is very fertile, partly prairie and partly timber-land. Cattle, grain, and wool are staple products. Carriages, harnesses, etc. are manufactured. Coal is abundant. The county is traversed by the Chicago Rock Island and Pacific, the Chicago Burlington and Quincy, and other railroads. Cap. Cambridge. Pop. 35,506.

Henry, county of E. Central Indiana. Area, 360 square miles. It is generally undulating and fertile. Cattle, grain, and wool are staple products. Carriages, lumber, harnesses, and flour are leading articles of manufacture. It is traversed by the Pittsburg Cincinnati and St. Louis and the Fort Wayne Muncie and Cincinnati R. Rs. Cap. New Castle. Pop. 22,986.

Henry, county in the S. E. of Iowa. Area, 432 square miles. It is a fertile prairie region, with considerable timber and limestone, with perhaps coal. Cattle, grain, and wool are staple products. Carriages and wagons are leading manufactured articles. It is traversed by the Burlington and Missouri River R. R. Cap. Mount Pleasant. Pop. 21,463.

Henry, county in the N. of Kentucky. Area, 220 square miles. The navigable Kentucky River flows along the E. border. The soil is calcareous and very fertile. The county is well timbered and undulating. Tobacco, corn, and live-stock are leading products. The Louisville and Cincinnati and the Louisville and Lexington R. Rs. traverse the county. Cap. Newcastle. Pop. 11,066.

Henry, county of the W. of Missouri. Area, 775 square miles. It is fertile, consisting of prairie and woodland. Coal is mined; cattle, grain, and wool are the other staple products. The county is traversed by the Missouri Kansas and Texas R. R. Cap. Clinton. Pop. 17,401.

Henry, county in the N. W. of Ohio. Area, 393 square miles. It is level and fertile, and is traversed by the Toledo Wabash and Western and the Dayton and Michigan R. Rs., and the Maumee River and Canal. Cattle, grain, wool, and lumber are staple products. Cap. Napoleon. P. 14,028.

Henry, county of West Tennessee, bounded on the N. by Kentucky. Area, 550 square miles. The Tennessee River forms a part of its E. boundary. It is highly fertile, and produces live-stock, corn, and especially tobacco. It is traversed by the Memphis Clarkesville and Louisville R. R. Cap. Paris. Pop. 20,380.

Henry, county of Virginia, bounded on the S. by North Carolina. Area, 325 square miles. It is a hilly region. Tobacco and grain are staple products. Cap. Martinsville. Pop. 12,303.

Henry, city and tp. of Marshall co., Ill., on the Illinois River, 120 miles S. from Chicago, also on the Peoria branch of the Chicago Rock Island and Pacific R. R. A combined wood and iron bridge, costing $80,000, spans the river, with a high turnpike half a mile long at its eastern terminus. The first lock and dam to improve the Illinois River is located here. The city contains 2 grist-mills, a paper-mill costing $45,000, 3 carriage-factories, a large wagon-factory, a fire-engine company, with hose company and hooks and ladders, several fire-alarm bells, 8 churches, 1 newspaper, 2 public school buildings, a seminary in the suburbs, a national bank. Pop. of v. 2162; of tp. 2613.

George Burt, Jr., Ed. "Republican."

Henry, tp. of Fulton co., Ind. Pop. 1919.

Henry, tp. of Henry co., Ind. Pop. 2818.

Henry, tp. of Vernon co., Mo. Pop. 680.

Henry, tp. of Wood co., O. Pop. 685.

Henry, tp. of Hanover co., Va. Pop. 3347.

Henry, post-tp. of Sussex co., Va. Pop. 1220.

Henry, tp. of Clay co., W. Va. Pop. 484.

Henry I. (Beauclerc), king of England, son of William the Conqueror and Queen Matilda, and successor of William Rufus, was b. at Selby, Yorkshire, in 1068. His youth was marked by strange quarrels with his elder brothers; and when William II. died Henry hastened to assume the crown (1100) while Robert was absent in Palestine. He at once recalled Anselm, declared the validity of the Confessor's laws, and married Maud of Scotland, shrewdly securing the Church, the Anglo-Saxon English, and the Scots against Robert in the coming struggle, in which Henry was entirely successful; he was acknowledged duke of Normandy in 1106, and soon engaged in advantageous wars with France. The drowning of his son William in 1120 broke the king's heart, and the troubles with his nephew William in Normandy, and with the Welsh in the W. of England, greatly disturbed the last of his reign. D. at Rouen Dec. 1, 1135, leaving as his heir his daughter, the countess Matilda of Anjou, former wife of Henry V. of Germany.

Henry II., first Plantagenet king of England, son of Geoffrey Plantagenet and of Matilda, former empress of Germany, the heiress and only surviving child of Henry I., was b. at Mans, in Maine, Mar., 1133; was educated in Normandy and England; and in 1152 invaded England with troops for the overthrow of the king Stephen, with whom in 1153 a peace was concluded by which Henry was acknowledged as heir to the crown; succeeded Stephen in 1154, having in 1151 become count of Anjou, Touraine, and Maine by his father's death; and by his marriage in 1152 with Eleanor of Aquitaine, the divorced and dishonored queen of France, he acquired sovereignty over nearly half of France, subject in some degree to French suzerainty. The great events of Henry's eventful reign were the Irish conquest; the wars with the Scots, Welsh, and the French king; the destruction of more than 1000 feudal castles in England—"dens of thieves," Henry called them; the contest with Thomas à Becket; the subscription to the Constitutions of Clarendon (1164); and the rebellion of his sons and queen. He was, says Freeman, the great legislator of English feudalism, but was always Angevine, never English, in his feelings. D. at Chinon July 6, 1189.

Henry III. of England, b. at Winchester Oct. 1, 1207, succeeded John, his father, in 1216. His reign of 56 years was the longest except that of George III. in British history. Henry's minority at his accession, and the great power acquired by the barons under King John, crippled his power and made his reign a weak one. Simon de Montfort, earl of Leicester, is the central figure of this reign, and he was the great leader in the task of recovering for the nobles the privileges lost under Henry II. Henry III. was, notwithstanding the misfortunes of his reign, a man of fine talents, chiefly eminent as a builder; many of the finest structures in the Early English Gothic style are the work of Henry and of his brother Richard, king of the Romans. D. at Westminster Nov. 16, 1272, and was succeeded by his son, Edward I.

Henry IV. of England, first Lancastrian king, b. at Bolingbroke, Lincolnshire, Apr. 4, 1366, son of John of Gaunt, the fourth son of Edward III., while his mother was a lineal descendant of Henry III. He was made earl of Derby and duke of Hereford. With his adversary, the duke of Norfolk, he was banished in 1398 by Richard II., who seized his immense estate upon the death of John of Gaunt in 1399. Soon Henry landed at Ravenspur with a small following, the king being absent in Ireland. All England joined Henry, and Richard was dethroned and Henry crowned. Henry's defective title led him to persecute the Lollards, so as to win the support of the Church, but his reign was much disturbed by formidable rebellions. D. Mar. 19, 1413.

Henry V. of England, son and successor of Henry IV., was b. at Monmouth Aug. 9, 1388; served in his youth against the rebellious Glendower and Hotspur. The tales of his irregular life in youth are not supported by good evidence. He was very popular with the people, and his father seems to have been jealous of him. He came to the throne in 1413, persecuted the Lollards, and in 1414 announced to Parliament his intention of making the conquest of France upon the strength of Edward III.'s claim to that sovereignty; landed at Harfleur, which he took Sept. 22, 1415; totally defeated the greatly superior force of the French at Agincourt Oct. 25; occupied the greater part of France, aided by the duke of Burgundy and other malcontents; married in 1420 the French princess Catharine, and was recognized as heir-presumptive. The remainder of his reign was occupied by wars in France. D. at Vincennes Aug. 31, 1422.

Henry VI. of England, the last Lancastrian king, son of Henry V., b. at Windsor Dec. 6, 1421, succeeded his father on Sept. 1, 1422, and in 1431 was crowned king of France at Paris. His reign was marked by the wars of the Roses, maintained on the Lancastrian side more by the energy of Margaret of Anjou, the queen, than by the pious but irresolute Henry. In these wars the old nobility of England was almost exterminated, and the power of the Lancastrian house overthrown. In France, Joan of Arc and her followers had expelled the English, and the popular sense of disgrace vented itself upon the unoffending king, whose title was indeed defective. Henry founded Eton School (1440) and King's College, Cambridge (1443). Was found dead in the Tower (where he had been imprisoned) May 22, 1471.

Henry VII. of England, the first of the Tudor kings, was b. in Wales Jan. 21, 1456. He was descended, on his mother's side, from John of Gaunt (son of Edward III.) and Catharine Swynford, whose offspring had been legitimated by the pope, the king, and the Parliament. His father was a son of Owen Tudor, a Welsh gentleman, and Catharine, widow of Henry V. of England, whose marriage to Tudor has been denied. Young Henry became earl of Richmond; was attainted by the Yorkists 1461; and in 1471 retired to France; attempted a revolt in 1483; landed at Milford Haven in 1485; defeated and killed Richard III. at Bosworth; married Elizabeth, heir of the Yorkist sovereigns, 1486. His reign was much disturbed by insurrections. The king was politic, encouraged commerce and industry, and filled his treasury by means previously untried, and unquestionably illegal. D. Apr. 22, 1509.

Henry VIII. of England, son and successor of Henry VII., was b. at Greenwich June 28, 1491; became in 1502 prince of Wales on the death of his brother Arthur; married Catharine of Aragon, Arthur's widow, in 1509, a papal dispensation having permitted the unlawful union; succeeded to the crown in 1509; joined the emperor Maximilian in a war with France 1511–14, during which war the Scots were utterly overthrown at Flodden Sept. 9, 1513; made Wolsey chancellor 1515; was involved in competition with Francis I. and Charles V. for the empire of Germany; wrote in 1521 his book on the sacraments against Luther, for which he received from the pope the title of "defender of the faith," a distinction claimed, as we are told, by some ancient English kings; made war in 1522 against France in the interest of Charles V.; applied in vain in 1528 to the pope for a commission to inquire into the legality of his marriage. The king applied in 1529, by Cranmer's advice, to the universities with better success. The influence of the king and Wolsey at Rome was completely foiled by the Spanish interest in the queen's behalf, and the great seal was taken from Wolsey and given to Sir Thomas More. The convocation was now compelled to acknowledge Henry as the head of the English Church; the king married Anne Boleyn in 1533, and Cranmer, now archbishop of Canterbury, declared the former marriage null. In 1535 the papal authority was set aside by act of Parliament, More and Fisher were executed, Thomas Cromwell made vicar-general, and the visitation and destruction of monasteries commenced. Anne Boleyn was executed, and Jane Seymour married in 1536; Roman Catholic insurrections broke out in 1536, and Queen Jane d. in 1537; Anne of Cleves was married to the king in 1540, soon after which Cromwell was executed, and the marriage annulled by convocation and Parliament; Henry married Catharine Howard in the same year, and had her executed in 1542; was married in 1543 to Catharine Parr, his sixth and last wife. Many Roman Catholics, and Reformers as well, were executed during the latter part of Henry's reign, and great numbers of the nobles and aristocracy died on the scaffold on suspicion of treason. Among the darkest stains upon the conduct of the king is the murder of his best and truest friends, such as Cromwell, earl of Essex, whose only fault seems to have been a too faithful devotion to Henry's policy, and the carrying out of that policy in such a way as to seem too officious in the king's affairs. D. at Westminster Jan. 28, 1547. The two modern English political parties have been said to date from this reign, in which there was a conservative or national Catholic party, led by Bishop Gardiner and others (many of them becoming Roman Catholics again under Queen Mary), and a reforming party, led by Thomas Cromwell, Cranmer, and others scarcely less distinguished. (For the best defence of Henry's character see FROUDE'S *History;* see also PROF. JOHN SHERREN BREWER'S *Calendar of State Papers* (1862 *seq.*), and Brewer's ed. of FULLER'S *Church History.*)

Henry I., king of France, b. 1011, succeeded Robert II., his father, 1031; was a weak prince, whose reign was much disturbed by civil wars and public calamities. D. at Vitri Aug. 4, 1060, and was succeeded by Philip I., his son.

Henry II. of France, b. Mar. 31, 1519; married Cathárine de' Medici 1533; succeeded Francis I., his father, 1547. His reign was distinguished by bloody persecutions of the Protestants, and by wars with Charles V. and his son, Philip II. of Spain. These wars were advantageous to France as military operations, but by the disastrous peace of Cateau-Cambresis (1559) Henry gave up the greater part of his advantages. D. July 10, 1559, in consequence of a wound received in a tournament.

Henry III. of France, son of Henry II. and Catharine de' Medici, b. at Fontainebleau Sept. 19, 1551; served as duke of Anjou against the Huguenots 1569–73; was crowned king of Poland in 1574; abandoned Poland, and succeeded his brother, Charles IX., as king of France 1575. His reign was disturbed by the wars of the League, designed to prevent the succession of Henry IV., and is further memorable for the assassination of the Guises 1588, and for the king's unbounded licentiousness. Henry was stabbed with a knife by Jacques Clément, a partisan of the Guises, and d. Aug. 2, 1589. He was the last of the Valois line, and was succeeded by Henry IV., the first Bourbon king.

Henry IV., king of France and Anjou, the first Bourbon monarch of France, succeeded Henry III. in 1589, being a lineal descendant of Louis IX. Henry was b. at Pau Dec. 14, 1553, the son of Antoine de Bourbon and Jeanne d'Albret, queen of Navarre; he was bred a Protestant by his mother, and trained to all hardy exercises. In 1569 he joined the Protestant army under Coligny. In 1572, after the peace of St. Germain, and just before the massacre of St. Bartholomew, he married Margaret of Valois, sister of Charles IX., and was compelled to abjure his faith. Henry, who had just succeeded to the crown of Navarre, was detained at court until 1576, when he escaped and put himself at the head of the Protestants, and by his valor and skill greatly bettered the Protestant fortunes in the wars which followed. In 1584, Francis of Anjou d., and Henry became heir-presumptive to the crown. In 1585 he was excommunicated by Sixtus V., and declared incapable of the succession. Then followed the "war of the three Henries" (1586–87), the murder of Henry III. (1589), the claim of the cardinal of Bourbon to the throne, the battle of Ivry, the siege of Paris, the Spanish invasion under Parma, and a long and varied war, in which Henry, with small means and the ineffectual support of the English, performed prod-

igies of valor and activity. In 1593, Henry professed the Roman Catholic faith, and the fear of the ambition of Philip II. caused many of Henry's former enemies to go over to his side; he was anointed king at Chartres 1594; entered Paris, and in the course of four years had expelled the Spaniards and brought all France to subjection. In 1598 he published the Edict of Nantes and restored toleration. Prosperity followed such as France had never known before. Henry was murdered by one Ravaillac, a fanatic, May 14, 1610, and all France mourned the event as a national calamity. Brave, courtly, amiable, and talented, Henry's worst fault was licentiousness. His religious preferences must have been unimportant, and his lifelong friendliness to the Protestants was only a feeling of comradeship for his old companions-in-arms.

Henry (I.) the Fowler, king of Germany and duke of Saxony, b. in 876, succeeded his father, Otho I., as duke in 912; elected to succeed Conrad I. in 919; carried on wars with Lorraine (which he conquered 923–925), with the Hungarians, the Slavi, Danes, etc. This great monarch was one of the founders of the German supremacy in the Middle Ages, as terrible in war as he was just and wise in peace. He is reckoned as Henry I. in the line of German emperors, but never bore the imperial title, except in consequence of having been saluted *imperator* by his troops, in the old Roman fashion. D. at Mansleben July 2, 936.

Henry II., Saint, emperor of Germany, the last of the Saxon line of German monarchs, and the first Henry who properly bears the imperial title, known also as *the Lame*, was b. May 6, 972; succeeded to the duchy of Bavaria 995; was elected king of Germany, to succeed Otho III., in 1002; carried on wars in Poland, and with vassals in Germany, and with Italy and France, etc.; erected Hungary into a kingdom 1007; was crowned emperor of the Romans 1014. D. at Grone, Saxony, July 14, 1024; was canonized 1152 on account of his zeal for the Church, and is honored July 15.

Henry III. of Germany, "the Old," "the Black," or "the Pious," b. at Osterbeck, in the Low Countries, Oct. 28, 1017; was elected king in 1026, and succeeded Conrad II., his father; ruled with the greatest dignity and success, managed the affairs of Church and State alike, and made and unmade popes at his will; was crowned emperor in 1046; won applause by challenging Henry I. of France to mortal combat, and d. at Botfeld Oct. 5, 1056. His first wife was a daughter of Canute of England.

Henry IV. of Germany, b. Nov. 11, 1050, was elected king when but three years old, and succeeded Henry III., his father, in 1056. His reign was a long series of bloody contests with vassals at home and with Pope Gregory VII. in Italy, who at the period of Henry's lowest fortunes compelled him to sue at Canossa for absolution in the most humiliating manner (1077). This he received, and after many years of warfare in Germany he compelled the pope to retire under the protection of Robert Guiscard to Salerno (1084). Henry was dethroned and imprisoned by his son, Henry V., in 1105, but escaped, and d. at Liège Aug. 7, 1106.

Henry V. of Germany, b. Aug. 11, 1081, was crowned king and colleague of his father, Henry IV., in 1099; deposed his father 1105; was crowned emperor 1111. His reign was much disturbed by discussions with the popes regarding investitures, and he was four times excommunicated. Wars at home and with Flanders, Hungary, and Poland vexed Germany during his reign. He married Matilda, daughter of Henry I. of England. D. at Utrecht May 23, 1125. He was the last of the Salic line.

Henry VI. of Germany, the Cruel, b. in 1165, succeeded Frederick Barbarossa, his father, in 1190. His reign was much disturbed by Italian wars, and is famous for the imprisonment of Richard Lion-heart at Trifels (1192–94). D. at Messina Sept. 28, 1197, poisoned, as it was thought, by his wife.

Henry VII. of Germany (Henry of Luxemburg), b. 1262; was elected king of the Romans in 1308; invaded Italy at the head of a Ghibelline army, and had an interview with Dante; received the iron crown in 1311; was crowned emperor in 1312. D. at Buonconvento Aug. 24, 1313, poisoned, it was said, while receiving the Eucharist.

Henry (Caleb Sprague), D. D., b. at Rutland, Mass., Aug. 2, 1804; graduated at Dartmouth in 1825, studied divinity at Andover and at New Haven. After holding Congregational pastorates at Greenfield, Mass. (1828–31), and at Hartford, Conn. (1833–35), he was ordained in the Protestant Episcopal Church, and was appointed professor of mental and moral philosophy in Bristol College, Pa. In 1837 he became one of the founders of the New York *Review*. He was (1839–52) professor of philosophy and history in the University of New York; 1847–50 rector of St. Clement's, New York. He afterwards held rectorships in Poughkeepsie and Newburg, N. Y., and Litchfield, Conn. In 1874 he removed to Stamford, Conn. Among his works are an enlarged translation of Bautain's *History of Philosophy*, Cousin's *Psychology* (1834; 4th ed. 1856), *Compendium of Christian Antiquities* (1837), *Moral and Philosophical Essays* (1839), Guizot's *History of Civilization*, *About Men and Things* (1873).

Henry (Gustavus Adolphus), a distinguished orator and statesman of Tennessee, supported Harrison for the Presidency in 1840, Clay in 1844, Taylor in 1848, Scott in 1852, Fillmore in 1856, Bell in 1860. Was a member of the Senate of the Confederate States 1862–65.

Henry (Joseph), LL.D., b. Albany, N. Y., Dec. 17, 1797; educated in the common schools of that city and in the Albany Academy, where (1826) he became professor of mathematics, and (1827) commenced a course of investigation which was continued for a number of years, and resulted in certain highly important discoveries in electricity and electro-magnetism. Though previously to these investigations the electro-magnet in a certain sense was known, it was nothing more than a philosophic toy, in which a feeble magnetism was excited by currents of low intensity and short circuit. The means of developing in soft iron a high degree of magnetic energy, or of producing such an effect at a distance in any appreciable degree at all, were unknown. Prof. Henry's first success consisted in producing the electro-magnet properly so called; an exceedingly important invention which no subsequent improvement has essentially modified. He next demonstrated that the difficulty of exciting magnetic energy at a distance, which had led Barlow in 1824 to pronounce the idea of an electric telegraph to be "chimerical," may be completely overcome by the use of an intensity battery, provided that the receiving electro-magnet be constructed with many turns of a single wire. He also showed that a large iron bar may be powerfully magnetized by a quantity battery, if surrounded by many helices forming separate short circuits; but that if the wires of these helices be so united as to form a single continuous circuit, a battery of intensity is required to produce the effect. It was the invention of the intensity-magnet which first made the electric telegraph a possibility. In a communication made to the *American Journal of Science* in 1831, describing some of his experiments, Prof. Henry called attention to the practicability of applying the intensity-magnet to telegraphic uses. During the same year he produced the first mechanical contrivance ever invented for maintaining continuous motion by means of electro-magnetism; a contrivance which, though simple in form, involved the essential principle (pole-changing) of every effective electro-magnetic machine which has been since devised; and he also constructed and exhibited a similar contrivance for making signals by electro-magnetism at a distance—the signals being produced by means of a lever striking on a bell. This was operated by an intensity-current sent through more than a mile of insulated wire carried in successive turns around the walls of an apartment in the Albany Academy. He also devised a scheme for producing large mechanical effects at a distance, by causing heavy weights to fall in consequence of the rupture of electric currents. Some of the electro-magnets constructed by him at this time were of enormous power. One of these, prepared for Yale College (1831), sustained a weight exceeding a ton, and another at the College of New Jersey carried not less than 3600 pounds. In 1832 he made the discovery of the secondary currents produced in a long conductor by the induction of the primary current upon itself; and succeeded also in the same year in producing the electric spark by means of a purely magnetic induction. The spark was similarly and almost simultaneously produced by Mr. J. D. Forbes of Edinburgh (afterwards Principal Forbes), but the two results were independent of each other. These discoveries embraced the germ of the science of magneto-electricity, which received subsequently from Faraday so large a development, and of which the recent practical applications are so numerous and important.

In 1832, Prof. Henry was elected professor of natural philosophy in the College of New Jersey, and in his earliest lectures at Princeton demonstrated the feasibility of an electro-magnetic telegraph, with experimental illustrations. He visited Europe in 1837, and in London held interesting interviews with Prof. Wheatstone, the inventor of the needle magnetic telegraph, to whom his discoveries were already well known, and whom he acquainted with his plans for producing not only signals, but large mechanical effects at distances indefinitely great, by means of electro-magnetism. In 1846 he was elected secretary of the Smithsonian Institution at Washington, being the first incumbent of that office, a position which he held till his death (1878).

In 1849 he was elected president of the American Association for the Advancement of Science. In 1868 he was elected president of the National Academy of Sciences, succeeding the lamented Bache. This distinguished post he held till his death. He was made chairman, in 1871, of the lighthouse board of the U. S., an important bureau of the treasury department; and in this capacity was constantly engaged in very active and laborious duty till 1878. He received the honorary degree of doctor of laws from Union College in 1829, and from Harvard University in 1851. He published *Contributions to Electricity and Magnetism* (1839), and numerous papers in the *Am. Philos. Trans.*, the *Am. Jour. of Science*, the *Jour. of the Franklin Inst.*, the *Proceedings of the Am. Assoc. for the Adv. of Sci.*, and in the annual reports of the Smithsonian Institution from its foundation. D. May 13, 1878. F. A. P. BARNARD.

Henry (MATTHEW), son of Philip Henry, b. at Broad Oaks, Flintshire, Wales, Oct. 18, 1662; studied law and divinity; became nonconformist (Independent) pastor at Chester 1687, at Hackney, London, 1712. D. at Nantwich June 22, 1714. Chiefly remembered for his *Exposition* of the Bible (1710, often reprinted and still very highly esteemed; best ed. London, 1869). He also wrote other religious works and a *Life* of his father (1698). His own *Life* has been written by J. B. Williams and by W. Tong.

Henry (PATRICK), b. at Studley, Hanover co., Va., May 29, 1736. His father, Col. John Henry, was a magistrate and school-teacher, a native of Aberdeen, Scotland, and a nephew of the historian Robertson. Young Henry was instructed chiefly by his father, but was easily diverted from his studies by his passion for hunting and fishing. At eighteen years of age he married the daughter of an innkeeper, and for a time assisted his father-in-law at Hanover Court-house. He twice became bankrupt before the age of twenty-four, when, after six weeks' study, he was admitted to the bar. For three years he obtained no practice, when his triumphant plea for the people's rights in the celebrated "parsons' cause" won him immense applause and popularity. In 1765 he introduced into the conservative or passive house of burgesses his famous resolutions against the Stamp Act, which he carried through by a majority of one after a stormy debate, in which he exclaimed, "Cæsar had his Brutus, Charles I. his Cromwell, and George III." (here he was interrupted by cries of "Treason!") "may profit by their example. If this be treason, make the most of it." Thenceforward, Mr. Henry was the acknowledged leader of the friends of freedom in Virginia. In 1769 he was admitted to practise law in the general court, where his distinguished ability as a speaker won him a fortune, for, though poorly read in the law, and never of more than respectable legal knowledge, he possessed a marvellous power over the feelings of juries. He was the first Speaker of the General Congress at Philadelphia in 1774, where his power as an orator was fully recognized. In 1775, in the Virginia convention, was delivered his most famous speech, that in favor of his resolution for putting the colony into a state of defence. In 1775 he was for a time a colonel of militia, and from 1776 to 1779 was governor of the State, and again 1781–86. In 1788 he opposed the ratification of the Federal Constitution as inconsistent with the sovereignty of the States. In 1794 he left public life, and afterward declined the secretaryship of state, the mission to France, and the governorship. Elected to State senate in Mar., 1799, but did not take his seat. D. at Red Hill, Charlotte co., Va., June 6, 1799. He printed and circulated at his own expense an edition of Butler's *Analogy* and Jenyns's *View of Christianity*. CHARLES W. GREENE.

Henry (PHILIP), b. Aug. 24, 1631, at Whitehall Palace, where his father was a page; was educated at Westminster and Christ Church, Oxford; was Presbyterian minister of Worthenbury, Flintshire, 1657–62. D. June 24, 1696. His published sermons and miscellaneous writings have found many warm admirers.

Henry (ROBERT), D. D., b. at Muirtown, Stirlingshire, Scotland, Feb. 18, 1718; was educated at Edinburgh; became Presbyterian minister of Carlisle 1748, of Berwick 1760, of New Grey Friars, Edinburgh, 1768, of Old Grey Friars 1776. D. Nov. 24, 1790. Chiefly remembered for his unfinished *History of Great Britain* (6 vols., 1771–93).

Henry (ROBERT), D. D., LL.D., b. at Charleston, S. C., Dec. 6, 1792; graduated at the University of Edinburgh 1814; became minister to the French Protestant church of Charleston; professor of logic and moral philosophy 1818, and later of metaphysics and political philosophy in South Carolina College; its president 1834–35 and 1840–45; besides holding other professorships there. D. at Columbia, S. C., Feb. 6, 1856. His abilities were of the first order.

Henry (WILLIAM), M. D., F. R. S., b. at Manchester, Eng., Dec. 12, 1775; took his medical degree at Edinburgh 1807; published *Elements of Chemistry* (1810), for many years a standard work; made important observations on the laws of the absorption of gases by water under pressure; won the Copley prize of the Royal Society 1809; committed suicide Sept. 2, 1836.

Henry (WILLIAM ALEXANDER), Q. C., a Canadian statesman, b. at Halifax, N. S., Dec. 30, 1816; was admitted a barrister in 1841 and queen's counsel in 1849. He has been for many years prominent in the affairs of Nova Scotia; was solicitor-general 1854, 1859, and 1863; provincial secretary 1856–57; and has been surrogate, mayor of Halifax, etc. He took a prominent part in the question of the union of the provinces in 1867.

Henry the Navigator (b. at Oporto Mar. 4, 1394; d. at Sagres Nov. 13, 1460), the fourth son of King John I. of Portugal, distinguished himself highly at the conquest of Ceuta in 1415, and was in 1420 placed at the head of African affairs. He now fixed his residence at Sagres in Algarve, near Cape St. Vincent, and here he established a school of navigation in which a number of young Portuguese noblemen were educated. From this school issued that movement of maritime discovery and commercial enterprise which placed the Portuguese people at the head of European civilization for more than half a century, and whose two greatest results were the discovery of America and the discovery of the water-route to India. The introduction of the compass and the astrolabe are due to him.

Henry Clay, tp. of Fayette co., Pa. Pop. 951.

Hen'ry's, tp. of Pickens co., Ala. Pop. 589.

Hen'shaw (DAVID), b. at Leicester, Mass., Apr. 2, 1791, where he was educated; apprenticed to a firm of druggists in Boston, during which period he devoted his spare hours to the improvement of his mind; entered business with his brothers in 1814; elected to the State senate 1826; member of the board of internal improvements 1828, and during its continuance; active promoter of railroad enterprises, and director of Worcester R. R. from its organization till his death; collector of the port of Boston 1830–38; member of the legislature 1839; in 1843 appointed secretary of the navy by Pres. Tyler. In politics he was an ardent Democrat and advocate of free trade. Author of numerous political papers and pamphlets. D. Nov. 11, 1852.

Hen'shaw (JOHN PRENTISS KEWLEY), D. D., b. at Middletown, Conn., June 13, 1792; graduated at Middlebury College in 1808; was ordained deacon in the Protestant Episcopal Church 1813, a priest in 1816; officiated for a time in St. Ann's, Brooklyn, N. Y., and was (1817–43) rector of St. Peter's, Baltimore. In 1843 he was consecrated bishop of Rhode Island. D. at Frederick, Md., July 20, 1852. He published *Theology for the People* (1840), *Memoir of Bishop Moore* (1842), *On the Second Advent* (1842), and several other works.

Hens'ley, tp. of Champaign co., Ill. Pop. 804.

Hensley, tp. of Johnson co., Ind. Pop. 1668.

Hen'son Spring, post-v. and tp. of Sanford co., Ala. Pop. 334.

Hentz (CAROLINE LEE), a daughter of Gen. John Whiting, was b. at Lancaster, Mass., in 1800. In 1825 she married N. M. Hentz, a French gentleman who taught the languages and belles-lettres (d. 1856), and with him she resided successively at Northampton, Mass., Chapel Hill, N. C., Covington, Ky., Cincinnati, O., Florence, Ala., Tuscaloosa, Ala., Tuskegee, Ala., Columbus, Ga., and Marianna, Fla., where she d. Feb. 11, 1856. She wrote a novel, poem, and play before she was thirteen years old, and afterwards the prize play *De Lara*, *Lamorah*, a tragedy, *Constance of Werdenberg*, the tales *Linda* (1850), *Rena* (1851), *Eoline* (1852), *Helen and Arthur* (1853), *The Planter's Northern Bride* (1854), *Ernest Linwood* (1855), and numerous other novels and some poetry. Her writings enjoyed a great popularity.

He'par Sul'phuris [Lat., "liver of sulphur," so called from its color], a crude mixture of the bisulphide and trisulphide of potassium with the sulphate of potash. It is employed to some extent as a remedy for some diseases.

Hepat'icæ, or **Liv'erworts** (*Musci hepatici*, or "liver-mosses"), a natural order of little moss-like plants, mostly of a loose cellular structure throughout, usually procumbent, and emitting rootlets from beneath, propagated by spores, and also frequently by gemmæ, rarely by tubers. Vegetation sometimes frondose—*i. e.* the plants without distinct stem and leaves, but expanded into a leaf-like mass (*frond*), which is usually furnished with a midrib, with scales, or (rarely) with slender hairs underneath, and

often with pores above; sometimes foliaceous, when there is a distinct stem and leaves, as in *Musci*, the leaves entire or lobed (most commonly 2-lobed), or often laciniated, never costate, and never composed of more than one thickness of (flattish) cells, 2 ranked, and often with an imperfect row (*amphigastria*), on the under side of the stem, which is often much branched, but the branches do not proceed from axillary buds, as in mosses; if one of the lobes of the leaf is inflated, it is termed an *auricle*. Rootlets consisting of a simple, much-elongated, flattish cell; excepting in the Jungermanniaceæ this cell is usually granulose or papillose on the inner surface of its wall; it is merely a modified cell of the frond, stem, or leaf from which it proceeds. Inflorescence monœcious or diœcious. Reproductive organs and evolution of the fruit much as in mosses, but the calyptra usually closely invests the capsule until this is nearly or quite mature, when it commonly ruptures irregularly near the apex, and is left at the base of the fruit. The capsule, usually globose or ovate, is immersed in or sessile upon the frond, or attached to the under side of disk-like peduncled receptacles, or borne on a long cellular pedicel; it is 4-valved (rarely either more or less) in the Jungermanniaceæ, dehisces more or less irregularly by 2 to 8 valves, or by an operculum in the Marchantiaceæ (rarely indehiscent in both); it is long and pod-like, usually tapering into a pedicel, 2-valved, often with stomata in its outer wall, and bears the calyptra (which ruptures early near the base) upward on its apex in the Anthocerotaceæ; it contains spores mixed with elaters (*elateres*), (rarely wanting); these are thin, usually threadlike, simple cells, containing 1 to 4 spiral (rarely annular) fibres: a columella is rarely present. The *perianth* is a tubular organ (sometimes absent), enclosing the pistillidia, and is usually (if not always) formed after their fertilization. Surrounding the perianth is the *involucre* (occasionally wanting), which is either tubular or composed of leaves of particular forms (*involucral leaves*). The antheridia in the foliaceous species are usually situated in the axils of perigonial (occasionally of the involucral) leaves; in the frondose species they are naked upon the surface of the frond, or immersed in its substance, or in sessile or peduncled receptacles, which are disk-like in the Marchantiaceæ. In the Marchantiaceæ the central portion of the midrib and peduncle is composed of a kind of vascular tissue, consisting of remarkably long and slender cells, marked within by annular or short spiral fibres, or oftenest by papilla-like points (rudimentary or imperfect rings or spirals). A peculiar kind of vascular tissue also occurs in at least one species of the Jungermanniaceæ (*Pellia epiphylla*), in a series of parallel vertical and transverse networks of anastomosing fibres. COE F. AUSTIN.

Fimbriaria tenella: 1, plants; 2, a fertile receptacle; 3, vertical section through two involucres, showing perianths and capsule; 4, capsule dehiscing; 5, 5, spores; 6, 6, elaters.

Hepati'tis [Gr. ἧπαρ, the "liver"], an inflammation of the liver. Hepatitis is not a very common disease in any country. Several kinds are recognized: (1) Suppurative hepatitis, or abscess of the liver, sometimes occurring in India, but rare in other countries. (2) Interstitial hepatitis, called, rather incorrectly, cirrhosis, known also as granular liver and gin-drinker's liver. It is incurable, and is probably always caused by the improper use of alcoholic drinks. It frequently leads to ascites or abdominal dropsy. (3) Portal phlebitis, or inflammation of the portal vein, may occur. (4) Inflammatory disease of the liver is sometimes a syphilitic complication. Each of the above-named conditions is a grave one, and in few cases can treatment be of much avail.

Hep'burn, tp. of Lycoming co., Pa. Pop. 971.

Hephæs'tion, the friend of Alexander the Great, b. at Pella about 357 B. C. At what time he and the prince became companions is not known; they are first mentioned together on the occasion of Alexander's visit to Troy, where Hephæstion brought the same honors to the grave of Patroclus as Alexander to that of Achilles. But after that time they never separated until the death of Hephæstion in Ecbatana in 325, one year before that of Alexander. The beauty of their friendship was not only its intimacy, but its soundness. Alexander never preferred Hephæstion to a better man, and Hephæstion never disappointed the confidence Alexander placed in him.

Hephæstion [Ἡφαιστίων], a Greek grammarian of Alexandria, according to Suidas, flourished about A. D. 150, as Julius Capitolinus speaks of him among the tutors of the emperor Verus. To him is ascribed the Ἐγχειρίδιον περὶ μέτρων ("Manual of Metres"), from which most of our knowledge of the Greek metres is obtained. Suidas assigns to him other works not now extant. Best edition of the *Manual* is by Gaisford (Oxford, 1810, 8vo; Leipsic, 1832; revised, Oxford, 1856, 2 vols.). H. DRISLER.

Hephæstus. See VULCAN.

Hep'penheim, an old, queer-looking town of Hesse-Darmstadt, with about 5000 inhabitants, is noted for the excellent wine produced in its neighborhood, and for the interesting ruins of the castle of Starkenburg.

Heptan'omis ("the seven nomes") was the name of the central part of Egypt, from the Delta to Upper Egypt—that is, from lat. 30° to lat. 27° N. It contained all the greatest Egyptian cities and monuments, and its inhabitants were less mixed up with Greeks and Nubians than those of the two other parts.

Hep'tarchy [Gr. ἑπτά, "seven," and ἀρχή, "sovereignty"], a government by seven, especially applied to the seven principalities of the Anglo-Saxons in England before the reign of Egbert, the first king of England, who became king of Wessex 800, and d. 836. Eight kings, of six different kingdoms (all except Essex and Mercia), had at times possessed a certain supremacy over the rest. The actual number of kingdoms was sometimes greater and sometimes less than seven, and yet seven stand out so prominently as to justify the use of the term heptarchy. The seven kingdoms were 1st, Kent (449–823); 2d, Sussex (477–823); 3d, Wessex (519–823); 4th, Essex (526–823); 5th, Northumbria (547–827); 6th, East Anglia (571–823); 7th, Mercia (584–827). In 828, Egbert of Wessex, the eighth bretwalda, became the first hereditary king of England; but some of the minor kingdoms existed for many years thereafter.

Hep'worth (GEORGE HUGHES), b. in Boston, Mass., Feb. 4, 1833; studied divinity at Cambridge, Mass.; was pastor of a Unitarian church at Nantucket 1855–57; of the Church of the Unity, Boston, 1858–70; became in 1862 a regimental chaplain in Louisiana, and served in 1863 on the staff of Gen. Banks. He was (1870–72) pastor of the Church of the Messiah, New York. In 1872 he became a Trinitarian, and soon organized the "Church of the Disciples," of which he was pastor till Feb. 14, 1879. Author of *Whip, Hoe, and Sword* (1864) and *Rocks and Shoals* (1870).

Hera. See JUNO.

Heraclei'a, a Greek city of Lucania, in Southern Italy, near a place now called Policoro, and not far from the Tarentine Gulf. It was founded 432 B. C., and attained great wealth and power, and became a kind of capital for the Italiote Greeks. It had peculiar privileges under the Romans. Its site is marked by extensive mounds, and among the relics found here in 1732 were the bronze tablets containing the *Lex Julia municipalis* (45 B. C.), so highly important to the student of Roman jurisprudence. Many other ancient towns bore this name, among which was one on the S. coast of Sicily, which was long a place of great naval and commercial importance.

Heraclei'dæ [Gr. Ἡρακλεῖδαι], the descendants of Heracles (Hercules), to whom many prominent Greek families traced their origin. But the name especially belongs to those Heracleidæ who joined the Dorians in their invasion and conquest of the Peloponnesus, which is often called the "return of the Heracleidæ," because they were considered as Achæans by race. The Greek historians narrate with considerable detail the exploits and successes of the Heracleidæ in the early Dorian wars, and it is considered that much of the story must be regarded as possessing historic truth. The Heracleidæ became the progenitors of several princely houses, and were even admitted to rule over Dorians.

Heracli'des [Ἡρακλείδης] **Pon'ticus** (so called from his native place, Heraclea, on the *Pontus* Euxinus), b. probably B. C. 378. He appears to have gone at an early age to Athens, where he attached himself to Plato, about 361 or 358; he attended the lectures of Aristotle also, and must have studied the Pythagorean philosophy, which he followed in his writings on natural philosophy. He was a man of great learning, and wrote on a great variety of subjects—philosophy, natural science, mathematics, music, grammar, history, and poetry—so that he was fairly entitled to the designation of *polyhistor*. Of all his writings only fragments remain, with the exception of a small treatise entitled (Ἐκ τῶν περὶ πολιτειῶν ("Extracts from Forms of Government"), which is believed to be merely a compilation from different writings of the author, possibly also from Aristotle's treatise on the subject. Another work, called Ἀλληγορίαι Ὁμηρικαί ("Allegories from Homer"),

passes under the name of Heraclides, but does not belong to its author. The best editions of the Περὶ πολιτειῶν are that of Köler (Halle, 1804), that of Coraes (Paris, 1805), of Schneidewin (Göttingen, 1847), and in Müller's *Fragm. Hist. Græc.* (vol. ii. pp. 197–224); of the Ἀλληγορίαι, that of Schow (Göttingen, 1782) and of Mehler (Leyden, 1851). (See ROULEZ, *Comment. de vita et scriptis Heraclidis* (Louvain, 1828); *Proleg.* to Schneidewin's and Müller's editions.) H. DRISLER.

Heracli'tus, surnamed THE DARK (σκοτεινός), was b. at Ephesus, according to some authorities, about 535 B.C., according to others, about 500. The son of Blyson (or Heracion), he belonged to the noble family of the Codrids. Unlike most of the philosophers of his time, he took no part in public affairs. He is said to have refused the proffered sovereignty of Ephesus, as well as an invitation to the court of Darius. The stories related about him—how, disgusted at the expulsion from Ephesus of his friend Hermodoras (perhaps the same who aided the Roman decemvirs in the drawing up of the Twelve Tables (see CURTIUS, *Ephesos*, pp. 16 seq.), he retired to the mountains and lived the contemplative life of a hermit, feeding upon roots and herbs; how, becoming, in consequence, affected with dropsy, he returned to the city in search of medical aid; how, failing in this, he tried to exsiccate his dropsy by imbedding himself in cow dung; and how the experiment terminated in his death—are to a very great extent legendary. They serve, however, to give us a general notion of his character. His contempt for the unthinking rabble, as well as for the social and political condition of Ephesus, was extreme. Though he was evidently acquainted with the works of Hesiod, Pythagoras, Xenophanes, and Hecatæus (see *Diog. Laert.* ix. 1, 1), he was apparently justified in asserting that he had learnt everything from himself. Dignified, self-sufficient, lofty, profound, devoted to truth and right, impatient of falsehood and wrong, contemptuous of ignorance and unreason, he looks to us now as a great, lonely, snow-clad mountain-peak, half hidden from us in the clouds of heaven and spurning the earth upon which it stands. The profoundest of the pre-Socratic philosophers, he had numerous disciples for many succeeding ages. He is known to have written only one work, which, like most other philosophical works of the time, was entitled *On Nature.* It went under several other names, and was divided into three parts: I. *On the All;* II. Political; III. Theological. The much talked-of obscurity of his writing, usually considered as intentional on his part, or as owing to fear of persecution for impiety, was probably due rather to the fact that he wrote only for the few, and that prose-writing and philosophical terminology were in his day very undeveloped. Socrates, who admired Heraclitus, thought it would require a Delian diver to explore his depths, and Aristotle tells us that his writing was hard to punctuate (διαστίξαι). Of the work of Heraclitus, which was apparently extant in the third century A. D., numerous fragments have come down to us scattered through the works of various authors. The best collections of them are in MULLACH'S *Fragmenta Philosophorum Græcorum*, vol. i. pp. 310–329, and in SCHUSTER'S *Heraklit von Ephesus*, vol. iii. of RITSCHL'S *Acta Societatis Philologæ Lipsiensis.* The latter is the best work on Heraclitus, and contains on pp. 351–358 an excellent Heraclitean bibliography. Besides these, the following works are valuable: SCHLEIERMACHER, *Herakleitos der dunkle von Ephesos* (1808); HEGEL, *Geschichte der Philosophie* (1833), vol. i. pp. 327–351; J. BERNAYS, *Heraclitea* (1848); F. LASSALLE, *Die Philosophie Herakleitos des dunkeln von Ephesos* (1858), 2 vols. 8vo, written from an extreme Hegelian standpoint, and with a very imperfect knowledge of Greek); A. GLADISCH, *Herakleitos und Zoroaster* (1859); BERNAYS, *Die Herakleitischen Briefe* (1869); E. ZELLER, *Philosophie der Griechen*, 3d ed., vol. i. pp. 523–603.

Philosophy.—The philosophy of Heraclitus, which Gladisch and others have tried to connect with Zoroastrianism, was, in fact, a development of the Ionic or Hylozoic doctrine, influenced by the speculations of the Eleatic Xenophanes. This development consists in an advance from the idea of *being* to that of *becoming.* The principle—*i. e.* the inner essence of all things (not their origin)—is fire (πῦρ, πρηστήρ), a fine, dry, ever-active, necessarily self-determined ether, whereof the purest form is soul or spirit, and which, by rhythmical, qualitative, and local change, resulting in condensation and rarefaction, creates and uncreates the sensible world. The way to creation (διακόσμησις), or the downward way (ὁδὸς κάτω), is through extinction or deprivation (χρησμοσύνη), and proceeds thus—fire, water, earth; the way to dissolution (ἐκπύρωσις), the upward way (ἡ ὁδὸς ἄνω), is through ignition or fulness (κόρος), and proceeds—earth, water, fire. All things are in motion (πάντα χωρεῖ): stability is an illusion produced by uniformity of motion. Resolution into original fire is utter spiritual activity, and, at the same time, rest and peace in the union of contraries: creation is relaxation of activity, but, at the same time, war, through the declared opposition of contraries. War, strife, is therefore the parent of all relative created things. These are known to us through our senses, which, however, though necessary, are bad witnesses, unless corrected by the inner, universal wisdom which alone recognizes in and through itself the inner λόγος or fate, which is the law of the universe—a law hidden from the foolish, but open enough to the wise. The soul is immortal, a part of the dry, primal fire, but takes rest from utter activity in the creation of a body. The microcosm is the image of the macrocosm, a shorter rhythmic pulse within a longer. No wonder that in Heraclitus, Hegel found a kindred spirit. THOMAS DAVIDSON.

Her'ald, an official connected with European courts, whose duties at present are the conducting of processions and the funerals of those entitled to bear coat-armor, the inspection of arms, the tracing of genealogies and titles. In the Middle Ages they marshalled the combatants in the lists, and served as messengers between princes. Wars were declared and defiances uttered by them in the sovereign's name. In England, besides the heralds mentioned in the article HERALDS' COLLEGE (which see), there are the following heralds: Bath king of arms (for Wales and the order of the Bath), with two subordinate heralds, Blanc Coursier and Brunswick, whose offices are, however, frequently performed by the members of the Heralds' College. There is also a king of arms for the order of St. Michael and St. George, kings of arms being heralds of the first rank, ordinary heralds occupying the second rank, while pursuivants are novices in the art. Further, there have been from time to time extraordinary heralds (as Norfolk) and extraordinary pursuivants (Blanch Croix, Mowbray, Blanch Lyon, Rouge Rose, Guisnes, Harrington). Esperance pursuivant (like many others whose names are forgotten) was attached to service of a noble family—the Percies.

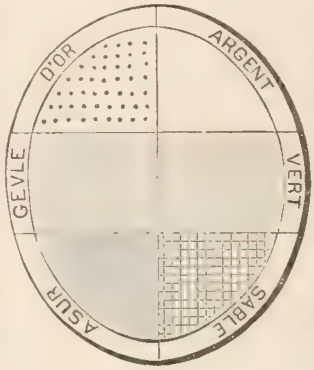
The extinct English heraldships are Faucon, Blanch Sanglier, Carlisle, and Montorgeuil. The Scottish heralds are Lyon king of arms; the heralds proper, Islay, Rothesay, Snowdoun, Marchmont, Albany, Ross; the pursuivants, Kintyre, Unicorn, Dingwall, Carrick, Bute, Ormond. The Irish heralds, Ulster king of arms; the heralds proper, Cork and Dublin; pursuivants, Athlone and St. Patrick. There was an Anglo-French king of arms called Guienne, whose title in England seems to have been maintained till Henry VIII.'s time. The same title occurs among the French heralds.

The principal French herald was Montjoie king of arms. There were 28 French provincial heralds, called also kings of arms. Other famous European heralds were Toison d'Or king of arms for Burgundy (whose title still exists in Austria), and Tower and Sword king of arms for Portugal.

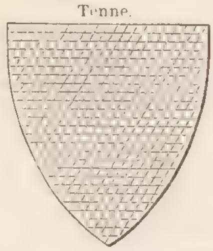
Her'aldry, in general, the science which treats of coat-armor, descents, precedence, ceremonies, and processions; in a narrower sense, the science of coat-armor, or the art of identifying, drawing, and describing coats of arms. In England the whole subject is entrusted to the College of Arms or Heralds' College, which has the right of granting and confirming coats of arms; of recording pedigrees and descents, and of visiting the counties of the kingdom for that purpose; of directing solemn ceremonies, particularly those of a coronation; and of deciding all questions of precedence. Its officers are Garter, Clarenceux, and Norroy kings of arms, with six heralds and four pursuivants. In the U. S. there is no official body charged with these functions. Private persons bear their hereditary arms, but there appears to be no mode by which new ones can be acquired. The subject of descents is left wholly to individuals or to voluntary societies, and questions of precedence are not likely very often to arise in a democratic republic. There, the chief value of this science is in tracing descents, a matter sometimes of very great importance when it becomes desirable to find the heir to a family which has ceased to exist in England. Cadets of many honorable families were among the early settlers of Virginia and other colonies. In case the elder branch should become extinct, the descendants of the younger would be entitled to the family inheritance. Hence the necessity of preserving clear evidences of descent. Little attention, however, seems to have been paid to this, and there probably are not many American families which can trace their descent beyond the first emigrant. The general subject is too wide for this article, which will therefore be limited to that of coat-armor only.

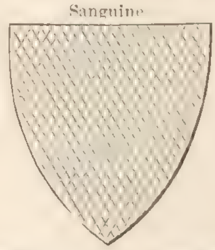
The older (though perhaps not the oldest) writers have attributed to this branch of heraldry a fabulous antiquity. When Lady Juliana Berners tells us, in the *Book of St. Alban's*, that Adam was a gentleman, she does not perhaps, in one sense at least, go beyond the bounds of reason; but

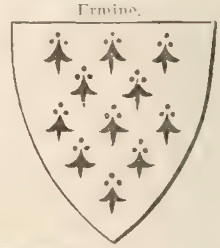
when Guillim ascribes coat-armor to the tribes of Israel, he, to say the least, gives free play to his imagination. The science of heraldry cannot be traced with any certainty beyond the twelfth century. It appears to have had its origin in necessity and common sense, and to have served much the same purpose as the modern uniforms and decorations of military officers. When warriors wore armor and looked exactly alike, even concealing their faces in their helmets, some method of distinguishing them was absolutely necessary. The shield was the most conspicuous part of their armor, and nothing would be more natural than to decorate it with color, applied according to certain fixed rules, or to enrich it with figures of natural or artificial objects. Hence arose tinctures, ordinaries, and charges; from which simple beginnings the whole science of heraldry, or, as some prefer calling it, of armory, has been developed. The tinctures are divided into metals, colors, and furs. The metals are two, gold and silver, called *or* and *argent*. The colors are red, black, blue, green, and purple, called respectively *gules*, *sable*, *azure*, *vert*, and *purpure*. To these some writers add orange tawny and blood-color, in heraldic language, *tenné* and *sanguine*, which they call *stainand* colors. Heralds of that school have also devised certain arrangements of the shield which they call abatements of honor, and distribute with much precision to the cowardly and slothful and to others; but as most men would be reluctant to carry about with them such tokens of disgrace, it is not surprising that stainand colors and abatements should have been long ago forgotten, if indeed they ever had any real existence. The usual pigments are gold, if possible, or else gamboge, for or, and pure white (flake-white) for argent. Silver is more correct, but its tendency to tarnish makes it objectionable. Vermilion, India-ink, ultramarine, and verditer with gamboge answer well for the colors, and purple can be readily made by mixing carmine (lake) with Prussian blue. The furs are ermine and vair; the former white, with black spots, arranged in a peculiar way, the latter composed of bell-shaped figures, alternately argent and azure, placed in rows, base to base, so that the base of every white figure touches that of every blue one. Modifications of these furs have been introduced from time to time. They are ermines, with the field sable and the spots argent—*i. e.* ermine reversed—and therefore more correctly called by the French heralds contre-ermine; erminois, the field or and the spots sable; erminites, the same as ermine, but with a red hair on each side of the white spots; pean, the field sable and the spots or. The derivatives of vair are vair en point, when the point of one figure is opposite the base of another, and countervair, when those of the same tincture are placed base to base. The term vairé is also used, when the figures, but not the tinctures of vair are given. Thus, the arms of Earl Ferrars are blazoned vairé, or, and gules. A modification of vair in which the skins take the form of crutch-heads, or potents, is known as potent-counter-potent. This fur, which is extremely rare in English heraldry, only two coats appearing in Burke in which it forms the field (Amos and Manchester), may be of any metal and color. When a charge appears in its natural colors, it is said to be proper. The annexed arrangement of tinctures (omitting purpure, which is given separately) is borrowed from Mr. Planché, who has engraved it from Sir Nicholas Bysshe's edition of *Upton*, A. D. 1674. The mode of indicating the tinctures which it presents, and which is found very useful in engravings or in sculpture, or under any circumstances in which the blazon or description cannot be given, is said to have been invented by Father Silvestre de Petrasancta in the seventeenth century. Or is shown by a multitude of dots; argent is left plain; gules is indicated by perpendicular and azure by horizontal lines; vert by diagonal lines from right to left, and purpure by similar lines from left to right; sable is marked by perpendicular and horizontal lines crossing each other. It should be borne in mind that the right or dexter part of the shield is opposite the left hand of the person looking at it, and the left or sinister opposite his right hand; and that charges, unless it be otherwise specified in the blazon, always look to the dexter. Modern writers, however, like Burke and Lodge, make little use of the lines of Petrasancta, but, following the example of Guillim, prefer giving the arms in their books in outline or trick, and accompanying them with the blazon—an arrangement which is, upon the whole, more satisfactory. It is a general rule that color is not to be placed upon color, nor metal upon metal. Exceptions, however, occasionally occur; and they are called by the French, arms pour enquirir, meaning that there is something peculiar in their origin, about which inquiry is to be made. A celebrated example is found in the arms of the kingdom of Jerusalem: "Argent, a cross potent between four plain crosses or." The allusion is said to be to the psalm, "Ye shall be as the wings of a dove that is covered with silver wings and her feathers like gold."

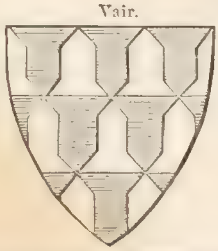



Purpure.

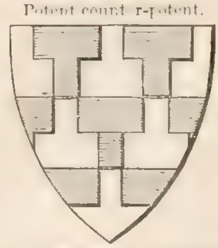

Tenne.

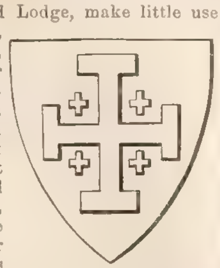

Sanguine.


Ermine.


Vair.

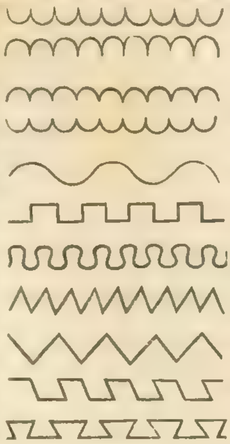

Counter-vair.


Potent counter-potent.



The ordinaries are divisions of the shield formed usually by straight lines, though the lines may be engrailed, invected, embattled, wavy, nebuly, indented, dancettée, raguly, and dovetailed. Invected is the reverse of engrailed—*i. e.* in the former the points turn outward, in the latter toward the inner part of the ordinary. The honorable ordinaries are nine in number, and are usually reckoned thus: the chief, the bend, the fess, the pale, the bend sinister, the cross, the saltire, the chevron, and the bar. Mr. Planché, indeed, suggests the substitution of the quarter and the pile for the bend sinister and the bar, but he supports his proposal by no very cogent argument. "The two latter," he says, "are merely varieties of the bend and the fess;" but that is probably the very reason why they are introduced. The principle of the ordinaries is the triple division of the shield. The four first named are the same division in different positions. The cross is compounded of the pale and fess, and the saltire of the bend and bend sinister. The bar, which seldom or never occurs singly, is the fess divided into parts; and the chevron is probably two bars shortened

and placed end to end, so as to resemble the rafters of a roof. The argument for the usual arrangement thus seems to be sufficient.

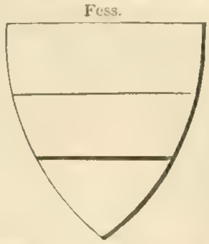


The dimensions of the ordinaries are usually one-third of the shield when charged, or one-fifth when uncharged, except the chevron and the bar, which occupy one-fifth. In practice, however, it is hardly possible to follow these stringent rules; and if it were, the effect upon the educated eye would be much the same as that of the earlier examples of the Gothic revival upon persons accustomed to the study of older art. The earlier draughtsmen permitted themselves to be guided by the eye, and the accomplished modern painter is [illegible] to circumstances. The character of the charges may require slight variations in the dimensions of the ordinaries. Working by rule, without judgment or intelligence, may lead to accuracy, but to an accuracy which will be distressing.

The chief is formed by a horizontal line, cutting off the chief or upper part of the shield; the bend, by two parallel diagonal lines from the dexter chief to the sinister base; the fess, by two similar lines crossing the shield; and the pale, by the like lines from chief to base. The bend sinister is the bend reversed. Several of the ordinaries have diminutives, as the couple-close for the chevron, and the cottise for the bend. A bend borne between two cottises, or narrow figures like itself, is said to be cottised, and the same word is applied to other ordinaries in like positions. If the field—*i. e.* the groundwork—of the shield be metal, the ordinary must be color, and the reverse; but furs may be combined with either metal or color. The same rule applies to charges. The ordinaries also admit of certain variations of form. Except the chief, they may be humetty—*i. e.* they may have the ends cut off. The chevron may be rompu or couched, and the bend may be enhanced, or


Chief.


Bend.


Fess.

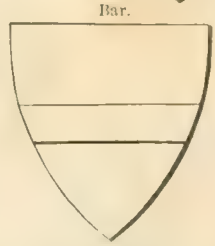

Pale.


Bend sinister.


Cross.


Chevron.


Saltire.


Bar.

borne in the upper part of the shield, instead of the middle. The cross admits of an immense variety of forms. More than 100 varieties of crosses are said to be known to heralds, though it is probable that many of them exist only in im-


Chevron rompu.

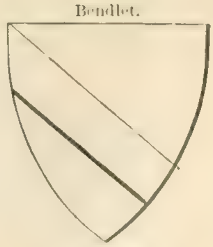

Chevron couched.

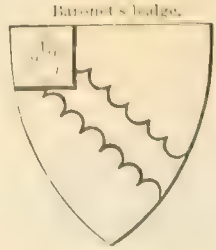

Chevron enhanced.

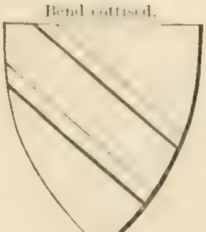

Chevronel.


Couple-close.

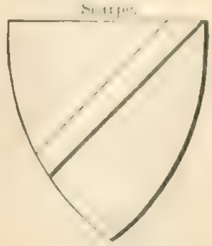

Bend cottised.


Bendlet.

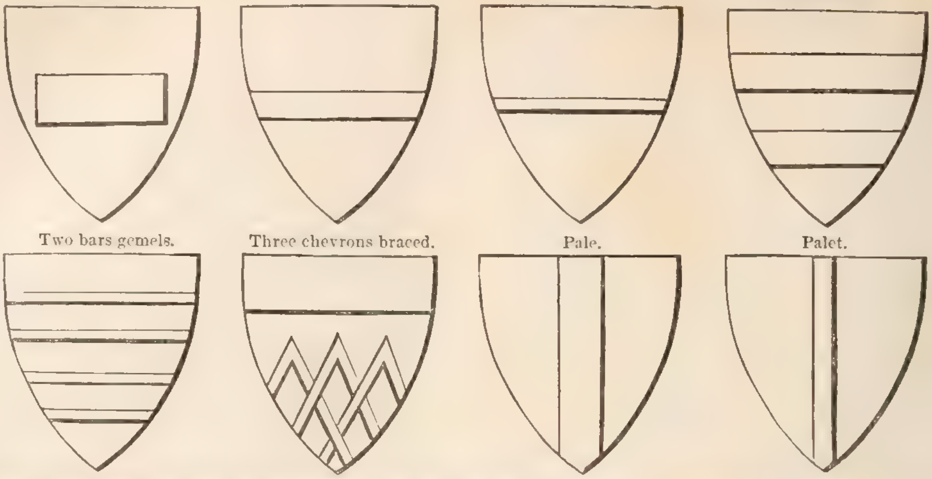

Baronet's badge.


Bend cottised.


Three bends enhanced.


Scarpe.


Baton.

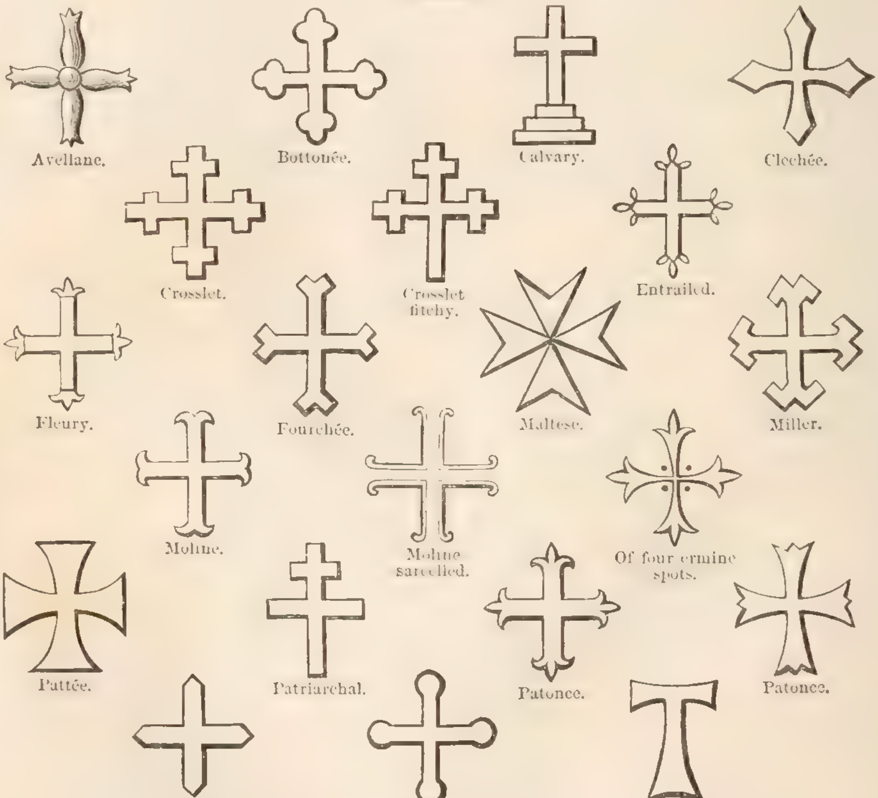


Fess humetty. Closet. Barrulet. Two bars.

Two bars gemels. Three chevrons braced. Pale. Palet.

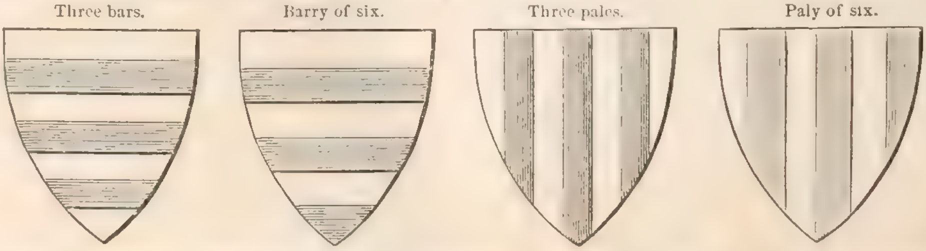
agination. The shield may also be divided by lines derived from the ordinaries, and is then said to be paly, bendy, barry, etc.; it is apparently filled with many little pales or bends, alternately of metal and color. There is a

CROSSES.



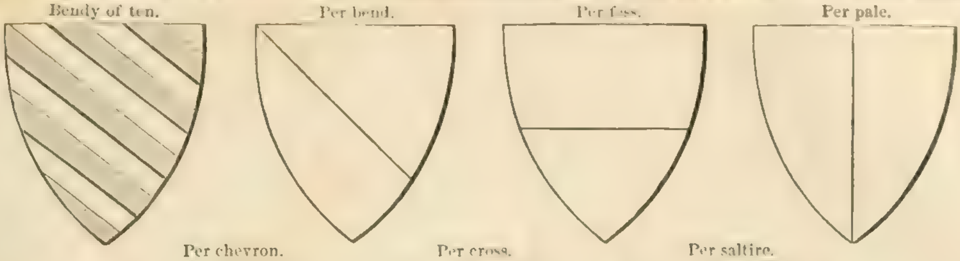
Avellane. Bottonée. Calvary. Clechée. Crosslet. Crosslet fitchy. Entrailed. Fleury. Fourchée. Maltese. Miller. Moline. Moline sarcellied. Of four ermine spots. Pattée. Patriarchal. Patonce. Patonce. Pointed. Potent. Tau.

distinction to be observed between arms which are paly or bendy, for instance, and those which contain several palets or bendlets. In the former case the number of divisions is even, and if the first be a metal the last is a color; in the latter, the number of divisions is unequal, and the first and the last are alike. Thus, paly of six argent and azure, given by Burke to a family of Gorney, is to be carefully distinguished from argent three pales azure, the arms of Thornton: and the arms of the U. S. are to be blazoned, not paly of thirteen argent and gules, but argent six palets gules, a chief azure. The sub-ordinaries are the bordure, the canton, the flanches (with their diminutives, flasques

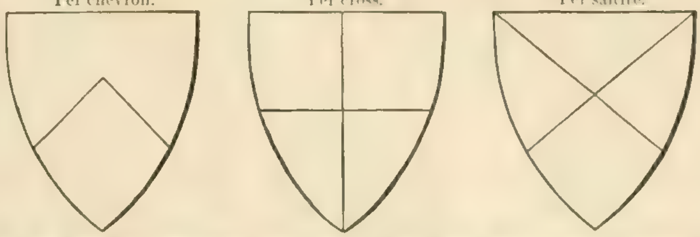


Three bars. Barry of six. Three pales. Paly of six.

Bendy of ten. Per bend. Per fess. Per pale.

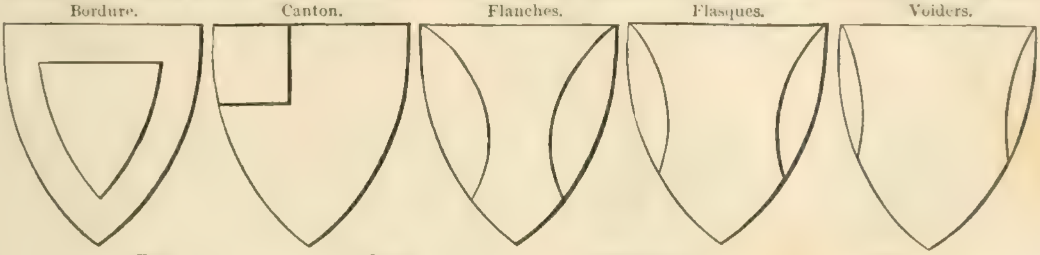


Per chevron. Per cross. Per saltire.

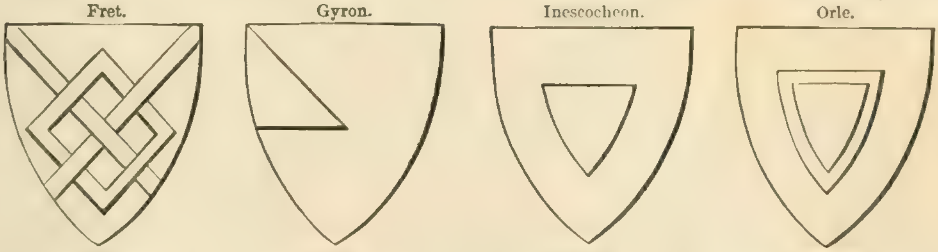


and voiders), the fret, the gyron, the inescocheon, the orle, the pile, the pall, the quarter, and the tressure; and these in their turn lead to new divisions of the shield, such as pily, chequy, compony, counter-compony, fretty; some

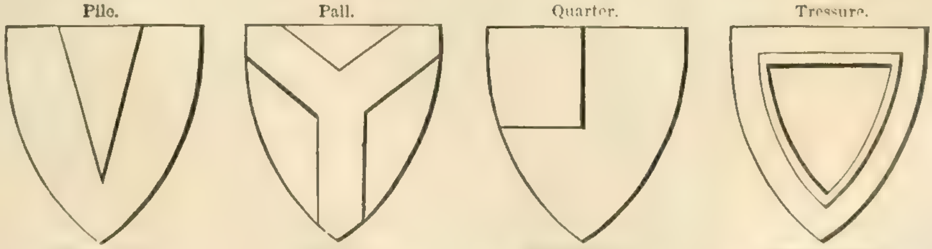
Bordure. Canton. Flanches. Flasques. Voiders.



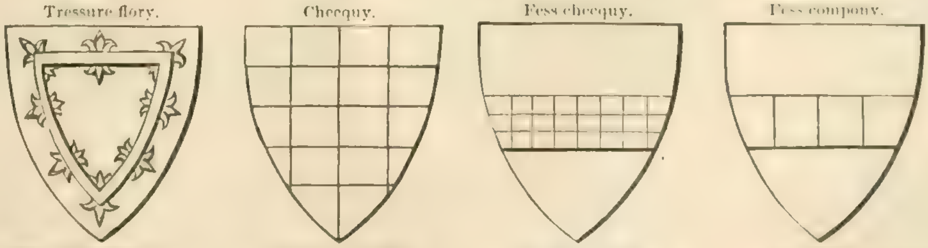
Fret. Gyron. Inescocheon. Orle.



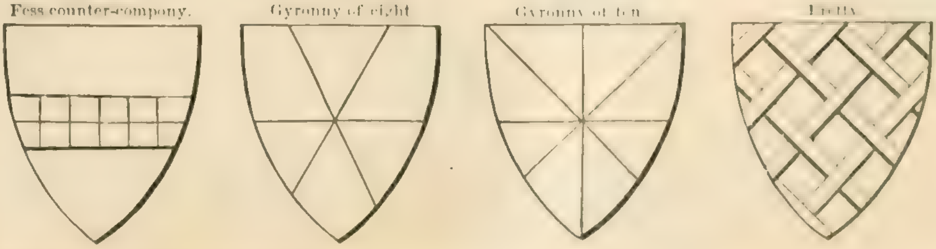
Pile. Pall. Quarter. Tressure.



Tressure flory. Checquy. Fess checquy. Fess compony.



Fess counter-compony. Gyronny of eight. Gyronny of ten. Fretty.



of which, like barry pily, bendy pily, are extremely complicated. A detailed account of these must be sought in heraldic manuals and grammars.

Charges may be anything in nature, or indeed out of it. Without following the elaborate divisions of Guillim and the older writers, who have overlaid what is really a very simple matter with a multitude of words, or have obscured it by irrelevant speculations, it will be sufficient to say that charges may be natural, artificial, or chimerical; the first speak for themselves; the last are the figures of imaginary animals, such as griffins, wiverns, harpies, dragons, and sphinxes, which have been invented or adopted by the heralds. A charge is a figure drawn either upon the field or upon an ordinary. The earliest charges appear to have been the lion, the eagle, and the boar's head. The first appears upon the shield of Philip I., count of Flanders, A. D. 1164, and, according to Mr. Planché, is "the earliest unquestionable example in which the lion appears as an heraldic bearing." About the same time it makes its appearance in definite heraldic form in the arms of the kings of England, and the eagle, as the arms of the Western emperors, is traced to the same age.

From the middle of the twelfth century heraldry developed itself as rapidly as printing did afterwards, and, like printing, it immediately reached perfection. Many of even the earliest coats are as elegant and graceful as any that have been since devised; far more so, indeed, than those of the last century, and even of the earlier part of the present, most of which show a decline in knowledge, skill, and correct taste, from which, however, this beautiful science is now happily recovering. The variety of figures used as charges is very great, and there appears to be no limit to the choice. Lions, eagles, wolves, tigers, and antelopes are generally drawn conventionally, and not naturally, though some modern painters seem disposed to depart in this respect from the ancient rules. Other animals, fruits,


Griffin.


Wivern.


Antelope.


Wolf.


Tiger.


Lion rampant.


Eagle displayed.

and flowers commonly follow nature, but the heavenly bodies do not. Fishes do, except the dolphin. Artificial figures are drawn as they appear. There are also definite terms employed to describe the position of animals and other charges, as a lion rampant, a lion passant gardant. The former is called by the French heralds a lion, the latter a leopard. Ignorance of this simple fact has led to prolonged discussions whether the arms of England, gules three lions passant gardant in pale, or, gave lions or leopards. The disputants, for want of a very simple clue, failed to perceive that the two words were really intended to describe the same animal, but in different positions. Charges are generally readily understood, but some few, like the fleur-de-lis, the clarion, and the fylfot, are obscure, and are called doubtful charges. It is uncertain whether the fleur-de-lis be intended to represent a spear-head or a lily, and whether the clarion be a musical instrument or a lance-rest. No explanation has been given of the fylfot; and it is believed that the suggestion is here made for the first time


Lion saliant.


Crowned.


Double quevée.


Lion gardant.


Regardant.


Passant.


Passant gardant.


Segant.


Couchant.


Dormant.


Demi-lion.


Lion's head.


Gamb.


Tail.

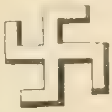

Stag's head caboshed.

that it is intended to represent the asterisk of the Greek Church, an instrument employed to cover the holy loaf at mass. The resemblance between the asterisk, as it is drawn in Dr. Neale's *Primitive Liturgies*, particularly when it is folded, and the mysterious fylfot of heraldry, is very striking.

Although there is practically no limit to the choice of charges, there are certain figures peculiar to heraldry, and of very frequent occurrence. The roundle is supposed to be derived from the gold coin of Byzantium, and therefore when it is or is called a bezant. When gules, it becomes a torteau; azure, a hurt; vert, a pomey; sable, a pellet or

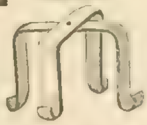
ogress: purpure, a golpe; argent, a plate; tenné, an orange; and sanguine, a guze. A roundle barry wavy

Fleur-de-lis.



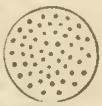
Fylfot.

Rest.



Asterisk.

argent and azure is a fountain or sykes, and is borne by a family of the latter name. When the field is replenished with pointed figures resembling drops, it is said to be gutté, and a single drop is called also a gutté. If the drops be white, the field is gutté d'eau—filled with drops of water. Guttés de larmes, blue drops, represent tears; de poix, sable, drops of pitch; de sang, red, drops of blood; d'huile or

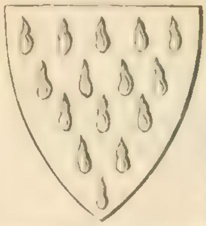


Bezant.

Fountain.

d'olive, green, drops of oil; d'or, gold, drops of gold. A lozenge is the common figure of that name: the horizontal diameter is equal to one of the sides, but the perpendicular diameter is longer: a mascle is a lozenge voided—i. e. having the middle removed, so that the field is visible through it, and marking the outline by two slender lines, one within the other. Ordinaries also may be voided. The fusil was originally the spindle, and in some old arms is borne in its original form: it is now merely the lozenge elongated. These charges give rise to the divisions of the shield known as lozengy, masculy, and fusilly, with their combinations. When lines like those of the fret are extended throughout the shield or cover an ordinary, it is said to be fretty. Billets are oblong figures representing a letter. Bird-bolts are blunt-headed arrows. The annulet is a ring; the mill-rind or fer-de-moline, the iron of a millstone; the pheon, an arrow-head; the caltrop, an iron instrument formerly strewn in a field of battle to entangle the feet of horses, and so constructed that a sharp point was always upper-

Guttes.



Lozenge.

Fusil.

Mascle.

Billet.

Caltrop.

Shackbolt.

Trefoil.

Bird-bolt.

Annulet.

Fer-de-moline.

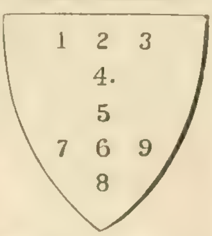
Pheon.

Cinquefoils.

most. For other charges it is necessary to refer the reader to some manual of heraldry.

Blazon is the art of so describing arms that a drawing can be made from the description. It is necessary first to understand the points of the escocheon, which are: (1) the dexter chief point; (2) the middle chief; (3) the sinister chief; (4) the honor point; (5) the fess point; (6) the nombril point; (7) the dexter base; and (8) the sinister base point. The terms of art must next be learned; not only the names of things, but the various attitudes of animals and the position of charges. Beasts of prey are blazoned rampant, passant, passant-gardant, sejant, rampant gardant, couchant, and dormant: and when at rest, statant, though this is generally understood. Beasts of chase, however, are not rampant, but springing; not passant, but trippant; not couchant, but lodged. A griffin is not rampant, but segreant. Lions are always langued and armed. If the field or the lion be gules, the tongue and claws are azure; if of any other tincture they should be gules. Stags, etc. are attired and unguled, horned and hoofed. Birds are displayed rising, volant, or at rest. Fishes are naiant when in fess, or hauriant when in pale. Flowers are often slipped, and trees eradicated or torn up by the roots. Certain charges, also, are blazoned in a peculiar manner. The sun, surrounded by rays and or, is said to be in his splendor; the full moon, argent, in her complement. Both are drawn conventionally, with a human face. When sable, the moon is said to be eclipsed. A crescent has its horns towards the chief, an increscent towards the dexter, and a decrescent towards the sinister side of the escocheon. A peacock with his tail extended is said to be in his pride, and is depicted proper. A pelican in her nest, feeding her young, is said to be in her piety. In blazoning care must be taken to use language with ex-

Points of escocheon.



Crescent.

Decrescent.

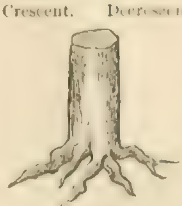
Increscent.

Estoile.

Mullet.

Pierced.

Sun.



Trunk.

treme accuracy, since the least departure from correctness may produce an entirely different coat from that which it is intended to describe; to use as few words as possible, and to avoid repetition, particularly of the name of a tincture or of numbers. The field must first be mentioned, then the ordinary, as, Azure a chevron or (*D'Abernon*). If the field be not plain, i. e. of one color, it must be blazoned first, as, Paly of six argent and gules (*De Neale*). Next to the ordinary, charges placed upon the field are to be named, as, Ermine, a chevron azure between three garbs or (*Masterson*). Garbs are wheat sheaves. If the ordinary and charge be of the same tincture, it need be named but once, as, Azure a chevron between three garbs or (*[illegible]*). If the ordinary be charged, it must be next mentioned, Azure on a bend ermine three mullets sable (*[illegible]*). Lastly,

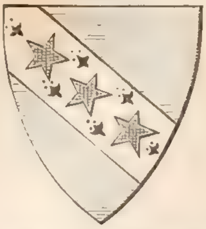
D'Abernon.

Fitz-Neale.

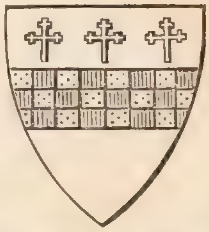
the bordure or chief must be mentioned, with its charges, if any, Azure, on a chevron or between three bells argent, an eagle displayed between two lions rampant gules, all within a bordure ermine (*Bellhouse*). If there be no addi-

nary, but a charge, it is to be treated in the same way, as, Sable a lion rampant or (*Bramhall*). Azure, a lion rampant

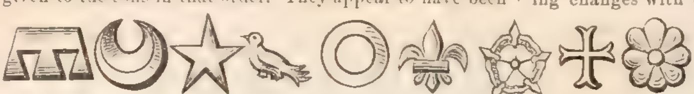
Gay.



Borges.



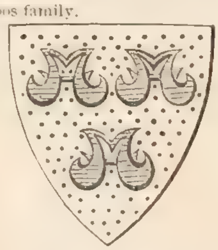
between three crosses crosslet or (*Jordon*). The repetition of the names of tinctures is to be avoided by using the expressions, "of the field," "of the first," "of the second," etc., as, Argent a fess chequy or and gules, in chief three crosses crosslet fitchy of the third (*i. e.* gules) (*Borges*). The repetition of numbers may be avoided thus: Sable on a chevron or between three estoiles of the second, as many crosses pattée fitchée gules (*Laud*). Finally, the difference and the baronet's badge, if there be any, the crest and the supporters, are to be described. The difference is a small charge employed to distinguish the arms of the sons of a house, from the first to the ninth. Modern differences, or marks of cadency, are the label, the crescent, the mullet, the martlet, the annulet, the fleur-de-lis, the rose, the cross moline, and the double quatrefoil, which are given to the sons in that order. They appear to have been



Differences.

in use since the fourteenth century as differences, but have been longer employed as charges. Ancient differences were much more conspicuous, and consisted in a variation of the tinctures, or even in the addition of a charge. An excellent illustration is found in the well-known and ancient family of Roos or Ros, two branches of which bore respectively Gules three water bougets argent, and Sable three water bougets or. The baronet's badge is the arms of Ulster in

Arms of Roos family.



Ireland, Argent a sinister hand, erect, open, and couped at the wrist or, and was given in commemoration of the purpose of the institution of that order by King James I. in 1611, to encourage plantations in Ulster. The badge of the Nova Scotia baronets appears to have been laid aside since 1629. As borne by the celebrated William Alexander, first earl of Stirling, it was, Argent on a saltire sable, an escocheon charged with the arms of Scotland, and was borne in an inescocheon ensigned with the royal crown. Above the arms the helmet is placed, which varies in form and material according to the degree of the wearer. This, in a complete atchievement, is covered by the mantling, which is understood to represent the lambrequin or cover of the helmet, and is slashed or jagged to indicate the cuts which it is presumed to have received in battle. Above the helmet is placed the wreath, in form like two cords twisted together; the tinctures of the mantling and wreath are properly those of the principal color and metal of the arms; but modern mantlings are oftenest red lined with white. Sometimes a cap of maintenance, or a coronet resembling that of a duke, is substituted for the wreath. Above all is the crest. Below the shield is the motto in a scroll. This is a brief sentence or a single word, frequently breathing some pious sentiment or vigorous thought, but often alluding to the arms, the name, or the crest. Of the former character are "Dum spiro spero" (*Dillon*), "Garde la foy" (*Coe*); of the latter, "Pie repone te" (*Pierrepont*). The motto of the late Dr. Hawks, "Never check," is admirable. That of Livingston, "Spero meliora," is an elegant allusion to the crest, a ship tossing in a stormy sea. It is the modern custom, however, to give only shield, crest, and motto, omitting the helmet and mantling.

Supporters are figures of men or animals placed one on each side of the shield, and so called because they appear to support and hold it up. They are borne in England by the sovereign and the princes of the blood, by peers and knights of the Garter, and grand crosses of the Bath, and, either by patent or prescription, by some baronets and private gentlemen.

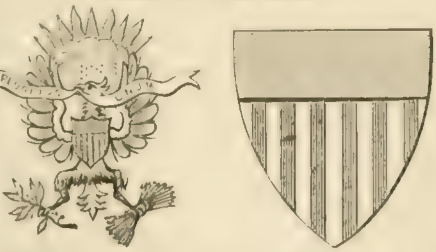
It is right to add that the foregoing is the merest outline of the rules of blazon. It is only possible to learn to blazon well by acquiring a correct knowledge of the terms of art and by the careful study of examples. It is not necessary to do more here than to allude to the methods of blazoning by planets and precious stones adopted by some of the older heralds, and not forgotten even so lately as the time of Guillim, but which nevertheless must be understood in order to read their works with satisfaction. Briefly, in blazoning the arms of sovereigns, they substituted the names of planets for those of the tinctures as they are now employed. Thus, or is Sol; argent, Luna; azure, Jupiter; gules, Mars; purpure, Mercury; sable, Saturn; vert, Venus. By this method the royal arms would be disguised as Mars three lions passant gardant in pale Sol. The arms of peers were blazoned by precious stones. Or is topaz; argent, pearl; azure, sapphire; gules, ruby; purpure, amethyst; sable, diamond; vert, emerald; sanguine, sardonyx; and tenné, jacinth. These fanciful methods have, however, long been abandoned as inconvenient and useless. Still more frivolous are the attempts of some of the older writers, like Leigh and Peacham, to give an arbitrary significance to every tincture and almost every charge. Gold is made to signify strength, silver charity, and the meaning changes with every combination. It is of course impossible to apply these allegorizing ideas in practice, or to extract any rational meaning from them. As Mr. Lower well observes, the application of them would produce the most startling combinations. "The coat Vert a bull's head or would signify as to the tinctures pleasure and joy, while as to the charge it would mean rage and fury. Again, Purpure, a wolf argent would mean a wrangler with a peaceable disposition."

Marshalling is the art of arranging arms with the externals in an atchievement. The mode of doing this when there is only one coat in the shield has been just explained. It should be added that in the arms of the sovereign the royal crown of England, sometimes called the imperial crown, or in those of peers of the realm the coronet of their degree, is interposed between the helmet and the shield. The crown of England is a circle of gold adorned with jewels, having upon its upper rim four crosses pattée, and as many fleurs-de-lis, and surmounted with two arches of gold and pearls, crossing each other, and having at the intersection a globe, above which is a cross pattée. The coronet of the prince of Wales is the royal crown, with one arch: that of the princess royal is composed of four fleurs-de-lis, two crosses pattée, and two strawberry-leaves. Other princes and princesses of the blood have coronets like that of the prince of Wales, without the arch. A duke's coronet is a rim of gold having on the upper edge eight strawberry-leaves, five of which are seen in profile; this must be distinguished from the ducal coronet, which is sometimes placed under the crest, and which shows only three strawberry-leaves; a marquess's coronet has four strawberry-leaves and as many large pearls set upon short points; an earl's has on the upper edge eight strawberry-leaves and as many pearls on high points; a viscount's has twelve, or, some say, sixteen pearls, and a baron's six (four of which are seen in a drawing), set upon the rim. Coronets are usually worn around a cap of crimson velvet, with a gold tassel and turned up with ermine, the velvet cap appearing above and the ermine below the coronet; but in drawing the coronet as a part of the atchievement the cap is omitted, except when, as is occasionally done, the crest, the mantling, and the helmet are left out, and the arms are ensigned with the coronet. Marshalling includes the arrangement of several coats of arms in a shield. Arms are classed under several heads, of which it will suffice to mention arms of dominion, of assumption, and of inheritance. The first are those which indicate sovereignty, as those of Scotland and Ireland added to the royal arms of England. The second are those of a prisoner of war, which the captor and his posterity may bear for ever. Thus, the Black Prince is said (though the story is probably untrue) to have won the ostrich-feathers and the motto "Ich dien" from John, the king of Bohemia, at the battle of Crecy. The third are those of families, which descend from father to son, to which are added, in English heraldry, those of heiresses who have intermarried into any family, as well as the arms which the heiresses themselves may have inherited. In French and German heraldry, however, the

arms of parents, grandparents, etc.—*i. e.* of all ancestors in a direct line, whether heiresses or not—are introduced into what is called a genealogical atchievement, and every gentleman of blood and coat-armor perfect is expected to be able to give not less than sixteen quarters. On the Continent they look only to descent, but the English arrangement contemplates both descent and inheritance, or the representation of families which are extinct in the male line.

The correct placing of many coats of arms in one shield is called quartering, and the rules which govern it are included among those of marshalling. There are several methods of marshalling arms. Those of a husband and wife, called *baron* and *femme*, are impaled, or placed side by side in one shield, and divided by a perpendicular line. Formerly, arms were occasionally dimidiated—*i. e.* only half of each coat was drawn—but this practice has been long abandoned, except in the case of bordures, orles, and tressures, the inner half of which is omitted in impaling or quartering. The arms of a bishop and his see are also impaled, those of the see occupying the dexter or baron's side, and are ensigned with a mitre. Those of a knight of the Garter and his wife are usually placed in two shields set side by side, and the former only is encircled by the garter. Unmarried women bear their arms in a lozenge, as do widows, but the latter may impale their arms with those of their husband. Arms descend to all the sons and their posterity for ever, but according to the rules of English heraldry women are only entitled to them during their life, unless they be heiresses, in which case they descend to their posterity. An heiress, in heraldry, does not necessarily inherit property, but represents a name; she is, in fact, a woman without brothers. Her arms, together with those which she may have inherited from female ancestors, other heiresses, descend to her children, who quarter them with their paternal coat. If but one coat of arms be thus inherited, it is placed in the second and third quarters, reckoning in rows from right to left, and the paternal arms in the first and fourth. If there have been many heiresses, their arms are placed in order, beginning with the second quarter, the oldest first; after the arms of every heiress are placed all that she has brought into the family in the same order. The number of quarterings must always be even; if it be not so, the paternal coat, which is placed in the first quarter, must be repeated in the last. When the royal arms occur, they are usually placed in the second quarter, as the most honorable position.

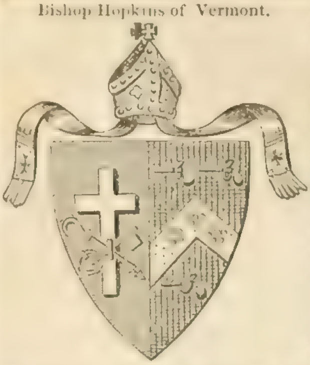
Arms of the United States.



The arms of the U. S. are arms of dominion. They are borne in rather an unusual way. The following is the blazon: Argent, six palets gules, a chief azure, borne on the breast of the American eagle displayed proper, in his dexter talon an olive branch, in his sinister thirteen arrows, also proper; above his head a sky azure charged with as many mullets 5, 4, 3, 1, argent, and environed with clouds proper, and beyond rays or; in his beak a scroll with the words "E Pluribus Unum." This blazon is from a painting in St. Paul's chapel, New York. As an illustration of a gentleman's atchievement borne in the modern manner, without helmet or mantling, the arms of Sigismund Hugget are given from a mural tablet in the same chapel. They are, Argent, a chevron gules, on a chief azure, two fleurs-de-lis of the first. Crest, two wings expanded, per fess gules and argent. Motto, "Dene agendo vel cavendo." This is an evident mistake for "Bene," but it is literally copied from the mural tablet. These are not the arms borne by the English family of Hugget. They may possibly be Dutch. The arms in the episcopal seal of the late Bishop Hopkins show the manner in which bishops should give their arms. They are Vermont impaling Hopkins, ensigned with a mitre. The arms of the diocese were devised by the bishop himself, and are an excellent piece of modern heraldry. The blazon is, Azure, a long cross argent, surmounted in base of a crosier in bend, over all a key in bend sinister, both of the second, impaling sable on a chevron between three pistols or, as many roses gules, barbed and seeded proper.

Hugget.

Bishop Hopkins of Vermont.



Funeral atchievements or hatchments, though familiar in England, are little known in America. They are usually hung on the fronts of houses or placed in churches. They follow the usual rules of marshalling, but are commonly drawn very large, and the arms, crest, and motto are placed on a ground in the form of a lozenge. If the hatchment be in memory of an unmarried person, the ground is all black, and the arms of a maid or widow are drawn in a lozenge and ensigned with a cherub instead of a crest. If the husband be dead and the wife living, his arms are placed on a black ground and hers on a white. If the wife die first, her arms are on the black ground, and her husband's on the white; but if both be dead, the ground is all black. The arms of a deceased bishop are impaled in the usual way with those of his see, and the latter are on a white ground. When the deceased is the last of his line, it is said that a death's head may be placed over his arms instead of or beside the crest. Marshalling is, in America, one of the most important parts of heraldry, since its purpose is to record descents and to give a clue by which pedigrees can be constructed.

The bibliography of heraldry is extensive, and it may be as well to mention one or two of the better books. Leigh's *Accidence of Armoury*, Ferne's *Blazon of Gentry*, and Peacham's *Complete Gentleman*, are entertaining and historically useful, but their authors belong to the mystical school, which tries to discover recondite meanings in the simplest matters, and their works must be read by the neophyte with caution. Guillim is high authority; his *Display of Heraldry* marks the beginning of the transition from the mode of treatment which allies heraldry with every subject under heaven and the stricter scientific method of the modern writers, though it nevertheless contains a great deal that is curious but irrelevant. Clark's *Grammar of Heraldry*, published in 1776, which has passed through fourteen editions, is the precursor of the modern method. Porny's *Heraldry* (by Porny, French master at Eton College and an accomplished scholar), published first in the *Encyclopædia Britannica*, and afterwards in a volume by itself, is a very good but not very complete treatise. Of recent works, Boutwell's and Whitmore's *Heraldry* are well adapted to the beginner; the latter, published in Boston, Mass., contains much information not to be found in the English books. The champions of the modern school are Lower and Planché. *The Curiosities of Heraldry* and *The Pursuivant of Arms* are endeavors to discuss the subject upon an historical and scientific basis. The *Glossary of Heraldry*, published by J. H. Parker in 1847, is perhaps the most complete of modern treatises, but it presupposes a great deal of elementary knowledge, as do the works of Fairbairn and the Burkes. The former has made a collection of crests in two large volumes. The *Peerages* and the *General Armory*, and the numerous productions of John and Sir Bernard Burke, are well known. Other peerages, Collins's, Douglas's, Lodge's, have a high reputation. Berry's *Encyclopædia* is one of the most voluminous of modern books. He, however, has a leaning to the imaginative school, and should be read with caution. B. R. Betts.

Heralds' College, or College of Arms, a corporation comprising all the English heralds except Bath king of arms, St. Michael and St. George king of arms, and the two heralds of Wales and the order of the Bath, the latter titles being indeed often bestowed upon members of the college. Heralds' College was instituted in 1464 by Edward IV., chartered in 1483 by Richard III., confirmed by Edward VI. in 1549, and reinstated by Philip and Mary in 1554. Its office is at Benet's Hill, Doctors' Commons, London. Its president is the duke of Norfolk, hereditary earl marshal of England. The three English kings of arms, Garter, Clarenceux, and Norroy,

the heralds, Richmond, York, Windsor, Chester, Somerset, and Lancaster, and the pursuivants, Portcullis, Bluemantle, Rouge Croix, and Rouge Dragon, are members of the chapter. The Lyon Office in Scotland and the Office of Arms in Ireland perform similar functions. (See HERALD.)

Her'ald's Prai'rie, tp. of White co., Ill. Pop. 1160.

Her'apath (WILLIAM), F. C. S., b. at Bristol, England, May 26, 1796; was a successful brewer; became in 1828 professor of chemistry in the Bristol Medical School; assisted in founding the London Chemical Society 1841. D. at Bristol Feb. 6, 1868; was a distinguished toxicologist.

Herapath (WILLIAM BIRD), M. D., b. 1820; graduated M. B. at London University 1844; M. D. 1851; D. at Bristol Oct. 12, 1868. He discovered the sulphate of iodoquinine, and announced its remarkable optical qualities, and subsequently prepared several other analogous compounds new to science.

He'rat, an important city in Western Afghanistan, on the Hari, in lat. 34° 50′ N. and lon. 62° 30′ E. It is fortified, and situated in a fertile and highly cultivated country. It has large bazaars, and besides its own manufactures of carpets, woollens, and leather, it has a considerable trade with China, India, and Persia. On account of its position it may become the point of contention between England and Russia in their Asiatic rivalries. Its population is estimated at between 30,000 and 80,000.

Hérault, department of Southern France, on the Mediterranean. The northern part is traversed by branches of the Cevennes, which enclose fine valleys. The coast is low and marshy. The mountains are rich in minerals—coal, iron, lead, copper, and marble; the valleys produce wheat, wine, and fruits. In the marshes is manufactured much salt, and the lakes and the sea furnish large quantities of fish. Cap. Montpellier. Pop. 429,878.

Herba'rium, or **Hor'tus Sic'cus** [Lat. "dry garden"], a botanist's collection of dried plants. If possible, plants with flowers, buds, and leaves should be chosen, and many small plants may be gathered, roots and all. If too large, collect branches with a few radical leaves. Thick roots may be sliced before drying. For drying, take plenty of soft, unsized bibulous paper, folded into a convenient size; common soft wrapping-paper will do. Stitch a dozen sheets or so into a book called a drier. Fold each specimen in a single sheet, place the sheet between driers, and put the whole into the press under as much weight as the specimen will bear without crushing. Change the driers every day or oftener for about a week. Plants which turn black in drying are sometimes rapidly dried by artificial heat under pressure, the process lasting but a few hours. Finally, the specimens may be carefully folded in sheets of thickish white paper, or fastened by slips of paper or by hot glue to half sheets of paper, about seventeen inches long and a foot wide. On each sheet should be written the name of the genus and species, the place and date of collection, and such other information as may seem important. The plants of one genus are folded in *genus covers* of stout paper; these are arranged in the appropriate natural orders, and are best preserved by placing them flatwise in compartments or on suitable shelves. Care must be taken to prevent the ravages of destructive insects. An alcoholic solution of mercuric chloride (one ounce to the quart), applied to the specimens before they are mounted, is useful to this end.

Her'bart (JOHANN FRIEDRICH), b. at Oldenburg May 4, 1776, his father being a public officer at that place. Herbart attended the gymnasium there, studying Wolff and Kant. In 1794 he entered the University of Jena, when Fichte was there unfolding his science of knowledge. From Fichte he received a great impulse. He criticised the system of Schelling and struck out an original path. In 1797 he became a tutor at Berne, where he made the acquaintance of Pestalozzi and composed a treatise on education. In 1802 he became *Docent* of philosophy and pedagogics in Göttingen, and in 1805 professor extraordinarius. In 1809, Wilhelm von Humboldt called him to Königsberg as professor ordinarius to succeed Krug, the successor of Kant. He founded a pedagogical seminary also. In 1833 he returned to Göttingen, where he remained till his death in 1841. His chief works are: *Lehrbuch zur Einleitung in die Philosophie* (1813), *Lehrbuch zur Psychologie* (1816), *Psychologie als Wissenschaft, neu gegründet auf Erfahrung, Metaphysik und Mathematik* (1824–25), *Allgemeine Metaphysik nebst den Anfängen der philosophischen Naturlehre* (1828–29), *Kurze Encyclopädie der Philosophie, aus practischen Gesichtspuncten entworfen* (1831). The complete works of Herbart have been edited in 12 vols. by G. Hartenstein (Leipsic, 1850–52).

The design of this article confines us to a brief sketch of the plan of Herbart's investigations, and forbids the introduction of much of his novel terminology, as it would be misunderstood without lengthy explanations. While engaged in the study of philosophy under Fichte, Herbart became convinced that, for a satisfactory settlement of the questions involved in self-consciousness, it was not only possible, but indispensable, to enter into the consideration of infinitesimal quantities by means of the Calculus, and all the ideas advanced by him are meant to subserve that end. He contends that the ultimate real elements of which the world is composed are infinitesimal parts of that which appears, absolutely simple, without parts as to space or time, mathematical points, distinguished only by difference of quality. In accordance with this view, he holds that original change and development, that infinite continuity of space and time, that substances possessing a multiplicity of qualities and forces, that causality transferring something from one essence to another, and that a self endowed with arbitrary and conflicting faculties, are, one and all, crude and contradictory suggestions of phenomena. The principal aim of his *Introduction to Philosophy* is to interrupt, by vigorous dialectic, the general dream as to the truth of such suppositions. Next, he proposes to reform them so as to satisfy both experience and the principle of identity embodied in his "real elements," in his *Metaphysics*. Impenetrability of simple substances must be limited to the extent of their similarity; if it was absolute, communication, relation, and causation between them, or the thoughts thereof, would be completely incomprehensible. Contiguous substances of different qualities attract each other with infinite force, occupying the same point of space, and exert repulsion in the measure of their identity. This elementary action does not, however, alter the primary qualities of the substances; and he therefore calls it self-preservation. The number of substances holding the same point of space is comprehended by the terms of "internal state" or "internal constitution;" the attractions and repulsions resulting from the "internal state," and producing a more or less constant relation to the surrounding elements, is termed the "external state or constitution." Consequently, the external constitution is defined by the internal state. The only substance and elementary actions of which we are directly conscious are the soul and its simple sensations, like those of sounds and colors; but the simple acts of all substances are acts of self-preservation, sensations; therefore are self-preservations of the soul. When an element, partly similar and partly dissimilar, enters the space of another element, a perturbation is created to which a definite self-preservation corresponds. While the soul, by perceptions, responds to countless perturbations, it expels from consciousness that which is contradictory, blending what remains in definite succession and order. The rich experience of the outer world is thus produced by the soul without innate categories of time and space, without being contaminated by an influx foreign to it, and without a fatalistic law of evolution. Moreover, the soul preserves itself with reference to these its own products, forming series of perceptions, weaving the series into textures, and grouping the textures. This is the origin of higher generalizations and of complicated intuitions, which are generally attributed to special faculties of an inner sense. The very idea of self is thus created by the soul; it is a work of the soul, not the soul itself; this latter operates not only consciously, but in sleep also. The construction of matter, of the imponderables, and of life by modifications of the preceding principles, constitute Herbart's *Natural Philosophy*. The proportion of attraction and repulsion, in a sum of simple substances filling space with incomplete interpenetration, determines for matter its density, elasticity, and crystallization. A great number of elements of one kind being required to produce a complete self-preservation in a single element of different kind, this furnishes the basis for discussing the facts connected with the imponderables. Life is defined as a system of self-preservations in one and the same substance, higher or lower, in proportion as the internal culture of the elements is more or less rich. The purpose of his *Rational Psychology* is to do away with the foundation of empirical psychology, the faculties of the soul, which evidently act without precision, concert, or assignable laws, and to explain, by a mathematical analysis, the apparently irregular and anomalous facts of consciousness, which seem to violate the autonomy of the soul. He lays down the principle that if the influence of moral laws resulting from the direct effort of the soul is set aside, the ideas become forces themselves, resisting the impediments by which they are partially obliterated in the direct ratio of their intensity. Distributing the total amount of impediment or arrest among several ideas, he finds that under certain conditions two of them are sufficient to force and hold below the horizon of consciousness a third, which henceforth and until revived is excluded from any influence upon whatever may be present to the mind. This view be-

comes the fruitful source of explanation for every kind of inner experience which is inconsistent with the expected operation of moral and logical laws, ranging from the slightest inattention through all the degrees of power exerted by error and passion, till it reaches that state of insanity in which the former idea of self is lost, and a foreign personality substituted. Such complete enthralment of ideas, and of what depends on them, is only in rare cases achieved all at once; more frequently it is effected gradually, under an infinite variety of modifying circumstances; while at the same time ideas partially free, and either isolated or associated, continue the effort to regain the maximum of consciousness, and those crowded out of it rebound into the mind as soon as the obstacle is removed.

We have thus far given an outline of his theoretical philosophy. The principles determining what ought to be are kept separate to ensure freedom of investigation, and are contained in his *Practical Philosophy*. The latter is not founded upon commands, either of society or conscience, nor is it based upon desires in connection with objects, but upon involuntary and axiomatic intuitions, succeeding inward and outward actions, approving of the harmonious, disapproving of the inharmonious relation of volitions. These momentary decisions are called "æsthetical judgments." We approve of the harmony of such intuitions with the will, disapprove of their discord—idea of inward liberty. The product of the will, uniting more complementary predicates, is preferred in comparison with the product containing less of them—idea of perfection. One will helping another will, in accordance with said ideas, without thought of compensation, is approved as divine—idea of benevolence. Not to intermeddle with volitions not conflicting among themselves is approved as the idea of right. To resist wrong and to return good for good is the idea of compensation (*Billigkeit*). We give scope to these ideas by cultivating them separately, without reference to definite purposes. Their joint application to the concerns of individual and social life constitutes virtue. The person who, in a conflict between the ideas and their reverse, is constrained to obey the ideas, has acquired moral character. God cannot be known by means of "real elements;" faith in his existence rests exclusively upon his moral attributes corresponding to the ideas enumerated, and is supported by the evidences of design in nature, for which the practical ideas are the organ of sight. The soul is of course indestructible, but the ministering organism is a beneficent arrangement of Providence. The degree of faithfulness with which these ideas are cultivated defines our actual freedom; the soul is neither absolutely free, nor is it ruled by laws foreign to itself, save in the measure that the ideas are neglected. An application of both his theoretical and practical philosophy was made by Herbart in his *Pedagogics*, with the design to educate by means of instruction. His *Encyclopædia* investigates the relation and interaction between the arts and sciences of civilized life.

The circle of scholars who have adopted Herbart's system is quite numerous, and their influence is increasing. Mor. Wilh. Drobisch, Gust. Hartenstein, H. G. Brzoska, Fried. Exner, G. F. Taute, C. A. Thilo, Theod. Wittstein, Ludw. Strümpell, Rob. Zimmermann, and others are authors of distinguished works on Herbart's philosophy.

Hugo Haanel.

Herbelot, d' (Barthélemy), b. at Paris Dec. 4, 1625; studied at the University of Paris, and became a profound scholar in the Oriental tongues; sojourned much in Italy; was patronized by Fouquet and Colbert; was royal secretary and Oriental interpreter, and in 1692 became Syriac professor in the College of France. D. at Paris Dec. 8, 1695. His *magnum opus* was *Bibliothèque Orientale* (1697), a storehouse of facts regarding Eastern literature which is even now highly valued.

Her'bert (Edward), Baron, of Cherbury, b. of an ancient family at Montgomery Castle, Shrewsbury, in 1581; educated at University College, Oxford; served with renown in the Netherlands, and became a gentleman of the court of James I.; was ambassador to France 1618–24; entered the Irish peerage in 1625, and the English in 1631. His celebrated *Tractatus de Veritate* appeared in 1624, and the *De Religione Gentilium* was added in 1645. His writings are somewhat obscure, but he maintained the existence of innate ideas and of a personal Deity, and taught that the mind of the devout seeker for truth may become illuminated by an inward light. The indistinctness of his expressions and the somewhat mystical subtlety of his notions have caused him to be little read or understood. D. at London Aug. 20, 1648.

Herbert (George), a brother of Lord Herbert of Cherbury, b. at Montgomery Castle Apr. 3, 1593; was educated at Trinity, Cambridge, where he received a fellowship in 1615 and proceeded M. A. in 1616; was university orator 1619–27, and sought in vain for civil promotion, which was promised by the king and courtiers; took holy orders in 1625; became a prebendary under the bishop of Lincoln 1626, and in 1630 rector of Bemerton, where he d. of a quotidian ague Feb., 1633. Herbert was a man of profound learning, sincere piety, refined taste, and extraordinary wisdom. The writings of the "holy Herbert" in prose and verse have often been reprinted. His poetry, with its rich imagery and quaint expressions, somewhat marred as it is by forced *concetti*, after the fashion of his times, includes some of the finest sacred lyrics in our language. The admirable sketch of Herbert by Izaak Walton has been often reprinted.

Herbert (Henry William), a son of the dean of Manchester and grandson of the earl of Carnarvon, was b. in London Apr. 7, 1807; was educated at Eton and Cambridge, and came to New York in 1831, having become hopelessly involved in debt. In this country he was for a time a highly successful teacher of Greek. He published a successful series of historical novels and some translations from the French and other languages, including a poetic version of the *Prometheus* and *Agamemnon* of Æschylus (1849). He was also author of the "Frank Forester" series of sporting volumes, partly tales of out-door life, but also including the *Field-Sports of the U. S.* (1849), *The Fish and Fishing of the U. S.* (1850), *The Horse and Horsemanship of America* (1857), *The Horse and his Management*, and other works of this character. He also produced some well written historical works, such as the *Captains of the Old World*, *Henry VIII. and his Six Wives*, etc., besides performing much editorial and other literary labor. He was a man of varied and remarkable accomplishments. D. at New York, by suicide, May 17, 1858.

Herbert (John Rogers), R. A., b. at Maldon, Essex, Eng., Jan. 23, 1810; attained distinction as a painter; became a Roman Catholic; an associate R. A. 1841; full academician 1846; was employed upon the frescoes of the new Houses of Parliament, and has executed many religious and scriptural pieces, especially since the death (in 1856) of his eldest son, Arthur J. Herbert, a young artist of much promise.

Herbert (Sidney), Baron, b. at Richmond in 1810, a younger son of the eleventh earl of Pembroke; studied at Harrow and Oriel College, Oxford; entered Parliament in 1832; secretary to the admiralty 1841; secretary at war 1845–46, 1852–55, and 1859; privy councillor 1852; raised to the peerage as Lord Herbert of Lea 1861. D. at Wilton Aug. 2, 1861. He was an able and popular Conservative leader, a liberal patron of art, and a man of great political ability and industry. His eldest son became in 1862 the thirteenth earl of Pembroke.

Herbiv'ora [Lat. plu. for "plant-eaters," cf. Animalia], a name given by some systematists to a proposed order of mammals corresponding in its limits to that known to most late writers as Ungulata (which see). The name Herbivora is objectionable, since it is equally applicable, as a descriptive term, to a very large number of mammals which cannot be included in the proposed order.

Hercula'neum, or, less properly, **Hercula'num,** a city of Campania, on the slope of Vesuvius, between Naples and Pompeii, to which Retina served as a port. This site was first occupied by the Osci, afterwards by Greek colonists, who named it *Herakleion*, and both in architecture and in institutions it had the character of a Greek city. Herculaneum was conquered by the Romans after the so-called War of the Allies, and in the time of the empire was much frequented as a pleasant resort. The Fabii and the Balbi had residences in Herculaneum; Agrippina also had a villa there. The earthquake of A. D. 63 did great damage to Pompeii, but comparatively little to Herculaneum, which appears to have been more solidly constructed. The houses of Pompeii were small, while Herculaneum had its palaces and temples. The great eruption of Vesuvius which buried Pompeii (A. D. 79) also overwhelmed Herculaneum; not, however, with burning lava, as many have supposed, but with volcanic ashes, afterwards converted into mud by water, and finally hardened into stone. Upon the soil deposited above the city have arisen Portici and Resina. Herculaneum was buried deeper and deeper by later eruptions of Vesuvius, until it had almost passed out of memory. In 1684 some ruins, now known to be those of the theatre, were found in digging a well. In 1720, in the excavations for the prince of Elbeuf's villa at Portici, several statues (among them those now in the Dresden Museum, called by Winckelmann vestal virgins, but by later archæologists the daughters of Balbo) were found, with twenty-four columns of giallo antico, etc. Charles III., having become king of the Two Sicilies in 1735, assumed possession of the property, and carried on the excavations energetically. The Academy of Herculaneum, founded in 1755, neglected the architectural

objects and concerned itself with the statues only. Between 1750 and 1760 a villa was excavated, where, besides beautiful pictures, candelabra, vases, household utensils, and works of art in bronze (the most beautiful bronze objects in the museum at Naples came from Herculaneum), was found a library of 2000 rolls or volumes. The wooden shelves and cases were decayed, but many of the manuscripts, though damaged by water and externally decomposed, have been unrolled by means of an invention of Padre Antonio Piaggi, and made legible. About 500 have been already opened, for the most part Greek treatises on philosophy by Epicurus and other less known writers. The Italian government is now publishing these texts at Naples. In 1828, under the reign of Francis I., the excavations were renewed with some zeal, and the house of Argos and that entitled the Publicium were found. Fiorelli, director of the excavations at Pompeii, is now turning his attention to Herculaneum, but means are wanting, and thus far no new discoveries of importance have been made. The student is referred to the volumes *Delle Antichità d'Ercolano del Museo Borbonico* (especially vol. viii.); the *Manuale per Ercolano, Pompeii, e Stabia, di* FINATI (Naples, 1844); ROUX AÎNÉ, *Herculanum et Pompeii*, accompagné d'un texte explicatif par M. L. BARRÉ (Paris); SELVATICO, *Le Arti del Disegno in Italia* (Milan, 1874, in course of publication); QUATREMÈRE DE QUINCY, *Dictionnaire*, article "Herculaneum;" BEULÉ, *Le Drame du Vesuve* (Paris, 1872). ANGELO DE GUBERNATIS.

Herculaneum, a v. of Jefferson co., Mo., on the Mississippi River, 23 miles below St. Louis. It has shot-towers, and exports shot and lead, which is mined in the vicinity.

Her'cules, or **Her'acles,** the most famous hero in the Greek mythology, was a son of Zeus and Alcmena. He was possessed of most extraordinary physical strength. While a babe in the cradle he strangled two serpents sent by Hera to kill him. When full grown he upheld the dome of the heavens while Atlas was away in the gardens of the Hesperides. He was sensual, but good-hearted, straightforward, and just. He happened to intoxicate himself and make an unseemly noise in the house of Admetus, but when he heard that his friend mourned the death of his wife, shame at once made him sober, and according to some writers he descended into Hades and carried back Alcestis. He killed the eagle and unchained Prometheus, whom Zeus had unjustly bound to the rocks. But Hera hated him, and struck him twice with insanity. During the first fit he slew his three children, and in order to expiate this horrible crime the Delphic oracle sent him to serve Eurystheus. While here he performed the twelve famous labors: (1) slaying the Nemean lion; (2) killing the Lernæan hydra; (3) catching the Arcadian stag; (4) hunting the Erymanthian boar; (5) cleansing the Augean stable; (6) destroying the Stymphalian birds; (7) capturing the Cretan bull; (8) carrying away the mares of Diomedes; (9) fetching the girdle of the queen of the Amazons; (10) chasing the oxen of Geryon; (11) stealing the apples of the Hesperides; and (12) seizing Cerberus and carrying him up into the daylight. During the second fit he killed his good friend Iphitus, and in obedience to the Delphian oracle he now went and served Omphale, the queen of the Lydians, as her slave. His death was tragical, and much more purely sublime than any part of his life. Believing that it was a philtre, Deianira, his wife, tinged his garment with a poison she had received from Nessus. When Hercules put on the garment the poison attacked his body, and, tearing the flesh from his bones, he fled from place to place in frightful agony. At last he could bear it no more. He heaped up a huge pile of wood, and, setting fire to it, he placed himself on its top. But when the flames began to lick his tortured body a cloud came down from the sky and carried him up to heaven. There is perhaps no name in the whole Greek mythology around which myths cluster so thickly as around that of Hercules; and although most of these tales are gross and indecent, many are genuinely humorous, and some exquisitely beautiful and sublime. He was also a favorite subject in epics and dramas, and with sculptors.

Her'cules Bee'tle (*Dynastes Hercules*), a giant beetle of the family Scarabæidæ, a native of Brazil. It is about six inches long, and the male has a huge horn upon the head and a smaller one upon the thorax.

Hercules, Pillars of, the name given by the ancients to Calpe (Gibraltar) and Abyla (now Ceuta), two rocky promontories, one on each side of the Strait of Gibraltar. It was fabled that Hercules found them one mountain, but tore them asunder, thus making a connection between the ocean and the Mediterranean Sea. In heraldry, they figure as the supporters of the Spanish national arms. They are seen with the motto *Ne plus ultra* ("No more beyond"), indicating that the pillars are at the end of the world, as anciently believed. These are the well-known pillars on Spanish coins; and the sign $, standing for "dollars," probably represents these pillars with the fillet for the motto across them.

Hercyn'ian For'est (*Hercynia Silva*), a name employed by ancient Greek and Latin geographers to denote the great central and southern forest-region of ancient Germany. The term was always a vague one. In its widest sense it seems to have included the Bohemian Forest, the Hartz (whose name seems allied to the ancient one), the Black Forest, and others.

Her'der, von (JOHANN GOTTFRIED), one of the founders of modern German literature, and one of the most powerful and wholesome influences of modern German civilization, b. Aug. 25, 1744, at Mohrungen, East Prussia, where his father kept a small school and held a subordinate position in the Polish Church. He was educated in his home till his fifteenth year, after which time he spent a couple of years in a position midway between a secretary and an errand-boy in the house of the minister, which he left to go to Königsberg and hear Kant. While here he had to maintain himself, yet when he left his knowledge of theology, philosophy, languages, art, and literature was very extensive, and his intellect was as bright and vigorous as comprehensive. From 1764 to 1769 he lived in Riga as rector of a kind of theological seminary, and there he published his *Fragments on German Literature*, which attracted considerable attention. After 1769 he travelled much in Germany, and held different positions until (1776) he settled down in Weimar, beside Goethe, Wieland, Schiller, and Schlegel, in an influential and responsible position as court-preacher, ephorus of the schools, and president of the consistory. D. Dec. 18, 1803. Although a theologian both by education and profession, the worth of his theological writings is nevertheless comparatively small. It is his influence on German poetry, literature, and civilization in general which constitutes his merit. The co-operation of Goethe and Winckelmann gave the German literature a new impulse, which may be characterized as a modern German recasting of the ideas of the antique Greek art. From the co-operation of Goethe and Herder started another movement, which is well known as the romantic school. Goethe gave the school its artistic form; Herder gave it its poetical principle. In his *Letters on Hebrew Poetry*, an analysis of the æsthetical character of the poetical part of the Old Testament; in his *Cid*, a translation or remodelling of the old Spanish ballads celebrating this hero; and in a number of minor essays published in different literary magazines, he showed that all the greatest works of art are also the most exclusively national. By establishing the principle of nationality as the vital principle of all great poetry, Herder made the German poetry German, and the wild aberrations of some members of the romantic school are no faults of his, or of his principles. He was a sober-minded and sound-hearted man; the elegance and dignity of his style are a true reflex of the brightness and soundness of his ideas. His most interesting and most important work is his *Ideen zur Philosophie der Geschichte der Menschheit* ("Ideas of the Philosophy of the History of Mankind"). During the eighteenth century the old, narrow view of history as a string of events, without any other causation than the passions and follies of individuals, had faded away. But, very characteristic with respect to the pedagogical turn of all ideas of that century, the highest idea of history became that of an educational process. (See LESSING'S *Ueber die Erziehung des Menschengeschlechts*.) Herder was the first to set forth the idea of history as the development of a national genius, as the growth of a vital power, as an evolution—an idea which reached its most brilliant perfection in the philosophy of Hegel. CLEMENS PETERSEN.

Herd Grass. See TIMOTHY.

Herd's Island, one of the sea-islands of McIntosh co., Ga. Pop. 13.

Heredit'aments, Incorpo'real, in law. By the term "hereditaments" is meant any property which on the death of an individual owner, without a disposition of it by will, passes to an heir. By the English common law all the property of an intestate must devolve either upon his administrator or his heirs; personal property passing to the administrator, and real to the heirs. The word "hereditaments" thus becomes one of the most comprehensive terms in the law to indicate real property or landed interests. The distinction between "hereditaments" on the one hand, and "chattels" (as indicating personal property) on the other, is thus of great practical importance, as the two classes of property are governed by distinct sets of rules. (See REAL PROPERTY.) Hereditaments are of two kinds—corporeal and incorporeal. The former term is used to indicate the land itself. (See LAND.) Incorporeal hereditaments, the subject of this article, are intangible, and are rights claimed by one person in the land of an-

other. The right in legal phrase is *dominant;* that is, it is superior to the claims of the owner of the land over which it is exercised. The land to which the right is attached is said to be *servient.* In other words, the right of the owner of it is subordinate to that of the owner of the incorporeal interest. The Roman lawyers, regarding the subject principally from this point of view, used the term "servitutes" to indicate this class of rights. (See SERVITUDES.) An illustration is readily found in the case of a highway. A private owner may own the land over which a highway passes, but his right to make use of it is plainly subservient to the power of the public to use it for the purposes of travel, etc.

There are a number of rights in England that are deemed to be incorporeal estates which have no existence in this country, such as *advowsons,* or a right of presentation to a church; *tithes,* a right of an ecclesiastical nature to take a portion of the profits of land for the use of the church (see TITHES); and certain public *offices,* of which an example is the office of a sheriff. *Dignities* or titles of nobility, and *annuities,* belong to the same class. In the U. S. incorporeal hereditaments are divisible into three principal classes—*profits à prendre, easements,* and *rents.* *Profit à prendre* is a phrase derived from the Norman-French language, indicating a profit which consists in taking something from the land of another, such as a right to take fish, petroleum, or minerals. Rights of this kind in the English law are sometimes known as "rights of common." These have been divided into four principal classes—pasture, piscary, turbary, and estovers. The first signifies a right of one or more persons to pasture cattle upon the land of another; the second, to take fish from another's land; the third, to take turf, coal, or minerals; and the fourth, to take necessary wood or timber for the purpose of repairs of buildings. These rights, so far as they refer to pasturage or fishing or repairs of buildings, are not frequently under consideration before the courts of this country. The right to take minerals is of great importance in certain districts. It is not uncommon in these localities to find grants by the owners of land conferring upon grantees the right to take specified minerals, or to sink wells to obtain salt or other substances. In this class of cases the right is dominant in the sense already explained; and if a grant of this kind be unrestricted, the owner of the land must submit to the disturbance of the soil in order to reach the minerals, and may, perhaps, be debarred from all profitable use of the land. A distinction must be carefully taken between the right to mine and a grant of the minerals. In the latter case there would be two ownerships—one of the surface land, and the other of the minerals beneath it; and it would not necessarily follow that the owner of the minerals could disturb the surface. The subject may be pursued in works upon mining; *e. g.* Bainbridge or Collier.

An easement differs from a *profit à prendre* in the fact that nothing is taken by the owner of the incorporeal right from the land over which it is exercised. This class of rights has already been considered. (See EASEMENT.) A special instance of the application of this branch of the law may be found in the interest which the public may acquire in the land of an individual by an act termed "dedication." The meaning of this word is the act of giving up one's land to public use, as for the purposes of a highway or park. The public, *as such,* cannot be a grantee, as it is a fluctuating body of persons. An easement is, however, acquired over the land of the dedicator by the doctrine of estoppel. (See ESTOPPEL.) The theory of the case is that there is a representation by the owner to the public that they may make use of his land for a special purpose, and an act done by them on the faith of the representation. A dedication may be implied in cases where the public encroach on the rights of the owner, and he makes no resistance for a considerable period of time; *e. g.* for twenty years. Under these doctrines the public must take the subject-matter dedicated according to the intent of the owner as expressed by his acts. Thus, if he should dedicate land for a highway in which there is an open pit he would be under no obligation to fill it up or make the place convenient for travel. The owner after dedication may still use the land in any way not inconsistent with his action towards the public, and must be regarded in all respects as owner, except so far as the public have claims upon him by virtue of the dedication. (The subject of easements may be further studied in WASHBURN *On Easements,* and in GALE on the same.)

The third class of incorporeal hereditaments is that of rents. By a rent is meant the right which one person possesses to call upon another to pay him periodically a sum of money or a thing as a return for the use of land. It differs from a *profit à prendre* in the fact that while this is a part of the land itself, a rent is no part of the land, but is some new and independent thing. (The details of this subject will be stated under RENT. See also GILBERT *On Rents,* and LUMLEY.)

There is an important class of incorporeal rights termed franchises (see FRANCHISE), which cannot be strictly ranged under either of the three principal classes of hereditaments already considered. A franchise is an exclusive privilege vested by law in individuals or corporate bodies. It is sometimes a *profit à prendre,* as an exclusive right to fish in public waters or to hunt on public grounds. Again, it may impose on the land of another an easement. Thus, an exclusive right to maintain a bridge or ferry within certain limits over a stream would impose a negative easement upon owners of lands within the prescribed limits not to use or permit their lands to be used so as to establish an interfering ferry or bridge. Accordingly, it is more convenient to consider franchises separately from other incorporeal rights, from the point of view that they are grants of the sovereign power conferring privileges and imposing obligations, and are in the nature of a contract between the state and the grantees, and liable to be resumed by the state, through judicial action, when improperly exercised or abused.

When an incorporeal right is enjoyed in connection with the ownership of an estate, it in general follows the ownership as that passes from one to another. A sale transfers it to a purchaser. An example is a right of way over the land of another as incidental to the ownership of adjoining land. On the other hand, the right may be a mere personal privilege, having no connection with the ownership of land, when it would be termed a right "in gross."

T. W. DWIGHT.

Hered'itary Characteris'tics. The laws which govern the transmission of hereditary characteristics are generally unknown, but the number and diversity of inheritable deviations of structure and peculiarities of temperament are endless. Every breeder of cattle is satisfied that the vigor, fleetness, and other qualities of the dam and sire are hereditary; theoretical writers alone have doubted the fact. Darwin considers that the correct way of viewing the subject is to look at the inheritance of every character whatever as the rule, and non-inheritance as the anomaly. No one, however, can explain why the same peculiarity in different persons is sometimes inherited and sometimes not. Scientists have not explained how it is that a man may possess characteristics which have been observed in his grandfather or great-grandmother, and have not appeared in his own parents. Equally inscrutable too is the fact of the transmission of a characteristic from one sex to both sexes, or to one sex alone, generally the like sex. Darwin is of opinion that at whatever period of life a peculiarity first appears, it tends to reappear in the offspring at a corresponding age, though sometimes earlier. An instance in point is in the writer's knowledge. A lady in her youth observed one of her toes to be growing in a slanting direction. In her daughter the same peculiarity was observable in early youth, and two granddaughters are at present developing the same feature. Another circumstance related by Mr. Galton is equally interesting. A gentleman of position was found by his wife to be in the habit, when lying on his back fast asleep in bed, of raising his right arm and dropping it suddenly with a jerk, so that the wrist fell heavily on the bridge of his nose. The nose was prominent, and suffered, as at times the trick was continued for an hour or more. It was not of nightly occurrence, but took place occasionally, and we are assured was independent of any ascertained cause. Some years after this gentleman's death his son married a lady who observed the same peculiarity in her husband. The blows were dealt with the right hand, were intermittent, and sometimes lasted during a greater portion of the night. They did not occur when the sufferer was half asleep, dozing in an arm-chair for instance; only when he was fast asleep. One of his children, a girl, has also inherited the trick. In her case the right arm is raised, and the palm of the half-closed hand, not the wrist, drops over and down the nose, striking it rather rapidly. The trick is intermittent; sometimes it will not occur for periods of some months, at other times it takes place incessantly. The value of the above anecdote consists in the fact that the hereditary characteristic cannot but be natural; as it occurs only during sound sleep, it cannot be due to imitation. Tendency to blush is likewise inherited. Dr. Burgess has treated this especial feature in detail in his work on the *Physiology of Blushing.* He gives a case of a family consisting of a father, mother, and ten children, all of whom blushed painfully. Separation from one another by travel was tried without success. Blush they all did until the end of their days. Sir J. Paget relates that when once examining the spine of a girl he was struck with the peculiarity of her manner of blushing. A splash of red appeared first on one cheek, and then other splashes scattered over the face and neck. The surgeon inquired of the mother

whether the daughter always blushed in the same manner, and the former, whilst assuring him of the fact, blushed in the same peculiar way herself.

With respect to animals, it has been ascertained that there is a prepotency in transmitting likeness running more strongly in one sex than the other. This rule applies to cases when one species is crossed with another, and when one variety is crossed with another variety. Darwin maintains that the ass has a prepotent power over the horse, so that both the mule and the hinny more resemble the ass than the horse, but that the prepotency runs more strongly in the male ass than in the female; so that the mule, which is the offspring of the male ass and mare, is more like an ass than is the hinny, which is the offspring of the female ass and stallion. (*Origin of Species.*) In like manner the offspring of a union of persons of the black and white human races is of an intermediate tint, but the color of the father usually predominates over that of the mother. Dr. Prosper Lucas, the author of two volumes on the subject (*L'hérédité Naturelle*), arrives almost at the same conclusion as does Mr. Darwin.

There are numerous instances on record of the strange and undoubted transmission of peculiarities. Lambert, "the porcupine man," whose skin was covered with warts which were moulted periodically, had all his six children and two grandsons similarly affected; whilst faces and bodies covered with long hair and deficient teeth were observable in three generations of a Siamese family. Dr. Hodgkin tells of an English family in which for many generations certain members possessed a single lock of a color different from the rest of the hair. Mr. Darwin knew an Irish gentleman who had a small white lock in the midst of black hair—a peculiarity evidently inherited, for his grandmother had a similar lock on the same side of the head, and his mother one on the opposite. Another remarkable case came under Mr. Darwin's own observation. "A boy had the singular habit when pleased," he writes, "of rapidly moving his fingers parallel to each other, and when much excited of raising both hands, with the fingers still moving, to the sides of the face on a level with the eyes; this boy, when almost an old man, could still hardly resist this trick when much pleased, but from its absurdity concealed it. He had eight children. Of these, a girl when pleased, at the age of four and a half years moved her fingers in exactly the same way, and, what is still odder, when much excited she raised both her hands, with her fingers still moving, to the sides of her face in exactly the same manner as her father had done, and sometimes even still continued to do when alone. I never heard of any one excepting this one man and his little daughter who had this strange habit; and certainly imitation was in this instance out of the question." (*Variation of Animals and Plants under Domestication.*) Anderson, in his *Recreations in Agriculture and Nat. Hist.*, states that a rabbit gave birth to a young one having but one ear, and that from this animal a breed was formed which produced one-eared offspring. Also a bitch with three legs has been known to produce puppies with the same deficiency. According to Hofacker (*Ueber die Eigenschaften*), a one-horned stag was seen in 1781 in a German forest; in 1788 two, and subsequently from year to year many more were seen carrying one horn on the right side of the head. Lord Brougham once found some of his grandfather's handwriting exactly similar to his own, which was itself peculiar. His grandfather had died before he was born, and his father's handwriting was widely different. Blumenbach declares that parents, either human or brute, that have suffered amputation or mutilation, often transmit the injuries to their offspring; that a bitch with a cropped tail will frequently produce puppies with cropped tails. Considerable doubt is felt whether the theory be correct; Darwin is not certain. Smallpox marks are not inherited, neither are Chinese children born with feet compressed and stunted. Jewish medical men aver that circumcision which has been practised for ages has produced no inherited effect (*Darwin*); and on the other hand Blumenbach asserts that in Germany Jews have been born in a state rendering circumcision difficult, to whom the term "born circumcised" has been applied. Dr. Prosper Lucas holds to Blumenbach's views, and gives a list of inherited injuries, of which that of a cow losing a horn from an accident and producing three calves hornless on the same side of the head, may be taken as an example. Blumenbach relates how a man suffered mutilation of one of his little fingers, causing the member to grow crooked, and how each of his sons had the same finger on the same hand crooked also.

It was for a long time doubted whether genius and talent were hereditary even where both parents were endowed. An admirable work by Mr. F. Galton (*Hereditary Genius*, London, 1869), has, however, settled the question. The writer desires to prove that, as it is easy by careful selection to obtain a remarkable breed of horses or dogs, it would be equally practicable to produce a highly-gifted race of men by judicious marriages during several consecutive generations; that, in fact, a man's natural abilities are derived by inheritance under the same limitations as are the form and features of the whole organic world. To prove the case the author discusses the relationships of a large body of eminent men, taking reputation to be the test of eminence. He reviews the judges of England from 1660 to 1868, the statesmen of the time of George III., and the prime ministers during the last 100 years. Subsequently, after discussing the relationships of illustrious commanders, men of letters and science, poets, painters, musicians, divines, scholars, oarsmen, and wrestlers, he arrives at his results. In the 300 families under discussion nearly 1000 are eminent and 415 illustrious. The general result is that one-half of the illustrious men have one or more eminent relations. For instance, in the case of lord chancellors the proportion is 24 in 30; statesmen of George III., 33 in 55; premiers, 8 in 16; commanders, 32 in 59; literary men, 37 in 56; scientific men, 65 in 83; poets, 40 in 100; musicians, 26 in 100; painters, 18 in 42; divines, 33 in 196; scholars, 14 in 36. These proportions reduced to decimals are .8, .6 and .5, .5, .7, .8, .4, .2, .4, giving a general average of .5, or one-half. (*Hered. Genius*, p. 322.)

The same writer has satisfactorily shown also that tendency to sterility is inherited. It is a fact that a large proportion of new English peerages are constantly dying out, and the ascertained reason is that many fresh-created peers or their sons marry heiresses. It can be argued that a woman who has no brothers or sisters is more likely to be sterile than one who possesses several, whilst the reasons for marriages between the eldest sons of new peers and heiresses are many and intelligible. Such marriages are usually unprolific. Mr. Galton draws a long list of judges who obtained peerages, and arrives at the conclusion—1st, That out of the thirty-one peerages there were no less than seventeen in which the hereditary influence of an heiress or co-heiress affected the first or second generation; that this influence was sensibly an agent in producing sterility in sixteen out of the seventeen peerages, and the influence was sometimes shown in two, three, or more cases in one peerage. 2d, That the direct male line of no less than eight peerages was actually extinguished through the influence of the heiresses, and that six others had very narrow escapes from extinction, owing to the same cause. One case alone, that of Lord Kenyon, is known where the influence of the heiress was not felt. 3d, Out of the twelve peerages that have failed in the direct male line, no less than eight failures are accounted for by heiress-marriages. (*Hered. Gen.*, p. 135.) Further research shows the following results from a list of marriages of certain peers after comparison with the numbers of the children when the mother was an heiress with those when she was not: One hundred who are heiresses have 208 sons and 206 daughters; 100 who are not heiresses have 336 sons and 284 daughters. (*Ibid.*, p. 139.)

That certain diseases are inherited is beyond all doubt. Insanity, gout, syphilis, consumption, scrofula, and kindred maladies have been long regarded as hereditary. Sir Henry Holland says: "The hereditary tendency to disease, regarding the subject in its most general light, shows itself either in the abnormal conformation of particular organs or textures, or in the presence and transmission from parent to offspring of certain morbid products, either altogether new or vitiated in kind or faulty by excess." Whether, however, these products be referable, as effects, to variations in some part of the organic structure, whether, in fact, the solids of the body alone, or the animal fluids and the blood also, carry on the peculiarities through generations, is a question not to be satisfactorily answered at present. The physician whose words are quoted above relates many personal experiences of hereditary disease. He knew a family in which the father and two children were unable to distinguish red as a color; he has seen squinting occur in five children when both father and mother were similarly afflicted. In another family, where the father possessed an elongation of the upper eyelid, seven children were born with the same malformation, whilst two or three did not inherit it. Dr. Jackson of Boston, Mass., discovered that emphysema of the lungs depends for the most part on hereditary influence, independently of any disposition to tubercular pulmonary disease. The frequency of certain maladies in particular districts is illustrative also of a tendency to the inheritance of disease. The goître, for instance, stone in the bladder, and plica polonica are known to infest certain localities where there is no obvious peculiarity of air, water, or food as a possible cause. Holland (*Medical Notes*) writes that when in Iceland in 1810 he had the opportunity of collecting some facts as to the singular frequency of the disease *Trismus*

neonatorum in the Vestmann Isles on the southern coast of this island. On these desolate rocks, the population of which does not exceed 160 souls, he found that in a period of twenty-five years 186 infants perished of this disorder under the age of twenty-one days, of which 161 died between the fourth and tenth days after birth; 75 on the eighth day. Though the condition of life of the people is destitute—fish and eggs of sea-birds are their only nutriment—yet it is not so different from that of the Icelanders of the mainland as to explain the frequency of the disorder among them. Sir H. Holland was of opinion that some constitutional and hereditary causes were concerned. In scrofulous temperaments it is well known that there is a marked diversity in the forms of the disease and the parts of the body it afflicts, yet there is a strong tendency to the same form in the same branch of a family affected. In some cases it results in partial or complete blindness; in others the joints are affected; in many cases pulmonary consumption sets in.

Disorders of the brain and the nervous system are generally hereditary, insanity being conspicuous as an inherited taint. Whence Holland is of opinion that some deviation of physical structure, obvious or not, is the cause of mental aberration—that part of the fabric of the brain, too minute for even subtle research to follow, is concerned in the transmission. Headaches and neuralgia offer constant evidence to medical men of the transmission of these disorders, although in nervous diseases like results are occasionally due to imitation. A noteworthy point in the consideration of the subject is the disposition of individuals of the same family to be similarly attacked by given maladies, and to suffer from the same after-effects, as in hooping cough, measles, and other infantile maladies. From which parent a predisposition to disease is more frequently derived is still an open question. Dr. Nasse of Bonn considers that in some cases the mother is answerable, whilst Sir H. Holland opines that the matter merges in the more general one of the transmission of physical resemblance from parent to child, and that diseases must be considered as derived equally through the two sexes. (*Principles of Human Physiology*, Carpenter, London; *Medical Notes and Reflections*, Holland, London.)

We have stated above that Mr. Darwin has declared the transmission of characteristics to be the rule, not the exception. The following are in his opinion checks to inheritance: "First, circumstances hostile to the particular character in question; secondly, conditions of life incessantly inducing fresh variability; and, lastly, the crossing of distinct varieties during some previous generation, together with reversion or atavism—that is, the tendency in the child to resemble its grand-parents or more remote ancestors, instead of its immediate parents." (*Variation of Animals and Plants under Domestication.*) W. J. Dixon.

Hereditary Privileges. See Privileges, by Pres. T. D. Woolsey, S. T. D., LL.D.

Her′eford, city of England, the capital of the county of Hereford, on the Wye. It is the see of an Anglican bishop; has a noble cathedral commenced in 1079, some manufactures of gloves and flannels, and a large cattle-fair. Pop. 18,355.

Hereford, post tp. of Berks co., Pa. Pop. 1260.

Her′efordshire, county of England, situated between South Wales and the counties of Worcester and Gloucester. It contains 534,823 acres of land, consisting of a heavy red loam, and has an undulating surface, which towards the W. rises into the Black Mountains, and towards the E. into Malvern Hills. Wheat, barley, oak-bark, and apples are the principal products; 20,000 hogsheads of cider of superior quality are made annually. Herefordshire belonged to the old province of Mercia, and is rich in interesting ruins from the times of the Saxons. The county is famous for its fine breed of cattle. Pop. 123,659.

Heren′cia, town of Spain, in the province of Ciudad Real. It is a handsome town. Pop. 7317.

Her′esy [αἵρεσις, from αἱρέω, "to take," "taking" (as of a city)], choice, preference, chosen way of life, of belief, doctrine, or teaching; a sect, school, party in philosophy, medicine, literature, or religion; the doctrine of such a party; hence discord, separation, faction as the result of such views. In the New Testament *hairesis* means sect and faction. The *hairetikos* (Tit. iii. 10) is a fomenter of divisions, whether by false doctrines or factious practices. Nearly all the languages of Christian nations have terms derived from the Greek *hairesis*. In its later sense, heresy involves an idea unknown to the classic religions. In this now universally prevalent sense, heresy is a doctrine in conflict with important truth. In the Church it is a doctrine perversely held by nominal Christians in conflict with an Article of Faith (which see). *Blackstone*: "Heresy consists not in a total denial of Christianity, but of some of its essential doctrines, publicly and obstinately avowed." (*Comm.* iv. 4.) *Carpzov*, the jurist: "A pertinacious error in articles of faith." *Sir Matthew Hale*: "An opinion concerning divine things devised by the human mind, publicly taught, and pertinaciously defended." *Jäger*: "In its broader sense, every doctrine which indeed on one side still retains the Christian religious character, but on the other embraces elements which logically carried out destroy the principle of Christianity and its absolute force." (*Herzog*, *R. E.*, v. 457.)

As the term is relative, all enumerations of heresies are relative. That is considered heresy on one standard which is accepted as sound belief on another. Heresy may be the opinion of individuals unorganized, or it may be the doctrinal basis of *heretical sects*. Such were the Gnostics and Manichæans (which see). That is heresy by the general judgment of the great body of the Christian world which is in conflict with the three general Creeds. (See Creed.) The Roman Catholic Church and Greek Church consider as heresy all doctrines conflicting with the general Creeds and their own confessional standards. *Hilgers*: "Heresy is a dogma or system claiming to be Christian, in opposition to the definitively expressed, universal faith of the Catholic Church." (*Welte's K. L.*, iii. 172.) Among evangelical Protestants the term heresy was most commonly applied to doctrines in conflict with the general Creeds. But at the beginning, almost universally, and still to some extent, the word is used to mark all doctrines in conflict with Fundamentals (which see), as defined in the confessions of particular Protestant bodies. A heretic is a fundamental errorist. The term is less and less used. From fixing odium, it has, by reaction produced by its abuse, become odious. Men dislike the term, and have become careless about the thing. Heresy is allied to Heterodoxy (which see), but is a narrower and harsher term. Infidelity (which see) rejects, and Skepticism (which see) doubts revealed truth. Schism or Sectarianism (which see) rends the Church on questions which really belong to her liberty. Heresy corrupts what it professes to accept. Schismatists separate from the Church, and heretics are cast out of it. Error, simple, may be no more than a mistake of the intellect; heresy involves a voluntary and persistent perversion of the truth; blasphemy is reproachful language against God or divine things. *Gerhard*: "Four things are necessary to constitute heresy: (1) error in the understanding; (2) in conflict with the faith, for not every error is heresy; (3) conjoined with pertinacity in the will; (4) membership in the Christian Church by baptism." (*Loci* (*Cotta*), xi. 251.) The heresies of an age are usually the shadows of its characteristic truths. The entire body of opinions seem to need shaking to bring truth to the top. When the human mind is attempting to settle in some finality of decision, all the theories which can test that decision or help to make it up become prominent. When God was manifest in the flesh the crisis of demon-power was also manifest in the flesh. The ultimata of orthodoxy and the counter-assertions of heterodoxy came to ripeness together. We have in the same age Arius and Athanasius, Pelagius and Augustine.

The infirmities of the human mind and character, the vast and profound problems involved in religion, the obscurities of the language interpreted and of the language interpreting, the extravagant development of isolated parts of a truth, the tardiness of pace on the part of some who remain behind in a position once general, but afterwards abandoned (such was Montanism, which see), the influences of education, of special mental types, of speculative and practical systems, the passions of men, the love of novelty, and the overbearing of a blind conservatism, and many of the best principles of our nature, mistaken, distorted, or perverted, are among the causes of heresies. Many heresies are mere blunders of phraseology, and the wars in them have been wars of words.

The *treatment* of heresy in the Church has been very varied. In the early Church, not merely from the necessity of her condition, but from principle, the means of correcting it were purely moral. Not until admonition, reproof, and instruction were exhausted did the Church resort to excommunication and anathema. The early Church was averse to capital punishment in general. Irenæus († 202) and Tertullian (before 240) were among the earliest authors of treatises against heresies. Novatianism (which see) was punished by deposition (251). With the conjunction of Church and State heresy came to be regarded as also a civil offence, in the nature of a double treason, and was punished by fine, imprisonment, forfeiture of office and dignities, deprivation of the right of bequeathing and receiving bequests, with confiscation of property, and death. The first instance of the infliction of death on heretics was the Spaniard Priscillian and two of his adherents (385). It was brought about by some of

the Spanish bishops, but was offensive to the larger part of the Church, and was protested against, among others, by Pope Siricius (384–398), though he had been specially active in repressing Priscillianism. From the twelfth and thirteenth centuries the treatment of heresy was one of general persecution, leading to bloody wars. Courts for the trial of heresy were established throughout Western Christendom, with a body of *judges* of heresy, presided over by *masters* of heresy. These courts formed the INQUISITION (which see). They made decisions involving the property, freedom, and life of all who were charged with deviation from the faith of the Roman Catholic Church. The first great official voucher for an important change from this state of things was the Peace of Westphalia (1648), according to which the three Confessions, the Roman Catholic, the Lutheran, and the Reformed, were acknowledged as in all civil respects non-heretical. The pope issued a bull declaring the provisions of the instrument of this peace null and void. In Rome, on Thursday of Holy Week, there was until Clement XIV. (1769–74) a public reading of the bull IN CŒNA DOMINI (which see), in which there is an enumeration and anathematizing of heresies. A similar document is read in the Greek Church by the patriarch of Constantinople on Quadragesima (hence called Orthodox) Sunday. In the Church of England the third collect for Good Friday embraces a prayer for all heretics.

In the earlier Reformed views of the treatment of heresy there was a concurrence in general with the principle that it should be dealt with by the civil magistracy. Calvin (1554) and Beza wrote in defence of the right and duty of putting heretics to death, and this was almost unchallenged among the earlier Calvinistic divines. It is the influence of association with this style of thought which accounts for the fact that Melanchthon, contrary to his gentle spirit and the judgment of all the German divines, concurred in the righteousness of the execution of SERVETUS (which see). Luther opposed the use of coercion in removing heresy, and Castellio quotes him and Brentius in his reply to Calvin (1554). The Augsburg Confession expressly denies the right of civil government over questions of heresy. (Abus. art. vii. 6.) The preface to the Book of Concord makes a solemn protest against the persecution of the HUGUENOTS (which see). The Lutheran Church stood almost alone for a time in denying that heresy should be punished with death. (See KRAUTH'S *Conservative Reformation*, 138–147.) In England, under the statute "De hæretico comburendo" (1401), many of Wiclif's followers were burned to death. Under Henry VIII. offences against the see of Rome ceased to be heresy, but (1539) the Six Articles, all of them asserting distinctive parts of the Roman Catholic doctrine, were set forth, and the penalty of death attached to the rejection of any of them. (See BROUGHAM'S *Political Philosophy*, iii. 261.) They were repealed in the first year of Edward VI. (1547). The law under which heretics were burned to death was abolished under Charles II. (1676). The last person put to death in Great Britain for heresy was Thomas Aikenhead, a young student of divinity, executed in Edinburgh (1696), under a statute against BLASPHEMY (which see). (See MACAULAY'S *History of England* (New York, 1856), iv. 621, and HUGH MILLER'S *Macaulay on Scotland*, a critique from the *Witness*.) The statute was repealed under George III. (See PERSECUTION.) The Arminian divines of Holland favored the milder judgment and treatment of heresies. (See CURCELLÆUS, *Opera* (1675), 81, 579–595, 830.) (For the most important trial for heresy of recent date see GORHAM CONTROVERSY.) It may now be regarded as a fixed principle of nearly the entire Protestant world that civil government has no right to interfere with the mere holding of religious opinions, however wrong, nor to repress any publication of them or acting upon them which does not interfere with the civil order and law of the land.

Heresy has given us a number of terms: *Heretic*, one who holds a heresy; *heretical*; *heresiarch*, a leader in heresy; *arch-heretic*, one who is prominent as a representative of heresy; *heresio-mastix*, a scourger of heresy; and the now obsolete *hereticate*, to stamp as heresy.

The literature of heresy embraces works on its general character (see *Danz. U. W. Ketzerei*); heresiology, the polemical works which discuss the various forms of heresy (see POLEMICS, THEOLOGICAL); works on its general history (such as Mosheim, 1748–50; Walch, 1762–85; Baumgarten, 1766; Fuessli, 1770–74; Von Einem, 1789); history of particular heresies (see under the special articles ALBIGENSES, APOLLINARIS, ARIUS, etc.). The best histories of the Church and of dogma in general also embrace the history of heresies; see ECCLESIASTICAL HISTORY. The bibliography will be found in Buddeus's *Isagoge*; Walch's *Bibliotheca Th. Sel.*; Winer, *Handbuch d. Theol. Lit.*; and in Hagenbach, *Encykl. u. Methodol.*, 9th edit. 1874, 244, 275–277.

C. P. KRAUTH.

Her'ford, town of Prussia, in the province of Westphalia, on the Werra. It has some manufactures of linen and yarn. Pop. 10,968.

Her'ing (CONSTANTINE), M. D., a Homœopathic physician, b. Jan. 1, 1800, at Oschatz, in Saxony, and in 1825 received medical, chirurgical, and obstetrical degrees at Würtzburg, and soon started on a scientific tour to Guiana, under the botanist Weigel. In 1834 he became a resident of Philadelphia. Author of *Rise and Progress of Homœopathy* (1834), *The Domestic Physician* (1858), *American Drug Provings* (1853), and various medical and other essays.

Her'iot (GEORGE), founder of the Heriot Hospital and Heriot Schools of Edinburgh, b. in that city about 1563. Having been appointed goldsmith to the king and the queen, he removed to London when James VI. became king of England, and here he accumulated a large fortune, of which he left the greater part on his death in 1624 to the town council and ministers of Edinburgh to found a hospital in that city for the maintenance and education of the sons of poor, deceased, or decayed burgesses. As in the course of time the revenues considerably exceeded the expenditures, a number of schools, in which free instruction is given to poor children, was added to the hospital in 1837. About 180 boys are now educated in the hospital, and about 3000 children receive instruction in the schools.

Heriot (JOHN), b. at Haddington, Scotland, Apr. 22, 1760; studied at the University of Edinburgh; entered in 1778 the royal marines, and became a lieutenant; was put on half-pay in 1791, and started, on the suggestion of Burke, *The Sun* in 1792, and *The True Briton* in 1793, which were published against the ideas of the French Revolution. In 1809 he received an office as paymaster, and in 1810 as controller at the Chelsea Hospital. D. June 30, 1833. He wrote also romances—*The Heart-broken*, *The Half-pay Officer*, etc.

Her'isau, an old, romantic, beautifully situated town of Switzerland, in the canton of Appenzell, capital of the Outer Rhodes, on the Glatt, has large manufactures of muslins and calicoes, and extensive dyeworks and bleaching-fields. Pop. 9736.

Heristal, or **Herstal,** town of Belgium, province of Liège, on the Meuse, forms now nearly a suburb of Liège, and is mostly inhabited by mechanics and workingmen. Is the seat of great manufacturing establishments, especially in iron and steel, and was the birthplace of Pepin, founder of the Carlovingian dynasty. Pop. 9326.

Her'kimer, county of N. E. Central New York. Area, 1745 square miles. Its surface is broken by numerous ridges. Iron ore and limestone are found, the latter abundantly. The soil is generally good, except in the N., and is especially adapted to grazing. Live-stock, wool, grain, hops, and dairy products are the great staples. Cheese, lumber, boxes, harnesses, flour, leather, lime, metallic wares, furniture, etc. are largely manufactured. The N. part of the county is a part of the great wilderness of Northern New York, and is very sparsely settled. The county is traversed by the Erie Canal, the river Mohawk, and the New York Central R. R. Cap. Herkimer. Pop. 39,929.

Herkimer, post-v. and tp., cap. of Herkimer co., N. Y., 81 miles W. of Albany, on the New York Central and the Hudson River R. Rs. It has good educational advantages, 1 bank, a paper-mill, 1 flouring-mill, a hoop-skirt factory, and the principal office of the Farm Building Fire Insurance Co.; 1 weekly newspaper, 3 churches, 4 hotels, and a horse railway 1½ miles in length. Pop. of v. 1220; of tp. 2949.

JACOB H. WEBER.

Herkimer (NICHOLAS), b. about 1720, the son of J. J. Herkimer (or Erghemar), a German from the Palatinate, who was one of the patentees of the Burnettsfield patent, now in Herkimer co., N. Y. The son became a militia lieutenant 1758, and commanded at Fort Herkimer on the Mohawk (now in German Flats, N. Y.) in that year, at the time of the French and Indian attack. He soon afterwards lived in the Canajoharie district, now in Montgomery co.; became colonel of militia for Tryon co. 1775; appointed brigadier-general by the State convention 1776; marched against Sir John Johnson's Tories and Indians 1776; led an expedition to the relief of Fort Stanwix (now Rome, N. Y.), then besieged by St. Leger; was ambuscaded by the Indians, defeated, and wounded in the leg, at Oriskany, Aug. 5, 1777; suffered unskilful amputation, and d. in consequence Aug. 17, 1777, at Danube, N. Y., where he resided. Congress voted (Oct. 1777) to erect a monument to "Brigadier Harkemer," but the vote was forgotten and the monument was not erected.

Her'man, post-v. of Washington co., Neb., on the Omaha and North-western R. R., 40 miles from Omaha.

Herman, post-tp. of Dodge co., Wis. Pop. 1935.

Herman, tp. of Sheboygan co., Wis. Pop. 2252.